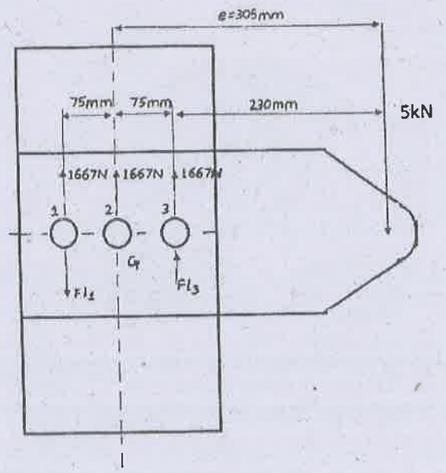
(b) A roller bearing is to be selected to withstand a radial load of 4000 N and have an L_{10} life of 1200 hours at a speed of 600 rpm.

(i) What is the basic dynamic load rating of the bearing to be selected?

(ii) If the reliability requirement is 99%, what load rating would be used? Take $b = 1.17$ and $V = S = 1$. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A steel plate is subjected to a force of 5 kN and fixed to a channel by means of 3 identical bolts as shown in figure. The bolts are made from plain carbon steel for which yield stress in tension is 380 N/mm² and factor of safety is 3. Determine the size of the bolts. (15)



Or

(b) A 50 mm wide, 5 mm high rectangular plate has 5 mm diameter central hole. The allowable tensile stress is 700 MPa. Find (i) The maximum tensile force that can be applied (ii) the maximum bending moment that can be applied to reach the maximum stress (iii) the maximum tensile force and the maximum bending moment if the hole is not present. Express the results as a ratio when compared to parts (i) and (ii). (15)

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13/12/18

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20814

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth/Fifth/Sixth Semester

Mechanical Engineering

ME 6503 — DESIGN OF MACHINE ELEMENTS

(Common to Mechanical Engineering (Sandwich)/Automobile Engineering/ Industrial Engineering/Mechanical and Automation Engineering/ Mechatronics Engineering)

(Regulations 2013)

(Also Common to PTME 6503 — Design of Machine Elements for B.E. (Part-Time) Fourth Semester – Mechanical Engineering – Regulations 2014)

Time : Three hours Maximum : 100 marks

(Usage of approved design data book is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define shock factor and what does it indicate.

2. Distinguish hardness and toughness.

3. Differentiate between rigid and flexible couplings.

4. List the different types of sunk keys and draw any one.

5. State the disadvantages of welded joints.

6. What is known as "bolt of uniform strength"?

7. While designing helical springs, K is introduced in the shear stress equation, why?

8. What is nipping in leaf springs?

9. List the advantages of hydrostatic bearings.

10. Give two applications where the inner race is rotating and outer race is stationary in rolling contact bearings.

PART B — (5 × 13 = 65 marks)

11. (a) A hypothetical machine member by 50 mm in diameter and 250 mm long is supported in one end as cantilever is subjected to various types of loadings, as given below. Find the principal stresses and maximum shear stress in each case.

(i) Axial load 15 kN. (2)

(ii) Transverse load 3 kN at the free end. (2)

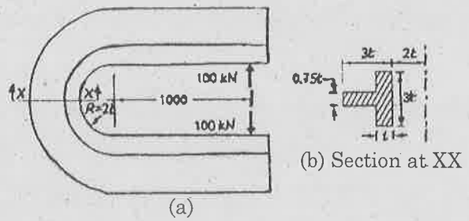
(iii) Twisting moment of 1 kNm at the free end, clockwise, while viewing from free end side. (2)

(iv) (i) and (ii) together. (3)

(v) (i) (ii) and (iii) together. (4)

Or

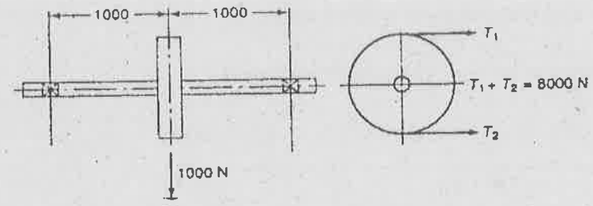
(b) The C-frame of a 100 kN capacity press is shown in fig. The material of the frame is gray cast iron FG 200 and the factor of safety is 3. Determine the dimensions of the frame. (13)



(b) Section at XX

(a)

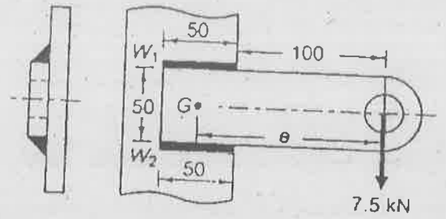
12. (a) A section of commercial shafting 2 m long between bearings carries a 1000 N pulley at its mid point, as shown in fig. The pulley is keyed to the shaft and receives 30 kW at 150 rev/min which is transmitted to a flexible coupling just outside the right bearing. The belt drive is horizontal and some of the belt tensions is 8000 N. Assume $K_t = K_b = 1.5$. Calculate the necessary shaft diameter and determine the angle of twist between bearings. $G = 80$ GN/m^2. (13)



Or

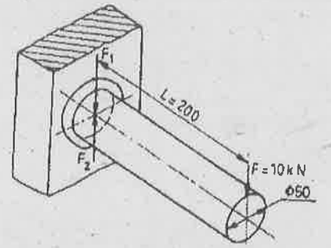
(b) A shaft made of AISI 1030 cold drawn steel transmits 50 kW at 900 rpm through a gear. Select an appropriate square key for the gear. (13)

13. (a) A welded connection, as shown in fig. below, is subjected to an eccentric force of 7.5 kN. Determine the size of welds if the permissible shear stress for the weld is 100 N/mm^2. Assume static conditions. (13)



Or

(b) The Figure below shows a cylindrical rod of 50 mm diameter, welded to a flat plate. The cylindrical fillet weld is loaded eccentrically by a force of 10 kN acting at 200 mm from the welded end. If the size of the weld is 20 mm, determine the maximum normal stress in the weld. (13)



14. (a) Design a helical compression spring to sustain an axial load of 3 kN. The deflection is 60 mm. Spring index is 6. The shear stress is not to exceed 300 MPa. Rigidity modulus for spring material is 81 GPa. (13)

Or

(b) At the bottom of a mine shaft, a group of 10 identical close coiled helical springs are set in parallel to absorb the shock caused by the falling of the cage in case of a failure. The loaded cage weighs 75 kN, while the counter weight has a weight of 15 kN. If the loaded cage falls through a height of 50 meters from rest, find the maximum stress induced in each spring if it is made of 50 mm diameter steel rod. The spring index is 6 and the number of active turns in each spring is 20. Modulus of rigidity, $G = 80$ kN/mm^2. (13)

15. (a) A 100 mm diameter full journal bearing supports a radial load of 5000 N. The bearing is 100 mm long and operates at 400 rpm. Permissible min film thickness 25 micron. Diametral clearance 152 microns. Using Raimond & Boyd curves find (i) viscosity of suitable oil (ii) μ (iii) heat generation rate (iv) amount of oil pumped through bearing (v) amount of end leakage (vi) rise in temperature of oil. (13)

Or