Register Number:……..

KUMARAGURU
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B.E. 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:-

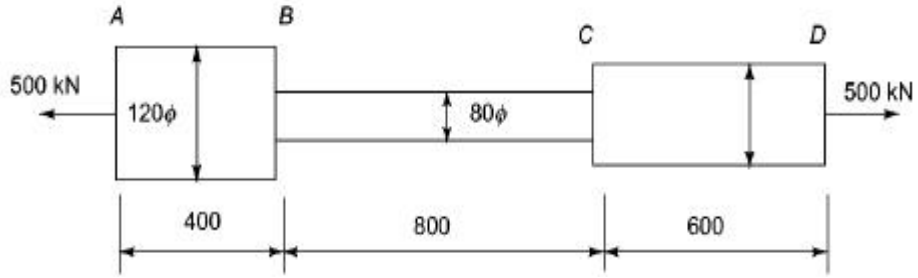
PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

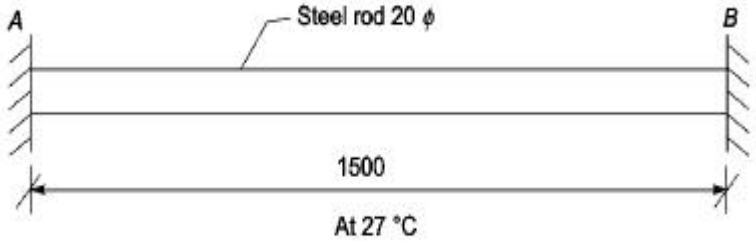
1.	A brass rod of diameter 25 mm and length 250 mm. It is subjected to an axial pull of 50 kN. The extension of the member is found to be 0.3 mm. Find the Youngs modulus for the material.	CO1	[K_3]
2.	Explain the behavior of ductile and brittle material before breaking with the help of Stress - strain diagram	CO1	[K_2]
3.	State the relationship between shear force and bending moment.	CO2	[K_2]
4.	A cantilever of span L is to withstand a downward load W at the free end. Draw the shear force and bending moment diagram.	CO2	[K_2]
5.	Discuss the significance of spring index of helical spring in the design.	CO5	[K_2]
6.	List the methods for finding out the slope and deflection at a section.	CO3	[K_2]
7.	Describe the toughness property of a material.	CO4	[K_2]
8.	Find the critical load of a circular column having 3 m length, 50 mm diameter and hinged at both the ends. E = 200 kN/mm^2	CO4	[K_3]
9.	Discuss the terms torsional rigidity and polar moment of inertia.	CO5	[K_2]
10.	Define the terms principal plane and principal stress	CO6	[K_2]

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

11.	a)	**A** bar has three sections of different diameters, 120 mm, 80 mm, and 100 mm, and is subjected to a load of *500* kN as shown in Fig. Find the total elongation of the bar and the maximum stress in the material. E = 200,000 MPa.	10	CO1	[K3]



	b)	**A** steel rod, 20 mm diameter and 1.5 m long, is constrained between supports *A* and ***B*** as shown in Fig. The material is stress-free at 27 °C. Determine the stress in the material when the temperature increases to 50 °C if the supports are unyielding. E for steel = 200 GPa and α for steel = 12 $\boldsymbol{x}$ 10^{-6} °C.	6	CO1	[K3]



12.	a)	A 10 m long simply supported beam carries two-point loads of 10 kN and 6 kN at 2 m and 9 m respectively from the left end. It also has a uniformly distributed load of 4 kN/m run for the length between 4 m and 7 m from the left end. Draw the shear force and bending moment diagrams.	12	CO2	[K3]
	b)	A cantilever beam of load 2m fails when a load of 2 kN is applied at the free end. If the section of the beam is 40 mm * 60 mm find the stress at failure.	4	CO2	[K3]
13.	a)	A beam of uniform rectangular section 200 mm wide and 300 mm deep is simply supported at its end. It carries a uniformly distributed load of 9 kN/m run over the entire span of 5 m. If the values of E for the beam material is 1 * 10^4 N/mm^2. Find (i) the slope at the supports and (ii) maximum deflection.	12	CO3	[K3]
	b)	Write the deflection equation and slop equation of simply supported beam (i) carrying a point load at centre and (ii) UDL for entire span	4	CO3	[K2]

14.	a)	A simply supported beam of length 4 meter is subjected to a uniformly distributed load of 30 kN/m over the whole length span and deflects 15 mm at the centre. Determine the crippling loads when this beam is used as column with the following conditions: (i) One end fixed and other end hinged (ii) Both the ends pin jointed.	12	CO4	[K_3]
	b)	Define slenderness ratio. State the limitations of Euler's formula	4	CO4	[K_2]
15.	a)	A shaft 800 kW of power at 210 rpm determines the actual working stress and diameter of the shaft if the shaft twists one degree on a length of 18 diameters and the shear stress is not to exceed 50 MPa. Take G = 81 GPa.	10	CO5	[K_3]
	b)	State the torsion theory and its assumptions. Write the expression for the torsion stress of a hollow shaft and show the shear stress distribution.	6	CO5	[K_2]
16.	a)	The stresses on two mutually perpendicular planes through a point in a body are 80 MPa and 50 MPa both tensile. Determine the maximum value of the shear stress which can be applied so that the maximum value of the permissible principal stress is limited to 120 MPa. What will be the inclination of the principal stress and the magnitude of the maximum shear stress?	10	CO6	[K_3]
	b)	A cylindrical pipe of diameter 1.5 m and thickness 1.5 cm is subjected to internal fluid pressure of 1.2 N/mm^2 Determine (i) longitudinal stress developed in the pipe and (ii) circumferential stress developed in the pipe.	6	CO6	[K_3]

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