Exam Date & Time: 19-Nov-2019 (02:00 PM - 05:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCE END SEMESTER EXAMINATIONS - NOVEMBER 2019 I SEMESTER B.Sc.(Applied Sciences) in Engg. MECHANICS OF SOLIDS [ICE 111]

Marks: 100

Duration: 180 mins.

Answer 5 out of 8 questions.

- 1)
- (10) With the help of neat diagram explain, i)Principal of Transmissibility ii) What is couple? What are the properties of couple?
- A)
- ^{B)} A bracket is subjected to five forces and a couple as shown in the figure. Determine the magnitude, direction and the line of action of the resultant. ⁽¹⁰⁾



2)

A)

With the help of diagram Explain the following:

- (10)
- 1. Conditions for Equilibrium of Concurrent Coplanar Force System
- 2. Space diagram
- 3. Freebody diagram
- ^{B)} Figure shows a rope supporting two loads W and P. If BC is horizontal and W = (10)
 600N, determine the load P. Also, find the tensile forces developed in the different segments of the rope.





3)

A)

A block weighing 4500N resting on horizontal surface supports another block of (10) 3000N as shown in figure. Find the horizontal force P required to just move the block to the left. Take the coefficient of friction for all the contact surfaces as 0.3



B) Locate the centroid of the shaded area w.r.t. to the axes shown.

(10)





- State and Prove the Parallel axis theorem for obtaining Moment of Inertia. (10)
- 4)

 - A) B)
- Determine the moment of inertia of 100mm x 150mm rectangle shown in figure about x- $^{(10)}$ x axis to which it is inclined at an angle θ =sin⁻¹(4/5).



26kN force is the resultant of the two forces, one of which is as shown in figure. ⁽¹⁰⁾ Determine the other.

A)

5)



^{B)} Derive Work energy relation for translation.

6)

A metal bar of length 3.6m is subjected to an axial tensile force of 200 kN. The initial ⁽²⁰⁾ 0.8m length of bar having uniform diameter of 60mm and it gradually reduces to 30mm over next 1m length of bar, followed by gradual increase in diameter from 30mm to 80mm over another 1m, and remaining length of bar having uniform diameter of 80mm.

Determine the total elongation of bar. Take $E = 200GN/m^2$



- A solid circular bar of diameter 20 mm when subjected to an axial tensile load of 40 (10)
 kN, reduction in diameter of bar was observed as 6.4 x 10⁻³ mm. the bulk modulus of the material is 67 GPa. Determine the following: (a)Young's modulus (b) Poisson's ratio (c) Modulus of rigidity (d) change in length per meter (e) change in volume of bar per meter length.
 - B) A reinforced concrete column 250 mm × 250 mm in cross section is reinforced with 8 ⁽¹⁰⁾ steel rods of total cross sectional area 2500 mm². The column carries a compressive load of 390 kN. If the modulus of elasticity for steel is 15 times that of concrete, find (i) the stresses in concrete and steel. (ii) Area of steel required so that column may support a load of 480 kN if maximum stress in concrete is 4.5 N/mm².
- B) Derive an expression for the total extension of the tapered bar of length L , (10) rectangular cross section (width at one end "a" varying uniformly to the width at the other end "b") and uniform thickness 't', when subjected to an axial tensile load P.
 - B) A boiler shell is to be made of 15mm thick plate having a limiting tensile stress of 120 ⁽¹⁰⁾ N/mm². If the efficiencies of the longitudinal and circumferential joints are 70% and 30% respectively determine;

i) The maximum permissible diameter of the shell for an internal pressure of 2 N/mm^2 .

(ii) Permissible intensity of internal pressure when the shell diameter is 1.5m.

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