CBCS SCHEME

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

17MT51

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Design of Machine Elements

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Machine Design and explain the Design procedure. **(10 Marks)**

b. List the factors which govern the selection of a material for a machine component. **(05 Marks)**

c. Briefly discuss three dimensional stress field and stress sensor. **(05 Marks)**

OR

2 a. A rod of circular section is to sustain a torsional moment of 300kN-m and bending moment 200kN-m selecting C_{45} steel (σ_{yt} = 353MPa) and assuming factor of safety is 3. Determine the diameter of rod as per following theories of failure.

i) Maximum shear stress theory

ii) Distortion energy theory. **(12 Marks)**

b. A notched flat plate as shown in Fig.Q.2(b) is subjected to bending moment of 10Nm. Determine the maximum stress induced in the member by taking the stress concentration into account.

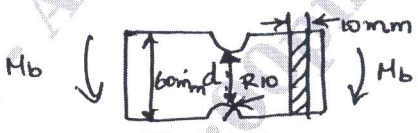

Fig.Q.2(b)

(08 Marks)

Module-2

3 a. Define key and with sketch, explain 2 types of keys. **(08 Marks)**

b. Design a square key for a gear shaft of diameter 25mm, 20kW power at 1000rpm is transmitted from the shaft to the gear. The yield strength of key material in tension is 450MPa and the factor of safety is 3. The yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimension of the key. **(12 Marks)**

OR

4 Design a socket and spigot type cotter joint to sustain an axial load of 100kN. The material selected for the joint has the following stresses. σ_t = 100N/mm^2, σ_c = 150N/mm^2 and τ = 60N/mm^2. **(20 Marks)**

Module-3

5 A horizontal piece of commercial shafting is supported by two bearing 1.5m apart. A keyed gear 20° involute and 175mm in diameter is located 400mm to the left of the right bearing and is driven by a gear directly behind it. A 600mm diameter pulley is keyed to the shaft 600mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1. With the slack side on top. The drive transmits 45kW at 330rpm. Take $k_b = k_t$ = 1.5. Calculate the necessary diameter of the shaft and angular deflection in degrees. Use allowable shear stress 40MPa and G = 80 × 10^9 N/mm^2. **(20 Marks)**

OR

6 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 a motor placed horizontally to the right. The angle of contact of the pulley is 180° and $\mu = 0.3$. Find the diameter of the shaft. Assume $C_m = 3.0$, $C_t = 2.5$, $\sigma_y = 190$MPa and $\sigma_{ut} = 300$MPa. **(20 Marks)**

Module-4

7 Design a pair of spur gears to transmit 20kW from a shaft rotating at 1000rpm to a parallel shaft which is to rotate at 310rpm. Assume number of teeth on pinion 31 and 20° full depth tooth form. The material for pinion is C45 steel untreated and for gear cast steel 0.20% C untreated. **(20 Marks)**

OR

8 Design a pair of helical gear to transmit 12kW at 2400rpm of pinion. The velocity ratio required is 4:1, Helix angle is 23°. The centre distance is to be around 300mm, pressure angle in the normal plane is 14½ involute. Pinion material is cast steel ASTM class B. Gear material is cast iron better grade. **(20 Marks)**

Module-5

9 a. Derive Petroff's equation for coefficient of friction for hydrodynamic bearing. State the assumption. **(10 Marks)**

b. Explain the mechanism of hydrodynamic lubrication in journal bearing. **(10 Marks)**

OR

10 Design the main bearing for a stationary slow speed steam engine for the following data: Journal diameter = 200mm, Maximum load on the Piston = 80kN, Engine speed = 200rpm. **(20 Marks)**

* * * * *