CBCS SCHEME

USN | | | | | | | | | | **17MT51**

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Design of Machine Elements

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. Any missing data may be assumed suitably.

Module-1

1 a. Briefly explain the classification of machine design. **(06 Marks)**

b. State and explain design considerations. **(06 Marks)**

c. A rectangular plate of thickness 15mm is subjected to an axial pull of 20kN as shown in the Fig.Q.1(c). Calculate the maximum stress. **(08 Marks)**

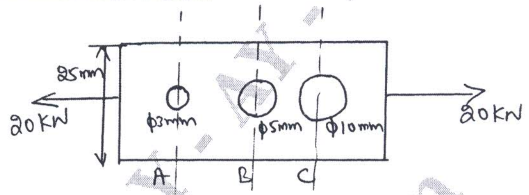

Fig.Q.1(c)

OR

2 a. Explain the following theories of failure:
i) Maximum normal stress theory
ii) Maximum shear stress theory
iii) Maximum distortion energy theory. **(10 Marks)**

b. A mild steel shaft of 50mm diameter is subjected to a bending moment of 200Nm and torque T. If the yield point of the steel in tension is 200MPa, find the maximum value of the torque which causes yielding according to maximum principle stress theory and maximum distortion energy theory. Take FOS = 1. **(10 Marks)**

Module-2

3 a. Determine the dimensions of tapered key to transmit 10kW at 1000rpm. Also find the axial force necessary to derive the key home. The permissible shear and compressive stresses in the key material are $60 N/mm^2$ and $130 N/mm^2$ respectively. [Given $\mu_1 = 0.25$, $\eta = 0.751$]. **(10 Marks)**

b. A flexible coupling is used to transmit 15kW power at 100rpm. There are six pins and pitch circle diameter is 200mm. The length of rubber bush is 35mm and the gap between the flanges on assembly is 5mm. The permissible shear and bending stresses in pin are 35MPa and 152MPa respectively. The permissible pressure for rubber bush is 1MPa. Calculate:
i) Pin diameter by shear consideration
ii) Pin diameter by bending consideration
iii) Outer diameter of the rubber bush. **(10 Marks)**

OR

4 a. Design a knuckle joint for connecting 2 rods subjected to an axial force of 12kN. The permissible stress are $40 N/mm^2$ in tension, $80 N/mm^2$ in compression and $32 N/mm^2$ in shear. **(10 Marks)**

b. Design a cotter joint for the following specification, axial thrust 100kN, allowable stress are
i) Tensile stress 100MPa ii) Shear stress 60MPa iii) Crushing stress 120MPa. **(10 Marks)**

Module-3

5 A shaft is supported between 2 bearings placed 1m apart. A 600mm diameter pulley is mounted at a distance of 300mm to the right of left hand bearing and this drives a pulley directly below with the help of belt with max tension of 2.25kN another pulley 400mm diameter is placed 200mm to the left of right hand bearing and is driven with the help of electric motor and belt which is placed horizontally to the right, the angle of contact for both the pulleys is 180° and coefficient of friction is 0.24. Determine the suitable diameter for the solid shaft allowing a working stress of 63MPa in tension and 42MPa in shear. **(20 Marks)**

OR

6 a. Find the diameter of a solid shaft to transmit 20kW at 200rpm. The ultimate shear stress for steel can be taken as 360MPa and FOS of 8. If a hollow shaft is to be needed in place of a solid shaft. Find the inside and outside diameter, when the ratio of inside to outside diameter is 0.5. **(10 Marks)**

b. A commercial steel shaft is required to sustain a torque of 450Nm and a bending moment of 300N-m. Determine:

i) Diameter of the solid shaft required
ii) The dimensions of hollow shaft taking $d_i = 0.8do$
iii) Angular deflection. **(10 Marks)**

Module-4

7 a. Explain the classification of gears. **(06 Marks)**

b. Design a pair of spur gears to transmit 40kW at 4000rpm of pinion to the gear at 800rpm. Assume number of teeth on pinion as 20. **(14 Marks)**

OR

8 a. Explain the advantages and disadvantages of gears. **(06 Marks)**

b. Following data refers to a helical gear power transmitted 34kW at 2800rpm of pinion speed reduction ratio equal 4.5, helix angle 45°. Material for both pinion and gear is medium carbon steel [$\sigma_d = 230N/mm^2$] pinion diameter is 120mm. Design the gear check the design for wear. **(14 Marks)**

Module-5

9 a. Briefly explain the classification of bearings. **(08 Marks)**

b. A full journal bearing of 50mm diameter, 75mm long supports a radial load of 1000N. The speed of the shaft is 600rpm. The surface temperature of bearing is limited to 60°C and the room temperature is 30°C. Determine the viscosity of the oil if the bearing is well ventilated and no artificial cooling is to be used. The ratio of journal diameter to diametral clearance is 1000. **(12 Marks)**

OR

10 a. Explain the following:

i) Coefficient of Friction
ii) Minimum oil film thickness
iii) Bearing materials. **(06 Marks)**

b. Determine the dimension of bearing and journal to support a load of 7.5kN at 1000rpm. The journal is made of hardened steel and the bearings is of babbit material. Abundant of oil is supplied by oil rings. The oil viscosity is 300say bolt seconds at 40°C and specific gravity is 0.915 at 15.5°C. The operating temperature of the oil is 75°C A clearance of 0.001mm per mm diameter. Also find the minimum film thickness. Assume suitable data. **(14 Marks)**

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