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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech VI SEMESTER END EXAMINATIONS (REGULAR) - JULY 2023

Regulation: UG-20

MACHINE DESIGN

Time: 3 Hours

MECHANICAL ENGINEERING

Max Marks: 70

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

- Discuss the procedural steps adopted in designing journal bearings, when the bearing load, the diameter and the speed of the shaft are known. [BL: Understand| CO: 1|Marks: 7]
 - A 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a radial clearance of 0.05 mm and the viscosity of the oil is 0.021 kg / m-s at the operating temperature. If the bearing is capable of dissipating 80 J/s, determine the maximum safe speed. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

- Enumerate the various forces acting on the connecting rod. Also, state the types of lubrication systems used in IC engines. [BL: Understand| CO: 2|Marks: 7]
 - Design a connecting rod for an IC, engine running at 1800 RPM. and developing a maximum pressure of $3.15N/mm^2$. The diameter of the piston is 100 mm; mass of the reciprocating parts per cylinder 2.25 kg; length of connecting rod 380 mm; stroke of piston 190 mm and compression ratio 6:1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressures as $10N/mm^2$ and $15N/mm^2$. The density of material of the rod may be taken as $8000kg/m^3$ and the allowable stress in the bolts as $60N/mm^2$ and in cap as $80N/mm^2$. The rod is to be of I-section for which you can choose your own proportions. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

- List and discuss briefly the factors that control the power transmission capacity of a belt. [BL: Understand| CO: 3|Marks: 7]
 - A leather belt $9\text{ mm} \times 250\text{ mm}$ is used to drive a cast iron pulley 900 mm in diameter at 336 RPM. If the active arc on the smaller pulley is 120° and the stress in tight side is 2 MPa, find the power capacity of the belt. The density of leather may be taken as $980kg/m^3$, and the coefficient of friction of leather on cast iron is 0.35. [BL: Apply| CO: 3|Marks: 7]
- Sketch the cross-section of a V-belt and label its important parts. Mention the advantages and disadvantages of V-belt drive over flat belt drive. [BL: Understand| CO: 4|Marks: 7]

- (b) Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 RPM., the compressor speed being 350 RPM. The minimum centre distance is 500 mm. The compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides.

[BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Write the expressions for static, limiting wear load and dynamic load for spur gears and explain the various terms used in it. [BL: Understand| CO: 5|Marks: 7]
- (b) The following particulars of a single reduction spur gear are given:
Gear ratio = 10:1; distance between centres = 660 mm approximately; Pinion transmits 500 kW at 1800 RPM.; involute teeth of standard proportions (addendum = m) with pressure angle of 22.5° ; permissible normal pressure between teeth = 175 N per mm of width. Find:
- The nearest standard module if no interference is to occur
 - The number of teeth on each wheel
 - The necessary width of the pinion
 - The load on the bearings of the wheels due to power transmitted.

[BL: Apply| CO: 5|Marks: 7]

6. (a) For bevel gears, summarize the following: i) Cone distance ii) Pitch angle iii) Face angle
iv) Root angle v) Back cone distance vi) Crown height. [BL: Understand| CO: 5|Marks: 7]
- (b) A pair of cast iron bevel gears connect two shafts at right angles. The pitch diameters of the pinion and gear are 80 mm and 100 mm respectively. The tooth profiles of the gears are of $14\frac{1}{2}^\circ$ composite form. The allowable static stress for both the gears is 55 MPa. If the pinion transmits 2.75 kW at 1100 RPM., find the module and number of teeth on each gear from the standpoint of strength and check the design from the standpoint of wear. Take surface endurance limit as 630 MPa and modulus of elasticity for cast iron as 84 kN/mm^2 .

[BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Discuss the various types of power threads. Give atleast two practical applications for each type. Write their relative advantages and disadvantages. [BL: Understand| CO: 6|Marks: 7]
- (b) A vertical screw with single start square threads of 50 mm mean diameter and 12.5 mm pitch is raised against a load of 10 kN by means of a hand wheel, the boss of which is threaded to act as a nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 60 mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential force applied by each hand to the wheel is 100 N, find suitable diameter of the hand wheel. [BL: Apply| CO: 6|Marks: 7]
8. (a) What do you understand by overhauling of screw and self-locking property of threads. Differentiate between differential screw and compound screw. [BL: Understand| CO: 6|Marks: 7]
- (b) The lead screw of a lathe has Acme threads of 50 mm outside diameter and 8 mm pitch. The screw must exert an axial pressure of 2500 N in order to drive the tool carriage. The thrust is carried on a collar 110 mm outside diameter and 55 mm inside diameter and the lead screw rotates at 30 RPM. Determine the power required to drive the screw and efficiency of the lead screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar.

[BL: Apply| CO: 6|Marks: 7]

