Bharatiya Vidya Bhavan's

# Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination/ ~~Re-Examination~~

December - 2025

First Year M.Tech Civil Structural engineering

Max. Marks: 100 Duration: 3 Hours

Class: M.Tech Semester: I Program: Civil Engineering

Name of the Course: Structural Dynamics Course Code : PC- MST 101

29/12/25

**Instructions:**

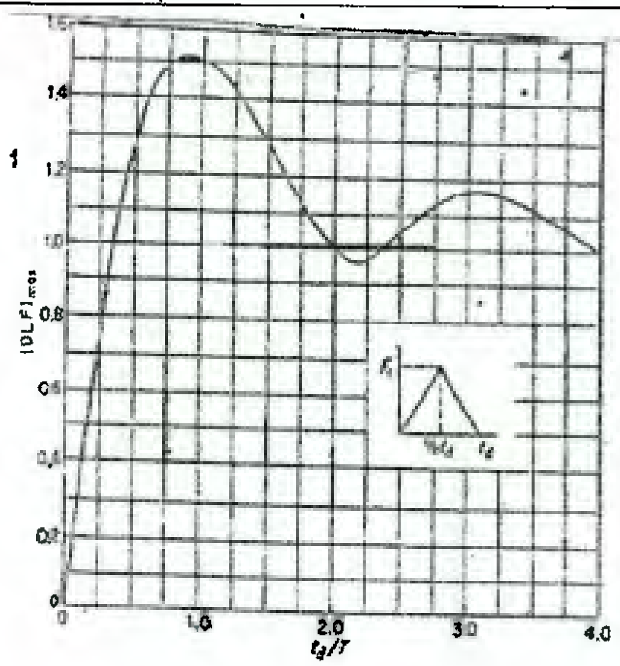
- Answer any five questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

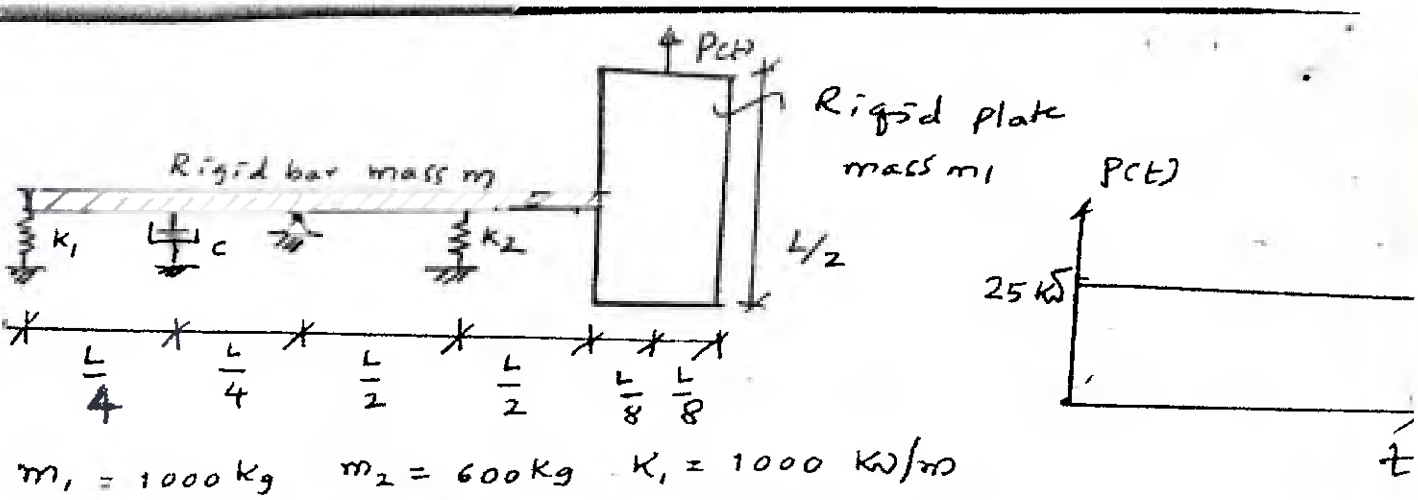
| Question No | | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| Q1 (a) | Distinguish between static and dynamic load | 3 | 1 | 2 | 1 |
| | | | | | |
| Q1(b) | For the rigid body system shown in figure 1:<br><br>(a) Formulate the equation of motion<br><br>(b) Determine the natural frequency and damping ratio<br><br>(c) Calculate the maximum response $u_0(x)$ | 12 | 2 | 3 | 4 |
| | | | | | |
| Q1(c) | A platform weighing 2000 N is supported on four columns. The columns are identical and clamped at both ends. It has been determined experimentally that a force of 300 KN horizontally applied to platform produces a displacement of 3.0 mm. Damping is 5%. Determine the following :<br><br>(i) Stiffness of structure (ii) Damped frequency (ii) Damping coefficient (iii) Logarithmic decrement (iv)Number of cycles and time required for the amplitude of motion to be reduced from initial of 3.0 mm to 0.3 mm. | 5 | 2 | 3 | 2 |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Q2 (a) | A hallow circular cantilever column shown in figure 2 is subjected to a triangular pulse type load as shown in figure. Calculate the maximum horizontal displacement maximum bending moment in column. The response spectra for this dynamic load are also shown in the figure. | 7 | 2 | 3 | 2 |
| | | | | | |
| Q2(b) | Derive the expression for Transmissibility Ratio and briefly explain how vibration isolation can be achieved. | 7 | 2 | 3 | 2 |
| | | | | | |
| Q2(c) | An air-conditioning unit weighing 6 KN is supported at the mid-span of the simply supported beam of span 6m.The motor in the air conditioning unit excite the vertical component of the force on the beam of amplitude 270 N at the speed of 300 rpm.(Harmonic load) Neglecting the weight of the beam and assuming 5% damping, determine the amplitude of steady state deflection of the beam at mid-span and the force transmitted to the supports. $E= 2x10^5 N/mm^2$, $I= 2x10^8 mm^4$. | 6 | 2 | 3 | 2 |
| | | | | | |
| Q3 | A three storey single bay frame has storey height of **4 m.** The columns on ground and first story are **250 mm** wide **X 750 mm** deep while at 2nd story the size a column is **250 mm x 600 mm** & beams are very stiff. The mass on 1st and 2nd floor is **30 t**. while on 3rd floor it is **25t. E = 20000 Mpa**. Calculate natural frequencies & mode shapes | 20 | 3 | 4 | 5 |
| | | | | | |
| Q4(a) | State and prove orthogonality principle. Also state the significance of orthogonality principle in dynamic analysis | 5 | 3 | 3 | 5 |
| | | | | | |
| Q4 (b) | A three storey frame with free vibration characteristics as given below is subjected to a suddenly applied constant force with amplitude 100 KN at the 3nd floor level , 75 KN amplitude at 2nd floor and 50K amplitude at 1st floor. Calculate maximum displacements of each storey. Take damping ratio =5%. | 15 | 2 | 4 | 6 |
| | | | | | |

| Story No. | Mass No. | Mass (t) | ω rad/sec | Mode shapes | | |
|---|---|---|---|---|---|---|
| | | | | $\Phi_{i1}$ | $\Phi_{i2}$ | $\Phi_{i3}$ |
| 1 | 1 | 30 | 15.73 | 1.0 | 2.259 | 2.976 |
| 2 | 2 | 30 | 49.85 | 1.0 | 0.327 | -0.406 |
| 3 | 3 | 25 | 77.82 | -1.0 | 0.732 | -1.633 |

| | | | | | |
|---|---|---|---|---|---|
| Q 5(a) | For the beam shown in figure 3 calculate the fundamental frequency using Rayleigh's Method. | 8 | 4 | 3 | 7 |
| | | | | | |
| Q 5(b) | A simply supported beam of 8m span, 300 mm wide 600 mm deep carries a suddenly applied force of 100 KN at mid span. Calculate the maximum displacement and bending moment responses under the load and shear force at left support. E= $2 \times 10^4$ Mpa. and density of material = 2500 $kg/m^3$. Take contribution from the four lowest contributing modes | 12 | 4 | 4 | 7 |
| | | | | | |
| Q6(a) | For the cantilever beam shown in figure 4, calculate the natural frequencies and mode shapes. | 10 | 3 | 4 | 5 |
| | | | | | |
| Q6(b) | If the beam referred in Q6 (a) above, a suddenly applied constant load of 100 KN under second mass $m_2$, calculated the maximum reposes under each mass. | 10 | 3 | 3 | 6 |
| | | | | | |
| Q 7(a) | Starting from first principal, derive the expression for natural frequency and mode shape for a simply supported beam with uniformly distributed mass. | 10 | 4 | 2 | 7 |
| | | | | | |
| Q 7(b) | Represent the periodic load shown in figure 5 in terms of Fourier Series and determine the response of damped SDOF system subjected above periodic load. | 10 | 5 | 3 | 3 |

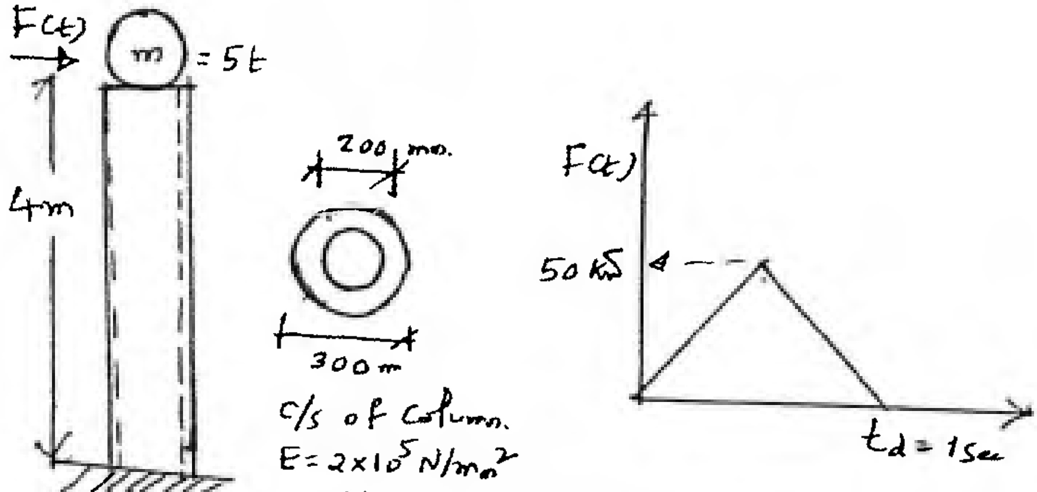





$m_1 = 1000$ kg  $m_2 = 600$ kg  $K_1 = 1000$ kN/m

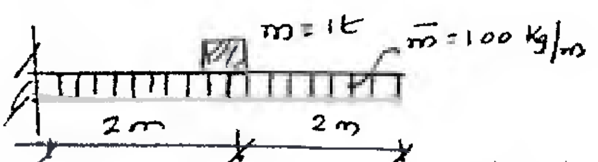
$K_2 = 500$ kN/m  $C_1 = 1$ kN-sec/m  $L = 2$ m

Figure 1



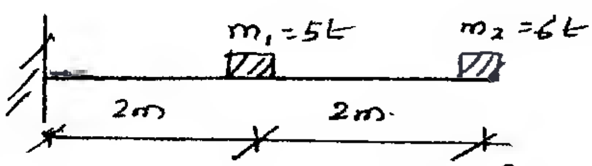

Use Response Spectra given in figure.

Figure 2




$E = 2\times10^5\ N/mm^2$  $I = 2\times10^8\ mm^4$.

Figure 3




$EI = 20,000\ kN\text{-}m^2$

Figure 4

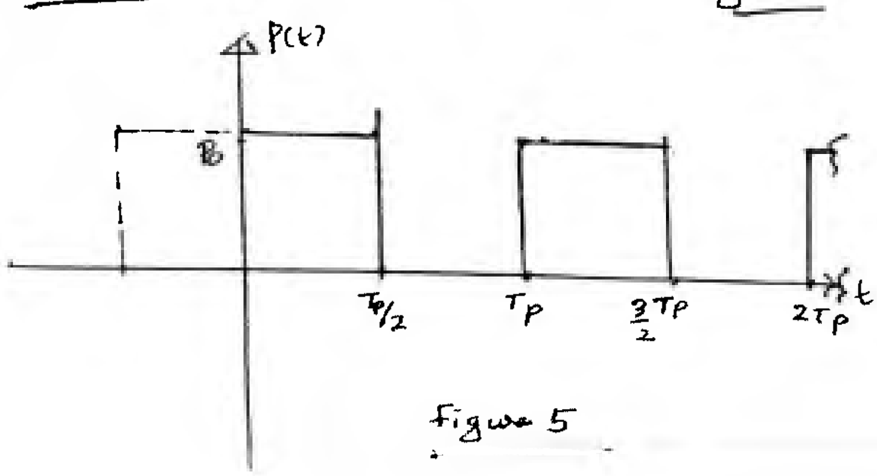



Figure 5

Bharatiya Vidya Bhavan's

# Sardar Patel College of Engineering

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Munshi Nagar, Andheri (West), Mumbai – 400058.

~~End Semester Examination~~/Re-Examination

~~December 2025~~ February 2026

First Year M.tech Civil Engg.

Max. Marks: 100 Duration: 3 Hours

Class: M Tech. Structural Semester: I Program: Civil Engineering

Name of the Course: Structural Dynamics Course Code: PC- MST 101

09/02/26

**Instructions:**

- Answer any five questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

| Question No | | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| Q1 (a) | What is Damping? Explain the effects of damping on structure. Also state the meaning of critical damping. | 3 | 1 | 1,2 | 1 |
| | | | | | |
| Q1(b) | For the rigid body system shown in figure 1:<br>(a) Formulate the equation of motion<br>(b) Determine the natural frequency and damping ratio<br>(c) Calculate the maximum response $u_0$ (x) | 12 | 2 | 3 | 4 |
| | | | | | |
| Q1(c) | A rigid steel frame shown in figure 2 is subject to harmonic load with amplitude of load 200KN and frequency 1.5 times the frequency of structure. Assuming the ratio as 2%, determine the maximum displacement at girder level and bending moment in the columns. | 5 | 2 | 3 | 2 |
| | | | | | |
| Q2 (a) | A hallow circular cantilever column shown in figure 3 is subjected to a triangular pulse type load as shown in figure. Calculate the maximum horizontal displacement maximum | 7 | 2 | 3 | 2 |

<table>
<tr><td></td><td>bending moment in column. The response spectra for this dynamic load are also shown in the figure.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Q2(b)</td><td>Derive the expression for Transmissibility Ratio and briefly explain how vibration isolation can be achieved.</td><td>7</td><td>2</td><td>3</td><td>2</td></tr>
<tr><td>Q2 (c)</td><td>A platform weighing 3000 N is supported on four columns. The columns are identical and clamped at both ends. It has been determined experimentally that a force of 300 KN horizontally applied to platform produces a displacement of 4.5 mm. Damping is 5%. Determine the following :<br><br>(i) Stiffness of structure (ii) Damped frequency (ii) Damping coefficient (iii) Logarithmic decrement (iv)Number of cycles and time required for the amplitude of motion to be reduced from initial of 4.5 mm to 0.45 mm.</td><td>5</td><td>2</td><td>3</td><td>2</td></tr>
<tr><td>Q3</td><td>A three story single bay frame has story height of 4 m. All columns are 300 mm wide X 750 mm deep& beams are very stiff. The mass on first and second floor is 50 t, and on third floor is 30 t. E = 20000 Mpa. Calculate natural frequencies & mode shapes</td><td>20</td><td>2</td><td>4</td><td>5</td></tr>
<tr><td>Q4</td><td>A three story frame with free vibration characteristics as given below is subjected to a rectangular pulse type load of 50 KN at 1st floor, 75 KN at 2nd floor level and 100 KN at the 3rd floor level. The load time history is shown in figure. Calculate maximum displacements of each story.<br>
<table>
<tr><td>Story No.</td><td>Mass No.</td><td>Mass (t)</td><td>ω rad/sec</td><td>Mode shapes</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>$\Phi_{i1}$</td><td>$\Phi_{i2}$</td><td>$\Phi_{i3}$</td></tr>
<tr><td>1</td><td>1</td><td>30</td><td>15.73</td><td>1.0</td><td>2.259</td><td>2.976</td></tr>
<tr><td>2</td><td>2</td><td>30</td><td>49.85</td><td>1.0</td><td>0.327</td><td>-0.406</td></tr>
<tr><td>3</td><td>3</td><td>25</td><td>77.82</td><td>-1.0</td><td>0.732</td><td>-1.633</td></tr>
</table></td><td>20</td><td>2</td><td>4</td><td>6</td></tr>
<tr><td>Q 5(a)</td><td>For the beam shown in figure 4 calculate the fundamental frequency using Rayleigh's Method.</td><td>10</td><td>2</td><td>3</td><td>7</td></tr>
<tr><td>Q5(b)</td><td>A two story frame with free vibration characteristics as given below is subjected to a harmonic force with amplitude 200 KN and at frequency of 20 rad/sec. at the 2nd floor level. Calculate maximum displacements of each story. Take damping ratio =5%</td><td>10</td><td>2</td><td>4</td><td>6</td></tr>
</table>

| Floor No. | Mass (t) | Mode No. | ω, rad/sec | Mode Shapes | |
|---|---|---|---|---|---|
| | | | | $\Phi_{i1}$ | $\Phi_{i2}$ |
| 1 | 20 | 1 | 14.58 | 1.0 | 1.481 |
| 2 | 15 | 2 | 38.07 | 1.0 | -0.822 |

| | | | | | |
|---|---|---|---|---|---|
| **Q6(a)** | For the dynamic load shown in figure 5, derive the expression for DLF | **10** | **2** | **3** | **2** |
| **Q6(b)** | Starting from first principal, derive the expression for natural frequency and mode shape for a simply supported beam with uniformly distributed mass. | **10** | 4 | 2 | 7 |
| **Q 7(a)** | Represent the periodic load shown in figure 6 in terms of Fourier Series. | **4** | 2,3 | 3 | 3 |
| **Q 7(b)** | A simply supported beam of 6m span, 300 mm wide 600 mm deep carries a suddenly applied force of 100 KN at mid span. Calculate the maximum displacement and bending moment responses under the load and shear force at left support. E= $2x10^4$ Mpa. and density of material = 2500 $kg/m^3$. Take contribution from the four lowest contributing modes | **12** | **4** | **4** | **7** |
| **Q7 (c)** | State and prove orthogonality principle. Also state the significance of orthogonality principle in dynamic analysis | **4** | | | |

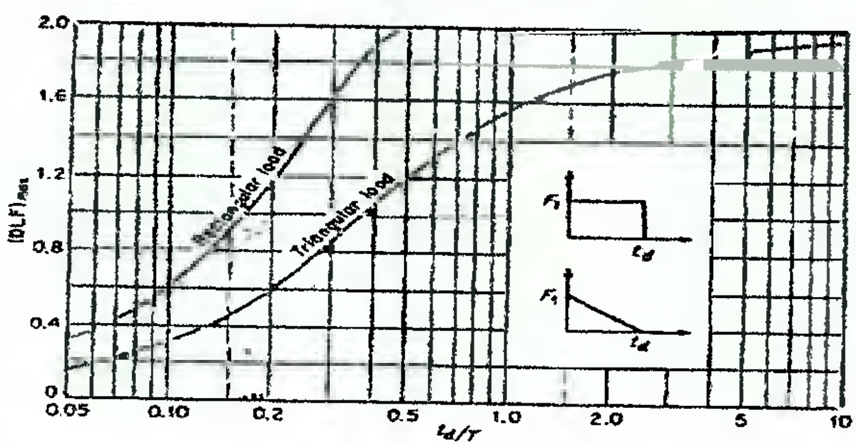
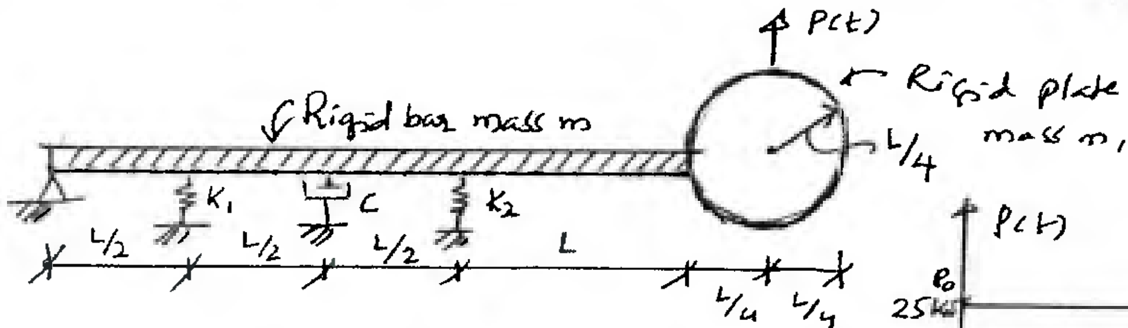
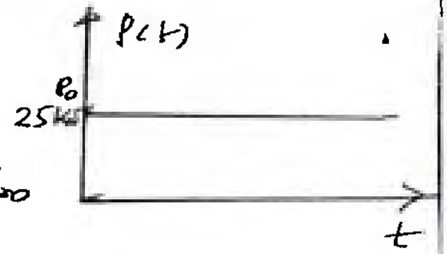


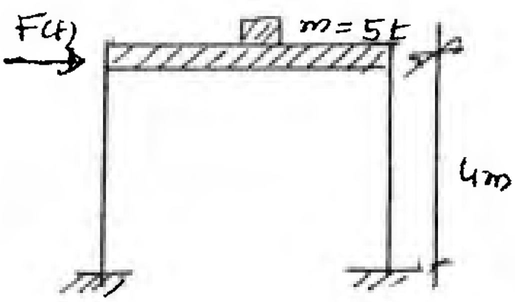

Figure for Q No (a)




$m_1 = 1000$ kg  $m_2 = 600$ kg  $K_1 = 1000$ kN/m

Figure 1  $K_2 = 500$ kN/m  $C = 1$ kN-sec/m.  $L = 2$ m.




$EI = 20{,}000$ kN-m$^2$.

Figure 2

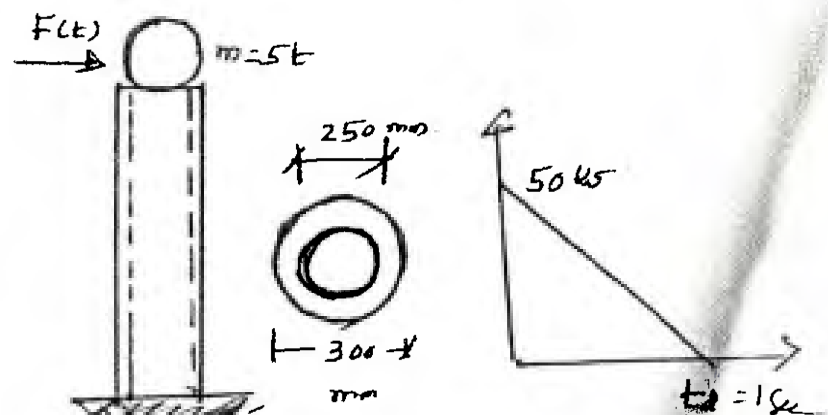
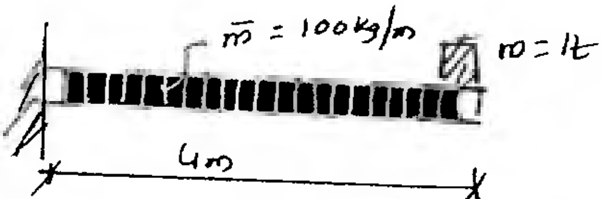



Figure 3

Use response spectra given




$E = 2\times10^5$ N/mm$^2$  $I = 2\times10^8$ mm$^4$

Figure 4

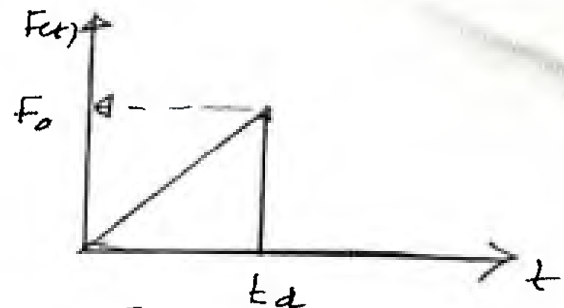



Figure. 5

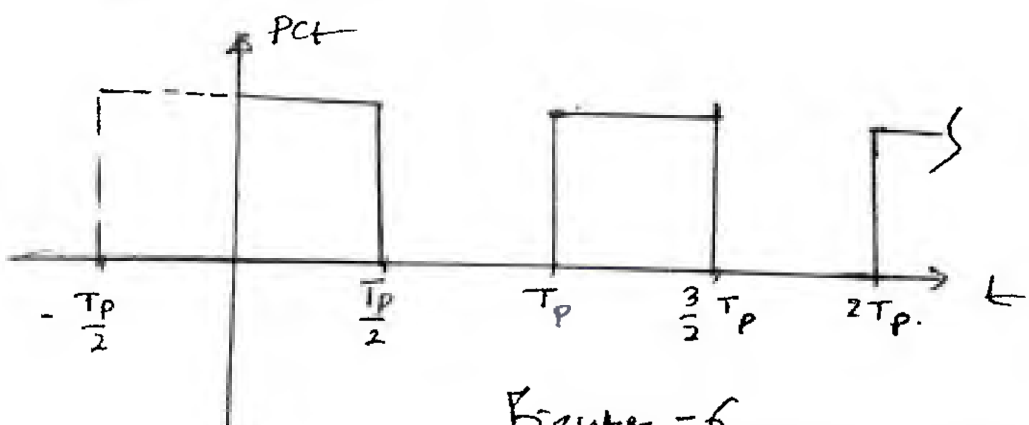



Figure -6

Bharatiya Vidya Bhavan's

# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

## END SEM/[redacted]-EXAM EXAMINATION DECEMBER 2025 / ~~JANUARY 2026~~

**Program: M. Tech Civil – Structures** First Year **Duration: 3 Hrs**

**Course Code: PC-MTSE102** M. Tech Civil-Structural **Maximum Points: 100**

**Course Name: Advanced Theory of Structures** **Semester: I**

31/12/25

**Notes:**

1. Attempt any 5 questions
2. Answer to each new question to be started on a fresh page.
3. Figures in brackets on the right-hand side indicate full marks.
4. Assume Suitable data if necessary and state it clearly.

| Q. No. | Questions | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| 1 | A. From the first principle, derive the stiffness matrix for the member of the plane frame. | 10 | 2 | 3 | 1 |
| | B. Generate the expressions for shear force, bending moment and twisting moment at any point in the ring beam of radius 'R', resting on 8 equally spaced supports, subjected to uniformly distributed load 'w'. Also determine maximum shear force, bending moment and twisting moment developed in the beam | 10 | 3 | 3 | 5 |
| 2 | A. From the first principle, derive the formulae for deflection, rotations, bending moment and shear force at any point for an infinite beam resting on elastic supports subjected to concentrated load acting at midpoint of the beam. | 10 | 4 | 3 | 7 |
| | B. Using the above formulae, plot the variation of the deflection, shear force and bending moment for an infinite beam of size 900 mm in width and 600 mm in depth subjected to a concentrated load of 300 kN at midpoint of the beam. Assume modulus of elasticity of the beam material as 20 GPa and soil stiffness as 2000 kN/m/m length of the beam. | 10 | 4 | 4 | 7 |
| 3 | A hook of a crane is made up of 100 mm diameter steel section with a mean radius of curvature of 100 mm. If the permissible tensile stress in material is 250 MPa in tension and 150 MPa in compression, determine maximum force resisted by the hook. Assume E = 200 GPa and G = 80 GPa. | 20 | 3 | 4 | 6 |
| 4 | Determine the forces developed in the rigid jointed plane frame shown in figure 1 using stiffness matrix approach. Also plot the variation of bending moment. | 20 | 1 | 4 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Determine the forces developed in the pin jointed plane frame shown in figure 2 using stiffness matrix approach. | 20 | 2 | 4 | 3 |
| 6 | Determine the forces developed in the beam shown in figure 3 using stiffness matrix approach. Also plot the variation of bending moment and the deflected shape of the beam. Note that support B settles down by 20 mm and beam is also subjected to a temperature change as shown in figure. Take $\alpha = 12 \times 10^{-6}$ /°C and EI = 25000 kN-m$^2$. | 20 | 2 | 4 | 3 |
| 7 | A. Determine the forces developed in the beam shown in figure 4 using flexibility matrix approach. Also plot the variation of bending moment of the beam.<br>B. Locate the Neutral axis for the circular section of diameter 200 mm used for a hook having mean radius of curvature of 150 mm. | 15<br>05 | 2<br>3 | 4<br>4 | 4<br>6 |

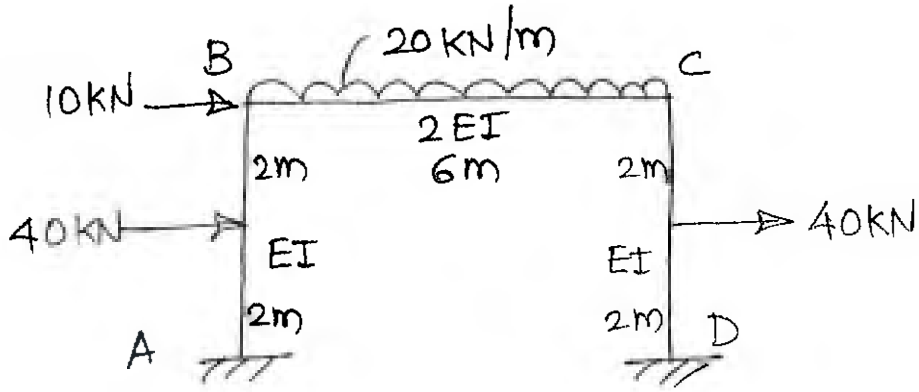



Figure – 1

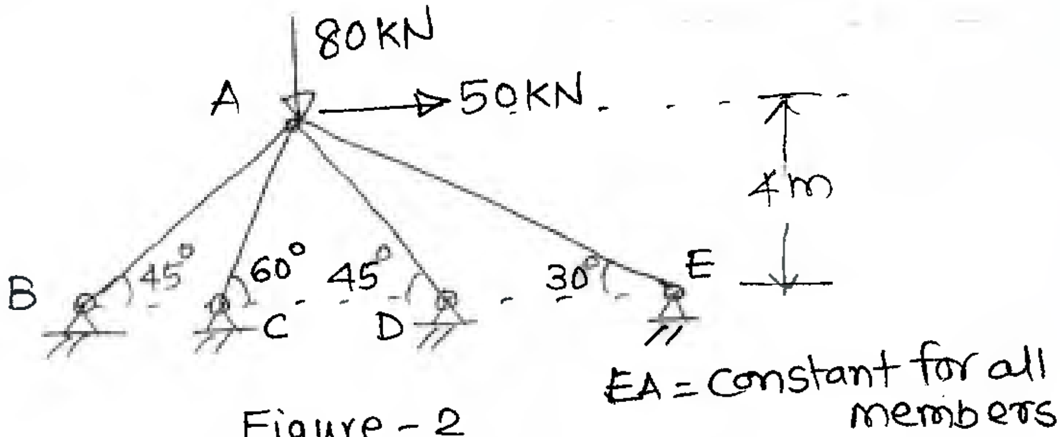
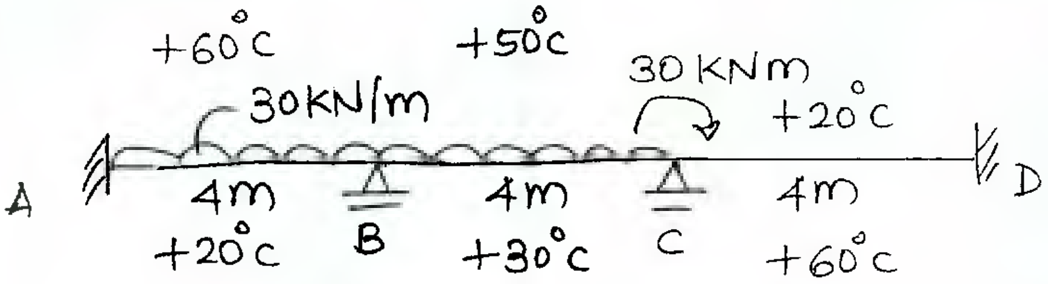



Figure – 2

**END SEM/RE-EXAM EXAMINATION DECEMBER 2025 / ~~JANUARY 2026~~**




Depth of all members = 0.5m
EI = Constant for all members.

Figure-3

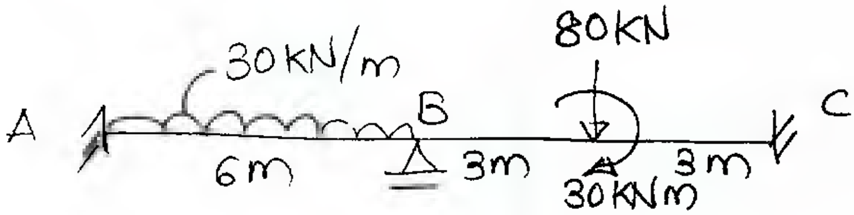



Figure-4

Bharatiya Vidya Bhavan's

# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

**End semester exam/~~Re-Exam~~ – ~~Dec 2025~~/Jan 2026**

First Year

**Program: M.Tech Civil Engineering - Structures** **Duration: 3 Hours**

**Course Code: PE-MTSE113** Structural Engg. **Maximum Points: 100**

**Course Name: Design of Prestressed Concrete Structures** **Semester: 1**

05/01/26

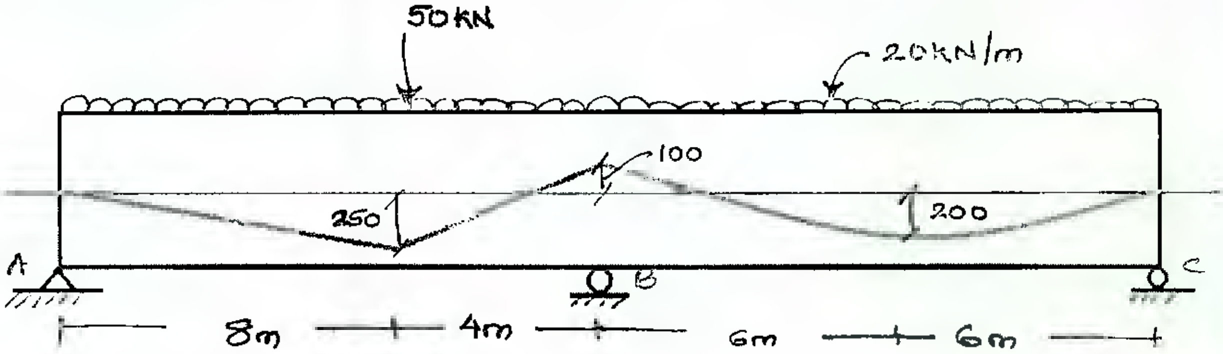
**Notes:**

- **Attempt any 5 main questions. Draw neat sketches to illustrate your answers**
- **Assume suitable data if missing and state the same clearly.**
- **Use of IS 1343 is allowed**

| Q.No. | Questions | Points | CO | BL | Module |
|---|---|---|---|---|---|
| 1.a) | A simply supported prestressed I girder has flange dimensions as 600x250mm and web dimensions as 250x1000mm. It is prestressed using a cable with parabolic profile, such that effective prestressing force is 1000kN. The cable is concentric at supports and has an eccentricity of 200mm at midspan. The girder supports a live load UDL of 15kN/m. Calculate the total stresses induced in the girder at midspan and supports using:<br>i) Stress concept<br>ii) Force concept | 10 | 01 | 03 | 1 |
| 1.b) | Explain kern distances and derive the expression for kern distance of a rectangular section. Evaluate the efficiency of following sections :<br>i) Rectangular cross section = (450x1000)mm<br>ii) I section<br>=> Flanges = (500x200)mm<br>=> Web = (250x1000)mm | 10 | 02 | 02 | 03 |
| 2.a) | Calculate the flexural capacity of a pre-tensioned T girder having the following properties:<br>Flange = (900x200)mm<br>Web = (350x1000)mm<br>Area of cables = 2800mm$^2$<br>Effective prestress = 1500MPa<br>Effective depth = 900mm<br>fck = 40MPa | 10 | 02 | 03,04 | 03 |
| 2.b) | Design the shear reinforcement for a simply supported beam at quarter span, of rectangular cross section 300mmx750mm and span 14m. It carries a live load UDL of 15kN/m. It is prestressed by a straight cable that has eccentricity of 250mm at midspan.<br>fck = 45MPa<br>Effective prestress in cable = 1000MPa<br>Characteristic strength of PT steel = 1500MPa; Area of prestressing steel = 500mm$^2$<br>Use Fe415 grade steel for reinforcement. | 10 | 02 | 03,04 | 03 |
| 3.a) | a) A simply supported post tensioned beam of span 20m with 2 cables; having a cross section of 400mmX 1500mm is successively tensioned from a single end in the order of cables 1-2.<br><table><tr><td></td><td>Profile</td><td>Eccentricity at midspan</td><td>Eccentricity at support</td></tr><tr><td>Cable 1</td><td>Parabolic</td><td>250mm (below N.A.)</td><td>120mm (above N.A.)</td></tr></table> | 15 | 2 | 03,04 | 02 |

| | | | | | |
|---|---|---|---|---|---|
| | Cable 2 \| Straight \| 450mm(below NA) \| 450mm(below NA)<br>Each cable has a cross section area of 550mm$^2$ and an initial tension of 1350MPa. Co-efficient for friction = 0.35; co-efficient for wave effect = 0.0015/m. Age of concrete at transfer of prestress = 28days. Anchorage slip = 4.25mm.<br>Es = 210kN/mm$^2$,Ec = 30kN/mm$^2$.<br>Calculate the % losses due to elastic shortening, shrinkage, friction and anchorage slip | | | | |
| 3.b) | Explain load-balancing concept. | 05 | 1,3 | 2 | 2,7 |
| 4. | Design a Type 1 pretensioned bonded girder (simply supported) for the following data<br>Effective span = 20m<br>Live load = 25kN/m<br>fck = 45MPa<br>fci = 35MPa<br>Assumed loss % = 30%<br>Calculate the size of section required, prestressing force, eccentricity with safe cable zone. If the characteristic strength of cables is 1500MPa, calculate the number of cables and its configuration required and draw neat sketch of the cable profile. | 20 | 3,4 | 4 | 05 |
| 5 | A 20m span simply supported composite beam consists of 300mmX1200mm precast stem and a cast-in-situ flange of 1200mmX300mm. The stem is a post tensioned unit subjected to an initial prestressing force of 1200kN. The tendons are provided at 100mm from the soffit of stem. The beam has to support a live load of 15kN/m. Determine the resultant stress distribution in the beam if the beam is a) unpropped; b) propped Draw neat sketches to show the variations of stresses at each stage | 20 | 03 | 3 | 06 |
| 6.a) | Derive the expression for deflection due to prestress when the profile is parabolic having eccentricity $e_1$ at ends and "$e_2$" at mid span for a simply supported beam<br><br>A simply supported prestressed beam of cross section 400mmX1000mm and span 20m has a parabolic profile of cable with eccentricity of 400mm below N.A at midspan and 120mm above NA at supports. It carries a live load of 20kN/m. The area of cable is 600mm$^2$ and it is initially tensioned to 1350N/mm$^2$.<br>% loss = 30%<br>Calculate the :<br>i) Instantaneous deflection due to dead load + prestressing force<br>ii) Long term deflection if the creep coefficient is 1.6<br>Grade of concrete = M40 | 10 | 02 | 03 | 03 |
| 6.b) | The end block of a post-tensioned beam has two anchorages with 300 mmx300mm size bearing plates located at 450mm from top and bottom respectively. The size of end block is 450x1350mm. An initial pre-stressing force of 700 kN is applied to each anchorage. Design the end zone reinforcement. Use M40 and Fe415 | 10 | 02 | 3,4 | 04 |

| | | | | | |
|---|---|---|---|---|---|
| 7. | The cable profile for a two span continuous beam is as shown in figure below. The prestressing force is 1750kN. **The beam carries loads as shown below**. Locate the thrust line and evaluate the stresses at point B. The cross section of beam is 400x900mm | 20 | 03 | 03 | 07 |




(Eccentricities in mm)

Bharatiya Vidya Bhavan's

# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

**~~End-semester-exam~~ / Re-Exam – ~~Dec 2025/Jan 2026~~**

First Year February 2026

**Program: M.Tech Civil Engineering - Structures** **Duration: 3 Hours**

**Course Code: PE-MTSE113** Structural engg. **Maximum Points: 100**

**Course Name: Design of Prestressed Concrete Structures** **Semester: 1** 11/02/26

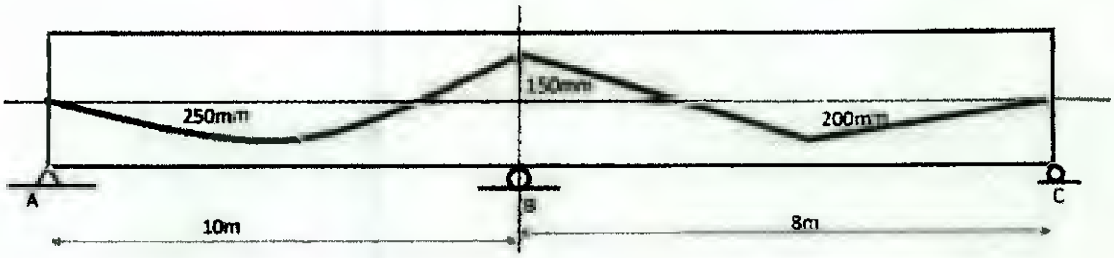
**Notes:**

- **Attempt any 5 main questions. Draw neat sketches to illustrate your answers**
- **Assume suitable data if missing and state the same clearly.**
- **Use of IS 1343 is allowed**

<table>
<tr><th>Q.No.</th><th>Questions</th><th>Points</th><th>CO</th><th>BL</th><th>Module</th></tr>
<tr><td>1.a)</td><td>Evaluate the stresses at quarter span in a prestressed section having cross section 300x900mm size and span = 15m. The beam is simply supported and has effective prestressing force 900kN. The eccentricity of prestressing is 300mm at midspan and it has a parabolic profile concentric at supports. Evaluate the stresses using : Stress approach and force approach</td><td>10</td><td>01</td><td>03</td><td>1</td></tr>
<tr><td>1.b)</td><td>Explain the process of post-tensioning of girders with neat sketch.</td><td>05</td><td>01</td><td>02</td><td>03</td></tr>
<tr><td>1.c)</td><td>Explain the concept of debonding of tendons and its necessity in pretensioning.</td><td>05</td><td>01</td><td>02</td><td>02</td></tr>
<tr><td>2.a)</td><td>A rectangular section of 400x950mm is pretensioned by wires of area 500mm$^2$ located at an effective depth of 750mm. If fck = 40MPa, characteristic strength of wires = 1600MPa, calculate the ultimate flexural strength section using IS code approach.<br>Explain the strain compatibility approach for calculating flexural strength and compare its accuracy with codal approach</td><td>10</td><td>02</td><td>03,04</td><td>03</td></tr>
<tr><td>2.b)</td><td>A prestressed post tensioned beam of cross sectional dimensions as 300mm X 850mm is subjected to the following design forces at a section: Bending moment : 600kN-m ,<br>Shear force : 100kN<br>Design suitable shear reinforcement at the section using following data :<br>fck = 35MPa<br>Area of prestressing steel = 800mm$^2$<br>Characteristic strength of prestressing steel = 1500MPa<br>Effective stress in prestressing steel = 1200MPa<br>The prestressing cable has a straight profile with a constant eccentricity of 300mm.<br>Use Fe415 reinforcement. Draw cross sectional details showing all reinforcements.</td><td>10</td><td>02</td><td>03,04</td><td>03</td></tr>
<tr><td>3.a)</td><td>a) A simply supported post tensioned beam of span 18m with 2 cables; having a cross section of 400mmX 1500mm is successively tensioned from a single end in the order of cables 1-2.
<table>
<tr><th></th><th>Profile</th><th>Eccentricity at midspan</th><th>Eccentricity at support</th></tr>
<tr><td>Cable 1</td><td>Parabolic</td><td>250mm (below N.A.)</td><td>120mm (below N.A.)</td></tr>
<tr><td>Cable 2</td><td>Straight</td><td>0mm</td><td>0mm</td></tr>
</table></td><td>15</td><td>2</td><td>03,04</td><td>02</td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | Each cable has a cross section area of $550mm^2$ and an initial tension of 1350MPa. Co-efficient for friction = 0.35; co-efficient for wave effect = 0.0015/m. Age of concrete at transfer of prestress = 28days. Anchorage slip = 4.25mm.<br>Es = $210kN/mm^2$,Ec = $30kN/mm^2$<br>Calculate the % losses due to elastic shortening, shrinkage, friction and anchorage slip | | | | |
| 3.b) | Explain load-balancing concept. | 05 | 1,3 | 2 | 2,7 |
| 4. | Design a Type 1 pretensioned bonded girder (simply supported) for the following data :<br>Effective span = 12m<br>Live load = 15kN/m<br>fck = 45MPa<br>fci = 35MPa<br>Assumed loss % = 30%<br>Calculate the size of section required, prestressing force, eccentricity with safe cable zone. Draw neat sketch of the cable profile. | 20 | 3,4 | 4 | 05 |
| 5 | A 15m span simply supported composite beam consists of 350mmX900mm precast stem and a cast-in-situ flange of 800mmX150mm. The stem is a post tensioned unit subjected to an initial prestressing force of 950kN. Loss =25%. The tendons are provided at 100mm from the soffit of stem. The beam has to support a live load of 25kN/m. Determine the resultant stress distribution in the beam if the beam is<br>i) Propped.<br>ii) Unpropped<br>Sketch the stress variations. Justify which type of construction will be better suited. | 20 | 03 | 3 | 06 |
| 6.a) | Derive the expression for deflection due to prestress when the profile is parabolic having eccentricity $e_1$ at ends and "$e_2$" at mid span for a simply supported beam (both eccentricities below CG)<br><br>A simply supported prestressed beam of cross section 350mmX900mm and span 20m has a parabolic profile of cable with eccentricity of 200mm below CG at midspan and 100mm below CG at supports. It carries a live load of 15kN/m. The area of cable is $700mm^2$ and it is initially tensioned to $1250N/mm^2$.<br>% loss = 28%<br>Calculate the :<br>i) Instantaneous deflection due to dead load + prestressing force<br>ii) Long term deflection if the creep coefficient is 1.6<br>Grade of concrete = M45 | 10 | 02 | 03 | 03 |
| 6.b) | Design the end block reinforcement for a post tensioned beam, prestressed using 3 cables each carrying a force of 1600kN with following data : Cross section dimensions = 300mmX900mm Side of anchor plate = 150mm, Strength of concrete at transfer = 40MPa, fck = 50MPa The anchor plate centres are located at 150mm, 450mm, 750mm from the top edge of the beam | 10 | 02 | 3,4 | 04 |

| | | | | | |
|---|---|---|---|---|---|
| | respectively. Design suitable reinforcement for the end zone using Fe415. Sketch the reinforcement details | | | | |
| 7 | The cable profile for a two span continuous beam ABC is as shown in figure below. The prestressing force is 900kN. The beam carries a UDL of 25kN/m on full span and point load = 110kN at midspan of BC. If the cross section of beam is 300x900mm, calculate the stresses at the continuous support. | 20 | 03 | 03 | 07 |



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# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

**End Semester Examination ~~December 2025/Re-~~ Examination- January 2026**

First Year M.tech Civil

**Program: M.Tech. (Structural Engineering)** | **Duration: 3 Hours**

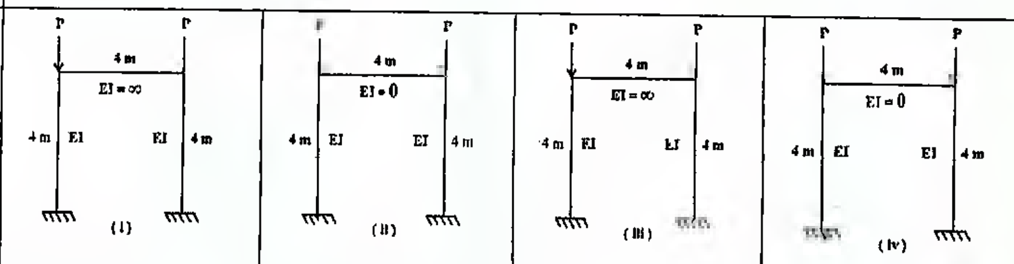
**Course Code: PE-MTSE121** | **Maximum Points: 100**

**Course Name: Program Elective-II: Non Linear Analysis** | **Semester: I**

07/01/26

**Instructions:**

- Attempt any FIVE questions out of SEVEN questions.
- **Answers to all sub questions should be grouped together.**
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

| Q.No | Questions | Points | CO | BL | Module No |
|---|---|---|---|---|---|
| Q1(a) | State and explain lower bound theorem. Why is it known as safe theorem? | (05) | 1 | 1,2 | 1 |
| Q1(b) | A steel beam of rectangular cross section 50 mmx 220 mm and span 5m, is subjected to end moments M at both the ends. The ends of the member are simply supported for bending about X and Y axes and the ends are prevented from rotating about z axis but are free to warp. Find the critical stress at which the beam buckles laterally. E=200 GPa, G=80 GPa. | (05) | 4 | 1,2 | 7 |
| Q1(c) | What is the buckling load P for each of the following 4 cases? Note that for (i) and (ii) side sway is prevented and for (iii) and (iv) side sway is permitted.  | (05) | 3 | 2 | 5 |
| Q1(d) | How is a solid section different from a thin-walled open section when subjected to axial load? Explain. | (05) | 4 | 2 | 6 |
| Q2(a) | Find the shape factor of an unsymmetrical I section with following details: Top flange width = 200 mm & thickness = 10 mm<br>Bottom flange width = 250 mm & thickness = 10 mm<br>Depth of web = 380 mm and thickness of web = 15 mm. | (10) | 1 | 3,4 | 1 |

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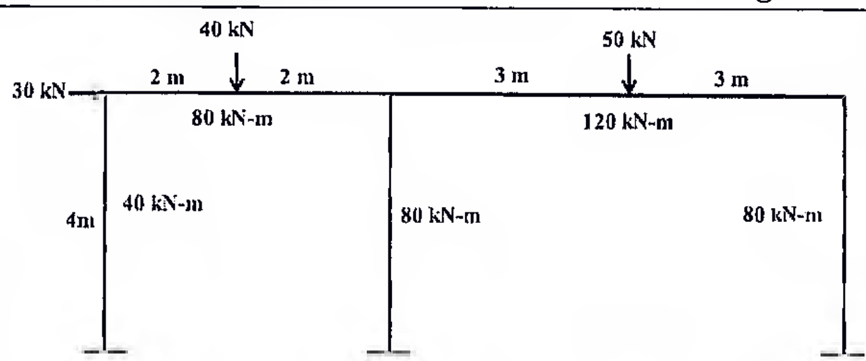
Munshi Nagar, Andheri (W) Mumbai – 400058

**End Semester Examination December 2025/Re- Examination- January 2026**

| | | | | | |
|---|---|---|---|---|---|
| Q2(b) | **Calculate the plastic moment capacity of a symmetric I cross section with the following details.**<br>**Top and bottom flange width = 210 mm & thickness = 20 mm**<br>**Depth of web = 540 mm and thickness of web = 12 mm**<br>**If the cross section is subjected to a shear force such that $N/N_P = 0.2$, find the reduced plastic moment capacity of the section. Also state the percentage loss in the plastic moment capacity of the section due to the shear force.**<br>**Take $\sigma_y = 250\ N/mm^2$.** | (10) | 2 | 2 | 3 |
| Q3(a) | **For the frame shown in figure below, find the true collapse load factor. Loads shown in the figure are working loads and the plastic moment capacity of each member in kN-m is also shown in the figure.** | (15) | 1 | 3,4 | 2 |

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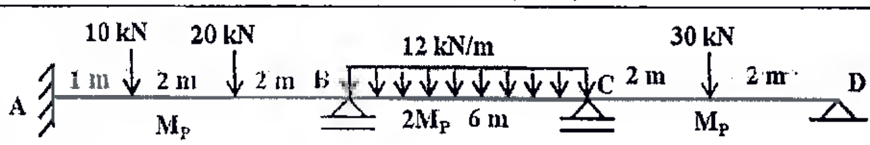
|---|---|---|---|---|---|
| Q3(b) | **Find the shape factor of a circular cross section of diameter D.** | (05) | 1 | 3,4 | 1 |
| Q4(a) | **A continuous beam is subjected to working loads as shown in figure below. If $M_P$ = 50 kN-m, calculate the (true) load factor for the beam.** | (10) | 1 | 3,4 | 1 |

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|---|---|---|---|---|---|
| Q4(b) | **Write a note on the effect of shear force on plastic moment capacity of a flexural member including derivation of expression for reduced plastic moment capacity of a rectangular cross section.** | (10) | 2 | 1,2,3 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| Q5(a) | A column of length L and pinned at both the ends is under the action of an axial compressive load P. Find the critical load by finite difference method if the flexural stiffness of the member varies according to<br>$EI(x) = EI_0 \quad 0 \le x \le L/5$<br>$= 2EI_0 \quad L/5 \le x \le 3L/5$<br>$= EI_0 \quad 3L/5 \le x \le L$ | (10) | 3 | 3,4 | 4 |
| Q5(b) | For the column given in Q5(a) above, find the critical load by energy method. | (10) | 3 | 3,4 | 4 |
| Q6(a) | A beam column of span 4 m, with simple supports at the end, is subjected to a transverse point load of 20 kN at a distance of 1m from the left support and an axial load of P at both ends. Derive the expression for the transverse deflection at any section between the left support and the point load. | (15) | 3 | 3,4 | 5 |
| Q6(b) | What is a beam column? Explain | (05) | 3 | 2 | 5 |
| Q7(a) | Write a note on the lateral buckling of a beam. | (05) | 4 | 2 | 7 |
| Q7(b) | A column of 3m length and of symmetrical I cross section is subjected to an axial force P. The boundary conditions of the column are such that the column is pinned at both the ends with regards to bending about both the X and Y axes. Further the ends of the column cannot rotate about Z axis and are free to warp. The dimensions of the I cross section are as given below.<br>Top and bottom flange width = 200 mm & thickness = 12 mm<br>Depth of web = 376 mm and thickness of web = 9 mm<br>Find the buckling load of the column. | (15) | 4 | 3 | 6 |

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# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

**~~End Semester Examination December 2025~~/Re- Examination- ~~January~~ 2026**

First Year Civil February

**Program: M.Tech. (Structural Engineering)** **Duration: 3 Hours**

**Course Code: PE-MTSE121** **Maximum Points: 100**

**Course Name: Program Elective-II: Non Linear Analysis** **Semester: I**

12/02/26

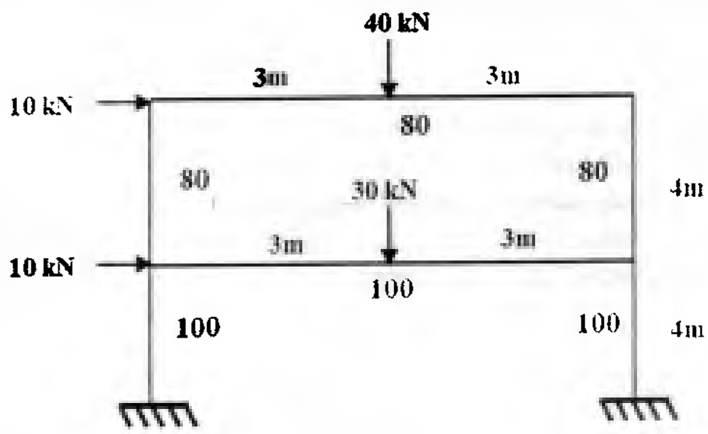
**Instructions:**

- Attempt any FIVE questions out of SEVEN questions.
- **Answers to all sub questions should be grouped together.**
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

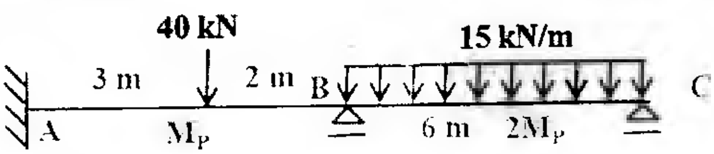
| Q.No | Questions | Points | CO | BL | Module No |
|---|---|---|---|---|---|
| Q1(a) | **What are the advantages and disadvantages of plastic analysis over elastic analysis?** | (05) | 1 | 1,2 | 1 |
| Q1(b) | **A steel beam of rectangular cross section 40 mmx 180 mm and span 4m, is subjected to end moments M at both the ends. The ends of the member are simply supported for bending about X and Y axes and the ends are prevented from rotating about z axis, but are free to warp. Find the value of M at which the beam buckles laterally. E=20 GPa, G=80 GPa.** | (05) | 4 | 1,2 | 7 |
| Q1(c) | **How is a beam column different from a beam and a column? Explain.** | (05) | 3 | 2 | 5 |
| Q1(d) | **Write a short note on torsion-bending torque.** | (05) | 4 | 2 | 6 |
| Q2(a) | **Find the shape factor of an unsymmetrical I section with following details:**<br>**Top flange width = 250 mm & thickness = 15 mm**<br>**Bottom flange width = 200 mm & thickness = 10 mm**<br>**Depth of web = 475 mm and thickness of web = 10 mm** | (10) | 1 | 3,4 | 1 |

**~~End Semester Examination December 2025~~/Re- Examination- January 2026**

| | | | | | |
|---|---|---|---|---|---|
| Q2(b) | **Calculate the plastic moment capacity of a symmetric I cross section with the following details.**<br>**Top and bottom flange width = 200 mm & thickness = 13 mm**<br>**Depth of web = 374 mm and thickness of web = 8.6 mm**<br>**If the cross section is subjected to an axial force such that $P/P_P = 0.5$, find the reduced plastic moment capacity of the section. Also state the percentage loss in the plastic moment capacity of the section due to the axial force. Take $\sigma_y = 250\ N/mm^2$.** | (10) | 2 | 2 | 3 |
| Q3 | **For the frame shown in figure below, find the true collapse load factor. Loads shown in the figure are working loads and the plastic moment capacity of each member in kN-m is also shown in the figure.** | (20) | 1 | 3,4 | 2 |




| | | | | | |
|---|---|---|---|---|---|
| Q4(a) | **A continuous beam is subjected to working loads as shown in figure below. If $M_P$ = 60 kN-m, calculate the (true) load factor for the beam.** | (10) | 1 | 3,4 | 1 |




| | | | | | |
|---|---|---|---|---|---|
| Q4(b) | **Write a note on the effect of axial force on plastic moment capacity of a flexural member including derivation of expression for reduced plastic moment capacity of a rectangular cross section.** | (10) | 2 | 1,2,3 | 3 |

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# SARDAR PATEL COLLEGE OF ENGINEERING

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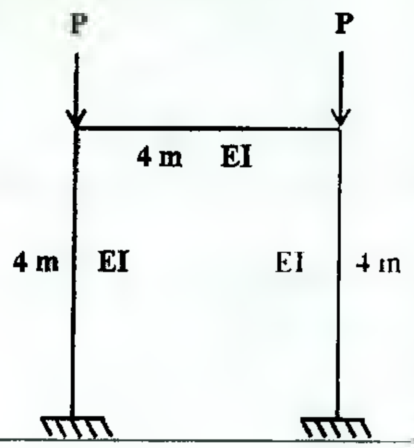
Munshi Nagar, Andheri (W) Mumbai – 400058

**~~End Semester Examination December 2025~~/Re- Examination- January 2026**

| | | | | | |
|---|---|---|---|---|---|
| Q5(a) | **A column of length L and pinned at both the ends is under the action of an axial compressive load P. Find the critical load by <u>finite difference method</u> if the flexural stiffness of the member varies according to**<br>$EI(x) = EI_0 \quad 0 \le x \le L/4$<br>$= 2EI_0 \quad L/4 \le x \le 3L/4$<br>$= EI_0 \quad 3L/4 \le x \le L$ | (10) | 3 | 3,4 | 4 |
| Q5(b) | **For the column given in Q5(a) above, find the critical load by <u>energy method</u>.** | (10) | 3 | 3,4 | 4 |
| Q6(a) | **Determine the critical load for the frame shown in figure. The frame is restrained from sway.** | (15) | 3 | 3,4 | 5 |
| |   | | | | |
| Q6(b) | **Find the St.Venant torsional constant J for the symmetric I section given in Question No 2(b).** | (05) | 4 | 3 | 6 |
| Q7(a) | **What are the possible ways to increase the critical stress of a rectangular beam at which it buckles laterally?** | (06) | 4 | 1,2 | 7 |
| Q7(b) | **Derive the governing differential equation for the torsional buckling of column with symmetrical cross- section.** | (14) | 4 | 1,2, 3 | 6 |

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# SARDAR PATEL COLLEGE OF ENGINEERING

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Munshi Nagar, Andheri (W) Mumbai – 400058

**END SEMESTER/RE EXAMINATION JANUARY/ ~~FEBRUARY~~ 2026**

**Program: M. TECH (STRUCTURES)** First Year M. tech Structural Engg. Civil **Duration: 3 HR**

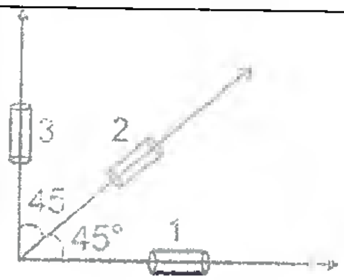
**Course Code: PE-MTSE131** **Maximum Points: 100**

**Course Name: Advanced solid Mechanics** **Semester: I**

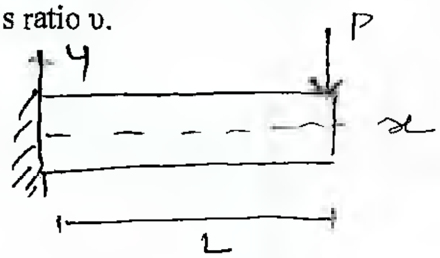
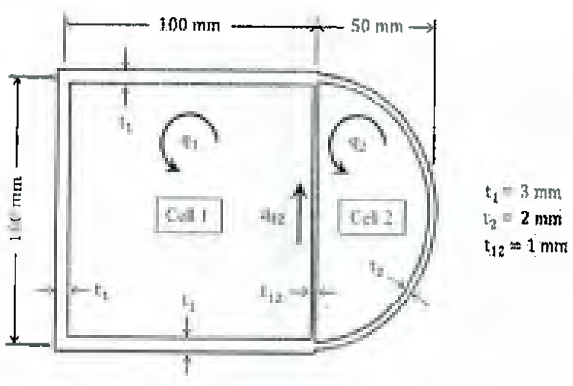
**Notes: Solve any 5 questions.**

| Q.No. | Questions | Points | CO | BL | Module |
|---|---|---|---|---|---|
| 1(a) | The state of stress in Mpa at a point is given by<br>$\begin{matrix} 1 & -5 & 2 \\ -5 & 10 & 4 \\ 2 & 4 & 8 \end{matrix}$<br>If the element is rotated by 45° about the y axis in the anticlockwise direction, Determine the new **Strain field** at the point. Use material constant matrix to solve.<br>Take E = 2 x $10^5$ N/ $mm^2$ · Poisson's ratio = 0.28. | 10 | 1 | 3 | 1 |
| 1(b) | A Plane Stress element in a part made of the 6061-T6 is found to have the following stress:<br>$\sigma_x$ = 39 Mpa ; $\sigma_y$ = 68.2Mpa, and $\tau_{xy}$ = 34.5 Mpa.<br>The Axial Yield Strength, $S_Y$, of 6061-T6 aluminum is 241 Mpa , and its Shear Yield Stress, $\tau_Y$, is 165 Mpa.<br>Determine<br>(a) Factor of Safety using Tresca Criterion.<br>(b) Factor of Safety using von Mises Criterion. | 10 | 3 | 4 | 6 |
| 2(a) | Consider a rectangular beam, length L, width 2b, depth 2h, subjected to a pure couple M along its length as shown in the Figure. If Airy's stress function used is<br>$\emptyset = a2\frac{x2}{2}$+b2 xy+c2$\frac{y2}{2}$<br>Show that $\sigma x = \frac{My}{I}$ | 12 | 2 | 3 | 3 |

**END SEMESTER/~~RE~~ EXAMINATION JANUARY/~~FEBRUARY~~ 2026**

| | | | | | |
|---|---|---|---|---|---|
| 2(b) | A body with a plane stress field has material properties E= 200 GPa and υ=0.3and has following displacement field,<br>$u(x, y) = ax^3 - bxy^2$<br>$v(x, y) = cx^2y - dy^3$<br>Where, a,b,c and d are constants<br>Determine $\sigma_x, \sigma_x, \tau_{xy}$ as functions of x and t<br>Check if the displacement field is compatible. | (08) | 1 | 3 | 5 |
| 3(a) | The stress field at a point with respect to X, Y, Z coordinate system is given by the array in Mpa as<br>45 18 22<br>18 15 −15<br>22 −15 16<br>Calculate principal stresses and direction cosine associated with maximum value of stress | 08 | 1 | 3 | 1 |
| 3(b) | <br>the strain rosettes read $\epsilon 1 = 0.001$, $\epsilon 2 = 0.004$ and and $\epsilon 3 = 0.006$<br>1) Calculate the shear strain $\gamma xy$ for an element oriented along the xy plane (Round your answer to 4 decimal points).<br>2) If the block is made of a material with elastic modulus E = 100 GPa and Poisson's ratio $\nu$ =0.3, use Hooke's law to find the stress components in the xy plane.<br>3) Determine the principal stresses in the block. | 12 | 3 | 4 | 7 |

**END SEMESTER/~~RE~~ EXAMINATION JANUARY/ ~~FEBRUARY~~ 2026**

| | | | | | |
|---|---|---|---|---|---|
| 4(a) | State plane stress and plane strain. Discuss the plane stress and plane strain for two dimensional problems with illustrations . | 08 | 1 | 3 | 2 |
| 4(b) | For the beam shown determine the displacement field due to bending only. Consider the cross section of beam to be rectangular and thin so that deflections are not functions of z. The stiffness of the beam is EIz and poisson's ratio υ.   | 12 | 2 | 3 | 2 |
| 5(a) | For a thin walled multi cell member subjected to torque T= 10 x 10 $^5$ N-m , the material properties are E= 60 GPa and Poisson's ratio = 0.33.<br>Calculate **a) shear flow in walls b) maximum shear stress**<br>**c) angle of twist per unit length**   | 14 | 2 | 3 | 5 |
| 5(b) | Each of the section shown is transmitting torque of 200 N-m. Estimate the maximum shear stress in each section and angle of twist per unit length | 06 | 2 | 3 | 5 |

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(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

**END SEMESTER/~~RE~~ EXAMINATION JANUARY/ ~~FEBRUARY~~ 2026**

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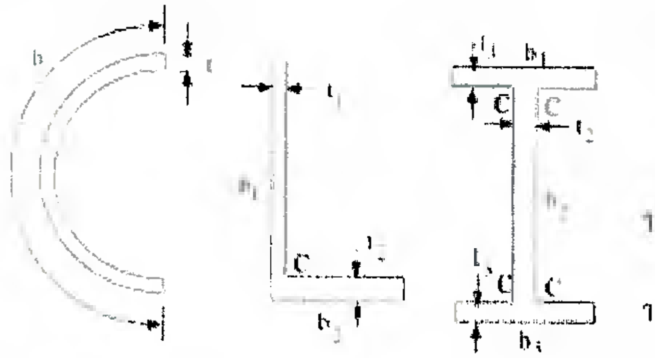
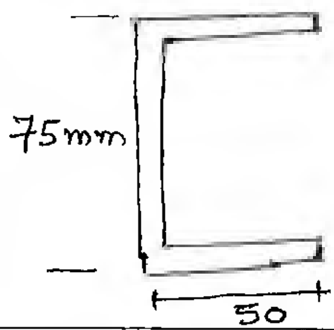
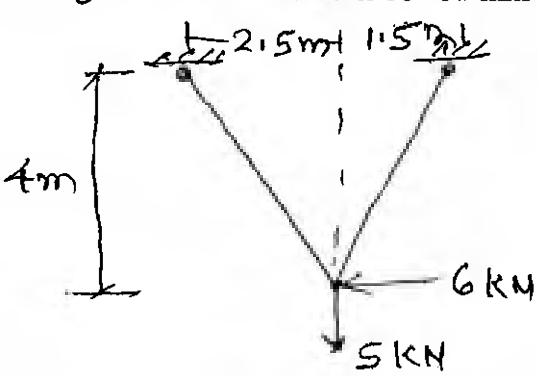
| |  | | | | |
| 6(a) | Determine the location of shear centre “e” for the cross section shown from first principle. All dimensions are in mm and thickness of walls is 0.1 cm.   | 10 | 2 | 3 | 5 |
| 6(b) | For the given cable arrangement calculate deflection of point B in vertical and horizontal direction for given load using complementary theorem. Cross section area of members 800 mm2 Take E = 2 x $10^5$ N/ $mm^2$   | 10 | 3 | 3 | 6 |
| 7 | For plate loaded in tension by force per unit area $\sigma$, is having circular hole at centre. Outer diameter of the plate is very large compared to diameter of hole 2a. Use Airy’s stress approach with polar coordinates | 20 | 2 | 4 | 4 |

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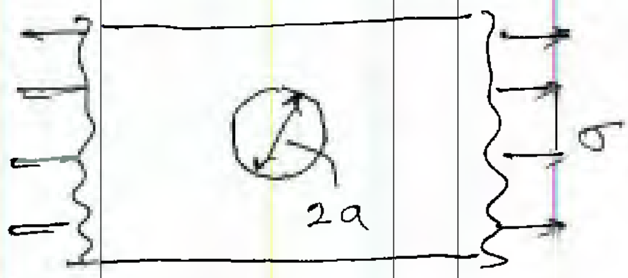
**END SEMESTER/~~RE~~ EXAMINATION JANUARY/ ~~FEBRUARY~~ 2026**




Derive equation for σr, σ and τ

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(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

**~~END SEMESTER~~/RE EXAMINATION ~~JANUARY~~/ FEBRUARY 2026**

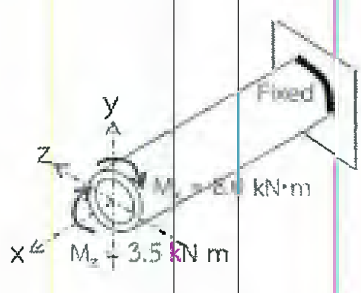
**Program: M. TECH (STRUCTURES)** First Year M.tech **Duration: 3 HR**

**Course Code: PE-MTSE131** Civil (Structural Engg) **Maximum Points: 100**

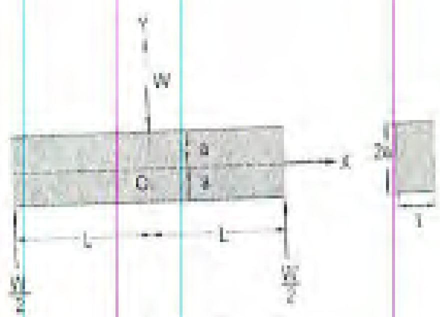
**Course Name: Advanced solid Mechanics** **Semester: I**

13/02/26

**Notes: Solve any 5 questions.**

| Q.No. | Questions | Points | CO | BL | Module |
|---|---|---|---|---|---|
| 1(a) | The state of strain at a point is given by $$\begin{bmatrix} 1 & -5 & 2 \\ -5 & 3 & 4 \\ 2 & 4 & 8 \end{bmatrix} \times 10^{-5}$$ If the element is rotated by 45° about the Z axis in the anticlockwise direction, Determine the new **STRESS field** at the point. Use material constant matrix to solve. Take E = 2 x $10^5$ N/ $mm^2$ · Poisson's ratio = 0.28. | 10 | 1 | 3 | 1 |
| 1(b) | The steel pipe as shown in Figure Ex10.4.a has an inner diameter of 60 mm and an outer diameter of 80 mm. If it is subjected to a torsional moment of 8 kN·m and a bending moment of 3.5 kN·m, determine if these loadings cause failure as defined by the Von Mises yield theory. The yield stress for the steel found from a tension test is $\sigma yp$ = 250 MPa   | 10 | 3 | 4 | 6 |

END SEMESTER/RE EXAMINATION JANUARY/ FEBRUARY 2026

| | | | | | |
|---|---|---|---|---|---|
| 2(a) | Show that for a simply supported beam, length 2L, depth 2a and unit width, loaded by a concentrated load W at the centre If Airy's stress function is as given, calculate stress field $$\phi = \frac{b}{6}xy^2 + Cxy$$ the positive direction of y being upwards, and x = 0 at mid span  | 12 | 2 | 3 | 3 |
| 2(b) | A body with a plane stress field has material properties E= 200 GPa and $\upsilon$=0.3and has following displacement field, $u(x, y) = 35x^2 - 10x^3y + 28y^3$ mm $v(x, y) = =11x^3 + 20xy^3 + 16y^2$ mm Where, x and y are in meters. Determine stresses and rotation of the body at x= 0.080 m and y= 0.025 met Check if the displacement field is compatible. | (08) | 1 | 3 | 5 |
| 3(a) | The stress field at a point with respect to X, Y, Z coordinate system is given by the array in Mpa as $$\begin{matrix} 35 & 14 & 25 \\ 14 & 20 & 31 \\ 25 & 31 & -10 \end{matrix}$$ Calculate principal stresses and direction cosine associated with maximum value of stress | 08 | 1 | 3 | 1 |

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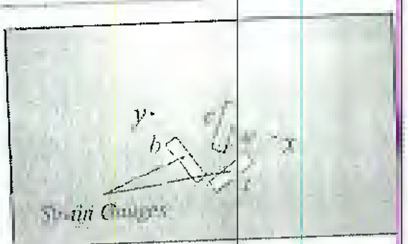
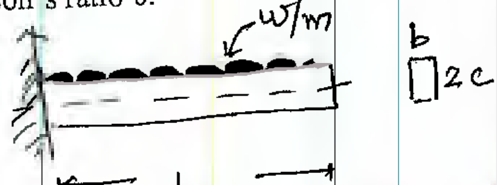
## END SEMESTER/RE EXAMINATION JANUARY/ FEBRUARY 2024

| | | | | | |
|---|---|---|---|---|---|
| 3(b) | A strain rosette having three strain gauges a, b and c is installed on a block as shown in Fig. 10.3. During a static test of the block in plane strain ($\epsilon z = 0, \gamma xz = 0$ *and* $\gamma yz = 0$), the strain rosettes read $\epsilon a = 0.003$, $\epsilon b = 0.001$ and and $\epsilon c = 0.001$.<br>1) Calculate the shear strain $\gamma xy$ for an element oriented along the xy plane (Round your answer to 4 decimal points).<br>2) If the block is made of a material with elastic modulus E = 100 GPa and Poisson's ratio $\nu = 0.3$, use Hooke's law to find the stress components in the xy plane.<br>3) Determine the principal stresses in the block.<br> | 12 | 3 | 4 | 7 |
| 4(a) | Prove that to convert a plane stress solution to a plane strain solution you substitute $E/1-\nu^2$, $\frac{\nu}{1-\nu}$ for E and $\nu$ respectively. | 08 | 1 | 3 | 2 |
| 4(b) | For the beam shown determine the displacement field due to bending only. Consider the cross section of beam to be rectangular and thin so that deflections are not functions of z. The stiffness of the beam is EIz and poisson's ratio $\upsilon$.<br> | 12 | 2 | 3 | 2 |

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END SEMESTER/RE EXAMINATION JANUARY/ FEBRUARY 2026

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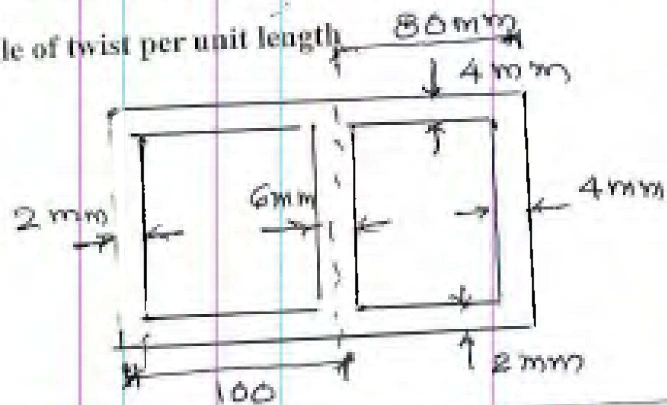
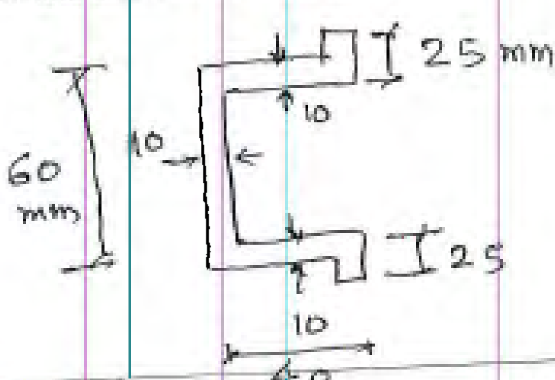
|---|---|---|---|---|---|
| 5(a) | For a thin walled multi cell member subjected to torque $T = 10 \times 10^5$ N-m , the material properties are E= 60 GPa and Poisson's ratio = 0.33. Calculate **a) shear flow in walls b) maximum shear stress** **c) angle of twist per unit length**  | 14 | 2 | 3 | 5 |
| 5(b) | Each of the section shown is transmitting torque of 200 N-m. Estimate the maximum shear stress in each section and angle of twist per unit length  | 06 | 2 | 3 | 5 |
| 6(a) | Determine the location of shear centre "e" for the cross section shown from first principle. All dimensions are in mm and thickness of walls is 0.1 cm.  | 10 | 2 | 3 | 5 |

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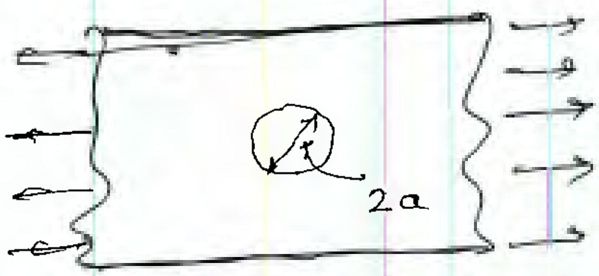
## END-SEMESTER/RE EXAMINATION JANUARY/ FEBRUARY 2026

| | | | | | |
|---|---|---|---|---|---|
| 6(b) | For the given cable arrangement calculate deflection of point B in vertical and horizontal direction for given load using complementary theorem. Cross section area of members 900 mm2 Take $E = 2 \times 10^5$ N/ mm$^2$   | 10 | 3 | 3 | 6 |
| 7 | For plate loaded in tension by force per unit area σ , is having circular hole at centre. Outer diameter of the plate is very large compared to diameter of hole 2a. Use Airy's stress approach with polar coordinates   Derive equation for σr, σ and τ | 20 | 2 | 4 | 4 |

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**END SEMESTER EXAMINATION ~~DEC 2025~~/ JAN2026**

First Year M.tech Civil Structural engineering
Semester – I 02/01/26

| MTech | MTech Civil-Structural Engineering | MTech Civil-Construction Management | MTech Electrical Power Electronics and Power System | MTech Mech-Machine Design | Duration : 3 hours<br>Max Points 100<br>Semester –I<br>Course Name : RMIPR |
|---|---|---|---|---|---|
| Course Code | PC MTSE103 | PC-MTCM103 | PC-MTPX103 | PC-MTMD103 | |

**Instructions:**

- Question 1 is compulsory
- Attempt any four questions out of remaining six
- Draw neat diagrams
- Assume suitable data if necessary
- Stadard data tables are permitted.

| Q.No. | Questions | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| Q1A | When to write a research paper? Why to write a research paper? With respect to a research paper writing provide specific guidelines based on following. (Consider Research of your own interest) :<br>• Title and Abstract<br>• Introduction<br>• Literature Review<br>• Methodology<br>• Results<br>• Discussion<br>• Conclusion<br>• References | 10 | CO1, CO2, CO3 | 5 | M4 |
| Q1B | Define what a research problem is and explain why its careful selection is crucial in the research process. Differentiate between a research topic, a research problem, and a research question. Give an example to illustrate your answer. | 10 | CO3 | 5 | M1 |

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## END SEMESTER EXAMINATION ~~DEC 2025~~ / JAN2026

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|---|---|---|---|---|---|---|
| Q2A | • Mr X flies quite often from town A to Town B,<br>• He can use the Airport Bus which cost Rs25 But if he takes it there is a 0.08 Chance that he will miss the flight.<br>• The stay in hotel costs Rs270 with a 0.96 chance of being in time for the flight.<br>• For Rs 350 he can use taxi which will make 99 percent chance of being on time for the flight.<br>• If Mr X catches the plane on time he will conclude the business transaction that will produce the profit of Rs 10000/- , otherwise he will lose it.<br>• Which mode of transport should Mr X use ? | 10 | CO2, CO3 | 5 | | M5 |
| Q2B | Imagine you are working on a research problem in your field (e.g., "Assessing the impact of Drone technology on Effectiveness on Construction Project Monitoring " *or* "Developing a sustainable concrete mix using industrial waste").<br>a) Develop a detailed flowchart depicting the step-by-step research methodology for your chosen problem. Your flowchart should include stages from problem identification to data analysis and reporting.<br>b) Label each step clearly and provide a brief justification for why each step is included in the sequence. | 10 | CO2 | 3 | | M1 |
| Q3A | • A population is divided into three strata so that N1 = 6500, N2 = 2500 and N3 = 3500.<br>• Respective standard deviations are: s1=16, s2=17 and s3=6.<br>• Respective Cost associated with strata Ci for Strata Ni<br>    ○ C1=4500, C2=1500, C3=1000<br>• How should a sample of size n = 89 be allocated to the three strata, if we want optimum allocation using disproportionate sampling design?<br>• Explain Interview techniques in detail. | 10 | CO2 CO3 | 4, | 5 | M2, M3 |
| Q3B | Provide two real-world scenarios where 100% Inspection is essential. Justify why sampling would not be appropriate in these cases.<br><br>Define 100% Inspection and Sampling Inspection. Explain the primary objectives of each inspection method. Why would an organization choose one over the other? | 10 | CO2 | 3 | | M3 |