B.E/B/TECH. Degree Examination, December 2020

Fifth Semester

ME16503 Design of Machine Elements

(Regulation 2016)

Time: Three hours Maximum : 80 Marks

(Use of Approved Design Data Book is permitted)

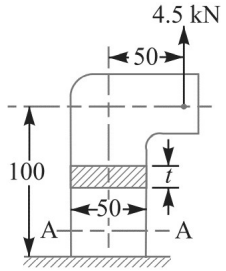
Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. A point of a body is subjected to plane stress. The value of maximum and minimum principal stresses are –20 MPa and –100 MPa respectively. The design is to be done on the basis of the maximum shear stress theory. Then yielding will just begin if the designer chooses a ductile material whose yield strength (MPa) is
   (A) 40 (B) 60
   (C) 120 (D) 80
2. In riveted joints, why are butt joints preferred overlap joints for heavy load transmission?
   (A) Due to the couple formed by forces in lap joints.
   (B) Due to the caulking in lap joints.
   (C) Due to the fullering in butt joints.
   (D) Due to the couple formed by forces in butt joints.
3. Torsional shear stresses are induced in the spring wire when
   (A) spring is under compression
   (B) spring is under tension
   (C) both (A) and (B)
   (D) none of the above
4. A journal bearing of diameter 5 cm and length 50 cm carriers a load of 250 kN. The average bearing pressure in (kN/cm^2) will be
   (A) 12.73
   (B) 10.2
   (C) 4 .3
   (D) 7.7
5. List out the factors affecting endurance strength
6. What is the effect of keyway cut in to the shaft?
7. Differentiate between single start and double start thread
8. Why flywheel is used in punching or shearing machine?

PART B - (4 X16 = 64 marks)

09. (a) A steel bracket is subjected to a load of 4.5 kN, as shown in Fig. 9a. Determine the required thickness of the section at A-A in order to limit the tensile stress to 70 MPa. **(16)**



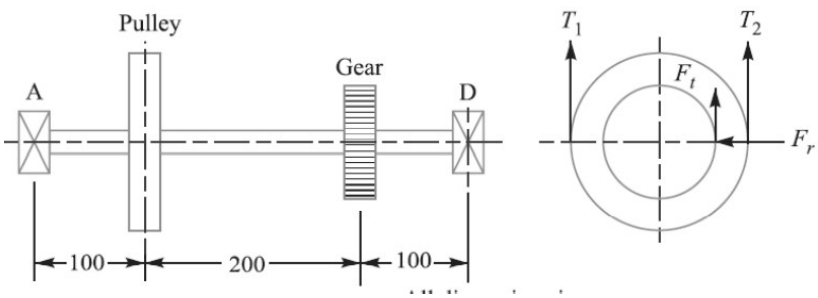
All dimensions in mm -Figure 9a

(OR)

(b) A cold drawn steel rod of circular cross-section is subjected to a variable bending moment of 565 N-m to 1130 N-m and as the axial load varies from 4500 N to 13 500 N. The maximum bending moment occurs at the same instant that the axial load is maximum. Determine the required diameter of the rod for a factor of safety 2. Neglect any stress concentration and column effect. consider the following values: **(16)**

Ultimate strength = 550 MPa Yield strength = 470 MPa, Size factor = 0.85, Surface finish factor = 0.89, Load correction factors 1.0 for bending and 0.7 for axial load. The endurance limit in reversed bending may be taken as one-half the ultimate strength.

10. (a) A shaft made of steel receives 7.5 kW power at 1500 r.p.m. A pulley mounted on the shaft as shown in Fig.10a has ratio of belt tensions 4. The gear forces are as follows: Tangential force F_t = 1590 N; Radial force F_r = 580 N. Design the shaft diameter by maximum shear stress theory. The shaft material has the following properties: Ultimate tensile strength = 720 MPa; Yield strength = 380 MPa; Factor of safety = 1.5. **(16)**



All dimensions in mm – Figure 10a

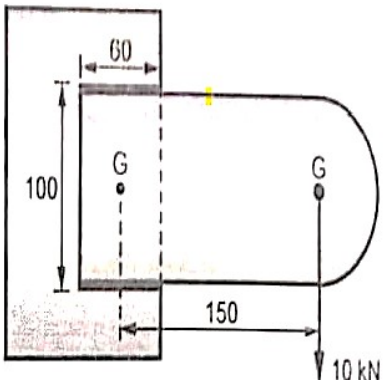
(OR)

(b) Design a cast iron protective type flange coupling to transmit 20 kW power at 250 r.p.m. from an electric motor to a compressor. The maximum torque is 25% greater than the full load torque. The permissible stresses are as follows: The Allowable shear stress for shaft and key is 40 MPa, The Allowable shear stress for bolts is 30 MPa, The Allowable crushing stress for shaft and key is 80MPa, The Allowable shear stress for cast iron flange is 14 MPa. After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. **(16)**

11 (a) Design a helical compression spring from the following data: Minimum load is 100 N, Maximum load is 225.6 N, Compression of spring is 10 mm. Take spring index of 5 and Consider Wahl's stress factor effect. Permissible shear stress for spring material is 440 MPa. Prefer the Spring end as square and ground ends. The Modulus of rigidity for the spring material is 0.80 X 10^5 MPa. Draw a neat sketch of the spring and indicate the main dimensions. **(16)**

(OR)

(b) A bracket shown in Fig11b Carries a load of 10KN. If permissible shear stress in the weld is 80 MPa. Find size of the weld **(16)**



All dimensions in mm – Figure 11b

12. (a) (i) A design of a journal bearing results in a diameter of 75 mm and a length of 125 mm for supporting a load of 20 kN. The shaft runs at 1000 rpm. The bearing surface temperature is not to exceed 75°C in a room temperature of 35°C. The oil used has an absolute viscosity of 0.01 kg/m-s at the operating temperature. Determine the heat generated, heat dissipated and the amount of artificial cooling required in watts. Take the ratio of diameter of the journal to diametral clearance as, d/c = 1000 **(12)**

(ii) List out the desirable properties of lubricating oil used in slider bearing applications **(04)**

(OR)

(b) (i) A single row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life of the bearings is20000 hours. The minimum acceptable diameter of the shaft is 75mm. select a suitable ball bearing for this application. **(12)**

(ii) State the applications of rolling contact bearings **(04)**