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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; July / August - 2022

Design of Machine Element - I

Time: 3 hrs *Max. Marks: 100*

Course Outcome's

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

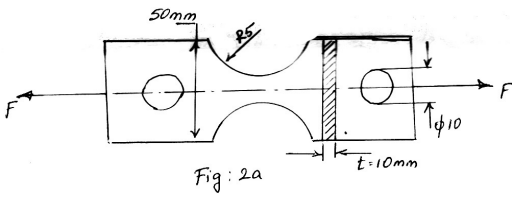
CO2: Compute the dimensions of the machine components subjected to dynamic loads

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

***Note**: i) **PART-A** is compulsory. One question from each unit for maximum of 2 marks*
*ii) **PART-B**: Answer any **TWO** sub questions (from a, b, c) from each unit for a Maximum of 18 marks.*

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	Define code and standard.	2
b.	How stress concentration can be reduced give example with neat sketch.	2
c.	List the merits and demerits of cotter Joints.	2
d.	List different types of riveted Joints.	2
e.	Write the expression for torque required for raising the load in the case of power screw.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	A circular shaft 50mm diameter fixed at one end is subjected to an axial load of 20 kN and a torque of 1.5 kN-m. If the length of the shaft is 300 mm, determine the nature and magnitude of stress at the critical point.	9
b.	A mild steel shaft is subjected to 3500 N-m of bending moment at it critical point and transmits a torque of 2500 N-m. The shaft is made of steel having yield strength of 231 MPa. Estimate the size of the shaft based in various 3 theories of failure and specify the final size. Take FDS = 2 and $\mu = 0.3$.	9
c.	Draw stress- strain diagram for mild steel. Name the salient points and explain.	9
	UNIT - II	**18**
2 a.	Determine the safe load that can be carried by a bar of rectangular c/s shown in Fig. 2(a) limiting the maximum stress to 130 MPa and taking stress concentration into account.  Fig : 2a	10

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b. A stepped shaft circular c/s shown in fig 2(b) 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 concentration factor into account. 10

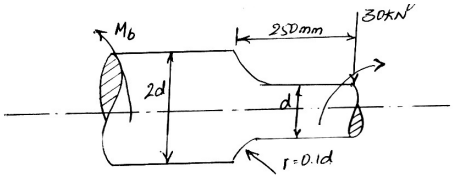

Fig: 2b

c. What is endurance limit? What are the factors that modify the endurance limit approximation? 8

UNIT - III **18**

3 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for the joint has the following design stresses. σ_t = 100 MPa, σ_c = 150 MPa and τ = 60 MPa. 12

b. Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weights 200 N and is located at 300 mm from the centre of bearing. The diameter of the pulley is 200 mm and maximum power transmitted is 1 kW at 120rpm. The angle of lap of the belt in 180° and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factor for bending and twisting are 1.5 and 2.0. The allowable shear stress in the shaft may be taken as 35 MPa. 12

c. Compare hallow shaft with solid shaft for strength, stiffness and weight. 6

UNIT - IV **18**

4 a. Design a double riveted lap joint with Zigzag riveting for 13 mm thick plates. The working stress to be used are σ_t = 80 MPa, τ = 60 MPa and σ_c = 120 MPa. State how the joint will fail and find the efficiency of the joint. 12

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. 4b. 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

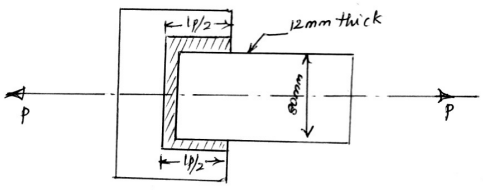

Fig. 4(b)

c. Explain the design procedure for circumfertial lap joint. 6

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UNIT - V **18**

5 a. A single start square threaded power screw is used to raise a load of 120 kN. The screw has a mean diameter of 24 mm and four thread per 24 mm length. The means collar diameter is 40 mm. The coefficient of friction is estimated as 0.1 for both thread and the collar. 12

i) Determine the major diameter of the screw

ii) Estimate the screw torque required to raise the load

iii) Estimate the overall efficiency

b. A cover plate is bolted on to the Hanged 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

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

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