CBCS SCHEME

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15MA54

Fifth Semester B.E. Degree Examination, June/July 2019
Elements of Machine Design

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Design data book is permitted.

Module-1

1 a. What are important properties of materials that are to be considered while selecting a material? **(08 Marks)**

b. A plate of C45 steel (σ_{yt} = 353 MPa) is subjected to the following stresses, σ_x = 150 N/mm^2, σ_y = 100N/mm^2 and τ_{xy} = 50N/mm^2. Find the factor of safety by
i) Maximum principal stress theory
ii) Maximum shear stress theory
iii) Hencky Mises theory. **(08 Marks)**

OR

2 a. What is stress concentration factor? What are the methods to determine stress concentration factors? **(08 Marks)**

b. An unknown weight falls through 20mm on to a collar rigidly attached to the lower end of a vertical bar 2m long and 500sq.mm section. If the maximum instantaneous extension is known to be 2mm. what is the corresponding stress and the value of the unknown weight. Take E = 200GPa. **(08 Marks)**

Module-2

3 a. Explain stress versus number of cycles (S-N) curve for ferrous and non-ferrous metal with the aid of experimental sketch and characteristics curve. **(08 Marks)**

b. A steel member of circular section is subjected to a torsional stress that varies from 0 to 35 MPa and at the same it is subjected to an axial stress that varies from −14MPa to +28MPa. Neglecting stress concentration and column effect and assuming that maximum stresses in torsion and axial load occur at the same time, determine :
(i) maximum equivalent shear stress
(ii) factor of safety based upon yield in shear.
The material has an endurance limit σ_{-1} = 206MPa and an yield strength σ_y = 480MPa. The diameter of the member is less than 12mm. Take load correction factor = 1. Surface correction factor = 1. **(08 Marks)**

OR

4 A machine shaft turning at 600rpm is supported on bearings 750mm apart. 15kW is supplied to the shaft through a 450mm pulley located 250mm to the 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 is at an angle of 60° above the horizontal. The pulley weights 800N to provide some flywheel effect. The ratio of belt tension 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_f = 1. **(16 Marks)**

Module-3

5 Design a pair of spur gears to transmit a power of 18kW from a shaft running at 1000rpm to a parallel shaft to be run at 250rpm maintaining a distance of 160mm between the shaft centers. Suggest suitable surface hardness for the gear pair. **(16 Marks)**

OR

6 Design a pair of bevel gears to transmit a power of 25kW from a shaft rotating at 1200 rpm to a perpendicular shaft to be rotated at 400rpm. **(16 Marks)**

Module-4

7 a. Design a sleeve type cotter joint to connect two tie rods subjected to an axial pull of 60kN. The allowable stress of C30 material used for the rods and cotters are σ_t = 65 N/mm^2, σ_c = 75N/mm^2, τ = 35 N/mm^2. Cast steel used for the sleeve has the allowable stresses, σ_t = 70N/mm^2, σ_c = 110 N/mm^2 and τ = 45N/mm^2. **(10 Marks)**

b. A rectangular sunk key 14mm wide × 10mm thick × 75mm long is required to transmit 1200 N-m torque from a 50mm diameter solid shaft. Determine whether the length is sufficient or not if the permissible shear stress and crushing stress are limited to 56MPa and 168MPa respectively. **(06 Marks)**

OR

8 Design a pin type flexible coupling to transmit 10kW at 500rpm. Assume C40 Steel as shaft, bolt (pin) and key material (σ_y = 328.6MPa) and C.I. as flange and hub material (σ_{ut} = 124.5MPa). **(16 Marks)**

Module-5

9 a. Derive Petroff's equation for co-efficient of friction for hydro dynamic bearing. **(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. **(08 Marks)**

OR

10 Design a journal bearing for a centrifugal pump running at 1200rpm. Diameter of journal is 100mm and load on bearing is 15kN. Take L/d = 1.5, bearing temperature 50°C and ambient temperature 30°C. Find whether artificial cooling is required. **(16 Marks)**

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