

B.Tech III Year I Semester (R20) Supplementary Examinations August 2023

DESIGN OF MACHINE MEMBERS

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

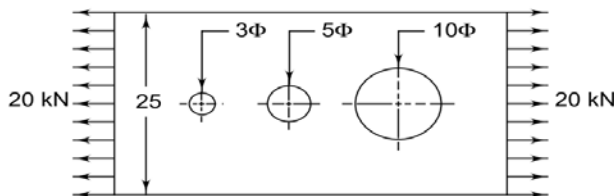
PART – A
(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- | | |
|--|----|
| (a) How will you account for stress concentration design of machine parts? | 2M |
| (b) What is fatigue stress concentration factor? | 2M |
| (c) What are the methods of preventing loosening of threads between the nut and the screw? | 2M |
| (d) What are the advantages of welded joints compared with bolted joints? | 2M |
| (e) What is the function of transmission shaft? | 2M |
| (f) What is the purpose of the rubber bush in bushed-pin flexible coupling? | 2M |
| (g) Why are clutches usually designed on the basis of uniform wear? | 2M |
| (h) State different types of brakes and give at least one practical application of each. | 2M |
| (i) What are the applications of sliding-contact bearing? | 2M |
| (j) What are the reasons for dynamic tooth loads in gears? | 2M |

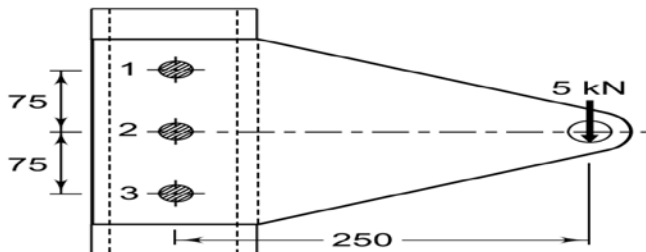
PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

- 2 A rectangular plate, 15 mm thick, made of a brittle material is shown in figure below. Calculate the stresses at each of three holes of 3, 5 and 10 mm diameter. 10M

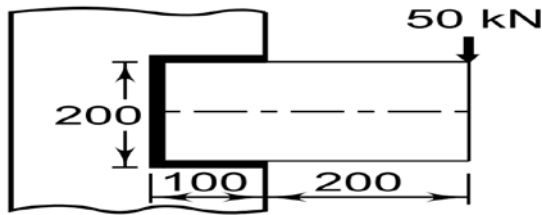
**OR**

- 3 A solid circular shaft, 15 mm in diameter, is subjected to torsional shear stress, which varies from 0 to 35 N/mm² and at the same time, is subjected to an axial stress that varies from -15 to +30 N/mm². The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of steel FeE 400 (Sut = 540 N/mm² and Syt = 400 N/mm²) and the corrected endurance limit of the shaft is 200 N/mm². Determine the factor of safety. 10M
- 4 A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in figure below. The bolts are made of plain carbon steel 30C8 (Syt = 400 N/mm²) and the factor of safety is 3. Determine the diameter of the shank. 10M

**OR**

Contd. in Page 2

- 5 A welded joint, as shown in Figure below. Is subjected to an eccentric load of 50 kN. Find the size of the weld, if the maximum shear stress in the weld is not to exceed 50 N/mm^2 . 10M



- 6 A transmission shaft is supported between two bearings, which are 750 mm apart. Power is supplied to the shaft through a coupling, which is located to the left of the left-hand bearing. Power is transmitted from the shaft by means of a belt pulley, 450 mm in diameter, which is located at a distance of 200 mm to the right of the left-hand bearing. The weight of the pulley is 300 N and the ratio of the belt tension of tight and slack sides is 2:1. The belt tensions act in vertically downward direction. The shaft is made of steel FeE 300 ($S_{yt} = 300 \text{ N/mm}^2$) and the factor of safety is 3. Determine the shaft diameter, if it transmits 12.5 kW power at 300 rpm from the coupling to the pulley. Assume ($S_{sy} = 0.5 S_{yt}$). 10M

OR

- 7 It is required to design a bushed pin type flexible coupling to connect the output shaft of an electric motor to the shaft of a centrifugal pump. The motor delivers 20 kW power to be assumed to be 150% of the rated torque. Design the coupling and specify the dimensions of its components. 10M

- 8 A simple band brake drum diameter 600 mm has a band passing over it with an angle of Contact 225° , while one end is connected to the fulcrum, the other end is connected to the brake lever at a distance of 400 mm from the fulcrum. The brake lever is 1000 mm long. The brake is to absorb a power of 15 kW at 720 rpm. Design the brake lever of Rectangular cross section, assume depth to be 3 times the width. Take allowable stress as 80 N/mm^2 assume $\mu = 0.3$. 10M

OR

- 9 A multi plate clutch has steel on bronze is to transmit 8 kW at 1440 rpm. The inner Diameter of the contact is 80 mm and the outer diameter of contact is 140 mm. The Clutch operates in oil with expected coefficient of friction 0.1, the average allowable Pressure 0.35 N/mm^2 . Assume uniform wear theory and determine the following Number of steel and bronze plates. Axial force required. 10M

- 10 Explain the mechanism of hydrodynamic journal bearing. A journal bearing 150 mm in diameter, 300 mm long carried a radial load of 9000 N at 1200 rpm. The radial clearance is 0.0375 mm. If 6 kW is wasted in friction, what is the viscosity of the oil being used at operating temperature. 10M

OR

- 11 A pair of carefully cut spur gear with 20° full depth in-volute profile is used to transmit 18 kW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 220 N/mm^2 . Determine the module, face width of spur pinion and gear. Suggest suitable hardness. Take 20 teeth on pinion. 10M

B.Tech III Year I Semester (R20) Regular & Supplementary Examinations January 2024

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PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- | | |
|--|----|
| (a) Write 7 essential steps in design process. | 2M |
| (b) How selection of materials is done in any design? | 2M |
| (c) Compare temporary joints and permanent joints with examples of each. | 2M |
| (d) List various stresses induced in the bolts. | 2M |
| (e) Define and compare shaft and coupling. | 2M |
| (f) List possible failures in shafts. | 2M |
| (g) Define clutch. List its types. | 2M |
| (h) Define leaf-spring with 2 important applications. | 2M |
| (i) What is sealing of bearings? | 2M |
| (j) What is Lewis equation used in gear design? | 2M |

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

- 2 Compare static and dynamic loading. What determines the allowable stress in designing for static loading of a machine? 10M

OR

- 3 Define factor of safety in design of machine elements. Discuss considerations for selection of factor of safety. 10M

- 4 What are bolted joints? List its application fields. Discuss Geometry and classification of various fasteners. 10M

OR

- 5 What are the assumptions in the design of welded joints? What factors must you consider when choosing a weld joint design? What are the problems with welded joints? 10M

- 6 A shaft carries a 900 N pulley in the centre of two ball bearings which are 1800 mm apart. The pulley is keyed to the shaft and receives 40 kW of power at 150 rpm. The power is transmitted from the shaft through a flexible coupling just outside the right bearing. The belt drive is horizontal and the sum of the belt tension is 8000 N. Calculate the diameter of the shaft if permissible stress in bending is 90 N/mm^2 and in shear it is 45 N/mm^2 . 10M

OR

- 7 A hollow shaft of diameter ratio is required to transmit 600 kW at 100 rpm, the maximum torque being 25% greater than mean. The shearing stress is not to exceed 65 MN/m^2 and twist in length of three metres is not to exceed 1.4 degrees. Determine the diameter of the shaft. Assume modulus of rigidity for shaft material as 84 GN/m^2 . 10M

- 8 State about various types of springs. Define Spring Buckling. Explain brief about fatigue loading of springs. 10M

OR**Contd. in Page 2**

9 Design a helical spring for a safety valve. The valve must blow off at a pressure of 1.2 MPa and should lift by 3 mm for 5% increase in pressure. The valve diameter is 55 mm. The max allowable shear stress is 400 MN/m^2 and the modulus of rigidity is $82.7 \times 10^3 \text{ MN/m}^2$. Take the spring index as 9. 10M

10 Write Reynold's equation for journal bearing. State its significance. State brief about factors affecting bearing life. 10M

OR

11 Design the journal bearing for a centrifugal pump from the following data: 10M
Load on the journal = 25 KN,
Speed on the journal = 600 rpm,
Ambient temperature = 25°C.
