Code No: R2021031 **R20** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, January - 2023
MECHANICS OF SOLIDS
(Com to ME, AME)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Explain all the relations relating the elastic constants. [6M]

b) A compound bar made of steel and Aluminium cylinder carries an axial load p=60KN as shown in Figure: 1. Determine the change in the axial length. Take E_{a1}= 70Gpa. [8M]

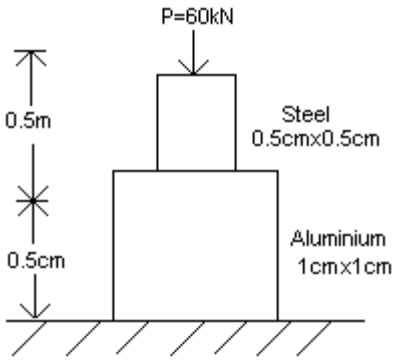

Figure: 1

OR

2 a) A steel rod of 20mm diameter passes centrally through a copper tube of 50mm external diameter and 40 mm internal diameter. The Tube is closed at each by rigid plates of negligible thickness. The nuts are heightened lightly home on the projections parts of the rod. If the temperature of the assembly is raised by 50^0C, calculate the stresses developed in copper and steel. Take E_s = 200 6N/m^2 and E_C = 100 6N/m^2 & α_S = 12 x $10^{-6}/^0$C and α_C = 18x$10^{-6}/^0$C. [9M]

b) Discuss briefly about working stress, lateral strain and volumetric strain. [5M]

UNIT-II

3 A beam of length 6m is simply supported at its ends. It is loaded with a gradually varying load of 750 N/m from left end to 1500 N/m to the right end. Construct the SF and BM diagrams and find the magnitude and position of the maximum BM. [14M]

OR

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4 Sketch the shear force and bending moment diagrams (Neat sketches) showing the salient values for the loaded beam shown in the figure 2 below. [14M]

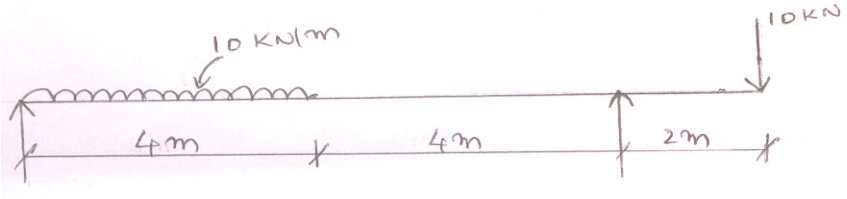

Figure: 2

UNIT-III

5 a) A beam of symmetrical section 30cm deep and I= 12000cm^4, carries U.D.L. of 16kN/m. Calculate the maximum span of the beam if the maximum bending stress is not to exceed160N/mm^2. With this span, calculate the maximum central load if the bending stress is not to exceed the limit given above. [9M]

b) From first principles show that the shear stress is not maximum at the neutral axis in case of an isosceles triangular section. [5M]

OR

6 The cross-section of a joist is a T-section 12.5 ×12.5×1.2cm with 12.5 cm side horizontal. Find the maximum intensity of shear stress and sketch the distribution of stress across the section if it has to resist a shear force of 90kN. [14M]

UNIT-IV

7 a) A beam of length 6m is simply supported at the ends. It carries a uniformly distributed load of 4 kN/m over a length of 2 metres from the left end. Find the maximum deflection of the beam. Take E = 2 x 10^5 N/mm^2 and I = 2 x 10^7 mm^4. [9M]

b) Explain double integration method with a suitable example. [5M]

OR

8 a) A cantilever 3 m long is of rectangular section 120 mm wide 240mm deep. It carries a uniformly distributed load of 2.5 kN per meter length for a length of 1.5 meters from the fixed end and a point load of 1 kN at the free end. Find the deflection at the free end. Take E = 10 GN/ m^2. [9M]

b) Derive torsion equation for circular shaft. [5M]

UNIT-V

9 Calculate the thickness of metal necessary for a cylindrical shell of internal diameter of 80mm to withstand an internal pressure of 25N/mm^2, maximum permissible tensile stress is 125N/mm^2. [14M]

OR

10 A water pipeline of 400.0 mm internal radius comprises segments simply supported over 6.0 m spans. Determine the minimum thickness of the pipe, if the allowable stresses in flexure and shear are 140.0 MPa and 100.0 MPa respectively. The effects of water pressure may be ignored. [14M]

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UNIT-I

1 a) A solid conical bar tapers uniformly from a diameter of 6cm to 2cm in a length of 100 cm. It is suspended vertically at the 6cm diameter, the 2 cm diameter end being downward. Calculate the elongation of the bar due to self-weight. Take unit weight of the bar material as 78.5 kN/m^3 and E = 204 kN/mm^2. [8M]

b) A metallic rod of 1 cm diameter, when tested under an axial pull of 10 kN was found to reduce its diameter by 0.0003 cm. The modulus of rigidity for the rod is 51 kN/mm^2. Find the Poisson's ratio, modulus of elasticity and Bulk Modulus. [6M]

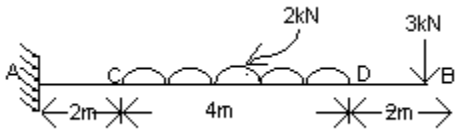
OR

2 a) A reinforced concrete column 50 cm in diameter has four 30 mm diameter steel rods embedded, and carries an axial load of 850 kN. Calculate the stresses in each of the two materials. E for steel = 2.04X10^5 N/mm^2 and E for concrete = 0.136X10^5 N/mm^2. What is the adhesive force between steel and concrete? [9M]

b) State Hooke's law. Draw stress-strain diagram for mild steel specimen tested under uni-axial tension till fracture and mark all the salient points. [5M]

UNIT-II

3 Determine the shear force and bending moment diagrams for the cantilever loaded as shown in figure bellow: [14M]



OR

4 A beam of span 10m is simply supported at two points 6m apart with equal overhang on either side. Both the overhanging portions are loaded with a uniformly distributed load of 2 kN/m run and the beam also carries a concentrated load of 10 kN at the mid span. Construct the SF and BM diagrams and locate the points of inflexion, if any. [14M]

UNIT-III

5 A simply supported rectangular beam is 150mm wide by 300mm deep carries a central concentrated load of 12KN and a distributed load of 8KN/m on a span of 3metres. Determine the maximum bending stress in the beam and find the bending stress at 1 metre from the left end. [14M]

OR

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6 A 60cm× 20 cm I- joist has 2.5cm thick flanges and 1.8cm thick web. Calculate the maximum intensity of shear stress and sketch the distribution of stress across the section, the S.F. at the cross-section being 650kN. [14M]

UNIT-IV

7 a) A beam of uniform section, 10 meters long, is simply supported at the ends. It carries point loads of 110 KN and 60 KN at distances of 2m and 5m respectively from the left end. Calculate: The deflection under each load and maximum deflection. Given: E = $200x10^6 N/m^2$ and I = $118x10^{-4} m^4$. [9M]

b) Explain transmission of power by circular shafts in series. [5M]

OR

8 A 3 meters long cantilever is loaded with a point load of 450 N at the free end. If the section is rectangular 80 mm (wide) × 160 mm (deep), and E = 10 GN/m^2, calculate slope and deflection. i. at the free end of the cantilever, ii. at a distance of 0.55 m from the free end. [14M]

UNIT-V

9 A cylindrical shell of 200 mm diameter and 1 metre length is filled with a fluid at atmospheric pressure. The wall thickness is 8mm. If an additional 2 x 10^4 mm^3 of the fluid is pumped into the cylinder, find the pressure exerted by the fluid on the wall of the cylinder. Find also the hoop stress induced. E = 2 x 10^5 N/mm^2 ; Poissson's ratio = 0.3. [14M]

OR

10 a) A cylindrical shell l0 m long and 50 cm in diameter and 12mm thick is at atmospheric pressure. What would be its dimensions when it is subjected to an internal pressure of 2 MN/m^2? Then E = 200 GN/m^2 and m = 4. [9M]

b) Explain the limitations of Rankine's formula. [5M]

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UNIT-I

1 a) The following data pertains to a tension test conducted in a laboratory. [9M]
i) Diameter of the specimen = 15 mm
ii) Length of the specimen = 200 mm
iii) Extension under a load of 10 kN = 0.035 mm
iv) Load at yield point = 110 kN
v) Maximum load = 190 kN
vi) Length of specimen after failure = 255 mm
vii) Neck diameter = 12.25 mm
Determine: (a) Young's Modulus (b) Yield stress (c) Ultimate stress (d) Percentage elongation (e) Percentage reduction in area (f) Safe stress using a factor of safety of 1.5.

b) Briefly discuss about gradual, sudden, impact and shock loadings. [5M]

OR

2 a) A bar of mild steel 20 mm diameter is subjected to an axial pull of 50 kN. The increase in length over a gauge length of 200 mm is measured to be 0.16 mm. The decrease in diameter was 0.0048 mm. From the above data determine the modulus of Elasticity and Poisson's ratio of mild steel. [9M]

b) Explain the stresses on an inclined plane under different uniaxial and biaxial stress conditions. [5M]

UNIT-II

3 An overhanging beam of 6m length is supported at the left end and at a point 4m away. It carries a uniformly distributed load of 2 kN/m run over the entire span and a point load of 2 kN at the right extreme end. Draw the shear force and bending moment diagrams. Also, locate the point of inflexion. [14M]

OR

4 A beam of span 12m is simply supported at two points 8m apart with equal overhang on either. The beam carries a uniformly distributed load of 2.5 kN/m run over the entire span. Construct the SFD and BMD. Locate also the points of contra flexure. [14M]

UNIT-III

5 a) Analyze theory of simple bending, assumptions and derive the bending equation $M/I = f/y = E/R$ [6M]
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b) An I-section having flanges 200 mm × 20 mm and web 400 mm × 15 mm is used as a beam. If at a section, it is subjected to a shear force of 150 KN, find the greatest intensity of shear stress in the beam and show the variation of shear stress across the section. [8M]

OR

6 a) A rectangular beam 125mm wide is subjected to maximum shear force of 110kN. Find the depth of the beam if the maximum permissible shear stress is 7MPa. [6M]

b) A beam of I-section is having overall depth of 700mm and overall width as 230mm. The thickness of the flanges is 25mm whereas the thickens of the web is 20mm. If the section carries a shear force of 64kN, Calculate the shear stress at salient points. [8M]

UNIT-IV

7 A rectangular beam 100mm wide by 300mm deep is used on a simply supported span of 5m. If the deflection is limited to 1/400 of the span, determine the load it can carry at 2m from one support. Neglect the effect of the beams self weight. Assume $E=1\times10^4 N/mm^2$. [14M]

OR

8 a) Evaluate Macaulay's method for finding out the slope and deflection of a beam? Discuss the cases, where it is of a particular use. [7M]

b) Explain shafts in series and shafts in parallel in detail. [7M]

UNIT-V

9 A cylinder container has 52cm external diameter, 1cm thickness, the length being 2m. Find the change in external diameter and the length when it is charged to $1000N/cm^2$, internal pressure. Take $E=10\times10^6 N/cm^2$ and $\gamma = 0.2$ [14M]

OR

10 a) Analyze buckling, stability and columns with pinned ends. [7M]

b) A boiler shell is to be made of 15mm thick plate having a limiting tensile stress of 100 MN/m^2. If the longitudinal and circumferential efficiencies are 70% and 30% respectively, determine maximum diameter of the shell that would be allowed for a maximum pressure of 2 MN/m^2. [7M]

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UNIT-I

1 A bar of elastic material is subjected to directed stress in a longitudinal direction, and its strains in the two directions at right angles are reduced to one-half and one third respectively to those which normally occur in a ordinary tension member. If E=200kN/mm^2 and m = 4, what is the value of elastic constant? [14M]

OR

2 a) A circular rod of steel 14mm diameter is testing in a testing machine and it is found that when the tension is 18kN the total extension on a 21cm length is 0.15mm.Find the value of E. [8M]

b) Explain Mohr's circle in detail. [6M]

UNIT-II

3 Sketch the shear force and bending moment diagrams showing the salient values for the loaded beam shown in the figure 1 below. [14M]

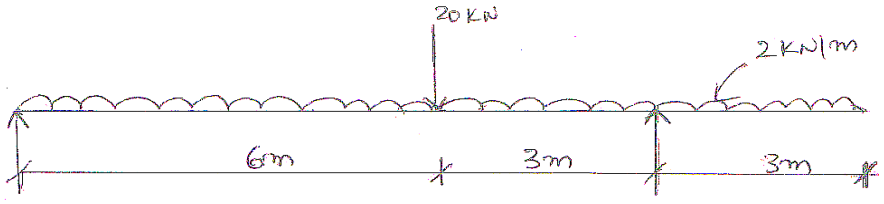

Figure: 1

OR

4 An overhanging beam of length 7m is supported centrally at two points 5m apart. It carries a uniformly increasing load of 400 N/m from the left end to 800 N/m at the mid span. It also carries a point load of 1000N at the right end. Draw the SF and BM diagrams and locate the point(s) of contra flexure. [14M]

UNIT-III

5 a) A T-section of a beam has the following dimensions: width of flange is 100 mm overall depth is 75 mm. Thickness of stem and flange is 10mm. Determine the maximum stress in the beam when a bending moment of 250 N-m is acting on the section. [9M]

b) Analyze the expressions for section modulus of rectangular and circular sections of both solid and hollow. [5M]

OR

6 The cross-section of a joist is a tee-section 150mm×100mm×13mm with 150 mm side horizontal. Find the maximum intensity of shear stress and sketch the distribution of stress across the section if it has to resist a shear force of 80kN. [14M]
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UNIT-IV

7 a) A beam AB of span l carries a distributed load of varying intensity from Zero at A to w per unit length at B. Measuring x from the end A, establish the equation for the deflection curve of the beam. [7M]

b) A 3.5 meters long cantilever carries a uniformly distributed load over the entire length. If the slope at the free end is one degree, what is the deflection at the free end. [7M]

OR

8 A simply supported beam AB of span 5 meters is carrying a point load of 30 kN at a distance 3.75 m from the left end A. Calculate the slopes at A and B deflection under the load .Take EI=$26x10^{12}$ N-mm^2 . [14M]

UNIT-V

9 a) Calculate the increase in volume of spherical shell, 1m diameter and 12mm thick, when it is subjected to an internal pressure of 1.6 N/mm^2. Take E = 2.05×10^5 N/mm^2 and 1/m = 0.28 [9M]

b) Explain the limitations of Euler's formula. [5M]

OR

10 a) Derive a formula for the proportional increase of capacity of a thin spherical shell due to an internal pressure. [5M]

b) A cylindrical tank open at top and having vertical axis, is of 2.75 m inside diameter and 20 m high. The tank is filled with water and is made of structural steel with a yield point of 220 MN/ m^2. Determine the thickness of the tank if (i) longitudinal joint is 90% efficient and (ii) longitudinal joint is 70% efficient. Assume factor of safety as 3. [9M]