



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Automobile Engineering

Semester End Examination; February / March - 2022

Design of Machine Elements - II

Time: 3 hrs

Max. Marks: 100

Course Outcomes

The Students will be able to:

CO1- Analyze the stresses in the critical section of a curved beam and design springs for different Applications.

CO2- Design Spur and helical and gears.

CO3- Design Bevel and worm gears.

CO4- Design clutches and brakes, with an understanding of safety issues related to brakes.

CO5- Select lubricants and design sliding contact bearings, select rolling contact bearings for different applications.

Note: I) PART - A is compulsory. Two marks for each question.

II) PART - B: Answer any Two sub questions (from a, b, c) for Maximum of 18 marks from each unit.

Q. No.	Questions	Marks	BLs	COs	POs
I : PART - A		10			
I a.	List the materials used for springs.	2	L1	CO1	PO1
b.	Identify the design consideration of gear drive.	2	L1	CO2	PO1
c.	List the components of resultant force acting on worm gears.	2	L1	CO3	PO1
d.	Discuss the merits of belt drive.	2	L1	CO4	PO1
e.	Enumerate the important properties of bearings material.	2	L1	CO5	PO1
II : PART - B		90			
UNIT - I		18			
1 a.	Identify the key difference between straight and curved beam and illustrate the stress distribution patterns in a curved beam.	8	L3	CO1	PO2
b.	Design a steel crane hook to have a capacity of 100 kN. Assume a factor of safety = 2 and trapezoidal section.	10	L3	CO1	PO2
c.	A helical valve spring is to be designed for an operating load range of approximately 90 to 135 N. The deflection of the spring for load range is 7.5 mm. Assume a spring index of 10 and factor of safety = 2. Design the spring.	10	L3	CO1	PO3
UNIT - II		18			
2 a.	Discuss the desirable properties of gear material.	4	L2	CO2	PO2
b.	Design a pair of spur gears to transmit a power of 18 kW from a shaft running at 1000 rpm to a parallel shaft to be run at 250 rpm maintaining a distance of 160 mm between the shaft centers. Suggest a suitable surface hardness for the gear pair.	14	L3	CO2	PO3
c.	Design a pair of helical gears to transmit power of 20 kW from a shaft running at 1500 rpm to a parallel shaft to be run at 450 rpm. Suggest suitable surface hardness for the gear pair.	14	L3	CO2	PO3

UNIT - III**18**

- 3 a. Discuss the thermal rating of Worm gear. 4 L3 CO3 PO3
- b. Design a pair of bevel gears to transmit a power of 25 kW from a shaft rotating at 1200 rpm to a perpendicular shaft to be rotated at 400 rpm. 14 L3 CO3 PO4
- c. A pair of worm and worm wheel is designated is 3/60/10/6. The worm is transmitting 2.5 kW power at 1440 rpm to the worm wheel. The coefficient of friction is 0.1 and the normal pressure angle is 20°. Determine the component of gears tools force acting on the worm and worm wheel. 14 L4 CO3 PO3

UNIT - IV**18**

- 4 a. Discuss the advantages and disadvantages of V-belt over flat belts. 6 L2 CO4 PO1
- b. Two shafts one meter apart are connected by a V-belt to transmit 90 kW at 1200 rpm of a drives pulley of 300 mm effective diameter. The driven pulley rotated at 400 rpm. The angle of groove is 40° and the coefficient of friction between the belt and pulley rim is 0.25. The area of belt section is 400 mm² and the permissible stress is 2.1 MPa. Density of belt material is 1100 kg/m³. Calculate the numbers of belts required and the length of the belt. 12 L3 CO4 PO2
- c. A simple band brake of drum diameter 600 mm has a band passing over it with an angle of contact of 225°, while the other end is connected to the fulcrum, the other end is connected to the brake levers at a distance of 400 mm from the fulcrum. The brake lever is 1 m long. The brake is to absorb a power of 15 kW at 720 rpm. Design the brake lever of rectangular cross section, assuming depth to be trice the width. Take allowable stress 80 MPa. 12 L3 CO4 PO1

UNIT - V**18**

- 5 a. Discuss the significance of bearing characteristic numbers in the design of sliding contact bearings. 6 L2 CO5 PO1
- b. A full journal bearing of 50 mm diameter, 750 mm long supports a radial load of 1000 N. The speed of the shaft is 600 rpm. The surface temperature of bearing is limited to 60°C and the room temperature is 30°C. Determine the viscosity of the oil, if the bearings are well ventilated and no artificial cooling is to be used. The ratio of journal diameters to diametrical clearance is 1000. 12 L3 CO5 PO2
- c. Determine the main dimensions and power loss of a multi collar trust bearing for a propeller shaft of 450 kW marine oil engine. The engine makes 250 rpm. The shaft diameter is 150 mm of the speed of the ship is 5 m/s. 12 L3 CO5 PO2

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