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Question Paper Code : X67645

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020

Fifth Semester

Mechanical Engineering

ME 1302 – DESIGN OF MACHINE ELEMENTS

(Regulations 2008)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

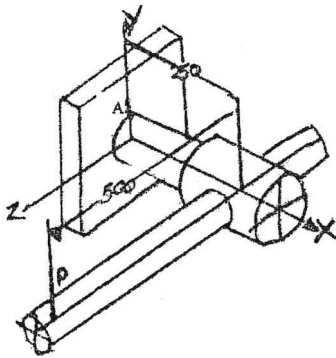
1. Why is maximum principal stress theory applicable to design a component made up of brittle material ?
2. Write the bending equation for a beam which is simply supported at its ends applied with vertical transverse loads and hence write the equation for maximum stress developed due to bending.
3. What are the various types of stresses induced in shaft ?
4. What is rigid coupling ? Give examples.
5. Why are square threads preferable to V-threads for power transmission ?
6. What are the assumptions made in the design of welded joint ?
7. List out the advantages of helical springs.
8. When do we use Belleville springs ?
9. What is meant by hydrodynamic lubrication ?
10. In what way does a flywheel differ from that of a governor ?



PART – B

(5×16=80 Marks)

11. a) i) Explain the following with mathematical expressions. Maximum Principal stress theory, Maximum distortion energy theory. (6)
- ii) The shaft of an overhang crank subjected to a force P of 1.2 kN is shown in Fig. 1. The shaft is made of plain carbon steel 45 C 8 and the tensile yield strength is 350 N/mm^2 . The factors of safety is 2. Determine the diameter of the shaft using the maximum shear stress theory. (10)

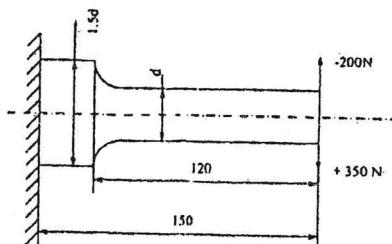


All dimensions are in 'mm'

Fig.1

(OR)

- b) A cantilever rod of circular section is subjected to a cyclic transverse load, varying from -200 N to $+350 \text{ N}$, as shown in Fig. 2. Determine the diameter, d of the rod, by
- i) Goodman method and (6)
- ii) Soderberg method using the following : Factor of safety = 2 ; Theoretical stress concentration factor = 1.5 ; Notch sensitivity factor = 0.85 ; Ultimate strength = 560 MPa; Yield strength = 300 MPa; Endurance limit = 260 MPa ; Size correction factor = 0.8 ; Surface correction factor = 0.88. (10)



All dimensions are in 'mm'

Fig. 2



12. a) A shaft made of mild steel is required to transmit 100 KW at 300 rpm. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 1500 N supported at a distance of 1 metre from the ends respectively. Assuming the safe value of shear stress is 60 N/mm^2 . Determine the diameter of the shaft. (16)

(OR)

- b) Design a Knuckle joint to transmit 150 KN. The design stress may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. (16)

13. a) A welded connection shown in Fig. Q 13 (a) is subjected to an eccentric force of 60 kN in the plane of the welds. Determine the size of the welds, if the permissible shear stress for the weld is 100 MPa. Assume static conditions.

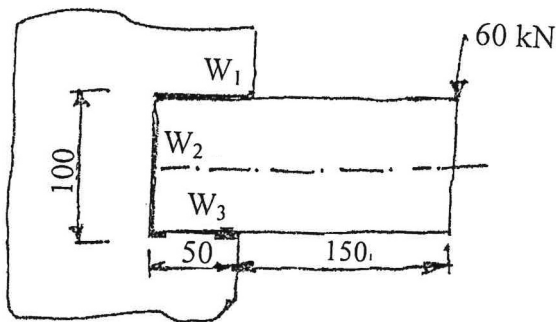


Fig.Q. 13 (a)

W_1, W_3 – Horizontal

W_2 –vertical weld

Note : All dimensions are in ‘mm’

(OR)

- b) A steam engine of effective diameter 300 mm is subjected to a steam pressure of 2 MPa. The cylinder head is connected by 4 bolts having yield stress 350 MPa and endurance limit is 260 MPa. The bolts are tightened with an initial preload of 1.6 times the steam load. A soft copper gasket is used to make the joint leak proof. Assuming a factor of safety 2.5, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.65.

14. a) A helical valve spring is to be designed for an Operating load range of 90 N to 135 N. The deflection of the spring for this load range is 7.5 mm assuming a spring index of 10, a permissible shear stress of 480 N/mm^2 and a modulus of rigidity of $0.8 \times 10^5 \text{ N/mm}^2$ for the material, determine the dimensions of the spring.

(OR)



- b) i) A Belleville spring is made of 5 mm sheet metal steel with an outside diameter of 120 mm and the diameter ratio as 3. The spring is dished 6 mm the maximum stress produced at the inner edge is 550 N/mm^2 . Determine (1) The deflection (2) The load that may be safety carried (3) Check the stress produced at the outer edge. **(10)**
- ii) Explain the various steps to be followed for designing lever. **(6)**
15. a) i) Explain the function of a flywheel in an IC Engine. **(6)**
- ii) A cast iron pulley transmits 9 kW at 480 rpm. The pulley is 1 m diameter and has 4 arms of elliptical cross section with major axis twice minor axis. Determine the dimensions of the arms if the permissible bending stress is 15 N/mm^2 . **(10)**
- (OR)
- b) i) What are the guidelines to select a proper type of bearing ? **(6)**
- ii) A ball bearing is to be used for a shaft whose speed is 400 rpm. The radial load on the bearing is 4000 N and the axial load is also 4000 N. The bearing is to have a life of 10000 hours at a reliability of 95%. Determine the dynamic capacity of the bearing. Take $b = 1.34$ in L/L'_{10} . Also assume F_a/C_o as 0.5. **(10)**
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