R18

Code No: 155AX

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2024
DESIGN OF MACHINE MEMBERS - I
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) What are the preferred numbers? Distinguish between 'basic series' and 'derived series. [2]
b) Which theory of failure is suitable for the design of cast iron component subjected to steady state loading? Why? [3]
c) List at least two methods to improve fatigue strength. [2]
d) How do you reduce stress concentration? [3]
e) What size of hole must be drilled in M34 bolt to make it bolt of uniform strength? [2]
f) State the advantages of welded joints over riveted joints. [3]
g) State any two conditions under which the use of knuckle joints is recommended. [2]
h) State where the following keys are used: sunk key, saddle key, and tangent key. [3]
i) Define coupling and write its function. [2]
j) Why are hollow shafts generally preferred over solid shafts? [3]

PART – B

(50 Marks)

2.a) Distinguish between Shaft-basis system and Hole-basis system to assign tolerances. What are the advantages of the Hole-basis system over Shaft-basis system?
b) A MS shaft is subjected simultaneously to a torque of 28 kN-m and bending moment of 22 kN-m. Find the diameter of the shaft if maximum shear stress is 30 N/mm^2 and normal stress is 50 N/mm^2. [5+5]

OR

3.a) A rod of length 100 mm and ϕ 20 mm is subjected (i) Pure torsion, (ii) Pure bending, and (iii) Combined bending and torsional load. Draw the typical stress distribution on the critical section of each case.
b) Distinguish between stiffness and strength of materials. Explain the concept of stiffness in tension, bending, torsion and combined situations. [5+5]

4.a) What do you understand by 'Stress concentration'? How do you take it into consideration in the case of a component subjected to dynamic loading?
b) Determine the diameter of a tensile member of circular cross section from the following data: Maximum tensile load = 20 kN; Maximum compressive load = 10 kN; Ultimate tensile strength = 600 MPa; Yield point = 390 MPa; Endurance limit = 290 MPa; Factor of safety = 4; Stress concentration factor = 2.2. [5+5]

OR

5. A 50 mm diameter steel shaft with a 20 mm transverse hole is simultaneously subjected to a bending stress which varies from + 100 MPa to – 70 MPa. And a torsional stress which varies from + 80 MPa to -50 MPa. Find the factor of safety for infinite life assuming the following properties. Ultimate strength in tension = 800 MPa, Yield strength = 550 MPa. Surface correction factor = 0.85, Size factor =0.85, and Notch sensitivity factor = 0.9. Use maximum distortion energy theory. [10]

6.a) What is meant by pre-tension in bolts? What is its significance?

b) Two lengths of mild steel rods having width 200 mm and thickness 12.5 mm are connected with a butt joint with equal width straps. Design lozenge joint if the permissible working stress in plate and rivet material are 80 N/mm^2 in tension, 50 N/mm^2 in shear, and 150 N/mm^2 in crushing. [5+5]

OR

7.a) Show by neat sketches the various modes of failure of riveted joint.

b) A plate 100 mm wide and 12 mm thick is to be welded to another plate by parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that the maximum stress induced in the weld should not exceed 50 N/mm^2. [5+5]

8.a) Explain the basic procedure to determine the dimensions of a knuckle joint, by assuming suitable data required.

b) A rectangular sunk key 14 mm wide, 10 mm thick and 75 mm long is required to transmit 1200 N-m torque from a 50 mm diameter solid shaft. Determine whether the length is sufficient or not if the permissible shear stress and crushing stress are limited to 56 MPa and 168 MPa respectively. [5+5]

OR

9.a) Discuss the design of square or flat key based on (i) failure due to shear stress, and (ii) failure due to compressive stress.

b) Design a cotter joint to support a completely reversed axial load of 30 kN. Use steel for all components. The allowable stress for steel are: in tension 40 N/mm^2, in compression 50 N/mm^2, and in shear 30 N/mm^2. [5+5]

10.a) Explain the design of a hollow shaft based on strength.

b) A mild steel shaft transmits 40 kW power at 280 r.p.m. Maximum torque transmitted exceeds mean torque by 25%. Maximum shear stress is 60 N/mm^2 and the angle of twist should not exceed 1° in a length of 20 diameter. The modulus of rigidity is 80 GN/m^2. Compute the diameter of the shaft. [5+5]

OR

11.a) What is a Gasket used for? Explain the different types and shapes of Gaskets.

b) Design a CI flange coupling to connect two shafts to transmit 7·5 kW at 720 r.p.m. The following permissible stresses may be assumed. Permissible shear stress for the shaft, bolt, and key material = 33 N/mm^2. Permissible crushing stress for the bolt and key material = 60 N/mm^2. Permissible shear stress for * CI = 15 N/mm^2. [5+5]

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