U.S.N

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

(An Autonomous Institution affiliated to VTU, Belagavi)
Fourth Semester, B.E. - Automobile Engineering
Semester End Examination; August - 2023
Design of Machine Elements - I

Time: 3 hrs   Max. Marks: 100

Course Outcomes

The Students will be able to:
CO1: *Explain basic design concept and analyze the various modes of failure of machine components under different static and impact load conditions and use appropriate theories of failures to design machine components*
CO2: *Compute the dimensions of the machine components subjected to dynamic loads*
CO3: *Design shafts as per ASME standards and Design mechanical joints such as Cotter, Knuckle joint and couplings*
CO4: *Design typical riveted joints and welded joints for boiler and structural applications*
CO5: *Select standard thread elements and design power screws for different applications*

<u>*Note:*</u> **I) PART - A** *is compulsory.* **Two** *marks for each question.*
     II) PART - B: *Answer any* <u>**Two**</u> *sub questions (from a, b, c) for a Maximum of* **18 marks** *from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	Define standardization.	2	L1	CO1	PO1
b.	Define Fatigue.	2	L1	CO2	PO1
c.	Explain Transmission.	2	L1	CO3	PO1
d.	List the different types of joints.	2	L1	CO4	PO1
e.	List Application of power screws.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	A cantilever circular rod has a diameter of 50 mm and 300 mm length. Find out the values of principal stress and maximum shear stress under the following conditions: i) Applying an axial load of 20 kN ii) Applying 4 kN load at an end, acting downwards creating bending stress iii) Applying a torque of 1.5 KN-m	9	L2	CO1	PO2
b.	A rotating shaft of diameter 16 mm shown in Fig. 2b is subjected to axial tensile load of 5000 N, a steady torque of 50 Nm and a maximum bending moment of 75 N-m. Assume 350 MPa and $\sigma = 0.3$. Calculate the factor of safety based on, i) Maximum normal stress theory ii) Maximum shear stress theory	9	L2	CO1	PO2

c.	Draw stress-strain diagram for mild steel. Name the salient points and explain.	9	L2	CO1	PO2

UNIT - II — **18**

3 a.	Determine the maximum tensile load that a flat 25 mm × 3 mm can carry if it has a central hole of 10 mm diameter and σ_{max} = 120 MPa.	10	L1	CO2	PO2
b.	A stepped shaft of circular cross-section shown in Fig.3b is made of 20 MN2 steel (σ_y = 431.5 MPa). Determine the value of 'd' and the fillet radius 'r' so that the maximum stress will be limited to a ratio corresponding to a factor of safety of 2.5 and taking stress concentration factor into account.	10	L2	CO2	PO3
c.	What is endurance limit? What are the factors that modify the endurance limit approximation?	8	L1	CO2	PO3

UNIT - III — **18**

4 a.	A solid shaft and a hollow shaft are made of same material and have equal strength in torsion. The outside diameter of hollow shaft is 25% larger than the solid shaft. What will be the ratio weight of hollow shaft to solid shaft?	12	L2	CO3	PO3
b.	Design a cotter joint to carry an axial force of 12 kN. Use the following stresses: Allowable stress in tension and bending = 40 MPa Allowable stress in crushing = 80 MPa Allowable stress shear = 32 MPa Sketch two views of the joint showing major dimensions.	12	L2	CO3	PO2
c.	Compare hallow shaft with solid shaft for strength, stiffness and weight.	6	L1	CO3	PO3

UNIT - IV — **18**

5 a.	Design a double riveted lap joint with chain riveting for mild steel plates of 20 mm thick taking the allowable value of stress in shear, tension and compression to 60 MPa, 90 MPa and 120 MPa respectively.	12	L2	CO4	PO3
b.	A 80 mm wide and 12 mm thick plate subjected to axial tensile load is welded to a vertical support by a single transverse fillet weld and a double parallel fillet weld as shown in Fig.5b The maximum tensile and shear stresses in the weld are 100 MPa and 70 MPa respectively. Find the length of each parallel weld, if the joint is subjected to; i) Static loading ii) Fatigue loading	12	L2	CO4	PO3
c.	Explain the design procedure for circumferential lap joint.	6	L1	CO4	PO3

UNIT - V   18

6 a. A single threaded power screw of 25 mm diameter has a pitch of 5 mm. A vertical load on the screw reaches a maximum load of 500 N. The coefficient of friction is 0.05 for collar and 0.08 for the screw. The frictional diameter of the collar is 30 mm. Find the torque required to raise and lower the load. Also find the efficiency of the power screw.   12   L2 CO5   PO3

b. A cover plate is bolted on to the flanged end of a pressure vessel through 6 bolts. The inner diameter of the pressure vessel is 200 mm and is subjected to an internal pressure of 10 MPa. Selecting carbon steel C40 as the material for the bolts, determine the size of the bolts also considering the initial tension for the following cases: 12   L2 CO5   PO3

i) Metal to metal joint

ii) A gasket joint

c. A bolt carries a tensile load of 8 kN and tightening load is 3 kN. It is made of steel having allowable tensile stress of 120 MPa. Find its size. A soft copper gasket is used.   6   L2 CO5   PO3
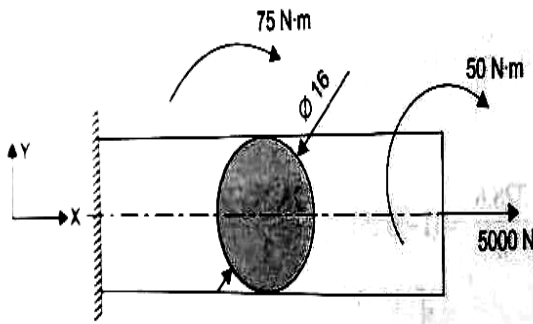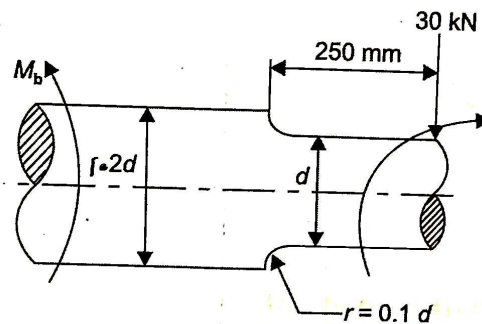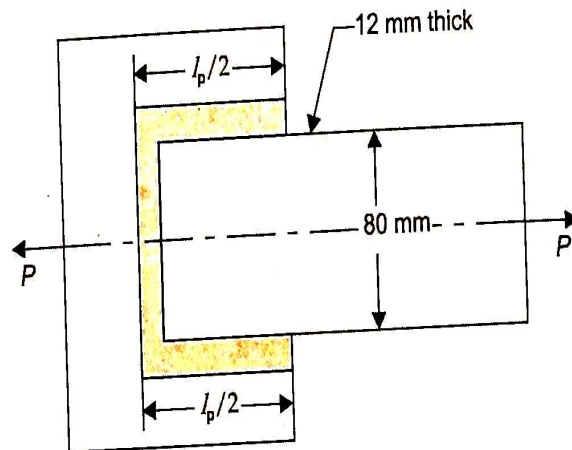
Fig: 2b   Fig: 3b

Fig: 5b

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