MRCET CAMPUS

# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUS INSTITUTION – UGC, GOVT. OF INDIA)


## Department of AERONAUTICAL ENGINEERING

# SOLID MECHANICS

# QUESTION BANK

**Prepared by:**

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**Code No: R20A2108**

**R20**

**MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY**
**(Autonomous Institution – UGC, Govt. of India)**
**II B.Tech II Semester Supplementary Examinations, January 2024**
**Solid Mechanics**
**(AE)**

| *Roll No* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

***Time: 3 hours*** ***Max. Marks: 70***

**Note:** This question paper Consists of 5 Sections. Answer **FIVE** Questions, Choosing ONE Question from each SECTION and each Question carries 14 marks.

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**SECTION-I** **Marks**

**1** ***A*** A rod of length 1m and diameter 20mm is subjected to a tensile load of 20 kN. The increase in length of the rod is 0.30mm and decrease in diameter is 0.0018mm. Calculate the Poisson's ratio. **[10M]**

***B*** The Young's modulus of a material is 210 kN/mm$^2$ and modulus of rigidity is 75 kN/mm$^2$, determine the bulk modulus. **[4M]**

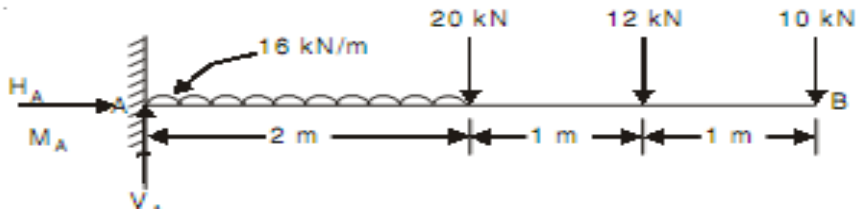
OR

**2** ***A*** Explain (i) Types of stress and (ii) State of stress at a point **[8M]**

***B*** A circular rod of diameter 20 mm and 500 mm long is subjected to a tensile force of 45 kN. The modulus of elasticity for the material is 2.1x10$^5$ N/mm$^2$. Find the stress, strain and the elongation of circular rod. **[6M]**

**SECTION-II**

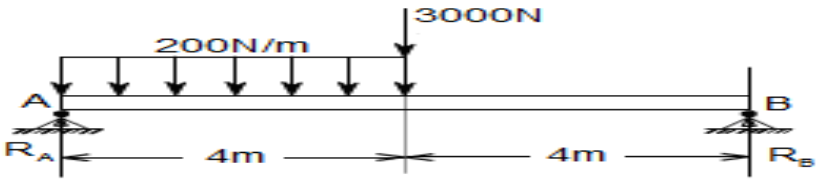
**3** Draw Shear force and Bending moment diagram for the beam set up shown below. **[14M]**




OR

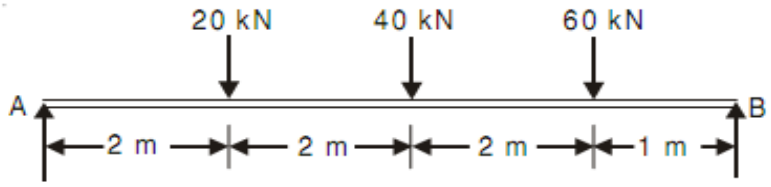
**4** ***A*** Classify beams. Explain statistically determinate beams **[6M]**

***B*** Draw Shear force and Bending moment diagram for the beam structure. **[8M]**




**SECTION-III**

**5** A simply supported beam is loaded as shown below is 200mm wide and 400mm deep. Find the slopes at the supports, Deflections under loads and magnitude of the maximum deflection. Take E = $2x10^4$ N/$mm^2$. Use Macaulay's method. **[14M]**




OR

**6** A steel simply supported beam of uniform cross section, 10m long carries point loads of 75kN and 20kN at two points 4m and 7m from one end respectively. Take: I=$60x10^{-4}m^4$, E=210GN/$m^2$ **[14M]**

Calculate:

(i) The deflection of the beam under the point loads

(ii) The deflection at a point 5m from one end.

(iii) The Maximum deflection.

**SECTION-IV**

**7** Find the Euler crushing load for a hollow cylindrical cast-iron column 200mm external diameter, 25 mm thick, 6 m long and hinged at both ends. Compare the load with the crushing load as given by the Rankine formula taking $\sigma_c$ = 550 MN/$m^2$ and a= 1/1600. For what length of column would these formulae give the same crushing load? Take E = 120 GPa. **[14M]**

OR

**8** ***A*** An I-section with 10 cm x 2 cm top and bottom flange and 115 cm x 2 cm middle web is used as a column of length 3m with both ends pinned. If E = 210 GPa, calculate the load the column can carry. Derive the formula used. **[10M]**

***B*** Explain the Euler's column curve **[4M]**

**SECTION-V**

| | | |
|---|---|---|
| **9** | Explain about maximum Principle Shear Strain Theory and Maximum Shear Stress theory. | **[14M]** |

OR

| | | |
|---|---|---|
| **10** | A shaft is loaded by a torque of 5 kNm. The material has a yield point of 350 MPa. Find the required diameter using Maximum shear stress theory | **[14M]** |

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Code No: R18A2108 **R18**

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

II B.Tech II Semester Supplementary Examinations, January 2024

Mechanics of Solids

(AE)

| Roll No | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

Time: 3 hours Max. Marks: 70

Note: This question paper Consists of 5 Sections. Answer FIVE Questions, Choosing ONE Question from each SECTION and each Question carries 14 marks.

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## SECTION-I

**1** Describe the Elastic constants and show the Relationship between them **[7M]**

Explain the Mohr's Circle of the Stresses with suitable diagram **[7M]**

OR

**2** point in a strained material is subjected to two mutually perpendicular tensile stresses of 150 MPa and 100 MPa along with shear stress of 75 MPa. Determine the intensities of normal, shear and resultant stresses and obliquity on a plane inclined at $40^0$ with the axis. **[14M]**

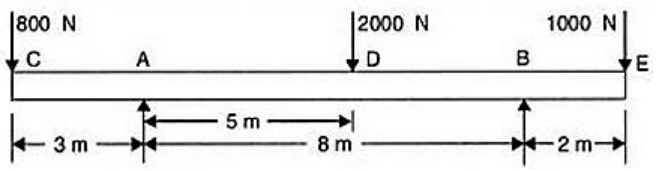
## SECTION-II

**3** Derive the relation between shear force, bending moment and intensity of loading **[7M]**

Differentiate Statically Determinate and Indeterminate Beams with examples **[7M]**

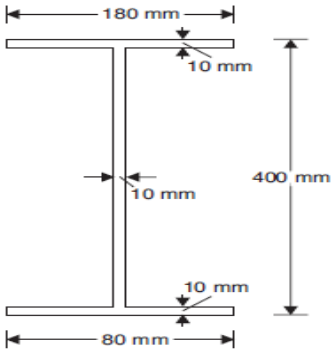
OR

**4** Evaluate Shear force and Bending moment and Draw shear force and bending moment diagrams for which is loaded as shown in figure. Determine the points of contra flexure within the span AB. **[14M]**




## SECTION-III

**5** Draw the shear stress distribution diagram for the I-section shown in figure. If it is subjected to a shear force of 100 kN. **[14M]**




OR

**6** **a)** A cantilever beam of length L carries a point load W at free end determine the maximum slope and deflection. **[7M]**

**b)** A cantilever beam 6 m long is subjected to a UDL of 5 KN/m over its entire span. Find the slope and deflection of cantilever beam at its free end. Take EI=2.5x$10^{12}$kN-$mm^2$. **[7M]**

## SECTION-IV

**7** **a)** A 2 m long steel column of rectangular cross section 120 mm X 100 mm is rigidly fixed at one end and hinged at other end. Determine the buckling load on the column and the corresponding axial stress using Euler's formula take E=210 Gpa **[7M]**

**b)** Derive the expression for crippling load by Euler's formula for a column having one end fixed and Other end is hinged. **[7M]**

OR

**8** Describe the effective length of column with different end conditions. And a solid column 3m long and 50 mm in diameter. Determine crippling load for the following conditions i) Both ends hinged ii) One end is fixed and other is hinged Take E=2.0 ×$10^5$ N/$mm^2$ **[14M]**

## SECTION-V

**9** What is criterion for failure? What are the different theories used to design the member? **[14M]**

OR

**10** The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory; 3. Maximum principal Strain theory; 4. Maximum strain energy theory; and 5. Maximum distortion energy theory. Take permissible tensile stress at elastic limit = 100 MPa and poisson's ratio = 0.3. **[14M]**

**R18**

**Code No: R18A2108**

# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

**(Autonomous Institution – UGC, Govt. of India)**

## II B.Tech II Semester Supplementary Examinations, April 2023

## Mechanics of Solids

**(AE)**

**Time: 3 hours** **Max. Marks: 70**

**Note:** This question paper Consists of 5 Sections. Answer **FIVE** Questions, Choosing ONE Question from each SECTION and each Question carries 14 marks.

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**SECTION-I**

**1** Derive the expression for normal and tangential stresses on an oblique plane subjected to biaxial stresses. **[7M]**

Draw stress- strain diagram for mild steel specimen tested under uni-axial tension till fracture and mark all the salient points. **[7M]**

OR

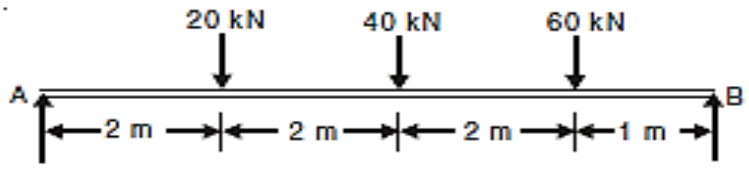
**2** certain point in a strained material the principal stresses are 100 N/mm$^2$ and 40 N/mm$^2$ both tensile. Find the normal, tangential and resultant stresses across a plane through the point at 40$^0$ to the major principle plane, using Mohr's circle of stress. Check the answers Analytically **[14M]**

**SECTION-II**

**3** erive the bending equation from first principles. And find the maximum bending stress induced in the beam of rectangular cross section with 75 mm wide and 150 mm deep is simply supported over a span of 5 meters. if the beam is subjected to a UDL of 4.5 KN/m over entire span **[14M]**

OR

**4** Plot shear and bending-moment diagrams for a simply supported beam with a point loads, shown in figure **[14M]**




**SECTION-III**

**5** **a)** A simply supported beam of length L is subjected to a point load W at the mid span. Find the maximum deflection of the beam? **[7M]**

**b)** A simply supported beam of span 2.4 m is subjected to a central point load of 15 [7M]

KN. What is the maximum slope and deflection at the center of the beam? Take EI for the beam as $6x10^{10}$ N-mm$^2$

OR

6 **a)** Derive an expression for the shear stress at any point in the cross-section of a beam. **[7M]**

**b)** A beam of rectangular cross section having width of 200 mm and height of 300 mm is subjected to a shear force of 25 kN. Find the value of maximum shear stress and draw shear stress distribution **[7M]**

**SECTION-IV**

7 **a)** Calculate the safe compressive load on a hollow cast iron column one end fixed and the other hinged of 150 mm external diameter, 100 mm internal diameter and 10 m in length. Use Euler's formula with a factor of safety of 5, and Take E= 95 KN/mm$^2$ **[7M]**

**b)** Derive crippling load by Euler's formula for a column having both ends of the column are pinned or hinged. **[7M]**

OR

8 **a)** Derive the Rankine's formula for both short and long column. **[7M]**

**b)** Find the crippling load by Rankine's formula for a hollow cylindrical steel column of 40 mm external diameter an 2.5 mm thick and the length of column is 2.5 m and hinged at its both ends take $\sigma_c$= 335 N/mm$^2$ and $\alpha$=1/7500 **[7M]**

**SECTION-V**

9 Explain the following failure theories

i. the maximum principal stress theory **[4M]**
ii. the maximum principal strain theory **[5M]**
iii. the maximum shear stress theory **[5M]**

OR

10 A steel specimen is subjected to the following principal stresses (i) 125 N/mm$^2$ tensile (ii) 70 N/mm$^2$ tensile and 35 N/mm$^2$ compressive. If the proportionality limit for the steel specimen is 260 N/mm$^2$. Find the factor of safety according to (a) the maximum principal stress theory (b) the maximum principal strain theory (c) the maximum shear stress theory. Take Poisson's ratio $\mu$ = 0.3. **[14M]**

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