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Question Paper Code: 41475

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

Fourth Semester

Mechanical Engineering

14UME405 - STRENGTH OF MATERIALS

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A material with identical material properties in all the directions is known as

   (a) Homogenous (b) Isotropic
   (c) Anisotropic (d) Orthotropic

2. Engineering stress-strain curve and True stress-strain curve are equal up to

   (a) Proportional limit (b) Elastic limit
   (c) Yield point (d) Tensile strength point

3. A continuous beam is one which has

   (a) two supports (b) more than two supports
   (c) less than two supports (d) no support

4. The neutral axis of a section is an axis, at which the bending stress is

   (a) zero (b) maximum (c) minimum (d) infinity

5. In the torsion equation $\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{I}$, the term J/R is called

   (a) section modulus (b) polar modulus
   (c) Young's modulus (d) shear modulus

6. The load required to produce a unit deflection in a spring is called

(a) flexural rigidity (b) torsional rigidity
(c) spring stiffness (d) Young's modulus

7. The ratio between buckling load and safe load is known as

(a) Slenderness ratio (b) buckling factor
(c) factor of safety (d) aspect ratio

8. The shear force distribution for a beam carrying uniformly varying load throughout its span follows

(a) a straight line path (b) a circular path
(c) a parabolic path (d) an elliptical path

9. If a body is acted upon by pure shear stresses on two mutually perpendicular planes, the planes inclined at 45^0 are subjected to _____stress.

(a) tensile (b) compressive (c) shear (d) bending

10. A body is subjected to two normal stresses 20 kN/m^2 (tensile) and 10 kN/m^2 (compressive) acting perpendicular to each other. The maximum shear stress is _____

(a) 5 kN/m^2 (b) 10 kN/m^2 (c) 15 kN/m^2 (d) 20 kN/m^2

PART - B (5 x 2 = 10 Marks)

11. Define resilience.

12. List the assumptions followed in simple bending equation.

13. What is Wahl's factor?

14. List four common methods to find slope and deflection of a beam.

15. What is the use of Mohr's circle?

PART - C (5 x 16 = 80 Marks)

16. (a) A compound bar of length 500 *mm* consists of a strip of aluminium 50 *mm* wide x 20 *mm* thick, and a strip of steel 50 *mm* wide x 15 *mm* thick rigidly joined at ends. If the bar is subjected to a load of 50 *kN*, find the stresses developed in each material and the extension of the bar. Take elastic modulus of a aluminum and steel as $1x10^5$ N/mm^2 and $2x10^5$ N/mm^2 respectively. (16)

Or

(b) A steel rail is 12.6 *m* long and is laid at a temperature of 24°*C*. The maximum temperature expected is 44°*C*.

(i) Estimate the minimum gap to be left between two rails so that temperature stresses do not develop

(ii) Calculate the thermal stresses developed in the rails if (1) no expansion joint is provided (2) if a 2*mm* gap is provided for the expansion. (16)

17. (a) A girder 6 *m* long rests on two supports with equal overhangs on either side and carries a uniformly distributed load of 30 *kN* per meter run over the entire length. Draw the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) and find the point of contraflexure. (16)

Or

(b) A cast iron beam has I section with top flange 80 *mm* x 40 *mm*, web 120 *mm* x 20 *mm* and bottom flange 160 *mm* x 40 *mm*. If the tensile stress is not exceed 30 N/mm^2 and compressive stress 90 N/mm^2, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6 *m* if the larger flange is in tension. (16)

18. (a) A shaft is required to transmit 245 *kW* power at 240 *rpm*. The maximum torque may be 10.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 1° per meter length. Take modulus of rigidity as 80 kN/mm^2. Determine the diameter required, if

(i) the shaft is solid

(ii) the shaft is hollow with external diameter twice the internal diameter. (16)

Or

(b) A closed coil helical spring is made with 12 *mm* diameter wire and is having mean diameter of 150 *mm* and 10 complete turns. The modulus of rigidity of the material of spring is 80 kN/mm^2. When a load of 450 *N* is applied, find

(i) maximum shear stress

(ii) strain energy stored

(iii) deflection and

(iv) stiffness of the spring. (16)

19. (a) A simply supported beam carries a uniformly distributed load over the entire span. Derive an expression for the slope and deflection through double integration method. (16)

Or

(b) A 2 *m* long pin ended column of square cross section is to be made of wood. Assuming E = 12 *GPa* and allowable stress being limited to 12 *MPa*, determine the size of the column to support the following loads safely.

(i) 95 *kN* and (ii) 200 *kN*.

Use factor of safety as 3 and Euler's crippling load for buckling. (16)

20. (a) A thin cylindrical shell, 2 *m* long has 200 *mm* diameter and thickness of metal as 10 *mm*. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in, find the pressure developed and hoop stress developed. Find also the changes in diameter and length. Take $E = 2 \times 10^5$ N/mm^2 and μ = 0.3. (16)

Or

(b) A piece of material is subjected to two perpendicular tensile stress of 100 *MPa* and 60 *MPa*. Determine the plane on which the resultant stress has maximum obliquity with the normal also find the resultant stress on this plane. (16)

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