CBCS SCHEME

USN | | | | | | | | | |

17MT51

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Missing data, if any, may be suitably assumed.

Module-1

1 a. State and explain design considerations. **(10 Marks)**

b. Find the diameter of the hole, if the stress concentration factor at the hole is to be same as at the fillet. [Ref. Fig.Q1(b)]. **(10 Marks)**

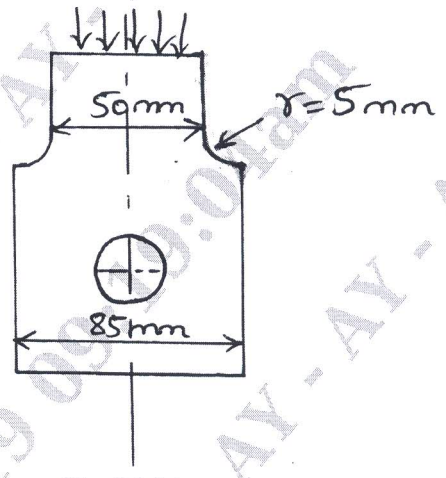

Fig.Q1(b)

OR

2 a. A mild steel shaft of 60mm diameter is subjected to a bending moment of 25×10^5N-mm and torque M_t. If the yield point of steel in tension is 230 N/mm^2, find the maximum value of this torque without causing yielding of the shaft according to :
i) Maximum principal stress theory
ii) Maximum shear stress theory
iii) Maximum distortion energy theory. **(10 Marks)**

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

Module-2

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

b. In a flange coupling used to connect two co-axial shafts of diameter 80mm to transmit 60kW at 200rpm, 6 bolts of M14 × 1.5 are used on a bolt circle diameter of 240mm. The hub diameter is 150mm and flange thickness is 20mm. Determine,

i) Shear stress induced in shaft if $\eta = 0.75$
ii) Shear stress induced in bolt
iii) Shear stress induced in key if allowable bearing stress on the key is 80 MPa
iv) Shear stress induced in flange. **(10 Marks)**

OR

4 a. Design a knuckle joint to connect two mild steel rods subjected to an axial pull of 150 kN. The allowable stresses for rods and pin are 80Mpa, 120MPa and 40MPa in tension crushing and shear respectively. The bending of the pin is prevented by selection of proper fit. **(10 Marks)**

b. A flexible coupling is used to transmit 15 KW power at 100 rpm. 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 35 MPa and 152 MPa 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)**

Module-3

5 A shaft is supported by two bearings 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 a motor placed horizontally to the right. The angle of contract of the pulley is 180° and the co-efficient of friction between the belt and the pulley is 0.3. Find the diameter of the shaft. Assume $C_m = 3.0$, $C_t = 2.5$, $\sigma_{yt} = 190$MPa and $\sigma_{ut} = 300$Mpa. **(20 Marks)**

OR

6 A steel solid shaft 1m long supported between two bearings. The pinion having 40 teeth of 5mm module is located 200mm to the right of the left bearing and receivers 20kN power at 1000 rpm from a gear mounted directly below it. Another gear having 50 teeth of 8mm module is located at a distance of 400mm to the left of the right bearing and delivers power to another gear mounted directly behind it. The shaft rotates clockwise as seen from the left bearing. If the shaft material has an ultimate strength of 500MPa and a yield point of 310MPa. Determine the diameter of the shaft. The combined shock and fatigue factor for bending and twisting are 2 and 1.5 respectively. The gears are 14½° involutes tooth form. **(20 Marks)**

Module-4

7 A pair of carefully cut gears with 20° full depth involute profile is used to transmit 8kW at 900 rpm of the pinion. The transmission ratio required is 4 and the pinion has 20 teeth. Take allowable static stress $\sigma_d = 103$ N/mm^2. Also assume service factor $C_S = 2$ and load stress factor $K = 1.893$ check the gear for wear. Assume face width as 10 times the module. **(20 Marks)**

OR

8 A pair of helical gears are used to transmit 75KW at a pinion speed of 1200rpm. The gear has to rotate at 400 rpm. The loading may be assumed as medium shock 8–10 hrs per day and gears are manufactured by gear hobbing process. Both gears are made up of steel material with σ_d = 240MPa. Face width can be assumed as 15mm. Determine module, face width, number of teeth and suggest suitable hardness. Assume tooth profile as 20°FDI and the helix angle as 23°. Take wear and lubrication factor C_W = 1.15, consider minimum number of teeth on pinion as Z_1 = 18 teeth with class II accuracy. **(20 Marks)**

Module-5

9 a. Briefly explain the classification of bearings. **(10 Marks)**

b. A 75mm long full journal bearing of diameter 75mm supports a radial load of 12kN at the shaft speed of 1800 rpm. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 pas at the operating temperature. Determine the following :

i) Sommerfeld number

ii) The co-efficient of friction based on Mckee equation

iii) Amount of heat generated. **(10 Marks)**

OR

10 a. 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. **(10 Marks)**

b. Briefly explain the following :

i) Minimum oil film thickness

ii) Co-efficient of friction in bearings

iii) Bearing materials. **(10 Marks)**

* * * * *