Code No: 155AX

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, January/February - 2023
DESIGN OF MACHINE MEMBERS - I
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	Enumerate the most commonly used engineering materials.	[2]
b)	Distinguish between fluctuating stress, repeated stress and reversed stress.	[3]
c)	Describe the causes of stress concentration.	[2]
d)	Explain the difference between the Gerber curve and Soderberg and Goodman lines.	[3]
e)	Enumerate the different types of riveted joints.	[2]
f)	What are the assumptions made in the design of welded joints?	[3]
g)	Differentiate between a cotter and a key.	[2]
h)	Write the importance and applications of jib and cotter joints.	[3]
i)	What is the significance of BIS code in design of shafts? Discuss with an example.	[2]
j)	What is a coupling? Classify shaft couplings.	[3]

PART – B

(50 Marks)

2.a) Explain in detail about "Machine Design". List out various factors to be considered while designing a machine element.

b) A shaft is designed based on maximum energy of distortion as the criteria of failure and factor of safety of 2. The material used is 30C8 steel with Sy = 310 MPa. The shaft is subjected to an axial load of 40 kN. Determine the maximum torque that can be applied to the shaft before yielding. Diameter of shaft is 20 mm. [5+5]

OR

3.a) What is notch sensitivity? How it can influence the design parameters? Explain.

b) The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to i) Maximum principal stress theory; ii) Maximum shear stress theory; iii) Maximum distortion energy theory. And comment on the solution obtained. [5+5]

4.a) Write Soderberg's equation and state its application to different type of loadings. What information do you obtain from Soderberg diagram? Explain.

b) A beam supporting a load of 2.5 kN is shown in figure 1. The beam is made of brittle material, with an ultimate tensile strength of 300 N/mm^2. The factor of safety is 3. Determine the dimensions of the beam. [5+5]

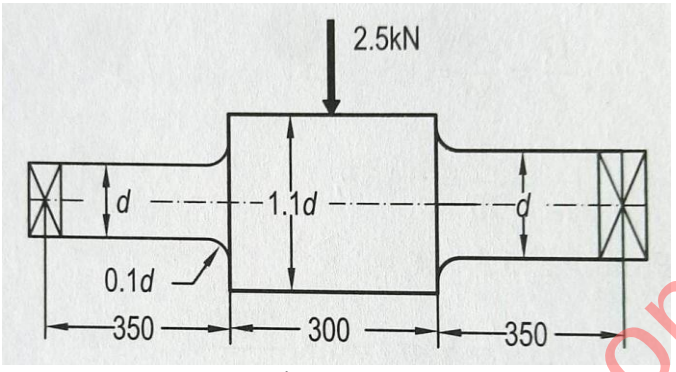

Figure 1

OR

5. A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design. [10]

6. A beam of rectangular cross-section is welded to a support by means of fillet welds as shown in figure 2. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 N/mm^2. [10]

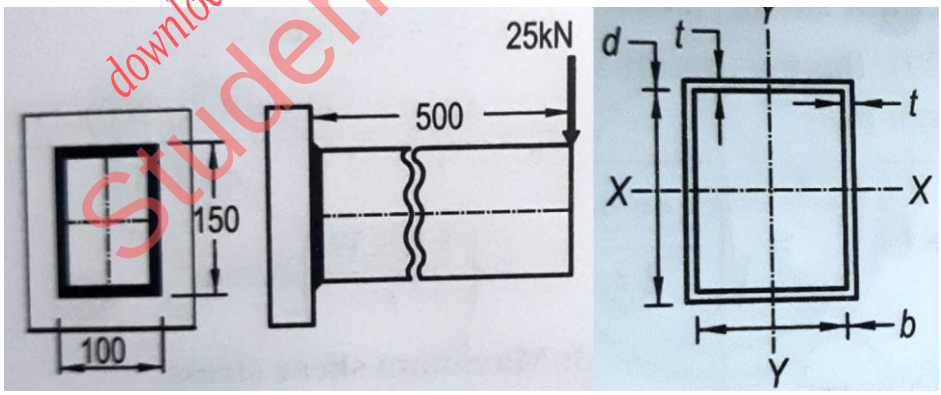

Figure 2

OR

7.a) Explain the design of bolt subjects to uniform loading.

b) A cylinder head is held on the cylinder by 8 numbers of bolts. The inner diameter of the cylinder is 350 mm. The pressure inside the cylinder varies from zero to a maximum pressure of 2.5 MPa. The ultimate tensile stress and yield stress are 630 MPa and 380 MPa respectively. The bolts are tightened with initial preload of 1.5 times the steam load. A copper asbestos gasket is used to make the joint leak proof. Take factor of safety is 2.5. Neglect stress concentration factor. Find the size of the bolt. [5+5]

8.a) The cross-section of a flat key for a 40 mm diameter shaft is 22 mm × 14 mm. The power transmitted by the shaft to the hub is 25 kW at 300 rpm. The key is made of steel ($S_{yc} = S_{yt} = 300$ N/mm^2) and the factor of safety is 2.8. Determine the length of the key. Assume ($S_{sy} = 0.577\ S_{yt}$).

b) Distinguish between feather key, flat key, and wood ruff key? Give their applications. [5+5]

OR

9.a) Describe the design procedure of a knuckle joint subjected to a normal loading.

b) It is required to design a knuckle joint to connect circular shafts subjected to an axial force of 50 kN. The rods are coaxial and a small amount of angular movement between their axes is permissible. Design the joint and specify the dimensions of its components. The allowable tensile, compressive and shear stress in the rod and pin material is limited to 80MPa, 100MPa and 40MPa respectively. [5+5]

10.a) Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.

b) Explain why hollow shaft has greater strength and stiffness than solid shaft of equal weight? [5+5]

OR

11.a) Explain the design procedure for Rigid flange coupling.

b) A rigid coupling is used to transmit 20 kW power at 720 rpm. There are four bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 ($S_{yt} = 380$ N/mm^2) and the factor of safety is 3. Assume ($S_{sy} = 0.577\ S_{yt}$) and determine the diameter of the bolts. Assume that the bolts are finger-tight in reamed and ground holes. [5+5]

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