Code No: R1921032 **R19** SET - 1

II B. Tech I Semester Regular Examinations, March - 2021
MECHANICS OF SOLIDS
(Com to ME, AME)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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1	a)	Draw the stress strain curve for mild steel mark the sailent features	8M
	b)	A mild steel rod 20mm diameter and 300mm long is enclosed centrally inside a hallow copper tube of external diameter 30mm and internal diameter 25mm.The end of the tube are brazed together and the composite bar is subjected to axial pull of 40kN. If E for steel and copper is 200 GN/m^2 and 100 GN/m^2 respectively .Find the stress developed in the rod the tube find the extension of the rod.	7M

Or

2	a)	A steel rod diameter 20mm diameter passes centrally through a copper tube of 50mm external diameter and 40mm internal diameter. Tube is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly come home on the projecting parts of the rod. If the temperature of the assembly is raised by 50^0C ,calculate stresses developed in copper and steel. Take E for steel and copper as $200GN/m^2$ and $100GN/m^2$ respectively and α for steel and copper 12×10^{-6} and 18×10^{-6} per^0C respectively	8M
	b)	The extension in rectangular steel bar of length 400mm and thickness of 3mm is found to be 0.21mm. the bar tapers uniformly in width from 20mm and 60mm E for the bar is 2×10^5 N/mm^2. Determine axial load on the bar	7M
3	a)	What is mean by positive or sagging BM ?	8M
	b)	Overhanging beam ABC of length 7m is simply supported over a span of 5m and the portion BC overhangs by 2m. Draw the shear force and bending moment diagram. Determine the points of contra flexure if its subjected to uniformly disturbed load of 3kN/m over a span of 3m from B and concentrated load of 8kN at C	7M

Or

4	a)	Derive relation between SF,BM and rate of loading at a section of beam	8M
	b)	A beam of uniform section 10m long carries a udl of 2KN/m for the entire length and concentrated load of 10KN at right end. The beam freely supported at left end. Find the position of second support so that maximum bending moment in the beam minimum possible. Also compute maximum bending moment	7M
5	a)	Compare the weights of two beams of same material and equal strength one being circular and solid and other being circular section and hollow ,the internal diameter being ¾ times the external diameter	8M
	b)	A beam size 150mm wide and 250mm deep carries a uniform load of w kN/m over entire span of 4m. A concentrated load 1kN is acting at a distance 1.2m from left support . If bending stress at section 1.8m from left support is not to exceed $3.25N/mm^2$, find the load w	7M

Or
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6	a)	Obtain a expression for shearing stress at a section of loaded beam?	8M
	b)	Cross section of joist is a T-section 120mm×200mm×12mm with 120mm side horizontal. Sketch the shear stress distribution and hence the maximum shear stress, if it has to resist a shear force of 200kN.	7M
7	a)	Find the slope and deflection of simply supported beam of span L ,carrying i) a point load P at centre ,ii) a UDL of w kN/m over the entire span using moment area method	8M
	b)	State the condition for the use of Macaulay's method	7M

Or

8	a)	A beam AB length 8m is simply supported at ends and carries two point load of 50kN and 40kN at distance of 2m and 5m respectively from left support determine , deflection under each load, maximum deflection and the position at where maximum deflection occurs . Take $E=2\times10^5$ N/mm^2 and $I=8.5\times10^6$mm^4	8M
	b)	Find the maximum deflection and slope using Macaulay's method for a simple supported beam of span 10m. Beam carries a point load of 15kN at distance of 2m from left end and uniformly disturbed load of 50kN/m for a length of 3m from right end	7M
9	a)	Derive lame's equations from the fundamentals in a thick cylindrical shell for a given radii (r_1 and r_2) and internal fluid pressure P	8M
	b)	What are the assumptions made in Euler's theory ? and limitations of Euler's formula ?	7M

Or

10	a)	A steel column of hollow circular section,65mm external diameter and 50mm internal diameter is 2.50m long and is hinged at its ends. The line of action of the load is parallel to the axis but is eccentric. Find the maximum eccentricity for crippling load equal to 75% of eulerian load. Take the yield stress of steel equal to 310N/mm^2 and $E=2.06\times10^5$N/mm^2	8M
	b)	A pipe 400mm internal diameter and 100mm thickness contains a fluid at a pressure of 8 N/mm^2. Find the maximum and minimum hoop stress across the section. Also the radial pressure distribution and hoop stress distribution across the section	7M

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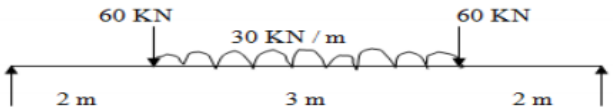
1	a)	Derive the relationship between the three elastic constants?	8M
	b)	The Modulus of rigidity for a material is 0.51×10^5 N/mm^2. A 0.01 m diameter rod of the material was subjected to an axial pull of 10 KN and the change in diameter was observed to be 3×10^{-3}mm.Calculate the Poisson's ratio and the modulus of Elasticity?	7M

Or

2	a)	Define the Strain Energy? Deduce the expression for Strain Energy absorbed by Cantilever beam subjected to point load?	8M
	b)	A bar of steel 25mm diameter is subjected to a tensile load of 30kN and the measured extension on a 200mm gauge length is 0.08 mm and the change in diameter is 2.32×10^{-3} mm. Calculate the Poisson's ratio and the values of three moduli.	7M
3	a)	Define the following: i) Bending Moment ii) Shear force iii) Point of contra flexure	8M
	b)	A cantilever beam of length 2m carries a uniformly distributed load of 3KN/m over a length of1.5m from its fixed end and a point load 5 KN at its free end. Draw the shear force and bending moment diagrams.	7M

Or

4	a)	Explain the different types of beams?	8M
	b)	Construct S. F. D & B. M. D for the simply supported beam shown in below figure.	7M



5	a)	Derive the bending equation from fundamentals M/I= f/y = E/R	8M
	b)	A beam of channel section 130mm × 65mm has a uniform thickness of 20mm. Draw a diagram showing the distribution of shear stress for a vertical section where shear force is 160KN. Find the ratio between maximum and mean shearing stresses.	7M

Or

6	a)	State the theory of simple bending? What are the assumptions made in the theory of simple bending?	8M
	b)	Obtain the shear stress distribution for a rectangular cross section 230mmx40mm subjected to a Shear force of 40KN. Calculate the maximum and average shear stress.	7M
7	a)	What are the limitations of the moment area method?	8M
	b)	Find the maximum slope and deflection of a cantilever beam, when loaded with uniformly distributed load?	7M

Or
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8	a)	Explain the various methods used for finding deflection and slope of beams?	8M
	b)	A simply supported beam of span 5 m, carrying a point load of 5 kN at a distance of 3 m from the left end. Find (i) slope at the left support, (ii) deflection under the load and (iii) maximum deflection. Take E= $2x10^5$ N/mm2 and I = $1x10^8$ mm^4 .Use double integration method.	7M
9	a)	A thin cylinder 75 mm internal diameter, 250 mm long with walls 2.5 mm thick is subjected to an internal pressure of 7 MN/m^2.Determine the change in internal diameter and the change in length. If, in addition to the internal pressure, the cylinder is subjected to a torque of 200 N m, find the magnitude and nature of the principal stresses set up in the cylinder. E = 200 GN/m^2,μ = 0.3.	8M
	b)	Distinguish between thin walled cylinder and thick walled cylinder?	7M

Or

10	a)	A steel cylinder 240mm internal diameter is to withstand an internal pressure of $5N/mm^2$. The increase in area of the bore due to the resulting radial expansion is limited to 0.1% of the nominal area. Calculate the necessary thickness of the cylinder and the circumferential stress induced in the section. Take E = $2x10^5N/mm^2$, μ = 0.3.	8M
	b)	Derive the expression for Hoop stress induced in Thin walled cylinder?	7M

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1 a) A load of 4000N has to be raised at the end of a steel wire. If the stress in the wire must not exceed 80N/mm^2,what will be the minimum diameter required ? what will be the extension of 3500mm length wire ? E=2×1055 N/mm^2 8M

b) A 20mm diameter brass rod was subjected to a tensile load 40,000N. The extension of the rod was found to be 254 divisions in the 200mm extensometer. If each division is equal to 0.001mm,find the modulus elasticity of the brass 7M

Or

2 a) The principal stresses at a point in the section of a boiler shell are 80N/mm^2,and 40N/mm^2,both tensile. Find the normal, tangential and the resultant stresses across a plane through the point inclined at 50^0 to the plane carrying 80 N/mm^2 stress 8M

b) The Modulus of rigidity for a material is 0.51x10 ^{5} N/mm^2 . A 10 mm diameter rod of the material was subjected to an axial pull of 10 kN and the change in diameter was observed to be 0.003 mm. Calculate Poisson's ratio and the modulus of elasticity. 7M

3 a) Explain briefly the relationship between shear force and the bending momement at a section? 8M

b) Draw the S. F. D & B.M.D. for the beam shown in Figure:1 7M

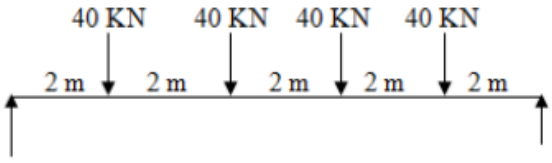

Figure:1

Or

4 a) What do you understand by term 'Point of contra flexure'? Explain with reasons if it exists in a cantilever beam, simply supported beam, and an overhanging beam 8M

b) An overhanging beam is shown in Figure 1. Draw the S.F and B.M diagrams. 7M

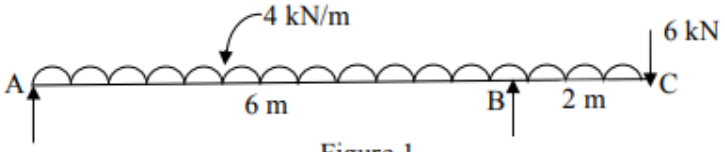

Figure 1

5 a) A beam of channel section 130mm × 65mm has a uniform thickness of 20mm. Draw a diagram showing the distribution of shear stress for a vertical section where shear force is 160KN. Find the ratio between maximum and mean shearing stresses. 8M

b) A 120 mm x 50 mm I- section is subjected to a shearing force of 10 kN. Calculate the shear stress at the neutral axis and at the top of the web. Given I = 220x10^4 mm^4 , Area = 9.4x102 mm^2 , web thickness = 3.5 mm and flange thickness = 5.5 mm. 7M

Or

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6	a)	Obtain the expression for shearing stress at a section of a loaded beam?	8M
	b)	A T – section beam with 100 mm x 15 mm flange and 150 mm x 15 mm web is subjected to a shear force of 12 kN at a section. Draw the variation of shear stress across the depth of the beam and obtain the value of maximum shear stress of the section.	7M
7	a)	Derive the expression with notations for the maximum deflection in a simply supported beam subjected to a point load at the mid span	8M
	b)	Find the max. slope and deflection of a cantilever beam, when loaded with uniformly distributed load.	7M
		Or	
8	a)	Derive the expression for the slope and deflection of a cantilever beam of length L, carrying a point load W at the free end by double integration method.	8M
	b)	A beam length 5000mm and uniform rectangular section is simply supported at its ends. It carries a uniformly load of 9000N/m run over the entire length. Calculate the depth and width of the beam if the permissible bending stress is 7 N/mm^2 and central deflection is not exceed 10mm. Assume $E=1\times10^4 N/mm^2$	7M
9	a)	Differentiate between Thin cylinder and Thick cylinder	7M
	b)	A thin spherical shell of 1.8m diameter is 10mm thick. It is filled with a liquid so that the internal pressure is $1N/mm^2$. Find the increase in diameter and capacity of the shell. Take E = 2 X 105 N/mm^2 , $\mu = 0.3$	8M
		Or	
10	a)	A long boiler tube has to withstand an internal pressure of $6N/mm^2$. The internal diameter of the tube is 60 mm. Determine the thickness and mass/m of the tube if the circumferential stress is not to exceed 130 N/mm^2 . Mass density of steel is 7850 kg/m^3 .	8M
	b)	A cylindrical shell with internal diameter 60mm and having a thickness equal to 3 mm is made of mild steel. Determine the permissible internal fluid pressure if the factor of safety on maximum shear stress is 4.	7M

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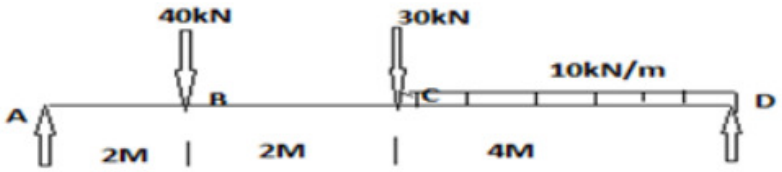
1	a)	Derive the relationship between the three elastic constants?	8M
	b)	A steel rod 100 mm^2 in cross section stretches by 0.4 mm over a gauge length of 50 mm under an axial load of 30 k N. What is the strain – energy stored in it? If the load at the elastic-limit is 45 k N, find the elongation at elastic – limit and the proof resilience?	7M

Or

2	a)	Deduce the relation between the Modulus of Elasticity and Modulus of Rigidity from fundamentals.	7M
	b)	A steel tube of internal dia. 100mm and external dia. 125mm is surrounded by a brass tube of external dia. 150mm. The composite bar is subjected to an axial pull of 10kN. Find the load carried by each tube and the stresses and strains developed in them if E_S = 200 Gpa and E_b = 100 GPa.	8M
3	a)	Draw the shear force and B.M. diagrams for a simply supported beam carrying a uniformly varying load from zero at left end to w per unit length at the right end	7M
	b)	Draw SFD and BMD for the beam shown below 	8M

Or

4	a)	Deduce the relation between Shear force and intensity of loading.	7M
	b)	A cantilever of length 7m carries a gradually varying load, zero at the free end to 5KN/m at the fixed end. Draw the S.F and B.M diagrams for the cantilever.	8M
5	a)	An I – section beam 350mm × 250mm has a web thickness of 12mm and flange thickness of 20mm. It carries a shear force of 120KN. Sketch the shear stress distribution across the section.	8M
	b)	Derive the simple bending equation?	7M

Or

6	a)	Explain about design of simple beam sections?	7M
	b)	For a T – section with dimensions flange width 100mm, Depth = 200mm and uniform thickness of 40mm. obtain shear stress distribution and calculate maximum and average shear stresses if it is subjected to a S.F. = 100 KN.	8M
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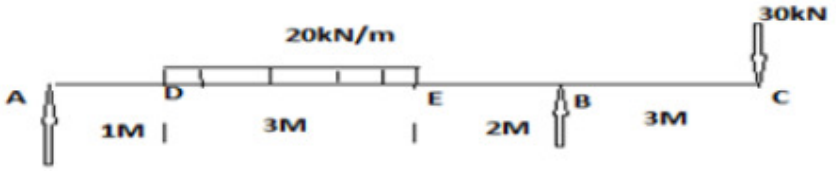
7 a) A 6.5 m long Cantilever carries a uniformly distributed load over the entire length. If the slope at the free end is 1^o (one degree), what is the deflection at the free end? 8M

b) Distinguish between slope and deflection. Explain the same with examples for simply supported beam 7M

Or

8 a) An overhanging beam ABC supported at A and B is loaded as shown in the figure Determine the deflection at free end C and the maximum deflection between A and B. 8M



b) Derive an expression for the slope and the deflection of a cantilever beam length L which carries UDL over a length a from the fixed end. 7M

9 a) Explain about Lame's theory for thick cylinders and thin cylinders? 7M

b) A cylindrical shell 1m long, 180mm internal diameter, thickness of metal 8mm is filled with a fluid at atmospheric pressure. If an additional 20,000 mm^3 of the fluid is pumped into the cylinder, find the pressure exerted by the fluid on the wall of the cylinder. Also find the hoop stress induced. Take E = 2 X 105 N/mm^2, $\mu = 0.3$ 8M

Or

10 a) Explain about thick and thin spherical shells? 7M

b) A pipe of 400 mm internal diameter and 100mm thickness contains a fluid pressure $80N/mm^2$. Find the maximum and minimum hoop stresses across the section, Also sketch the radial and hoop stress distribution across the section. 8M