DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Semester Examination – MAY - 2019

Branch: SY Mechanical Engineering **Sem.: IV**
Subject with Subject Code: SOM (BTMEC403) **Marks: 60**
Date: 20-05-2019 **Time: 3 Hr.**

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Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

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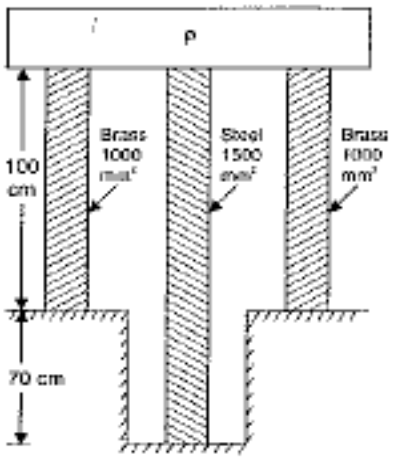
(Marks)

Q.1. a) Define the following terms

i) Young's Modulus
ii) Modulus of Rigidity
iii) Poisson's ratio
iv) Factor of safety
v) Hook's law **(05)**

b) Two brass rods and one steel rod together support a load as shown in Fig below. If the stresses in brass and steel are not to exceed 60 N/mm^2 and 120N/mm^2, find the safe load that can be supported .Take E for steel = 2 x 10^5 N/mm^2 and for brass = 1 x 10^5 N/mm^2. The cross sectional area of steed rod is 1500 mm^2 and of each brass rod is 1000 mm^2. **(07)**



OR

b) A steel rod of 3 cm diameter is enclosed centrally in a hollow copper tube of external diameter 5 cm and internal diameter of 4 cm. The composite bar is then subjected to an axial pull of 45000 N. If the length of each bar is equal to 15 cm. Determine:

i) The stresses in the rod and tube.
ii) Load carried by each bar. **(07)**

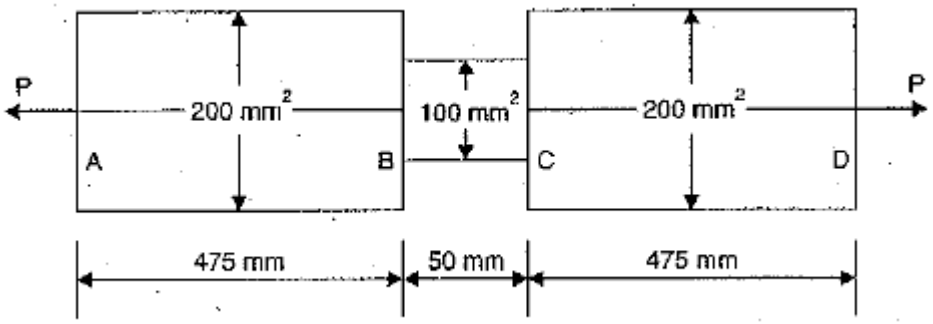
Q.2. a) Prove that stress induced in a body when the load is applied with the impact is given by

$$\sigma = \frac{P}{A}\left(1 + \sqrt{1 + \frac{2AEh}{P.L}}\right)$$

where P = Load applied with impact, A = Cross-sectional area of the body, h = height through which load falls, L= Length of the body, and E = Modulus of elasticity. **(06)**

OR

a) The maximum stress produced by a pull in a bar of length 1 m is 150 N/mm^2. The area of cross-sections and length are shown in Fig. Calculate the strain energy stored in the bar if E = 2 x 10^5 N/mm^2. **(06)**



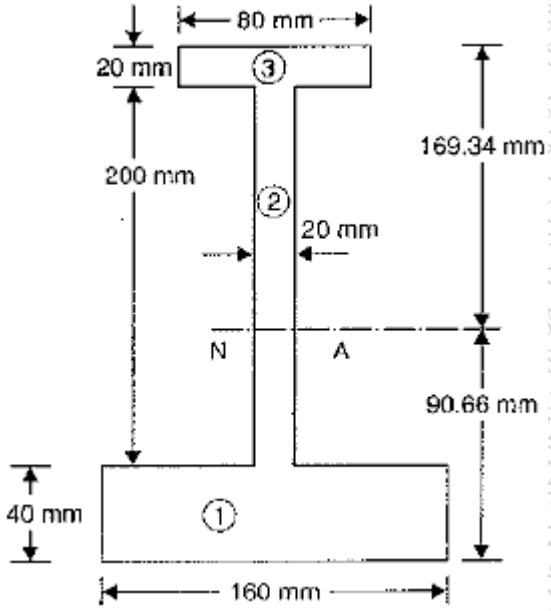
b) The stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major stress. Also determine the maximum intensity of shear stress in the material at the point. **(06)**

Q.3. a) A hollow rectangular section is having external size 500 mm x 450 mm internal size 400 mm x 350 mm. It carries a vertical load of 100 kN at outer edge of the column on X-axis. Calculate maximum and minimum intensities of stresses in the section. Assume 500 mm side horizontal. **(06)**

b) Draw the shear force and bending moment (B.M.) diagram for a simply supported beam of length 9 m and carrying a uniformly distributed load of 10 kN/m for a distance of 6 m from the left end. Also calculate the maximum B.M. on the section.

(06)

Q.4. A cast iron beam is of I-section as shown in Fig. The beam is simply supported on a span of 5 m. If the tensile stress is not to exceed 20 N/mm^2, Find the safe uniformly load which the beam can carry. Find also the maximum compressive stress. **(12)**



Q.5. **a)** A cantilever of length 3 m carries a point load of 10 kN at a distance of 2 m from the fixed end. If E = 2 x 10^5 N/mm^2 and I = 10^8 mm^4, find the slope and deflection at the free end using conjugate beam method. **(05)**

OR

a) A cantilever of length 2 m carries a point load of 20 kN at the free end and another load of 20 kN at its center. If E = 10^5 N/mm^2 and I = 10^8 mm^4 for the cantilever then determine by moment area method, the slope and deflection of the cantilever at the free end. **(05)**

b) A cantilever of length 2 m carries a uniformly distributed load 2 kN/m over a length of 1 m from the free end, and a point load of 1 kN at the free end. Find the slope and deflection at the free end if E = 2.1 x 10^5 N/mm^2 and I = 6.667 x 10^7 mm^4.

(07)

Q.6. **a)** Derive the relation for a circular shaft when subjected to torsion as given below

$$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$

where T = Torque transmitted,

J = Polar moment of inertia,
τ = Max. Shear stress,
R= Radius of the shaft,
C = Modulus rigidity,
θ = Angle of twist, and
L = Length of the shaft. **(06)**

b) A hollow shaft, having an inside diameter 60% of its outer diameter, is to replace a solid shaft transmitting the same power at the same speed. Calculate the percentage saving in material, if the material to be used is also the same. **(06)**

OR

b) A solid round bar 4 m long and 5 cm in diameter was found to extend 4.6 mm under a tensile load of 50 kN. This bar is used as a strut with both ends hinged. Determine the buckling load for the bar and also the safe load taking factor of safety as 4. **(06)**

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,
LONERE – RAIGAD -402 103
Supplementary Winter Semester Examination: Nov. – 2019

Branch: Mechanical Engineering **Sem.:- IV**
Subject: - Strength of Materials (BTMEC403) **Marks: 60**
Date:- 30/11/2019 **Time:- 3 Hr.**

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Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly.

Que.1 a) State and explain following terms **6 Marks**
i Hooke'law
ii Bulk Modulus
iii Poisson's ratio

b) A metallic bar 300 mm × 100 mm × 40 mm is subjected to external forces as shown in fig. 1. Determine change in volume of the block. Take $E = 2 \times 10^5$ N/mm2, $\mu = 0.25$. **6 Marks**

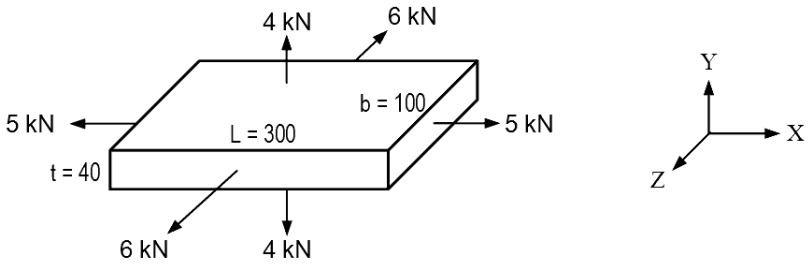

Figure.1

Que.2 a) A point in a strained material is subjected to stresses shown in fig. 2. Determine normal, tangential and resultant stresses across oblique plane by Mohr's circle method. Also calculate angle of obliquity. **8 Marks**

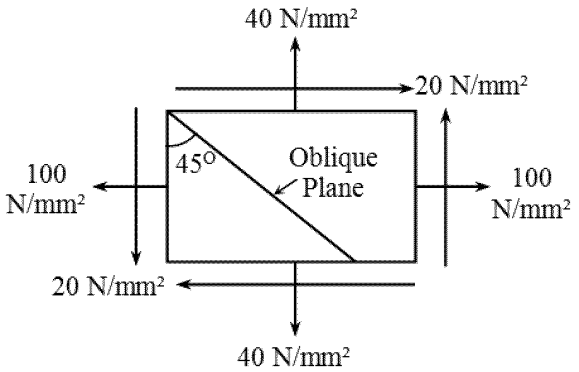

Figure.2

b) A bar 1.5 m long and 10 mm diameter hangs vertically and has a collar securely fixed at the lower end. Find the maximum stress induced in the bar when a load of 150 N falls on the collar from a height of 25 mm. Take E = 2×10^5 N/mm². Also find strain energy stored in the bar. **4 Marks**

Que.3 a) A square column 300 mm × 300 mm carries an axial load of 200 kN. Find the position of 30 kN load along the axis bisecting the width of cross section so that end stresses developed at the other extreme of the column will be zero. **6 Marks**

b) A simply supported beam AB of span 4 m carries an uniformly distributed load as shown in fig. 3. Draw S.F. and B.M. diagrams for the beam. Find magnitude of maximum B.M. **6 Marks**

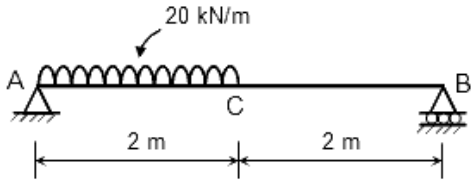

Figure.3

Que.4 a) A rectangular beam 300 mm wide and 200 mm deep is simply supported over a span of 8 m. What u.d.l. per meter the beam may carry, if the bending stress is not to exceed 120 N/mm^2 **4 Marks**

b) A channel section shown in fig. 5 (a) is used as a beam loaded as shown in fig. 5 (b). Draw the shear stress distribution diagram for the cross-section carrying maximum shear force. **8 Marks**

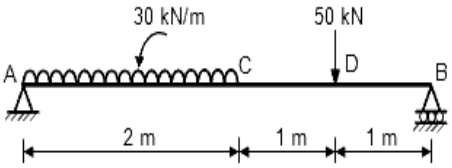

Fig. 5 (a)

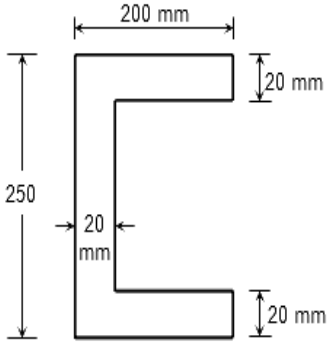

Fig. 5 (b)

Que.5 a) A simply supported beam carrying a point load is shown in fig.6. Determine : **8 Marks**

1) Slope at A and B

2) Maximum deflection.

Take E = 200 GPa, I = 60×10^6 mm^4.

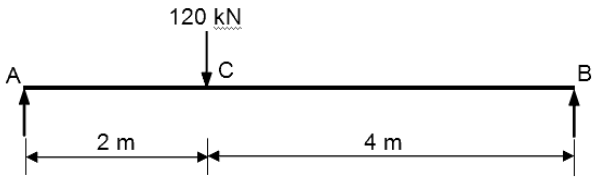

Figure.6

b) A simply supported beam 5 meter long, carries 10 kN of load at the mid-point. Calculate by moment area method, the slope at the supports and deflection at the mid-span. **4 Marks**

Take E = 2×10^5 N/mm^2 and I = 1×10^6 mm^4.

Que.6. a) Two shaft AB and BC are connected in series as shown in fig. 7. The diameters of AB and BC are 100 mm and 50 mm respectively and their lengths are 200 mm and 300 mm respectively. Both the shafts are made of the same material having modulus of rigidity as 8×10^4 N/mm^2. Determine : **6 Marks**

i) Shear stresses set up in each shaft, and

ii) The total angle of twist.

The torque applied at the one end is 10 kNm.

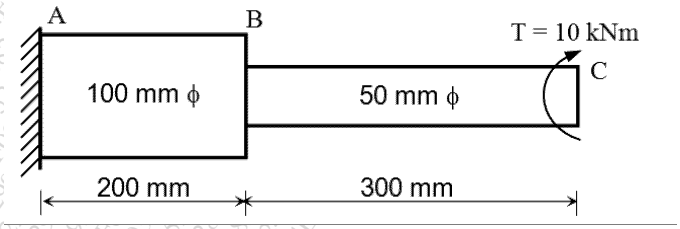

Figure.7

b) The external and internal diameter of a hollow C.I. column is 5 cm and 4 cm respectively. If the length of its column is 3 m and both of its ends are fixed. Determine the crippling load using Rankine's formula. **6 Marks**

Take $\sigma c = 550$ N/mm^2 and $\alpha = 1/1600$ in Rankine's formula.

PAPER END

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Regular End Semester Examination – Summer 2022

Course: B. Tech. **Branch : Mechanical Engineering** **Semester : IV**

Subject Name: Strength of Materials **Subject Code: BTMES404**

Max Marks: 60 **Date:24/08/2022** **Duration: 3.45 Hr.**

Instructions to the Students:

1. *All the questions are compulsory*
2. *The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in ( ) in front of the question*
3. *Use of non-programmable scientific calculators is allowed*
4. *Assume suitable data wherever necessary and mention it clearly*

		(Level/CO)	Marks
Q. 1	**Attempt Any Two**		
A)	Derive an expression for deformation of uniformly tapering circular cross-sectional body	(CO1)	**6**
B)	A composite bar made of copper, steel and brass is rigidly attached to the end supports as shown in figure 01. Determine the stresses in the three portions of the bar when the temperature of the composite system is raised by 70^0C when i) The supports are rigid ii) the supports yield by 0.6 mm. E_c = 100 GPa, E_s = 205 GPa, E_b = 95 GPa $\alpha_c = 18 \times 10^{-6} / {}^0C$, $\alpha_s = 11 \times 10^{-6} / {}^0C$, $\alpha_b = 19 \times 10^{-6} / {}^0C$	(CO2)	**6**

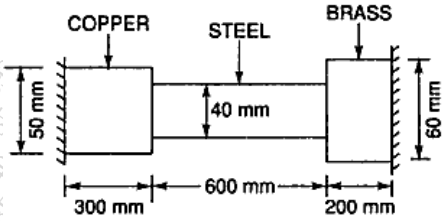

Figure 01

C)	A plane element in a boiler is subjected to tensile stresses of 400 MPa on one plane and 150 MPa on the other at right angle. Each of the above stresses is accomplished by a shear stress of 100 MPa such that when associated with the minor stress tends to rotate the element in anticlockwise direction. Find; i. Principal stresses and their direction ii. Maximum shear stress	(CO3)	**6**
Q.2	**Attempt Any Two**		
A)	A wagon weighing 20 kN is attached to a wire rope and is moving at the speed of 5.4 kmph. The rope suddenly jams and wagon is brought to rest. If length of rope is 50 m and diameter is 36 mm, find maximum instantaneous stress and elongation of rope. Take E = 200 GPa.	(CO2)	**6**
B)	A rectangular pier is subjected to a compressive load of 450 kN as shown in figure 02. Find stress intensities on all the four corners of the pier.	(CO3)	**6**

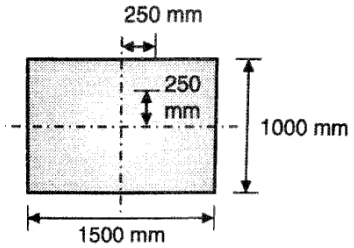

Figure 02

C) Interpret a relationship between rate of loading, shear force and bending moment (CO4) **6**

Q. 3 Attempt Any Two

A) An I-section beam 350 mm X 150 mm has a web thickness 10 mm & flange thickness 20 mm. If the shear force acting on the section is 40 kN, then find; (CO3) **6**

a) Maximum shear stress developed in the section
b) Sketch the shear stress distribution diagram
c) Total shear force carried by web

B) Derive an expression for Flexural equation along with assumptions (CO2) **6**

C) A beam of T-section, 4 m long carries a uniformly distributed load 'w' per meter run throughout its length. The beam is simply supported at its ends. The T-section has web 18.8 cm X 1.2 cm and flange is 10 cm X 1.2 cm. What is the maximum value of 'w', so that the stress in the section does not exceed 60 MPa? (CO3) **6**

Q.4 Attempt Any Two

A) Derive an expression for Torsional formula along with assumptions (Understand) **6**

B) A Hollow shaft with diameter ratio of 3/8 is required to transmit 500 kW at 100 rpm, the maximum torque being 20% greater than mean. The maximum shear stress is not to exceed 60 N/mm^2 and the twist in the length of 3 m is not to exceed 1.4°. Calculate the minimum diameter required for the shaft. (Apply) **6**
Take G = 84 N/mm^2.

C) A hollow CI column of external diameter 200 mm, length 4 meter with both the ends fixed, supports an axial load of 800 kN. Determine the thickness of the column required by using Rankine's formula taking constant of 1/6400 & working stress at 80 MN/m^2 (Apply) **6**

Q. 5 Attempt Any Two

A) Draw shear force and bending moment diagrams for the beam loaded as shown in figure 03 (CO4) **6**

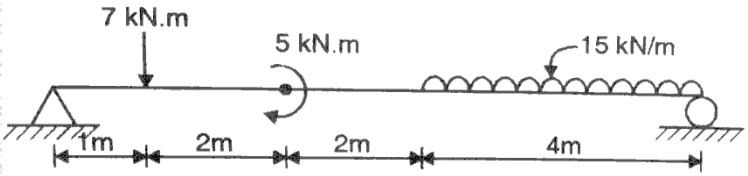

Figure 03

B) Draw shear force and bending moment diagrams for the cantilever beam as shown in figure 04 (CO4) **6**

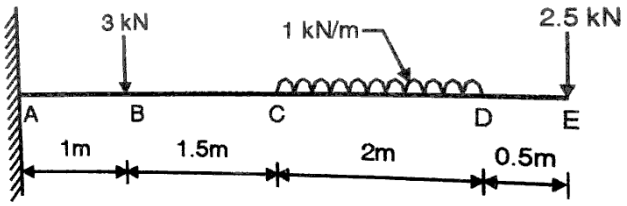

Figure 04

C) A beam ABCD has an internal hinge at B and is loaded shown in figure 05. Plot shear force and bending moment diagrams and locate point of contra flexure. (CO4) **6**

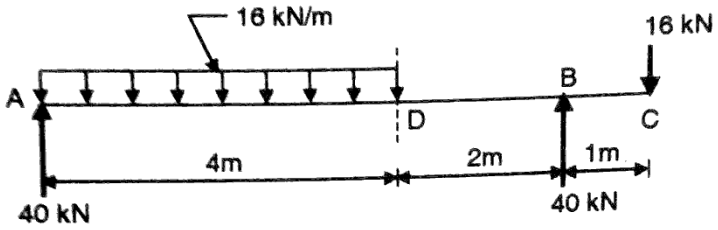

Figure 05

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