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Fifth Semester B.E. Degree Examination, Aug./Sept.2020
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. **(10 Marks)**

Fig.Q.2(c)
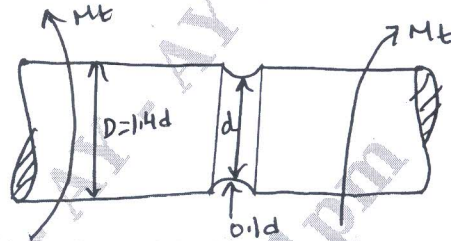
Module-2

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

OR

4 Design a flange coupling to connect the shafts of a motor and centrifugal pump for the following specifications:
Pump output = 3000litres/minute, total head = 20m, pump speed = 600rpm, pump efficiency = 70%, select C40 steel (σ_y = 328.6MPa) for shaft and C35 steel (σ_y = 304MPa) for bolts with factor of safety 2. Use allowable shear stress in cast iron flanges equal to 15N/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 weights 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 torque pulley. Choose C15 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 machine shaft turning at 600rev/min is supported on bearings 750mm apart 15kW is supplied to the shaft through a 450mm pulley located 250mm to the right to right bearing. The power is transmitted from the shaft through a 200mm spur gear located 250mm to the right of the left bearing. The belt drive d is at an angle of 60° above the horizontal. The pulley weights 800N to provide fly wheel effect. The ratio of belt tensions is 3:1. The gear has a 20° tooth form and mesh with another gear located directly above the shaft. If the shaft material selected has an ultimate strength of 500MPa and a yield point of 310MPa. Determine the necessary diameter using $K_b = 1.5$ and $K_t = 1.0$.   **(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. With assumptions. Derive Petroff's equation.   **(08 Marks)**
     b. Mention any five important properties of lubricant.   **(04 Marks)**
     c. 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.   **(08 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)**

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