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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; March / April - 2022

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Explain the steps involved in casting processes.

CO2: Distinguish between various casting processes.

CO3: Explain special types of welding processes.

CO4: Analyze shear angle using Merchants circle diagram. Explain various types of cutting tool materials.

CO5: Estimate Tool life and Describe Mechanism of machines.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.		Questions	Marks	BLs	COs	POs
		I : PART - A	**10**			
I	a.	Define principle of super position.	2	L1	CO1	PO1
	b.	Differentiate between thin and thick cylinders.	2	L1	CO2	PO1
	c.	What is meant by point of contra-flexure?	2	L1	CO3	PO1
	d.	What are the different elastic constants?	2	L1	CO4	PO1
	e.	Explain the relationship between actual crippling load and crushing load by Euler's theory.	2	L1	CO5	PO1
		II : PART - B	**90**			
		UNIT - I	**18**			
1	a.	Derive an expression for uniformly tapering circular rod.	9	L3	CO1	PO2
	b.	A tensile load of 40 kN is acting on a road of diameter 40 mm and of length 4 m. A bore of diameter 20 mm is made centrally on the rod. To what length the rod should be bored so that the total extension will increase 30% under the same tensile load. Take E = 200 GPa.	9	L3	CO1	PO2
	c.	Two vertical rods of steel and copper are each rigidly fixed at top and 500 mm apart. Diameter and length of each bar are 20 mm and 4 meters respectively. A cross bar fixed to the rods at the lower ends carries a load of 5 kN such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 1 \times 10^5$ N/mm^2.	9	L3	CO1	PO2

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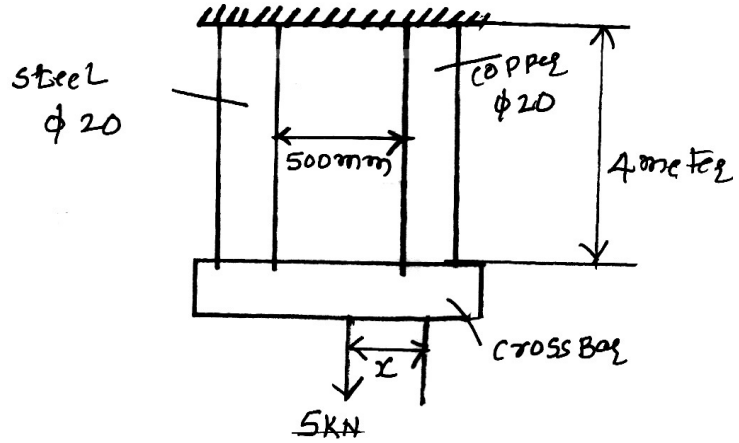
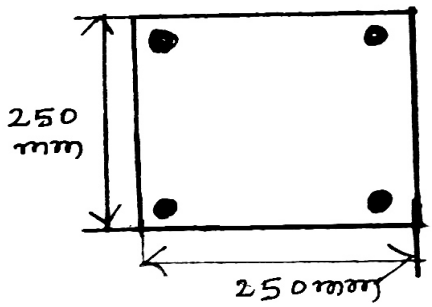


UNIT - II **18**

2 a. A weight of 300 kN is supported by a short column of 250 mm square section. The column is reinforced with 4 steel bars of cross section area 5500 mm^2. Find the stresses in steel and concrete, if $E_s = 15E_c$ (i.e., modular ratio is 15). If the stress in the concrete must not exceed 4.5 MN/m^2, what area of steel is required in order that the column may support a load of 500 kN. 9 L3 CO2 PO2



b. A steel rail is laid so that there is no stress in the rails at 10°C. The maximum temperature expected is 45°C. Find;

i) The minimum gap between two rails to be left so that temperature stresses do not develop, if the length of each rail is 30 meters

ii) Stress developed in the rails at the maximum temperature, if there is no allowance for expansion 9 L3 CO2 PO2

iii) Stress developed in the rails at the maximum temperature, if there is an expansion allowance of 7.5 mm per rail

c. At a certain point in a strained material the stress condition is show in Fig. Q2(c). Find;

i) Normal stress and shear stress on the inclined plane AB 9 L3 CO2 PO2

ii) Principal stresses and principal planes

iii) Maximum shear stresses and their planes

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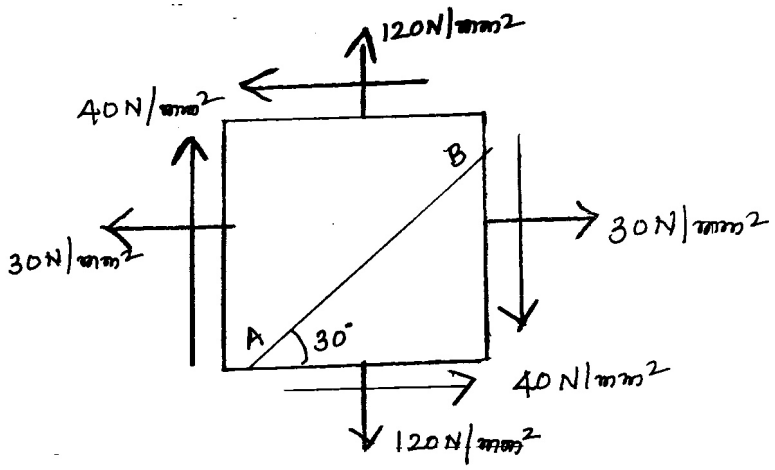

UNIT - III **18**

3 a. A thick cylinder with internal diameter 80 mm and external diameter 120 mm is subjected to an external pressure of 40 N/mm^2. Calculate circumferential stress at external and internal surfaces of the cylinder. Plot the variation of circumferential stress and radial pressure on the thickness of the cylinder. 9 L2 CO3 PO2

b. i) With a neat sketch, explain the different types of beams. 3 L1 CO3 PO1

ii) A Cantilever beam of length 5 m carries a uniformly distributed load of 2 kN/m length over the whole length and a point load of 4 kN at the free end. Draw the SF and BM diagram for the beam. 6 L3 CO3 PO2

c. Draw the SFD and BMD for the simply supported beam shown in Fig. Q 3(c) 9 L2 CO3 PO2

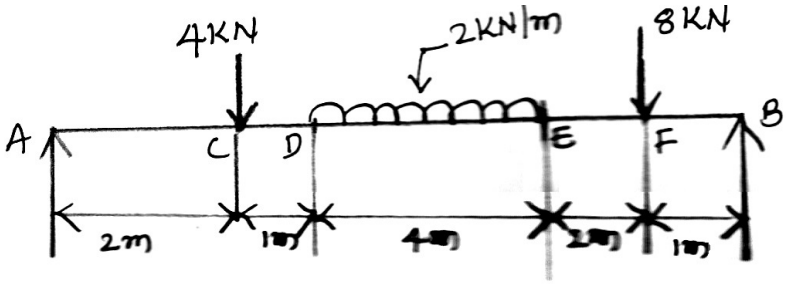

Fig Q 3(c)

UNIT - IV **18**

4 a. The T-section shown in Fig. Q 4(a) is used as a simply supported beam over a span of 4 meters. It carries a uniformly distributed load of 8 kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section. 9 L3 CO4 PO2

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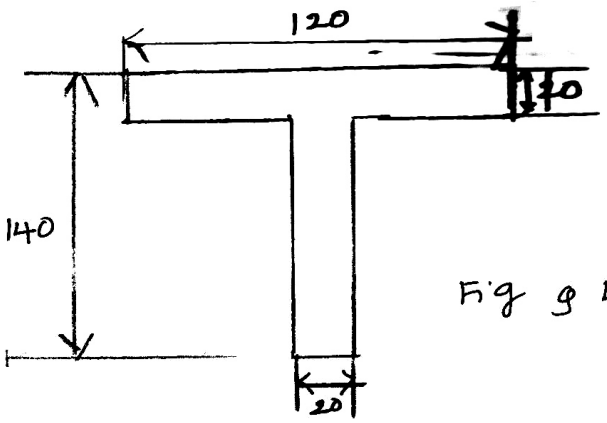

Fig g 4(a).

b.	A beam of I section 200 mm × 300 mm web thickness 10 mm and flange thickness 10 mm carries a uniformly distributed load of 10 kN and is simply supported. Calculate the maximum Tensile stress developed. Take E = 200 GPa. Take length = 4 m.	9	L3	CO4 PO2
c.	For the given stress, compare the moment of resistance of a beam of square section when placed; i) With its two sides horizontal ii) With its tow diagonals horizontal	9	L2	CO4 PO2

UNIT - V **18**

5 a.	Derive an equation for deflection of a cantilever beam with a uniformly distributed load.	8	L3	CO5 PO2
b.	A shaft rotating at 1000 rpm transmits 50 kW. Maximum torque is 20% more than the mean torque. Material of the shaft has the allowable shear stress of 50 MPa and modulus of rigidity 80 GPa angle of twist in the shaft should not exceed 1 degree in one meter length, determine the diameter of the shaft.	10	L3	CO5 PO2
c.	A T-section 150 mm x 120 mm x 20 mm is used as a strut of 4 m long with hinged at its both ends. Calculate the crippling load, if the Young's modulus for the material to be 200 GPa.	8	L3	CO5 PO2

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