

Introduction to Mechanical Design (ME-401)

Full Marks.: 70

Time : 3 hours

Use separate Answer script for each half
Attempt any three questions from each half
All the questions carry equal marks

First Half

1. (a) What do you understand by the term 'Mechanical Design'? Explain.
(b) Define Stress concentration.
(c) Suggest design changes, with neat sketches, for reduction of the effect of stress concentration for any four mechanical components.
2. (a) Show the distribution of stress around a hole in a plate subjected to tensile load.
(b) Write a short note on Notch sensitivity.
(c) Explain- why the effect of stress concentration on a ductile material is not severe under static loading?
3. (a) Write down the different applications of Knuckle Joint.
(b) A Knuckle joint connects two rods to carry axial tensile load of 100 kN. The eye, fork and the pin are made of same steel having allowable stresses which are as follows:
In Tension 60 MPa, in shear 45 MPa and in crushing 100 MPa.
Determine the salient dimensions of the joint and show those on a neatly drawn diagram.
4. Two rods are to be joined by a spigot and socket cotter joint to carry a load of 1 MN in tension. Design the joint. The material of all the elements of the joint is steel having following permissible stresses.
In tension 300 MPa, In crushing 450 MPa and In shear 275 MPa..

SECOND HALF

~~Full Marks/35~~

Attempt any Three questions.
All questions carry equal marks.

5. (a) Derive an expression for the maximum value of tensile stress developed in a fillet weld under bending.
(b) A rectangular cross sectioned member, the cross section being of length $l = 55$ mm and width $b = 75$ mm, is welded to a flat plate. The fillet weld is loaded eccentrically by a force of 11 kN acting at a distance of 260 mm from the welded end. If the permissible normal stress for the weld material is 75 MPa, determine the size of the weld.
6. (a) How do you classify riveted joints? What are the advantages and disadvantages of riveted joints? Explain the various ways of failure of riveted joints.
(b) A triple riveted lap joint is to be made between 7 mm thick plates, having zig-zag riveting. Calculate the diameter, pitch and distance between rows of the rivets for the joint. Also find the efficiency of the joint. Take, $f_s = 75$ MPa, $f_t = 100$ MPa and $f_c = 150$ MPa. Symbols have their usual meaning.
7. (a) Explain the importance of Preferred Numbers in design.
(b) Find an expression for the length of belt in a Flat-belt (open) drive.
(c) Find out the necessary expressions for the following
(i) Tensile strength of transverse fillet weld.
(ii) Shear strength of parallel fillet weld.
8. (a) Deduce an expression for the tension (T_c) in a flat belt drive due to centrifugal force.
(b) Design and select a flat-belt drive for a compressor running at 900 r.p.m. The compressor is driven by a 45 kW, 1600 r.p.m. motor. The available space for the centre distance is 5 m. The belt is open type and the belt velocity may be taken as 18 m/s.

Use the following table to determine the arc of contact factor (F_d)

Wrap angle(θ) in degree	120	130	140	150	160	170	180	190	200
F_d	1.33	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

The standard widths of the belts (in mm.) are the following:

3-ply	25	40	50	63	76					
4-ply	40	44	50	63	76	90	100	112	125	152
5-ply	76	100	112	125	152					
6-ply	112	125	152	180	200					

9. Write short notes on the following:

- (a) Advantages of welded joints over riveted joints.
(b) Riveted Lap joints and Riveted Butt joints.
(c) Advantages and disadvantages of flat belt drive.