



CBCS SCHEME

18AU53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021 Design of Machine Elements – I

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Design data hand book is permitted.
3. Missing data may be suitably assumed.*

Module-1

- 1 a. Explain the stress-strain diagram for a ductile material and show the salient points on them. (06 Marks)
- b. Define standards and codes. (04 Marks)
- c. A point in a structural member subject to plane stress as shown in Fig. Q1 (c). Determine
 - (i) Normal and tangential intensities on the plane inclined at 45° .
 - (ii) Principal stresses and their directions.
 - (iii) Maximum shear stress and directions. (10 Marks)

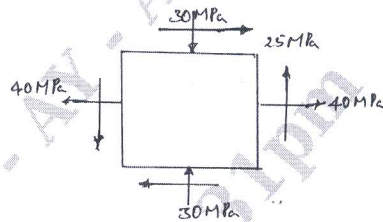


Fig. Q1 (c)

OR

- 2 a. Explain the following theories of failure:
 - (i) Maximum normal stress theory.
 - (ii) Maximum shear stress theory.
 - (iii) Distortion energy theory. (10 Marks)
- b. A rod of circular section is subjected to bending moment of 200 kN-m and twisting moment 300 kN-m selecting C45 steel ($\sigma_y = 353$ MPa) and assuming factor of safety as 3. Determine the diameter of rod according to,
 - (i) Maximum normal stress theory of failure.
 - (ii) Maximum shear stress theory of failure. (10 Marks)

Module-2

- 3 a. What is stress concentration? How to reduce it? Explain any three methods with sketches. (10 Marks)
- b. A bar of rectangular section is subjected to an axial pull as shown in Fig. Q3 (b). Determine the thickness of plate, if the allowable stress in bar is 200 MPa. (10 Marks)

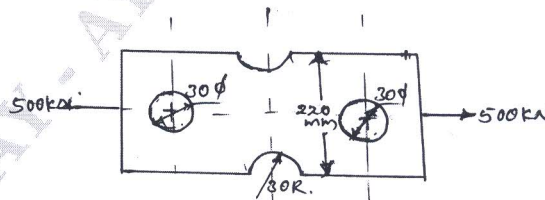


Fig. Q3 (b)

OR

- 4 a. Derive an expression for impact strength in the axial bar. (06 Marks)
 b. A hot rolled steel shaft is subjected to a torsional load varying from +330 N-m to -110 N-m and applied bending moment varies from +440 N-m to -220 N-m. Determine the shaft diameter, take $\sigma_u = 550$ MPa, $\sigma_y = 410$ MPa. FOS = 1.5, $\sigma_{en} = 225$ MPa, size factor = 0.85. Neglect the effect of stress concentration. (14 Marks)

Module-3

- 5 a. Design a rigid flange coupling to transmit 18 kW at 1440 rpm. The allowable stress for CI flange is 4 MPa. The shaft, key and bolts are made up of steel material having allowable stresses 93 MPa, allowable crushing stress for key is 186 MPa. (10 Marks)
 b. Design a knuckle joint to transmit a load of 40 kN. The material selected for joint has following design stresses:
 $\sigma_t = 100$ MPa, $\sigma_c = 120$ MPa, $\tau = 55$ MPa (10 Marks)

OR

- 6 A shaft is supported by two bearings placed 1m apart. A 500 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with help of belt having maximum tension of 3000 N. The pulley weighs 1000 N. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing is driven by motor and the belt placed horizontally to the right. The pulley weighs 500 N. Determine the diameter of a solid shaft assuming torque on one pulley is equal to another pulley. The angle of contact for both pulleys is 180° and $\mu = 0.24$, $\sigma_y = 235.4$ MPa. (20 Marks)

Module-4

- 7 a. Explain in brief failures of riveted joints. (06 Marks)
 b. Design a double riveted butt joint to connect two plates 20 mm thick. The joint is zig-zag riveted and has equal width cover plates. The allowable tensile crushing and shear stresses for riveted material are 100 MPa, 120 MPa and 60 MPa respectively. Calculate the efficiency of joint also. (14 Marks)

OR

- 8 a. Write the advantages and disadvantages of welded joint over riveted joint. (06 Marks)
 b. Determine the size of weld required for an eccentrically loaded weld joint as shown in Fig. Q8 (b). The allowable stress in the weld is 75 MPa. (14 Marks)

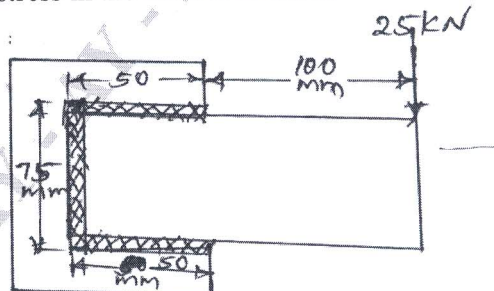


Fig. Q8 (b)

Module-5

- 9 a. The cylinder head of a reciprocating air compressor is held by 10 bolts. The total input stiffness is 4 times the total bolt thickness. Each bolt is tightened to an initial tension of 5 kN. The total external force acting to separate the joint is 20 kN. Find the size of bolt so that the stress in bolts is 100 MPa. (10 Marks)
- b. A radial drilling machine with circular base is mounted to a base plate by means of three steel bolts equally spaced on a bolt circle diameter of 0.3 m. The diameter of the circular base is 0.4 m. The spindle is positioned at a radial distance of 0.335 m from the centre of column. During the drilling operation, the spindle is subjected to a force of 4.5 kN. Determine the size of bolt, if allowable stress in bolt is 100 MPa. (10 Marks)

OR

- 10 a. Explain overhauling of screws. Derive condition for self locking of square thread with collar friction. (06 Marks)
- b. A single start square threaded power screw is used to rise a load of 120 kN. The screw has mean diameter of 24 mm and 4 threads per 24 mm length. The mean collar diameter is 40 mm. The co-efficient of friction is estimated as 0.1 for both thread and collar. Determine
- The major diameter of screw.
 - Torque required to rise the load.
 - Overall efficiency.
 - Check self locking of screw.
- (14 Marks)
