

4E 4143

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B.Tech. IV Semester (Main/Back) Examination, May - 2018  
Mechanical Engg.  
4ME4 Design of Machine Elements - I  
AE, ME, PI

Time : 3 Hours

Maximum Marks : 80  
Min. Passing Marks : 26

Attempt any five questions, selecting one question from each unit. All Questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

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Unit - 1

- ✓ a) Discuss the following mechanical properties of the material: (4)
- i) Hardness
  - ii) Toughness
  - iii) Creep Strength
  - iv) Fatigue strength
- ✓ b) Discuss fits, types of fit and tolerance? Also discuss the shaft basis and hole basis system. (12)

OR

1. Write short note on followings: (16)
- a) Design consideration for casting.
  - b) Material selection.
  - c) Standardization and interchangeability.
  - d) BIS designation of Plain carbon steel.

Unit - II

2. a) Why gibs are used in a cotter joint? (4)  
b) Describe the design procedure of a gib and cotter joint with the help of neat sketch the use of single and double gib. (12)

OR

- 2 Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate tensile strength of the material of the tearing is 420 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6. (16)

Unit - III

3. a) What is lever? Discuss the first, second and third type of levers with neat sketch. (4)

- b) A cranked lever has the following dimensions:

Length of the handle = 300 mm

Length of the lever arm = 400 mm

Overhang of the journal = 100 mm

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If the lever is operated by a single person exerting a maximum force of 400 N at a distance of 1/3rd length of the handle from its free end, find:

- i) Diameter of the handle, (4)  
ii) Cross-section of the lever arm, and (2)  
iii) Diameter of the journal. (2)

The permissible bending stress for the lever material may be taken as 50 MPa and shear stress for shaft material as 40 MPa. (12)

OR

3. a) Discuss the nipping and camber in the leaf spring. (4)  
b) A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves and length of each leaf. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring. (12)

### Unit - IV

4. A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is  $180^\circ$  and  $\mu = 0.24$ . Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley. (16)

OR

4. A shaft is supported on bearings A and B, 800 mm between centres. A  $20^\circ$  straight tooth spur gear having 600 mm pitch diameter, is located 200 mm to the right of the left hand bearing A, and a 700 mm diameter pulley is mounted 250 mm towards the left of bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having  $180^\circ$  angle of wrap. The pulley also serves as a flywheel and weighs 2000 N. The maximum belt tension is 3000 N and the tension ratio is 3 : 1. Determine the maximum bending moment and the necessary shaft diameter if the allowable shear stress of the material is 40 MPa. (16)

### Unit - V

5. a) Discuss screw the initial stresses developed in fastening due to screwing up forces. (4)
- b) The cylinder head of a steam engine is subjected to a steam pressure of  $0.7 \text{ N/mm}^2$ . It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa. (12)

OR

5. A steam engine of effective diameter 300 mm is subjected to a steam pressure of  $1.5 \text{ N/mm}^2$ . The cylinder head is connected by 8 bolts having yield point 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5. (16)