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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: ME202

Course Name: ADVANCED MECHANICS OF SOLIDS (ME)

Max. Marks: 100 Duration: 3 Hours

(Data handbooks not permitted)

PART A

Answer any three questions. Each question carries 10 marks.

1 a) What is meant by the state of stress at a point? (3)

b) The state of stress at a point is characterised by σ_x=18 σ_y= - 50, σ_z= 32 τ_{xy} = 0, τ_{xz}= 24,τ_{yz}= 0 (All stress values are in kPa); Calculate the principal stresses and the direction of largest tensile principal stress? (7)

2 a) Explain the plane stress and strain with ONE example each? (4)

b) A displacement field u=2xyi+3zk where i and k are unit vectors along x and z directions is acting at (1, 1, 0). Find the rectangular components of strain and obtain the state of strain matrix? (6)

3 a) Describe the Airy's stress function with the help of second degree polynomial? (4)

b) Obtain the bending stress on the cross section of a cantilever beam carrying point load at the free end using polynomial stress function method? (6)

4 a) Write the generalized Hook's law for an isotropic material. (5)

b) State and prove uniqueness theorem. (5)

PART B

Answer any three questions. Each question carries 10 marks

5 a) Obtain the stress distribution in a rotating solid disc of radius 'b' with no external forces at the outer surface. (7)

b) Sketch the circumferential stress distribution for a thick cylinder subjected to internal pressure only. (3)

6 a) Draw the stress distribution around a small hole (diameter 'b'), on a thin plate having large width ('a') where b<<a, subjected to uniform tensile forces at the two edges. (4)

b) What are the assumptions involved in axisymmetric problems. Write the governing equilibrium equations for the axisymmetric problem with sketch indicating stress components. (6)

7 a) Find the value of load P in Fig.1, so that the maximum bending stress allowed is 15MPa for the case of beam shown below, subjected to unsymmetrical bending. (8)

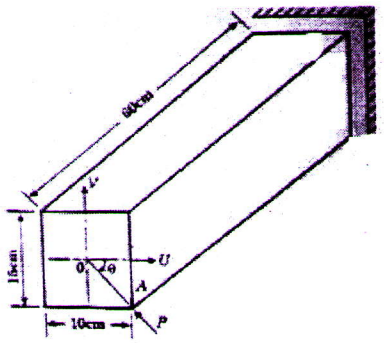

Fig.1

b) What is meant by shear centre? (2)

8 a) Obtain the expression for strain energy in a bar subjected to:- (6)

i) axial force ii) bending moment iii) twisting moment

b) State and prove reciprocal relation in strain energy. (4)

PART C

Answer any four questions. Each question carries 10 marks.

9 a) Explain the principle of virtual work? (3)

b) State and prove Castiglianos's first theorem. (7)

10 a) Write the general expression for twisting moment for shafts of non-circular cross section incorporating warping function $\Psi(x,y)$. (3)

b) What is meant by warping of non-circular shafts? Prove that St.Venants warping function is harmonic? (7)

11 a) Explain the minimum potential energy theorem? (2)

b) Find the support reaction R in Fig.2 at the end of the cantilever beam using strain energy method. (Load acting is P at a distance of 'b' from the roller support). (8)

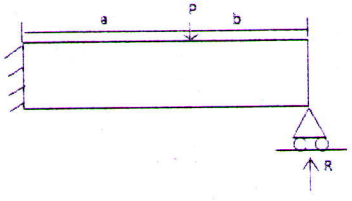

Fig.2

12 a) Discuss the Maxwell reciprocal theorem. (2)

b) A shaft of square section as shown in Fig. 3 below is subjected to a twisting moment such that the maximum shear stress is limited to 250GN/mm^2 Obtain the torque and angular twist, if shaft is 1.6m long (Take G= 70000N/mm^2). (8)

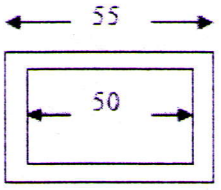

Fig.3

13 a) Why closed sections are having better torsional rigidity than open sections, briefly explain? (4)

b) Find an expression for the maximum shear stress induced in an elliptical bar under torsion? (6)

14 a) A thin walled box section 2a × a × t is to be compared with a solid circular section having diameter 'a' shown below in Fig.4. Find the thickness 't' so that both sections have: - (8)

i) Same shear stress for same torque
ii) Same stiffness.

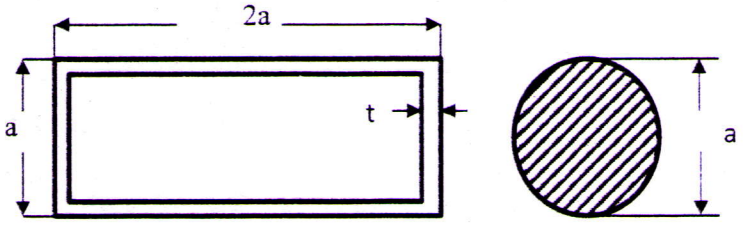

Fig. 4

b) Define the term shear flow in a thin walled tube? (2)

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