Register Number:……..

KUMARAGURU
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B.E/B.TECH DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Fourth Semester

MECHANICAL ENGINEERING

U18MEI4201: Strength of Materials

COURSE OUTCOMES

CO1: Apply fundamental concepts and compute simple stresses and deformations in structural members.
CO2: Construct shear force and bending moment diagrams for statically determinate beams and determine stress distribution.
CO3: Compute slope and deflection in statically determinate beams.
CO4: Examine the buckling failure in columns and calculate strain energy under varying load conditions.
CO5: Solve problems on shafts and springs subjected to twisting moment.
CO6: Apply the concepts of complex stress system in 2D systems and in thin walled containers.

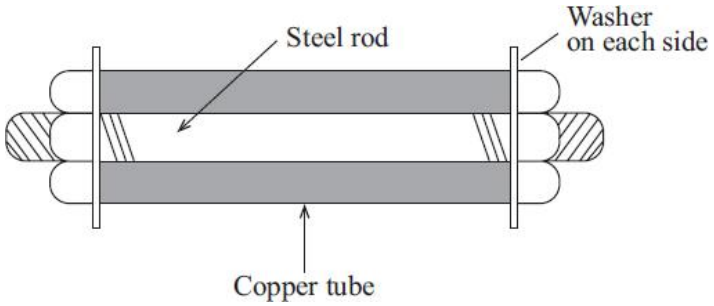
Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	A material has a Young's modulus of 1.25 x 10 N/mm2 and a Poisson's ratio of 0.25. Calculate the modulus of rigidity.	CO1	[K3]
2.	What does the radius of Mohr's Circle refers to?	CO1	[K1]
3.	What do you mean by Point of Contraflexure?	CO2	[K1]
4.	What is meant by shear stresses in the beam ?	CO2	[K1]
5.	What is cantilever? What approach would you use to finding of slope and deflection of a cantilever?	CO3	[K1]
6.	Summarize the two theorems of conjugate beam method.	CO4	[K_2]
7.	What are the assumptions made in torsion equation?	CO5	[K_2]
8.	Distinguish between closed coil helical spring and open coil helical spring.	CO5	[K_2]
9.	How will you determine the forces in a member by method of joints?	CO6	[K_2]
10.	How can you calculate the maximum shear stresses at any point in a cylinder?	CO6	[K_2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

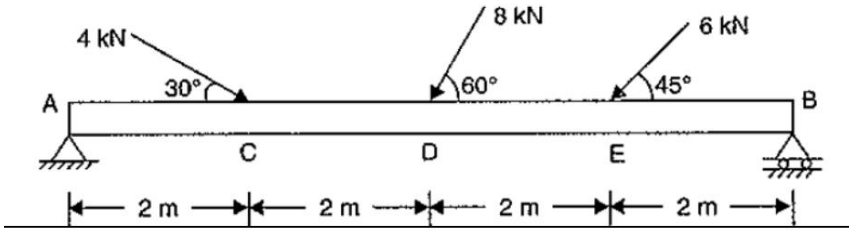
11. a) A steel rod of 25 mm dia passes centrally through a copper tube of 30 mm inside diameter and 40 mm outside diameter. Copper tube is 850 mm long and is closed by rigid washers of negligible thickness, which are fastened by nut threaded on the rod. The nuts are tightened till the load on the assembly is 20 kN. Calculate: CO1 [K3]
i) the initial stresses on the copper tube and steel rod and
ii) also calculate increase in the stresses, when one nut is tightened by one quarter of a turn relative to the other.
Take pitch of the thread as 1.5 mm., E for copper = 100 GPa and E for steel = 100 GPa.



b) At a point within a body subjected to two mutually perpendicular directions, the stresses are 80 N/mm^2 tensile and 40 N/mm^2 tensile. Eachof the above stresses is accompanied by a shear stress of 60 N/mm^2. Determine the normal stress, shear stress and resultant stress on an obliqueplane inclined at an angle of 45° with the axis of minor tensile stress. CO1 [K3]

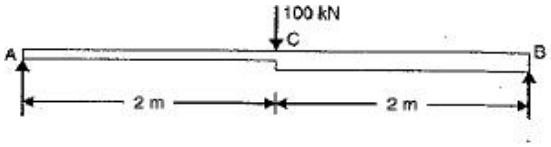
12. a) A beam of length 6 m is simply supported at the ends and carries a uniformly distributed load of 1.5 kN/m run over its whole length and three concentrated loads of 1 kN, 2 kN, and 3 kN acting at 1.5 m, 3.0 m and 4.5 m respectively from the left end. Draw the S.F. and B.M. diagrams and find the maximum bending moment. CO2 [K3]

b) A horizontal beam AB of length 8m is hinged at A and placed on rollers at B. the beam carries three inclined point loads as shown in fig. Draw the SF and BM and axial force diagrams of the beam. CO2 [K4]



13. a) A simply supported beam of length 5 m carries a point load of 5 kN at a distance of 3 m from the left end. If E = 2x10^5 N/mm^2 and I = 108 mm^4. Determine the slope, at the left support and deflection under the point load using conjugate beam. CO3 [K4]

b) Determine the slope at the two supports and deflection under the loads. Use conjugate beam method. E = 200 GN/m^2, I for right half is 2 x 10^8 mm^4 I for left half is 1 x 10^8 mm^4 the beam is given in figure. CO3 [K3]



14. a) A solid steel shaft has to transmit 7.5 kW at 200 r.p.m. Taking allowable shear stress as 70 N/mm^2, find suitable diameter for the shaft, if the maximum torque transmitted at each revolution exceeds the mean by 30%. CO5 [K3]

b) A close coiled helical spring of 10 cm mean diameter is made up of 1 cm diameter rod and has 20 turns. The spring carries an axial load of 200 N. Determine the shearing stress. Taking the value of modulus of rigidity = 8.4 x 10^4 N/mm^2, determine the deflection when carrying this load. Also calculate the stiffness of the spring and the frequency of free vibration for a mass hanging from it. CO5 [K3]

15. a) A thin cylindrical tube 80 mm internal diameter and 5 mm thick, is closed with its ends and is subjected to an internal pressure of 6 N/mm^2. A torque of 2009600 N-mm is also applied to the tube. Find the hoop stress, longitudinal stress, maximum and minimum principal stresses and the maximum shear stress. CO6 [K3]

b) A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3 N/mm^2. The dia. of cylinder is 25 cm and length is 75 cm, calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and volume of the cylinder. Take E = 2.1 x 10^5 N/mm^2 and μ = 0.286. CO6 [K3]

16. a) A beam is simply supported and carries a uniformly distribute load of 40 kN/m run over the whole span. The section of the beam is rectangular having depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment of inertia of the section is 7 x 10^8 mm^4, find the span of the beam. CO3 [K3]

b) Two shafts of the same material and of same lengths are subjected to the same torque, if the first shaft is of a solid circular section and the second shaft is of hollow circular section, whose internal diameter is 2/3 of the outside diameter and the maximum shear stress developed in each shaft is the same, compare the weight of the shafts. CO2 [K3]

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