

**013619**

May 2023

**Design of Machine Elements-II (PCC-ME-306)**

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
  2. Answer any four questions from Part -B in detail.
  3. Different sub-parts of a question are to be attempted adjacent to each other
  4. Use of design data handbook is allowed

**PART -A**

- Q1 (a) Explain different theory of failures. (1.5)
- (b) What is torsional rigidity? (1.5)
- (c) What are ergonomic considerations in design? (1.5)
- (d) Explain Buckingham equations. (1.5)
- (e) What is a zero-film bearing? (1.5)
- (f) With design point of view which shaft among solid & hollow is better & why? (1.5)
- (g) Explain the usefulness of turning moment diagram of flywheel. (1.5)
- (h) What are the drawbacks of worm gear drive? (1.5)
- (i) What is coefficient of fluctuation of energy and speed? (1.5)
- (j) Why helical gears are called helical? (1.5)

**PART -B**

- Q2 (a) Differentiate between finite & infinite life. (5)
- (b) A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm<sup>2</sup>. The bar is made of steel 40C8 (S<sub>ut</sub>= 600 N/mm<sup>2</sup>) Calculate the life of the bar for a reliability of 90%. (10)

- Q3 (a) What are terminologies used in power screws? (5)
- (b) The lead screw of a lathe has single-start ISO metric trapezoidal threads of 52 mm nominal diameter and 8 mm pitch. The screw is required to exert an axial force of 2 kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60 mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm. Calculate (10)
- (i) the power required to drive the lead screw; and
- (ii) the efficiency of the screw.
- Q4 A single-row deep groove ball bearing is subjected to a pure radial force of 3 kN from a shaft that rotates at 600 rpm. The expected life  $L_{10h}$  of the bearing is 30 000 h. The minimum acceptable diameter of the shaft is 40 mm. Select a suitable ball bearing for this application. (15)
- Q5 It is required to design a pair of spur gears with  $20^\circ$  full-depth involute teeth based on the Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10 kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4 : 1. The pinion as well as the gear is made of plain carbon steel 40C8 ( $S_{ut} = 600 \text{ N/mm}^2$ ). The factor of safety can be taken as 1.5. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears. (15)
- Q6 A machine is driven by a motor, which exerts a constant torque. The resisting torque of the machine increases uniformly from 500 N-m to 1500 N-m through a  $360^\circ$  rotation of the driving shaft and drops suddenly to 500 N-m again at the beginning of the next revolution. The mean angular velocity of the machine is 30 rad/s and the coefficient of speed fluctuations is 0.2. A solid circular steel disk, 25 mm thick, is used as flywheel. The mass density of steel is 7800 kg/m<sup>3</sup> while Poisson's ratio is 0.3. Calculate the outer radius of the flywheel disk and the maximum stresses induced in it. (15)
- Q7 Write short note on following; (15)
- Selection of suitable lubricant for bearings
  - Considerations for maximum power transmitting capacity for gears
  - Design considerations for casting & forging
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