

**R16**

Code No: 136BA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, December - 2019

DESIGN OF MACHINE MEMBERS - II

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 75

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

(25 Marks)

- 1.a) What is thick film lubrication? [2]
- b) What is bearing characteristic number as applied to the journal bearing? [3]
- c) What is rolling-contact bearing? What are the applications of rolling-contact bearing? [2]
- d) Differentiate ball bearings and roller bearings with neat sketches. [3]
- e) What is an internal combustion engine? [2]
- f) What are the forces acting on the connecting rod? [3]
- g) What is surge of spring? [2]
- h) Why is the cross-section of the pulley an elliptical arm? Why is the major axis of the cross-section in the plane of rotation? [3]
- i) State two important reasons for adopting involute curve for gear tooth profile. [2]
- j) Compare the contact between mating teeth of spur and helical gears. [3]

**PART - B**

(50 Marks)

2. Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor  $ZN/p$  may be taken as 28 for centrifugal pump bearings. The bearing is running at  $75^{\circ}\text{C}$  temperature and the atmosphere temperature is  $30^{\circ}\text{C}$ . The energy dissipation coefficient is  $875 \text{ W/m}^2/^{\circ}\text{C}$ . Take diametral clearance as 0.1 mm. [10]

**OR**

- 3.a) State any two advantages of hydrostatic bearings over hydrodynamic bearings.
- b) State any four desirable properties of a good bearing material. [5+5]

4. A rolling contact bearing is subjected to the following work cycle :  
(a) Radial load of 6000 N at 150 r.p.m. for 25% of the time; (b) Radial load of 7500 N at 600 r.p.m. for 20% of the time; and (c) Radial load of 2000 N at 300 r.p.m. for 55% of the time. The inner ring rotates and loads are steady. Select a bearing for an expected average life of 2500 hours. [10]

**OR**

- 5.a) Explain types of bearing failure.
- b) Explain lubrication of rolling contact bearings. Also compare the advantages of oil with grease as lubricant. [4+6]

6. The following data is given for a four-stroke diesel engine:  
 Cylinder bore = 250 mm, Length of stroke = 300 mm, Speed = 600 rpm, Indicated mean effective pressure = 0.6 MPa, Mechanical efficiency = 80%, Maximum gas pressure = 4 MPa, Fuel consumption = 0.25 kg per BP per h, Higher calorific value of fuel = 44 000 kJ/kg. Assume that 5% of the total heat developed in the cylinder is transmitted by the piston. The piston is made of grey cast iron FG 200 ( $S_{ut} = 200 \text{ N/mm}^2$  and  $k = 46.6 \text{ W/m}^{\circ}\text{C}$ ) and the factor of safety is 5. The temperature difference between the centre and the edge of the piston head is  $220^{\circ}\text{C}$ .
- Calculate the thickness of piston head by strength consideration.
  - Calculate the thickness of piston head by thermal consideration.
  - Which criterion decides the thickness of piston head?
  - State whether the ribs are required.
  - If so, calculate the number and thickness of piston ribs.
  - State whether a cup is required in the top of the piston head.
  - If so, calculate the radius of the cup. [10]

OR

- What are the lubricating methods for bearings at small and big ends of the connecting rod? [5+5]
- Why are connecting rods made of I sections?

8. A concentric spring consists of two helical compression springs having the same free length. The composite spring is subjected to a maximum force of 2000 N. The wire diameter and mean coil diameter of the inner spring are 8 and 64 mm respectively. Also, the wire diameter and mean coil diameter of the outer spring are 10 and 80 mm respectively. The number of active coils in the inner and outer springs are 12 and 8 respectively. Assume same material for two springs and the modulus of rigidity of spring material is  $81370 \text{ N/mm}^2$ . Calculate:
- The force transmitted by each spring;
  - the maximum deflection of the spring; and
  - The maximum torsional shear stress induced in each spring. [10]

OR

- Derive the ratio of driving tensions for flat belt drive.
  - Derive velocity of the belt for maximum power. [7+3]
- Discuss the design procedure of spur gears.
  - How the shaft and arms for spur gears are designed? [6+4]

OR

11. A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 40 teeth gear. The helix angle is  $25^{\circ}$  and the normal pressure angle is  $20^{\circ}$ . The normal module is 3 mm. Calculate (a) the transverse module; (b) the transverse pressure angle; (c) the axial pitch; (d) the pitch circle diameters of the pinion and the gear; (v) the centre distance; and (e) the addendum and dedendum circle diameters of the pinion. [10]

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