2002 SCHEME

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AU46

Fourth Semester B.E. Degree Examination, June 2012

Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions.***
2. Use of design data handbook is permitted.
3. Suitably assume and state missing data, if any.

1 a. Briefly explain different factors to be considered in the design of a product. **(05 Marks)**

b. How are the engineering materials designated? Give examples. **(02 Marks)**

c. A machine member is in the form of a cantilever beam. It is of circular cross section of diameter 75 mm and length 1 m. It is subjected to an axial load of 10 kN, transverse load of 1.5 kN at the free end of the beam in downward direction and a twisting moment of 2 kN–m. Determine the principal stresses at the critical section and show on the sketch the critical location. **(08 Marks)**

d. Derive an expression for input factor. **(05 Marks)**

2 a. What is a theory of failure? What is its importance in design? Explain briefly. **(04 Marks)**

b. State and Explain following theories of failure;
(i) Maximum normal stress theory; (ii) Maximum shear stress theory. **(06 Marks)**

c. The stress included at the critical point a machine component made of steel C40: σ_x = 80 MPa, σ_y = –60 MPa and τ_{xy} = 50 MPa. Calculate the factor of safety according to:
(i) Max shear stress theory; (ii) Distortion energy theory. **(10 Marks)**

3 a. Briefly explain the phenomenon of fatigue failure of materials. **(03 Marks)**

b. Differentiate between high cycle fatigue and low cycle fatigue. **(03 Marks)**

c. A hot rolled steel shaft is subjected to a torsional load varies from 330 N–m clockwise to 110 N–m anticlockwise as an applied bending moment at the critical section varies from +440 N-m to -220 N-m. The shaft is of uniform cross section and no key–way is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of (550 MPa) and a yield strength of 410 MPa. Tube FOS N = 1.5 and $\sigma_{en} = \sigma_4/_2$. **(14 Marks)**

4 a. Write a note on combined fatigue and shock factors. **(03 Marks)**

b. A shaft 900 mm between bearings supports a 600 mm dia pulley 300 mm to the right of the LH beaming and the belt drives a pulley directly below. Another pulley, 450 mm in dia is located 200 mm to the left of the R.H. bearing and is driven by a belt from a pulley horizontally to the right. The angle of contact for both the pulleys is 180° and the tension ratio is 2.2. The maximum tension in the belt on 600 mm dia pulley is 2200 N. Determine the diameter of the shaft. Material of the shaft is steel C40. Take a factor of safety of 2.5, weight of bigger pulley 800 N, smaller pulley 600 N. Also determine the power transmitted by the shaft, if shaft rotates at 600 rpm. **(17 Marks)**

5 a. What are the advantages and disadvantages of flexible coupling over rigid flange compling? **(03 Marks)**

b. Design a flexible coupling for connecting a motor shaft to a pump shaft. The power to be transmitted is 12 kW at 1000 rpm. Allowable bearing pressure in rubber bush may be taken as 0.3 MPa. **(17 Marks)**

6 a. A steel plate subjected to a force of 5 kN and fixed to a vertical channel by means of four identical bolts is shown in Fig.Q6(a). The bolts are made of plain carbon steel 45C8 (σ_y = 380 MPa) and the factor of safety is 2. Determine the normal diameter of the bolt. **(10 Marks)**

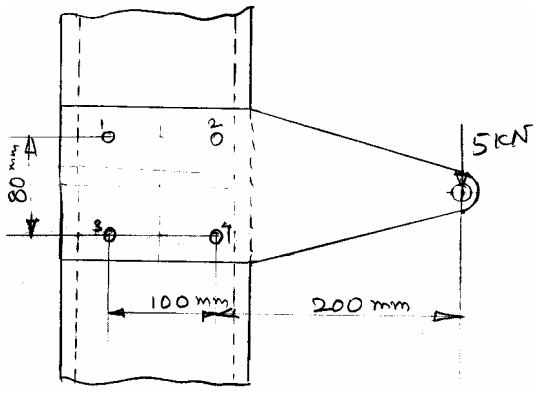


Fig.Q6(a)

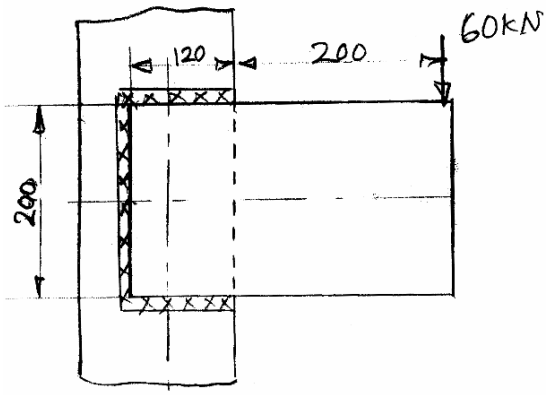
b. The nominal diameter of a double threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having other diameter of 100 mm and inner diameter of 65 mm. The coefficient of friction may be taben as 0.15. The screw is used to raise a load of 15 kN. Using wear theory for collar friction, calculate:
(i) Torque required to raise the load, and
(ii) Torque reqired to lower the load, and
(iii) The force required to raise the load, if applied at a distance of 400 mm. **(10 Marks)**

7 a. Design a knuckle joint to connect two mild steel rods. The joint has to transmit a tensile load of 80 kN. Use C10 steel and factor of safety of 2.5. **(10 Marks)**

b. Design a lap joint for a mild steel tie–bar 200 × 10 mm using 24 mm diameter rivets. Take diameter of rivet hole as 25.5 mm. Use diamond joint. Allowable stresses are: σ_+= 120 MPa, τ = 80MPa and $\sigma_{crushing}$ = 200 MPa. Also determine efficiency of the joint. **(10 Marks)**

8 a. For the following fillet welds determine the strengths.
Length of the weld (total) = L,mm
Size of the weld – 4 mm
(i) Paralled fillet weld
(ii) Transverse fillet –weld **(08 Marks)**
Draw the sketches.

b. Determine the size of fillet weld required for the flat plate loaded as shown in Fig.Q8(b) of allowable shear stress is 70 MPa. **(12 Marks)**



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