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B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

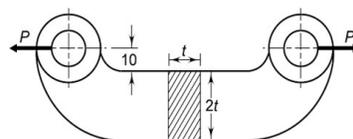
Fifth Semester

ME16503 – DESIGN OF MACHINE ELEMENTS*(Common to AE and ME)***(Regulation 2016)****Time: Three Hours****Maximum : 100 Marks***(Use of Approved Design Data Book is permitted)*Answer **ALL** questions**PART A - (10 X 2 = 20 Marks)**

	CO	RBT
1. What are unilateral and bilateral tolerances?	1	U
2. Define the terms stress concentration and stress concentration factor.	1	U
3. Why hollow shaft has greater strength and stiffness than solid shaft of equal weight ?	2	AP
4. What is key? State its functions.	2	U
5. What are the initial stresses induced in a bolt when it is screwing up tightly?	3	U
6. How is a bolt designated? Give example.	3	U
7. Distinguish between close coiled and open coiled springs.	4	U
8. Define the term co-efficient of fluctuation of speed in case of flywheel.	4	U
9. What is known as self – acting bearing?	5	U
10. Define dynamic load carrying capacity of rolling contact bearing.	5	U

PART B - (5 X16 = 80 Marks)

11. (a) An offset link subjected to a force of 25 kN is shown in Fig.11a It is made of grey cast iron FG300 with a Ultimate tensile strength of 300 N/mm^2 and the factor of safety is 3. Determine the dimensions of the cross-section of the link. **(16)**

**Figure11a****(OR)**

- (b) A circular bar of 500 mm length is supported freely at its two ends. (16) 1 AN
It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given by : ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.
12. (a) A horizontal nickel steel shaft rests on two bearings, A at the left and (16) 2 E
B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure $(F_t)_C$ of the gear C and $(F_t)_D$ of the gear D act vertically downwards. Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gears C and D weighs 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively.

(OR)

- (b) Design a protective type of cast iron flange coupling for a steel shaft (16) 2 E
transmitting 15 kW at 200 rpm. and having an allowable shear stress of 40 MPa. The allowable stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key. Consider that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The allowable shear stress of cast iron flange is 14 MPa. After designing the various elements, make a neat sketch of the assembly indicating the important dimensions.

13. (a) A bracket carrying a load of 15 kN is to be welded as shown in Fig13a. Find the size of weld required if the allowable shear stress is not to exceed 80 MPa (16) 3 AN

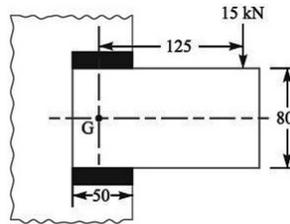


Figure13a

(OR)

- (b) A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing, find the minimum force per pitch which will rupture the joint. If the above joint is subjected to a load such that the factor of safety is 4, find out the actual stresses developed in the plates and the rivets. (16) 3 AN
14. (a) A multi-cylinder engine is to run at a constant load at a speed of 600 rpm on drawing the crank effort diagram to a scale of 1 m = 250 N-m and 1 mm = 3°, the areas in sq mm above and below the mean torque line are as follows: (16) 4 AP
- + 160, - 172, + 168, - 191, + 197, - 162 sq mm
- The speed is to be kept within $\pm 1\%$ of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine suitable dimensions for cast iron flywheel with a rim whose breadth is twice its radial thickness. The density of cast iron is 7250 kg/m³ and its working stress in tension is 6 MPa. Assume that the rim contributes 92% of the flywheel effect.
- (OR)
- (b) A safety valve, 50 mm in diameter, is to blow off at a pressure of 1.5 MPa. It is held on its seat by means of a helical compression spring, with an initial compression of 25 mm. The maximum lift of the valve is 10 mm. The spring index can be taken as 6. The spring is made of patented and cold-drawn steel wire with ultimate tensile (16) 4 AP

strength of 1500 N/mm^2 and modulus of rigidity of 81.4 KN/mm^2 . The permissible shear stress for the spring wire should be taken as 30% of the ultimate tensile strength. Design the spring and calculate: (i) wire diameter; (ii) mean coil diameter; (iii) number of active turns; (iv) total number of turns; (v) solid length; (vi) free length; and (vii) pitch of the coil. Draw a neat sketch of the free spring showing the main dimensions.

15. (a) The load on a 100 mm full hydro dynamic journal bearing is 9000N (16) 5 AP and speed of the journal is 320 rpm. Let $l/d=1$, $c/d= 0.0011$. The operating temperature = 65°C and minimum oil film thickness = 0.022 mm

(i) Select oil that will closely accord with stated conditions. For the selected oil, determine (ii) the friction loss (iii) the hydrodynamic oil flow through the bearings (iv) the temperature rise of the oil passes through the bearings (v) maximum oil pressure.

(OR)

- (b) Select a single row deep groove ball bearing for a radial load of (16) 5 AP 4000 N and an axial load of 5000 N, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load.