U.S.N

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Mechanical Engineering

Semester End Examination; July / Aug. - 2022

Design of Machine Elements - II

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Explain curved beams, Analyze helical and leaf springs with an understanding of safety issues related to springs.

CO2: Determine stresses in cylindrical pressure vessels, Analyze stresses due to different types of fit.

CO3: Analyze spur, helical and bevel gears.

CO4: Analyze worm gears, simple clutches and brakes, with an understanding of safety issue related to brakes.

CO5: *Analyze about stress distribution in lubricating fluids. Design sliding and rolling contact bearings.*

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

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

III) *Missing data, if any, may be assumed suitable.*

IV) *Use of Data hand book counter signed by competent authority is permitted.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Define surging in springs.	2	L1	CO1	PO1
b.	Differentiate between thick and thin cylinders.	2	L1	CO2	PO1,2
c.	State the applications of bevel gear.	2	L1	CO3	PO1
d.	Define clutch. List the different types of clutch.	2	L1	CO4	PO1
e.	Define and state the uses of Bearing characteristic Number.	2	L1	CO5	PO1,2
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Determine the value of 't' in the cross-section of a curved machine member shown in Fig. 1(a) so that the normal stress due to bending at extreme fibres are numerically equal. Also determine the normal stresses induced at extreme fibres due to a bending moment of 10 kN-m.	14	L3	CO1	PO3

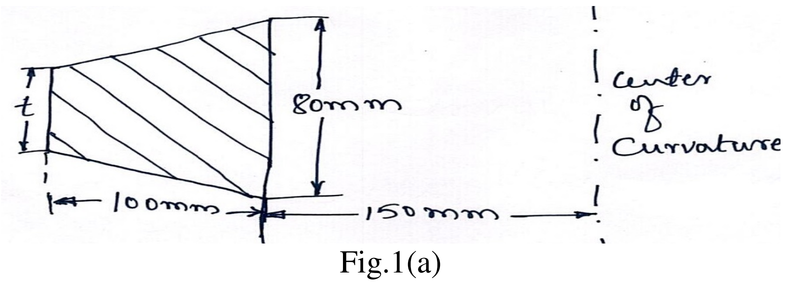

Fig.1(a)

b.	A railway wagon weighing 50 kN and moving with a speed of 8 km/hr has to be stopped by four buffer springs in which the maximum compression allowed is 220 mm. Find the number of turns or coils in each spring of mean diameter 150 mm. The diameter of spring wire is 25 mm. Take G = 84 GPa. Also find the shear stress.	14	L3	CO1	PO3

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		Marks	BT	CO	PO
c.	Derive an expression for shear stress in Helical compression spring of circular cross-section wire.	4	L2	CO1	PO2
	UNIT - II	**18**			
2 a.	Derive Lami's equation for thick cylinder with usual notations.	14	L3	CO2	PO3
b.	A 100 mm inside and 150 mm outside sleeve is press fitted on to a shaft of 100 mm diameter. The modulus of elasticity of material is 210 GPa and Poisson's ratio is 0.28. The contact pressure is not to exceed 60 MPa. Determine; i) Tangential stress at inner and outer surface of the sleeve and outside diameter of the shaft ii) Radial stress in the shaft and hub before press fit iii) Total Interference	14	L3	CO2	PO3
c.	A cast steel cylinder of 350 mm inside diameter is to contain liquid at a pressure of 13.5 N/mm^2. It is closed at both ends by flat cover plates which are made of alloy steel and are attached by bolts. Determine; i) Wall thickness of the cylinder, if the maximum hoop stress in the material is limited to 55 MPa ii) Minimum thickness necessary of the cover plates if the working stress is not exceed 65 MPa	4	L2	CO2	PO3
	UNIT - III	**18**			
3 a.	Design a pair of spur gear 20º involute to transmit 30 kW of power at 600 rpm of pinion. Number of teeth on pinion is 15, transmission ratio is 5:1. Material of the pinion is cast steel. [σ = 137.34 MPa] and that of Gear is High grade cast iron [σ = 103 MPa].	14	L3	CO3	PO4
b.	Design a Helical gear to transmit 15 kW at 1200 rpm of pinion. The gear is to rotate at 600 rpm. The helix angle is 17.5º. The center distance between the gears is 150 mm. The pinion is made of high carbon steel and gear of 0.4% carbon steel untreated.	14	L3	CO3	PO4
c.	List the reasons for dynamic loading in gears.	4	L3	CO4	PO3
	UNIT - IV	**18**			
4 a.	Design a worm gear drive to transmit 12 kW at 1200 rpm. The speed reduction designed is 30:1. The worm is made of hardened steel of σ = 210 MPa and gear is phosphor bronze of σ = 90 MPa. The teeth are 14.5º.	14	L3	CO4	PO3
b.	A single block brake as shown in Fig. 4b has a torque capacity of 15 N-m. The coefficient of friction is 0.3 and the maximum pressure on the brake lining is 1 N/mm^2. The width of the block is equal to its length. Calculate; i) Actuating force ii) Dimensions of the block	14	L3	CO4	PO3

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iii) Resultant hinge-pin reaction

iv) Heat generated. If the brake drum rotates at 50 rpm.

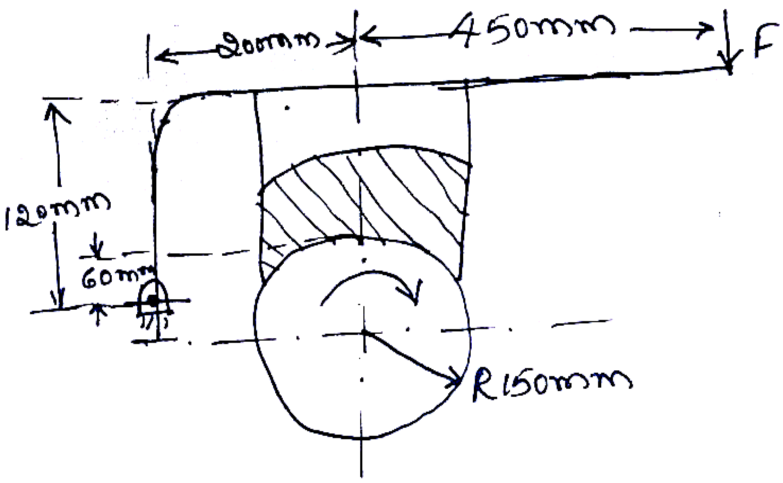

Fig.4(b)

c. A car engine develops maximum power of 15 kW at 1000 rpm. The clutch used is a single plate type of both sides effective having external diameter 1.25 times internal diameter μ = 0.3. Maximum axial pressure is not to exceed 0.085 N/mm^2. Determine the dimensions of the friction surface and the force necessary to engage the plates. Assume uniform pressure condition.	4	L2	CO4 PO2,3

UNIT - V **18**

5 a. A hydrodynamic journal bearing of radius 19 mm, length 38 mm has a radial clearance of 0.038 mm. The viscosity of oil is 0.02756 Pa-s. The load on the bearing is 2210 N and the speed of the journal is 30 rev/s. Determine; i) Minimum film thickness and its angular location ii) Eccentricity iii) Coefficient of friction iv) Torque to overcome friction v) Power loss due to friction vi) Total volumetric flow rate vii) Side flow viii) Maximum film pressure and the location of maximum and terminating pressures.	14	L3	CO5 PO3
b. Design the main bearing for a stationary slow speed steam engine for the following data. Journal diameter = 200 mm; Maximum load on the piston = 80 kN, Engine speed = 200 rpm.	14	L3	CO5 PO3
c. Explain with a neat sketch the hydrodynamic theory of lubrication.	4	L2	CO5 PO2

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