USN | | | | | | | | | |

17MT51

Fifth Semester B.E. Degree Examination, July/August 2022
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. Explain Rankine's theory and Guest's theory of failure. **(10 Marks)**

OR

2 a. Define stress concentration and mention the principal cause of stress raisers. **(06 Marks)**
   b. Mention any two methods of reducing stress concentration. **(04 Marks)**
   c. A grooved shaft is to transmit 5kwat 120rpm. Determine the diameter of the shaft at the groove if it is made of C15 steel (σ_y = 235.4MPa). Factor of safety is 2.

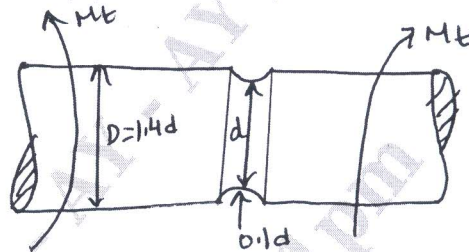Fig.Q.2(c) **(10 Marks)**

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 shaft is supported by two bearings placed 1m apart. A 500mm diameter pulley is mounted at a distance of 200mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3000N. The pulley weighs 1000N. Another pulley 300mm diameter is placed 300mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from the left bearing. This pulley weighs, 500N. The angle of contact for both the pulleys is 180° and μ = 0.24. Determine suitable diameter for a solid shaft, assuming torque on one pulley is equal to torque on other pulley. Choose (15 steel /σ_y = 235.4MPa, σ_u= 425MPa) as the shaft material and use ASME code for the design of shaft. Assume minor shock condition. **(20 Marks)**

OR

6   A solid steel shaft running at 600rpm is supposed on bearings 600mm apart. The shaft receives 40KW through a 400mm diameter pulley weighing 400N located 300mm to the right of left bearing by a vertical flat belt drive. The power is transmitted from the shaft through another pulley of diameter 600mm weighing 600N located 200mm to the right of right bearing. The belt drives are at right angles to each other and ratio of belt tension is 3. Determine the size of shaft necessary, if the allowable shear stress in the shaft material is 40MPa and the loads are steady.   **(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 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)**

* * * * *