USN | | | | | | | | | | |

17AU53

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

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions.*
2. Use of design data hand book is permitted.
3. Assume suitable missing data.

1 a. Explain standards and codes, with examples. **(04 Marks)**

b. Draw the stress-strain diagram for a ductile material and show the salient points on them. **(06 Marks)**

c. A circular rod of diameter 50mm is subjected to load as shown in Fig.Q.1(c). Determine the maximum stress at critical points. **(10 Marks)**

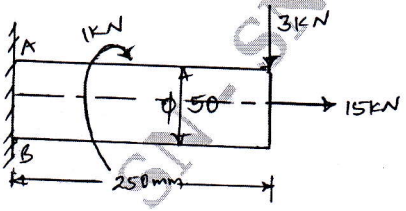

Fig.Q.1(c)

2 a. Explain the theories of failure. **(08 Marks)**

b. A steel shaft is subjected to an axial pull of 10kN and tangential force of 5kN. The yield strength of steel is 300MPa and factor of safety as 3. Determine the diameter of shaft according to i) Maximum normal stress theory of failure ii) Maximum shear stress theory of failure iii) Maximum distortion theory of failure. **(12 Marks)**

3 a. What is stress concentration? Explain methods of reducing stress concentration. **(08 Marks)**

b. A flat plate subjected to tensile load of 5kN as shown in Fig.Q.3(b). The plate material is gray cast iron of ultimate strength 200MPa. Determine the thickness of plate. Take FOS as 2.5. **(08 Marks)**

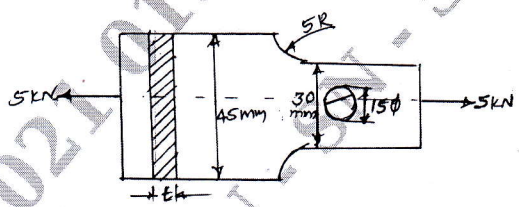

Fig.Q.3(b)

c. What is meant by fatigue failure and endurance limit? **(04 Marks)**

4 a. Derive Soderberg's equation with usual notations. **(06 Marks)**

b. A hot rolled steel shaft is subjected to a torsional load that varies from +330N-m to -110N-m and bending moment at critical section varies from +440N-m to -220N-m. The shaft is of uniform cross section. Determine the required shaft diameter. The strength properties of material are σ_u = 550MPa, σ_y = 410MPa, σ_{en} = 275MPa FOS = 1.5. The size and surface correction factors are 0.85 and 0.62 respectively. **(14 Marks)**

5 A shaft is supported by two bearing placed 1100mm apart. A pulley of diameter 620mm is keyed at 400mm to the right from the left hand bearing and this drives a pulley directly below it with a maximum tension of 2.75kN. Another pulley of diameter 400mm is placed 200mm to the left of right hand bearing and is driven with motor placed horizontalally to the right. The angle of contact of the pulleys is 180° and μ = 0.3. Find the diameter of the shaft. Assume C_m = 3.0, C_t = 2.5 and σ_y = 300MPa. **(20 Marks)**

6 a. Design a CI flanged coupling for steel shaft transmitting 18kW at 1440rpm. The allowable shear stress for shaft is 93MPa. The allowable shear stress for flange is 4MPa. The allowable crushing stress in key is 180MPa. The shaft, key and bolt are made up of same material. **(12 Marks)**

b. Design a knuckle joint to connect two mild steel rods to sustain an axial pull of 150kN. The pin and rod are made up of same material. Assume the working stress in the material as 8MPa in tension, 40MPa in shear and 120MPa in crushing. **(08 Marks)**

7 a. Explain the failures in riveted joint. **(06 Marks)**

b. Design a triple riveted butt joint to join two plates of thickness 10mm. The pitch of rivets in the extreme rows, which are in single shear is twice the pitch of rivets in the inner rows which are double sheer. The design stresses of the materials are as follows: σ_t = 120MPa, σ_c = 160MPa and τ = 80MPa. **(14 Marks)**

8 a. A plate 75mm wide and 12.5mm thick is joined with other plate by a single transverse welded and double parallel fillet weld. The maximum tensile and shear stress are 70MPa and 56MPa respectively. Find the length of each parallel fillet weld if the joint is subjected to both static and fatigue loading. **(08 Marks)**

b. A 16mm thick plate is welded to a vertical support by two fillet welds as shown in Fig.Q.8(b). Determine the size of weld if the permissible shear stress for the weld material is 75MPa. **(12 Marks)**

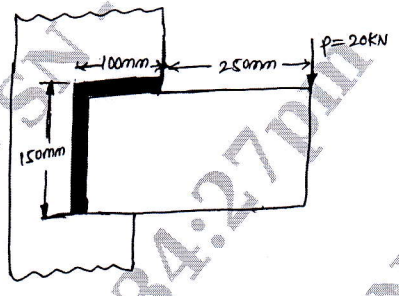

Fig.Q.8(b)

9 a. A bolt in a steel structure is subjected to a tensile load of 9kN. The initial tightening load on the bolt is 5kN. Determine the size of bolt taking allowable stress for bolt material to be 80MPa and K = 0.05. **(08 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 0.3m. The diameter of the circle base is 0.4m. The spindle is positioned at a radial distance of 0.335m from the centre of the column. During drilling operation, the spindle is subjected to a force of 4.5kN. Determine the size of bolts, if the allowable stress in bolt material is 100MPa. **(12 Marks)**

10 a. Explain overhauling of screws. Derive the condition for self locking of square thread with coller friction. **(06 Marks)**

b. A weight of 500kN is raised at a speed of 6m/min by two screw rods with square threads of 50 × 8mm cut on them. The two screw rods are driven through bevel gears by motor. Determine:

i) Torque required to raise the load
ii) Speed of rotation of screw assuming threads are of double start
iii) Maximum stress induced in screw rod
iv) Efficiency of screw drive
v) Length of nut
vi) Check for overhauling or self locking. **(14 Marks)**

* * * * *