Register No.: 

# 1598

## October 2024

*Time – Three hours*
*(Maximum Marks: 100)*

***N.B.*** Answer all the questions, choosing any two subdivision from each question. Each subdivision carries 10 marks.

1. (a) Explain the typical procedure for selection of materials.

   (b) Explain the classification of nano material based on their dimensions. Give examples for each type.

   (c) Explain the procedure of Rockwell hardness test with a neat sketch.

   (d) (i) Explain the concept of micro hardness testing. (5)
   (ii) Draw the sketch of Shore hardness test and label the parts. (5)

2. (a) A rectangular wooden column of length 3m and size 300×200mm carries an axial load of 300 kN. The column is found to be shortened by 1.5mm under the load. Find the stress, strain and Young's modulus.

   (b) A steel punch can be worked on to the compressive stress of 800N/mm$^2$. Find the least diameter of the hole which can be punched through a steel plate 28mm thick if the ultimate shear stress for the plate is 360 N/mm$^2$.

   (c) Draw and explain the stress-strain diagram of mild steel specimen with its salient point parameters.

   (d) Explain the procedure to conduct creep test with a neat sketch.

3. (a) (i) Define Poisson's ratio and Bulk modulus. (5)
   (ii) Define proof resilience. Also write the expression for strain energy stored in a bar due to axial load.(5)

   (b) For a given material, the Young's modulus is 1 X 10$^5$ N/mm$^2$ and modulus of rigidity is 0.4 X 10$^5$ N/mm$^2$. Find the bulk modulus of a round bar of 50mm diameter and 2.5m long when stretched by 3.2mm.

(c) Calculate the strain energy that can be stored in a steel bar of 70mm in diameter and 6m long, subjected to a pull of 200kN. Assume E=200 kN/mm$^2$.

(d) A weight of 1400 N is dropped on to a collar at the lower end of a vertical bar 3m long and area of 490mm$^2$ and instantaneous elongation is 1.8mm. Calculate the height of drop, if the maximum instantaneous stress is not to exceed 120 N/mm$^2$. Take E = 2 × $10^5$ N/mm$^2$.

4. (a) (i) State the assumptions made in theory of pure torsion. (5)
(ii) Differentiate between solid shaft and hollow shaft. (5)

(b) Describe the torsion testing machine with a neat sketch.

(c) A solid shaft is subjected to a torque of 15 kN-m. Find the necessary diameter of the shaft, if the allowable shear stress is 60 N/mm$^2$. The allowable twist is 1° for every 20m length of the shaft. Take C= 80x $10^5$ N/mm$^2$.

(d) A hollow shaft having external and internal diameter of 80mm and 50mm is required to transmit torque from one end to other. If the allowable stress is 45 N/mm$^2$, calculate the safe torque it can transmit.

5. (a) (i) List the types of springs and explain any one type of spring. (5)
(ii) Differentiate between open and closely coiled helical springs.(5)

(b) A closely coiled helical spring has to absorb 5 N-m of energy when compressed by 50mm. The mean diameter of the coil is 10 times the wire diameter and the number of coils are 10. Determine the diameter of the wire and the coil. Also find the maximum shear stress produced. Take C = 0.8 x $10^5$ N/mm$^2$.

(c) A cylindrical shell of 1.5m diameter is made up of 30mm thick plates. Find the circumferential and longitudinal stress in the plates, if the boiler is subjected to an internal pressure of 2.4 MPa. Take efficiency of the joints as 70%.

(d) A closed coil helical spring is made of steel wire of 10mm diameter has 10 coils of 120mm mean diameter. Calculate the stiffness and the deflection of spring under an axial load of 100N. Take C =1.2 x $10^5$ N/mm$^2$.

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