INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - DECEMBER 2022
Regulation: R18
ADVANCED MACHINE DESIGN
Time: 3 Hours   (MECHANICAL ENGINEERING)   Max Marks: 70

Answer FIVE Questions choosing ONE question from each module
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Classify the various types of lubrications. Describe basic modes of lubrication with neat sketches.
    [BL: Understand| CO: 1|Marks: 7]

   (b) A journal bearing is to be designed for a centrifugal pump for the following data :

   Load on the journal = 12 kN ; diameter of the journal = 75 mm ; Speed = 1440 rpm ; Atmospheric temperature of the oil = $16^0 C$; Operating temperature of the oil = $60^0 C$; Absolute viscosity of oil at $60^0 C$ = 0.023 kg/ms. Develop a systematic design of the bearing.
    [BL: Apply| CO: 1|Marks: 7]

2. (a) Enlist the factors on selection of ball and roller bearings. State the advantages and disadvantages of sliding contact bearings over rolling contact bearings.   [BL: Understand| CO: 1|Marks: 7]

   (b) A ball bearing subjected to a radial load of 5 kN is expected to have a life of 8000 hours at 1450 rpm with a reliability of 99%. Solve the dynamic load capacity of the bearing so that it can be selected from the manufacturer's catalogue based on a reliability of 90%
    [BL: Apply| CO: 1|Marks: 7]

MODULE – II

3. (a) Discuss the function of connecting rod? Explain in detail the design procedure of connecting rod.
    [BL: Understand| CO: 2|Marks: 7]

   (b) The cylinder of a four-stroke diesel engine has the following specifications: Brake power = 3 kW Speed = 800 rpm Indicated mean effective pressure = 0.3 MPa Mechanical efficiency = 80% Determine the bore diameter and length of the cylinder liner.   [BL: Apply| CO: 2|Marks: 7]

4. (a) Illustrate the design procedure of piston for an internal combustion engine. Interpret the function of the ribs for an IC engine piston   [BL: Understand| CO: 2|Marks: 7]

   (b) Determine the dimensions of small and big end bearings of the connecting rod for a diesel engine with the following data: Cylinder bore = 100 mm Maximum gas pressure = 2. 45 MPa (l/d) ratio for piston pin bearing = 1.5 (l/d) ratio for crank pin bearing = 1.4 Allowable bearing pressure for piston pin bearing = 15 MPa Allowable bearing pressure for crank pin bearing = 10 MPa.
    [BL: Apply| CO: 2|Marks: 7]

MODULE – III

5. (a) Discuss about the various types of belt drives with neat sketches. State the advantages and disadvantages of rope drives over chain drives.   [BL: Understand| CO: 3|Marks: 7]

   (b) A rope drive is required to transmit 750 kW from a pulley of 1 m diameter running at 450 rpm. The safe pull in each rope is 2250 N and the mass of the rope is 1 kg/m length. The angle of lap and the groove angle is 150^0 and 45^0 respectively. Find the number of ropes required for the drive if the coefficient of friction between the rope and the pulley is 0.3.

                                                                                           [BL: Apply| CO: 3|Marks: 7]

6. (a) Write the design procedure for a chain drive. Sketch the cross-section of a V-belt and label its important parts.   [BL: Understand| CO: 4|Marks: 7]

   (b) A-V belt is to transmit 20 kW from a 250 mm pitch diameter sheave to a 900 mm diameter pulley. The centre distance between the two shafts is 1000 mm. The groove angle is 40^0 and the coefficient of friction for the belt and sheave is 0.2 and the coefficient of friction between the belt and flat pulley is 0.2. The cross-section of the belt is 40 mm wide at the top, 20 mm wide at the bottom and 25 mm deep. The density of the belt is $1000 kg/m^3$ and the allowable tension per belt is 1000 N. Find the number of belts required.   [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

7. (a) Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.   [BL: Understand| CO: 5|Marks: 7]

   (b) Design a pair of spur gears with stub teeth to transmit 55 kW from a 175 mm pinion running at 2500 rpm. to a gear running at 1500 rpm. Both the gears are made of steel having B.H.N. 260. Approximate the pitch by means of Lewis equation and then adjust the dimensions to keep within the limits set by the dynamic load and wear equation   [BL: Apply| CO: 5|Marks: 7]

8. (a) Write the expressions for static strength, limiting wear load and dynamic load for helical gears and explain the various terms used.   [BL: Understand| CO: 5|Marks: 7]

   (b) A pair of helical gears consist of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 r.p.m. The normal pressure angle is 20° while the helix angle is 25°. The face width is 40 mm and the normal module is 4 mm. The pinion as well as gear are made of steel having ultimate strength of 600 MPa and heat treated to a surface hardness of 300 B.H.N. The service factor and factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of the gears.

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

MODULE – V

9. (a) Compare various types of screw threads used for power screws. Give at least two practical applications for each type and their relative advantages and disadvantages.

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

   (b) The lead screw of a lathe has square threads of 24 mm outside diameter and 5 mm pitch. In order to drive the tool carriage, the screw exerts an axial pressure of 2.5 kN. Find the efficiency of the screw and the power required to drive the screw, if it is to rotate at 30 rpm. Neglect bearing friction. Assume coefficient of friction of screw threads as 0.12

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

10. (a) In the design of power screws, on what factors does the thread bearing pressure depend? . Contrast differential screw and compound screw. [BL: Understand| CO: 6|Marks: 7]

(b) A sluice valve, used in water pipe lines, consists of a gate raised by the spindle, which is rotated by the hand wheel. The spindle has single start square threads. The nominal diameter of the spindle is 36 mm and the pitch is 6 mm. The friction collar has inner and outer diameters of 32 mm and 50 mm respectively. The coefficient of friction at the threads and the collar are 0.12 and 0.18 respectively. The weight of the gate is 7.5 kN and the frictional resistance to open the valve due to water pressure is 2.75 kN. Using uniform wear theory, determine : i) Torque required to raise the gate ii) Overall efficiency. [BL: Apply| CO: 6|Marks: 7]

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