

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, March - 2024

DESIGN OF MACHINE MEMBERS - II

(Mechanical Engineering)

Time: 3 Hours

Max. Marks: 75

- Note:** i) Question paper consists of Part A, Part B.
 ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
 iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.
 iv) Approved data book is permitted.

PART – A

(25 Marks)

- 1.a) What is Bearing Modulus? [2]
- b) Describe the various design parameters that influence the friction in the journal bearings. [3]
- c) Why ball and roller bearings are called 'antifriction' bearings? [2]
- d) List the important considerations for the selection of a bearing. [3]
- e) How the inertia forces are accounted in design of connecting rod? [2]
- f) Write the method to design a gudgeon pin. [3]
- g) How do you estimate permissible stress in helical spring design? [2]
- h) Explain the terms tensions on tight and slack sides, initial and centrifugal tension, and creep as applied to belt drives. [3]
- i) Explain the significance of velocity factor in gear tooth design. [2]
- j) Discuss the effect of helix angle on the performance of helical gears and state the range of helix angle suitable for different conditions. [3]

PART – B

(50 Marks)

2. Design a journal bearing for supporting a generator shaft of 150 mm diameter with a load of 15 kN running at 1440 rpm. Suitable data can be picked from the design data book. [10]

OR

3. The following data is given for a 360° hydrodynamic bearing:
 Radial load = 3.2 kN; journal speed = 1490 rpm; journal diameter = 50 mm
 Bearing length = 50 mm; radial clearance = 0.05 mm; viscosity of lubricant = 25 cP
 Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate
 a) Coefficient of friction;
 b) Power lost in friction;
 c) Minimum oil film thickness;
 d) Flow requirement in litres/min; and
 e) Temperature rise. [10]

- 4.a) A single-row deep groove ball bearing No. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition.
- b) A ball bearing, subjected to a radial load of 5 kN, is expected to have a life of 8000 h at 1450 rpm with a reliability of 99%. Calculate the dynamic load capacity of the bearing, so that it can be selected from the catalogue based on a reliability of 90%. [5+5]

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OR

5. A ball bearing operates on the following work cycle:

<i>Element No.</i>	<i>Radial load (N)</i>	<i>Speed (rpm)</i>	<i>Element time (%)</i>
1	3000	720	30
2	7000	1440	50
3	5000	900	20

The dynamic load capacity of the bearing is 20 kN. Calculate the average speed of rotation, the equivalent radial load and the bearing life. [10]

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6. Design a cast iron piston for a single cylinder four-stroke engine from following data:

Cylinder bore = 100 mm; Stroke = 120 mm; Maximum gas pressure = 5 MPa
Brake mean effective pressure = 0.6 MPa; Fuel consumption = 0.2 kg/kWh;
Speed = 2200 rpm; Assume suitable data if required. [10]

OR

7. A CI connecting rod is to be designed for a four stroke petrol engine having following specifications.

Diameter of piston = 150 mm; Stroke = 150 mm; RPM = 1500;
Mass of reciprocating parts = 20 N; Compression ratio 4:1
Length of connecting rod, centre to centre = 320 mm
Maximum explosion pressure = 2.5 MPa

Design and draw the connecting rod. Assume suitable data, if necessary. [10]

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8. Design a close coiled helical spring made of alloy steel of wire diameter 6 mm to fit inside a pipe of inner diameter 50 mm and length 100 mm. The permissible shear stress of wire is 400 MPa and the modulus of rigidity is 80 GPa. Determine the spring dimensions and the load carrying capacity of the spring. [10]

OR

9. A temporary construction elevator is designed to carry workers and materials to a height of 35 m. It is estimated that at least 10 workers with material load of 15 kN should be hoisted at a speed of 0.5 m/s which should be attained in the first 0.4 s. The recommended steel rope is 6 × 19 with wire diameter of 2.5 mm. Determine the factor of safety. [10]

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10. A pair of spur gear made of AISI 1020 HR steel with ultimate strength of 450 MPa is used for transmission of 5 kW power at 900 rpm of pinion between two shafts with a centre distance of 500 mm. The module is 5 mm and the pressure angle is 20° stub type. The speed reduction is 4: 1. The face width of the gear is 50 mm. Check the design on the basis of dynamic load. [10]

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OR

11. Two precision cut forged steel helical gears have 20° full-depth involute teeth. Find the transmitted and wear load for the following data. State whether the design is safe or not. The angle of helix = 23°; Permissible static bending stress = 100 MPa; Module = 3 mm; Face width = 300 mm. Gear ratio = 3 : 1
The speed of rotation of pinion = 600 rpm; Surface Endurance Strength = 600 MPa. [10]

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