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18AU63

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of design data hand book is allowed.*

Module-1

1 a. List the important applications of springs. **(05 Marks)**

b. A compression coil spring made of an alloy steel is having following specifications. Mean dia of coil = 50 mm, wire dia = 5 mm, Number of active coils = 20 (neglect the curvature effect) to which the spring material is subjected. **(05 Marks)**

c. Design a helical compression spring for a maximum load of 1000N for a deflection of 25 mm using the value of spring index as 5. The max permissible shear stress for spring wire is 420 MPa and modulus of Rigidity is 84 kN/mm^2. Take Wahl's factor $K = \dfrac{4c-1}{4c-4}$. **(10 Marks)**

OR

2 a. List and explain types of clutches. **(04 Marks)**

b. Determine the maximum minimum and average pressure in a plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. assume uniform wear. **(06 Marks)**

c. A rope drum of an elevator having 650 mm dia is fitted with a brake drum of 1 m dia. The brake drum is provided with four cast iron brake shoes each subtending an angle of 45°. The mass of the elevator when loaded is 2000 Kg and moves with a speed of 2.5 m/s. The brake has a sufficient capacity to stop the elevator in 2.75 mts. Assuming the coefficient of friction between the brake drum and shoes as 0.2. find :
   i) Width of the shoe if the allowable pressure on the brake shoe is limited to 0.3 N/mm^2
   ii) Heat generated in stopping the elevator. **(10 Marks)**

Module-2

3 A pair of carefully cut spur gears with 20° FD involute profile is used to transmit 12kW at 1200 rpm of pinion. The gear has to rotate 300 rpm. The material used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Determine the module and face width of spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion modulus of elasticity may be taken as 210 GPa. **(20 Marks)**

OR

4 A pair of carefully cut (class II) helical gears for a turbine has a transmission ratio of 10:1. The teeth are 20° stub involute in the normal plane. Pinion has 25 teeth and rotates at 5000 rpm. Material for pinion and gear is 0.4% carbon steel untreated. Determine the module in normal plane, diametral plane and face width of the gears. Suggest suitable hardness. Modulus of elasticity may be taken as 210 GPa. Helix angle = 30°, Power transmitted = 90kW. **(20 Marks)**

Module-3

5 a. List the basic assumptions used in theory of hydrodynamic lubricated bearings. **(04 Marks)**

b. List the important factors for the formation of thick oil film in hydrodynamic lubricated bearings. **(04 Marks)**

c. The load on the journal bearing is 150 kN due to turbine shaft of 300 mm dia running at 1800 rpm. Determine the following :
  i) Length of the bearing if allowable bearing pressure is 1.6 N/mm^2, and
  ii) Amount of heat to be removed by the lubricant per minute if bearing temperature is 60° C and viscosity of the oil at 60°C is 0.02 Kg/m-s and bearing clearance is 0.25mm. **(12 Marks)**

OR

6 a. List the advantages and disadvantages of rolling contact bearing over sliding contact bearing. **(08 Marks)**

b. The rolling contact ball bearing is 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 1kN. Consider life adjustment factors for operating conditions and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing from manufacturing catalogue, specified at 90% reliability. **(12 Marks)**

Module-4

7 Design a cast iron piston for a single acting four stroke engine for the following data :
Cylinder bore = 100 mm, stroke = 125 mm, Max gas pressure = 5 N/mm^2, indicated mean effective pressure = 0.75 N/mm^2, mechanical efficiency = 80%, Fuel consumption = 0.15 Kg per brake power per hour, higher calorific value of fuel = 42 × 10^{3}kJ/Kg, Speed = 2000 rpm, Any other required data for the design can be assumed. **(20 Marks)**

OR

8 a. Sketch a valve gear mechanism for vertical engine of IC engine and label its various parts. **(08 Marks)**

b. The conical value of an IC engine is 60 mm in diameter and is subjected to a max gas pressure of 4 N/mm^2. The safe stress in bending for the valve material is 46 MPa. The valve is made of steel for which K = 0.42. The angle at which the valve disc seat is tapered is 30°. Determine :
  i) Thickness of the valve head   ii) Steam diameter   iii) Maximum lift of the valve **(12 Marks)**

Module-5

9 a. List and explain the different forces acting on the connecting rod. **(12 Marks)**

b. Write a note on : i) offset connecting rods   ii) Buckling of connecting rod. **(08 Marks)**

OR

10 a. Write a note on Material and Manufacture of crankshafts. **(08 Marks)**

b. Explain Bearing pressure and stressess in crank shaft. **(12 Marks)**

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