Reg. No. : | | | | | | | | | | |

Question Paper Code: 31475

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER 2015

Fourth Semester

Mechanical Engineering

01UME405 – STRENGTH OF MATERIALS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Define principal planes and principal stresses.
2. State the relationship between Young's modulus and modulus of rigidity.
3. Write the equation for the simple bending theory.
4. Write down relations for maximum shear force and bending moment in case of a cantilever beam subjected to uniformly distributed load running over entire span.
5. Distinguish between closed coil helical spring and open coil helical spring.
6. Write down the equation for Wahl factor.
7. State the condition for the use of Macaulay's method.
8. A cantilever beam of spring 2 *m* is carrying a point load of 20 *kN* at its free end. Calculate the slope at the free end. Assume $EI = 12 \times 10^3\ kNm^2$.
9. Find the thickness of the pipe due to an internal pressure of 10 N/mm^2 if the permissible stress is 120 N/mm^2. The diameter of pipe is 750 *mm*.
10. What are types of stress in a thin cylindrical vessel subjected to internal pressure?

PART - B (5 x 16 = 80 Marks)

11. (a) A cast iron flat 300 *mm* long and 30 *mm* (thickness) × 60 *mm* (width) uniform cross section, is acted upon by the following forces : 30 *kN* tensile in the direction of the length 360 *kN* compression in the direction of the width 240 *kN* tensile in the direction of the thickness. Calculate the direct strain, net strain in each direction and change in volume of the flat. Assume the modulus of elasticity and Poisson's ratio for cast iron as 140 kN/mm^2 and 0.25 respectively. (16)

Or

(b) A steel rod of 20*mm* diameter passes centrally through a copper tube of 50*mm* external diameter and 40*mm* internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly home on the projecting parts of the rod. If the temperature of the assembly is raised by 50 ˚*C*, calculate the stress developed in copper and steel. Take *E* for steel and copper as 200 GN/m^2 and 100 GN/m^2 and α for steel and copper as 12 x 10^{-6} per ˚*C* and 18 x 10^{-6} per ˚*C*. (16)

12. (a) A beam of uniform section 10 *m* long carries an UDL of 2*kN/m* for the entire length and a concentrated load of 10 *kN* at right end. The beam is freely supported at the left end. Find the position of the second support so that the maximum bending moment in the beam is as minimum as possible. Also compute the maximum bending moment. (16)

Or

(b) A Simply supported beam 6 *m* span carries an UDL of 20 *kN/m* for left half of span and two point loads of 25 *kN* end 35 *kN* at 4 *m* and 5 *m* from left support. Find maximum shear force (SF) and bending moment (BM) and their location drawing SF and BM diagrams. (16)

13. (a) It is required to design a closed coiled helical spring which shall deflect 1*mm* under an axial load of 100 *N* at a shear stress of 90 *MPa*. The spring is to be made of round wire having shear modulus of 0.8 x 10^5 *MPa*. The mean diameter of the coil is 10 times that of the coil wire. Find the diameter and length of the wire. (16)

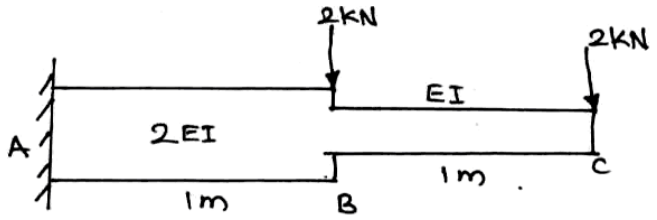
Or

(b) A solid cylindrical shaft is to transmit 300 *kW* power at 100 *rpm*. If the shear stress is not to exceed 60 N/mm^2, find its diameter. What percent saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals to 0.6 of the external diameter? The length, the material and maximum shear stress being the same. (16)

14. (a) A beam *AB* of length 8 *m* is simply supported at its ends and carries two point loads of 50 *kN* and 40 *kN* at a distance of 2 *m* and 5 *m* respectively from left support *A*. Determine, deflection under each load, maximum deflection and the position at which maximum deflection occurs. Take $E = 2 \times 10^5$ N/mm^2 and $I = 8.5 \times 10^6$ mm^4. (16)

Or

(b) For the cantilever beam shown in below figure, find the deflection and slope at the free end. $EI = 10000$ kN/m^2. (16)



15. (a) A thin cylinder 1.5 *m* internal diameter and 5 *m* long is subjected to an internal pressure of 2 N/mm^2. If the maximum stress is limited to 160 N/mm^2, find the thickness of the cylinder. $E = 200$ kN/mm^2 and Poisson's ratio = 0.3. Also find the changes in diameter, length and volume of the cylinder. (16)

Or

(b) A closed cylindrical vessel made of steel plates 5 *mm* thick with plane ends, carries fluid under pressure of 6 N/mm^2. The diameter of the cylinder is 35*cm* and length is 85*cm*. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and volume of the cylinder. Take $E=2.1 \times 10^5$ N/mm^2 and $1/m = 0.286$. (16)