Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Third Semester

MECHATRONICS ENGINEERING

U18MCT3103: Mechanics of Solids

COURSE OUTCOMES

CO1: Recognize the elastic response of the materials and calculate the stresses and deflection in simple and compound bars

CO2: Calculate the thermal stresses and the material response due to temperature variations

CO3: Find the stresses in bi-axial load system and strain energy for different loads

CO4: Develop the shear force, bending moment diagram and locate maximum values of shear force and bending moments induced in various types of beams

CO5: Estimate the slope and deflection of beams under various loading conditions and crippling load for a column with different end conditions

CO6: Determine the power transmitting, torque carrying capacities of the circular shafts and required thickness of the pressure vessel for a given internal pressure

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

1.	Define Poisson's ratio.	CO1	[K_1]
2.	List out the three elastic constants and give the relationship between them.	CO1	[K_2]
3.	Define "thermal stresses" and "thermal strain".	CO2	[K_2]
4.	Enumerate the uses of Mohr's circle in bi-axial load system.	CO3	[K_2]
5.	A steel bar 4cm in diameter, 5m long is subjected to an axial pull of 60KN. Taking E = 2 X 10^5 N/mm^2, calculate the amount of strain energy stored in the bar during elongation.	CO3	[K_2]
6.	Classify the various types of beams depending on its supports.	CO4	[K_2]
7.	Define the term "Point of Contraflexure".	CO4	[K_2]
8.	Classify the different types of columns.	CO5	[K_3]
9.	A solid shaft of diameter 75mm is subjected to a maximum torque of 5KNm. Calculate the maximum shear stress induced in the shaft.	CO6	[K_2]
10.	Distinguish between thick and thin cylinders.	CO6	[K_2]

Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

11.	A metallic bar 300 mm × 100 mm × 40 mm is subjected to a force of 5kN (tensile), 6kN (tensile), and 4kN (tensile) along x, y and z directions respectively. Determine the change in the volume of the block. Take E = 2 x 10^5 N/mm^2 and Poisson's ratio = 0.25. Also determine the change in dimensions of length, breadth and thickness. Also find the values of bulk modulus and rigidity modulus.	16	CO1	[K_2]
12.	A steel bar is placed in between two copper bars, each having the same area and length as steel bar at 200 C. At this stage, they are rigidly connected together at both the ends. When the temperature is raised to 320^{0}C, Calculate the final stresses in the bars. Take Es = 220 GN/m^2, Ec = 110 GN/m^2, αs = 12 x 10^{-6} /^{0}C and αc = 17.5 x 10^{-6} /^{0}C.	16	CO2	[K_3]
13.	The stresses at a point in a bar are 100 N/mm^2 (tensile) and 40 N/mm^2 (compressive). Determine the resultant stress, normal stress and shear stress in magnitude and direction on a plane inclined at 60^0 to the major principal stress plane. Also determine the maximum intensity of shear stress in the material at the point.	16	CO3	[K_3]
14.	Draw the shear force and bending moment diagrams for the beam as shown in figure 1. Clearly mark the position of the maximum bending moment and determine its value.	16	CO4	[K_3]

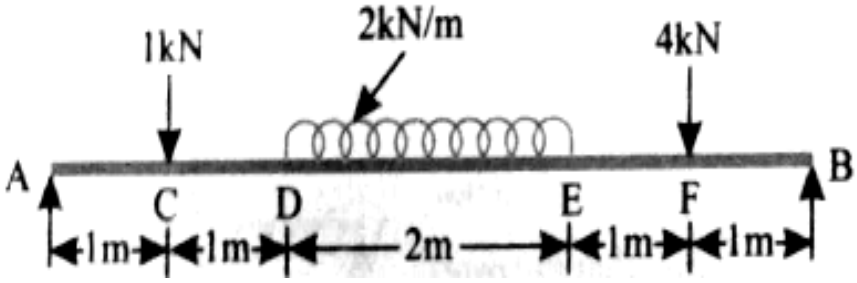

Figure – 1

15.	A hollow mild steel tube 4.5m long, 200mm external diameter and 20mm thickness is used as a strut with both ends fixed. Find the crippling load and safe load taking factor of safety as 4. Take E = 9.4 x 10^4 N/mm^2. Calculate the slenderness ratio and ratio of Euler's to Rankine's critical load. Take σ_c = 550 N/mm^2 and a = 1/1600 in Rankine's formula.	16	CO5	[K_3]
16.	A solid cylindrical shaft is to transmit 300 kW power at 100 rpm.	16	CO6	[K_3]

a) If the shear stress is not to exceed 80 N/mm^2, find its diameter.

b) What percentage saving in weight would be obtained if this shaft is replaced by a hollow one in which the internal diameter is equal to 0.6 of the external diameter, the length, the material and the maximum shear stress being the same?

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