CBCS SCHEME

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15ME54

Fifth Semester B.E. Degree Examination, June/July 2018
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 80

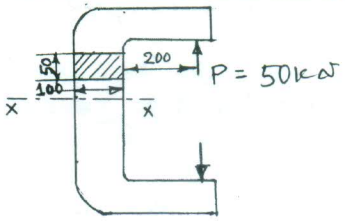
Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Use of design data handbook is permitted.
3. Assume missing data, if any, suitably.

Module-1

1 a. Briefly explain the process of mechanical engineering design. **(03 Marks)**

b. Explain the importance of standards in design and list different standards used. **(03 Marks)**

c. Determine extreme fiber stresses at section x - x of the machine member loaded as shown in Fig.Q1(c). Also show the distribution of stresses at this section. **(10 Marks)**



All dimensions are in mm.

Fig.Q1(c)

OR

2 a. State and explain following theories of failure:
(i) Maximum normal stress theory
(ii) Maximum shear stress theory **(06 Marks)**

b. A shaft made of C40 steel is subjected to a bending moment of 10 kN-m and a twisting moment of 8 kN-m. Factor of safety used is 2.5. Determine the required diameter of the shaft according to :
(i) Maximum shear stress theory of failure
(ii) Maximum distortion energy theory of failure. **(10 Marks)**

Module-2

3 a. Derive Soderberg equation for designing members subjected to fatigue loading. **(06 Marks)**

b. Machine member is in the form of a simply supported beam of length 1 m and cross section 50mm × 60mm. It is made of steel having permissible stress of 120 MPa. Determine the safe height from which a mass of 10 kg may be allowed to fall at the midpoint of the beam. **(10 Marks)**

OR

4 A transmission shaft carries a gear midway between two bearings. The bending moment at the gear varies from – 300 N-m to +500 N-m, as the twisting moment varies from 100 N-m in c.w. direction to 200 N-m in c.c.w direction. The frequencies of variation of bending and torsional moments are equal to the shaft speed. The shaft is made of C30 steel. The endurance limit may be taken as 50% of ultimate strength. Determine the diameter of the shaft taking size factor as 0.85, surface finish factor as 0.88 and factor of safety of 2. **(16 Marks)**

Module-3

5 A power transmission shaft 1400 mm long is supported at its extreme ends. The shaft receives a power of 50 kW through a gear drive located 500 mm to the right of the left end of the shaft at a rated speed of 600 rpm. PCD of gear is 200 mm, pressure angle 20° and weight 500 N. This gear receives power from another gear directly behind. This power is delivered through a belt drive located a distance of 400 mm to the left of the right support. The belt pulley has a pitch diameter of 350 mm and weighs 800 N. The belt moving on the pulley is directed towards the observer, below the horizontal and inclined at 45° to it. The ratio of belt tensions is 3. Selecting carbon steel C40, factor of safety of 2.5 design the solid circular shaft consider the loading to have minor shocks. **(16 Marks)**

OR

6 a. A cast iron protected type flange coupling is used to connect two shafts of 80 mm diameter. The shaft runs at 300 rpm and transmits a power of 150 kW. The permissible shear stress for shaft and bolt materials is 50 MPa and permissible shear stress for flange is 10 MPa. design the coupling and draw the sketch. **(08 Marks)**

b. Design a knuckle joint for a tie rod of circular cross section to sustain a maximum tensile load of 75 kN. The material used for the joint has the following permissible stresses: 120 MPa in tension 80 MPa in shear and 180 MPa in crushing. **(08 Marks)**

Module-4

7 a. Design a double riveted double strap longitudinal butt joint with unequal straps for a pressure vessel. The ID of the pressure vessel is 1.2 m and vessel is subjected to an internal pressure of 2.5 MPa. The pitch of the rivet in the outer row is to be double the pitch in the inner row. The allowable tensile stress for the plate material is 120 MPa. The allowable shearing and crushing stress for rivet material are : 80 MPa and 170 MPa respectively. The strength of the rivet in double shear is to be taken as 1.875 times that in single shear. Assume efficiency of the joint as 85%. **(08 Marks)**

b. Determine the size of rivets required for the eccentrically loaded joint as shown in Fig.Q7(b). The allowable shear stress for the rivet material is 60 MPa. **(08 Marks)**

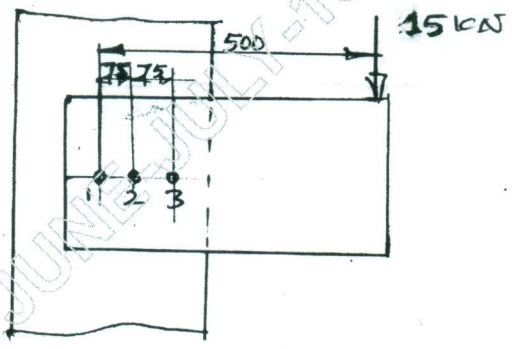


Fig.Q7(b)

OR

8 a. What are the advantages and disadvantages of welded joint over riveted joints? **(03 Marks)**

b. What is a 'Lozange' joint? Where is it used? **(03 Marks)**

c. Determine the size of the weld required for a flat plate welded to a steel column and loaded as shown in Fig.Q8(c). The permissible shear stress for the weld material is 70 MPa. **(10 Marks)**

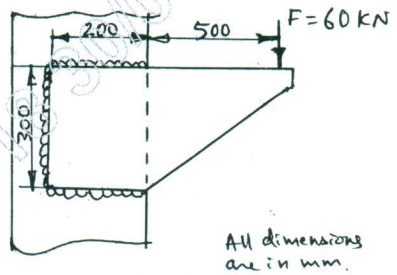


Fig.Q8(c)

Module-5

9 a. The cylinder head of a steam engine is subjected to a pressure of 0.6 MPa. It is held in position by means of 12 bolts. Each bolt is subjected to an initial tension of 5 kN. A soft copper gasket is used to make the joint leak proof. Effective diameter of the cylinder is 250 mm. Find the size of bolts so that the stress in the bolt is not to exceed 100 MPa. **(08 Marks)**

b. A bracket is fixed to the support using four bolts as shown in Fig.Q9(b). Select the suitable size for bolts if the allowable tensile stress in the bolts is 120 MPa. **(08 Marks)**

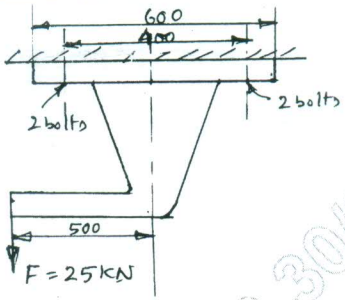


Fig.Q9(b)

OR

10 a. Explain self locking in power screws and its importance. **(03 Marks)**

b. A screw jack is to lift a load of 100 kN through a height of 400 mm. Screw is made of steel with allowable stresses of 100 MPa in tension and compression, 60 MPa in shear. The material for the nut in phosphor bronze for which the allowable stress in tension is 30 MPa, in compression it is 60 MPa and in shear 25 MPa. The bearing pressure between nut and screw is not to exceed 18 MPa. Design the screw and nut. Also check whether the screw is self locking. Take coefficient of friction between screw and nut threads as 0.14 and for collar 0.1. **(13 Marks)**

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