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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, July/August - 2021
DESIGN OF MACHINE MEMBERS - II
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks
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1.   A 150 mm diameter shaft supporting a load of 12 kN has a speed of 1500 rpm. The shaft runs in a bearing whose length is 1.5 times the shaft diameter. If the diametral clearance of the bearing is 0.15 mm and the absolute viscosity of the oil at the operating temperature is 0.011 kg/m-s, find the power wasted in friction.   [15]

2.a)   List the important physical characteristics of a good bearing material.
  b)   Design a journal bearing for the following data: Journal diameter = 70 mm, Journal speed = 450 rpm, Clearance = 0.0025 mm/mm, Viscosity of the oil = 10, centipoise at 75^0C, Ambient temperature = 27^0C, Specific gravity of oil = 0.9.   [5+10]

3.a)   Explain the following terms as applied to ball or roller bearings:
       i) rating life   ii) minimum life
  b)   A ball bearing operates on the following work cycle:

	Radial load (N)	Speed (R.P.M)	Element time (%)
1	3000	720	30
2	7000	1440	40
3	5000	900	30

       The dynamic load capacity of the bearing is 16600N. Calculate
       i) The average speed of rotation;
       ii) The equivalent radial load
       iii) The bearing life.   [5+10]

4.a)   Where are the angular contact and self-aligning ball bearings used?
  b)   The rolling contact ball bearing are to be selected to support the overhung countershaft. The shaft speed is 720 rpm. The bearings are to have 99% reliability corresponding to a life of 24000 hours. The bearing is subjected to an equivalent radial load of 1 kN. Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing from manufacturer's catalogue, specified at 90% reliability.   [5+10]

5. Design a suitable aluminum alloy piston with two compression rings and one oil ring for a petrol engine of following particulars:

Cylinder = 0.10 m
Peak gas pressure = 3.2 MPa
Mean effective pressure = 0.8 MPa
Average side thrust = 2400 N
Skirt bearing pressure = 0.22 MPa
Bending stress in piston crown = 36 MPa
Crown temperature difference = 700
Heat dissipated through crown = 157 kJ/m^2 s
Allowable radial pressure = 0.04 MPa
Bending stress in rings = 90 MPa
Heat conductivity, k = 160 W/m^{0}C

Draw a full-scale dimensioned drawing and indicate the method of reducing the thermal expansion in the skirt of designed piston. [15]

6. Design a connecting rod for four stroke petrol engines with the following data. Piston diameter = 0.10 m, stroke = 0.14 m, length of the connecting rod from center to center = 0.315 m, weight of reciprocating parts = 18.2 N, speed = 1500 rpm with possible over speed of 2500 compression ratio = 4:1, probable maximum explosion pressure = 2.45 MPa. [15]

7. Design a helical spring for a spring loaded safety valve (Ramsbottom safety valve) for the following conditions: Diameter of valve seat = 65 mm; Operating pressure = 0.7 N/mm^2; Maximum pressure when the valve blows off freely = 0.75 N/mm^2; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 = 3.5 mm; Maximum allowable stress = 550 MPa; Modulus of rigidity = 84 kN/mm^2; Spring index = 6. Draw a neat sketch of the free spring showing the main dimensions. [15]

8. Design a pair of spur gears with stub teeth to transmit 50 kW from a 150 mm pinion running at 2250 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. [15]

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