Ref. No.: Ex/ME/5/T/313/2024

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)
THIRD YEAR, FIRST SEMESTER - 2024
MACHINE DESIGN- II

Time: 3 hours **Full Marks: 100**

Data if missing may be assumed reasonably
The symbols used in the questions, bear their usual meaning

Answer any Five questions

1. a) What do you understand by the efficiency of riveted joint? Draw and explain with the help of a simple riveted lap joint. [8]

   b) What are the advantages of butt joint over a lap joint in case of riveting [2]

   c) A bracket, attached to a vertical column by means of four identical rivets, is subjected to an eccentric force of 25 kN as shown in Fig. Q1c. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm^2. [10]

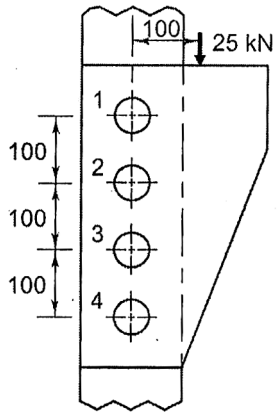

Fig. Q1c

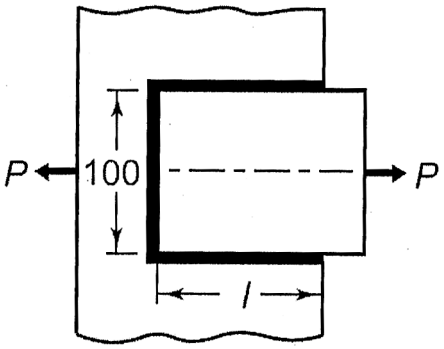

Fig. Q2a

2. a) Why are riveted joints nowadays largely replaced by welded joints? [2]

   b) A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds, as shown in Fig. Q2a. The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for both weld material and the plates are 70 and 50 N/mm^2 respectively. Assuming the tensile force acting on the plates as static,
   i) Find the length (l) of each parallel fillet weld.
   ii) If l is doubled, what is the percentage increase in the strength of the joint? [10]

   c) Derive the expression for torque required in case of lowering a load for a square threaded power screw. What is self-locking screw? [8]

3. a) Define the following: Nominal diameter, Root diameter and pitch diameter. Sketch if required. [5]

   b) What is the need of multi start threads? Name one application. [2]

   c) Name two popular methods of manufacturing threads. As a designer which one would you prefer and why? [3]

[Turn over

d) A bracket is fastened to the steel structure by means of six identical bolts as shown in Fig. Q3d Assume the following data: l_1 = 300 mm l_2 = 200 mm l_3 = 100 mm l = 250 mm P = 50 kN. Neglecting shear stress, determine the size of the bolts, if the maximum permissible tensile stress in any bolt is limited to 100 N/mm^2. [10]

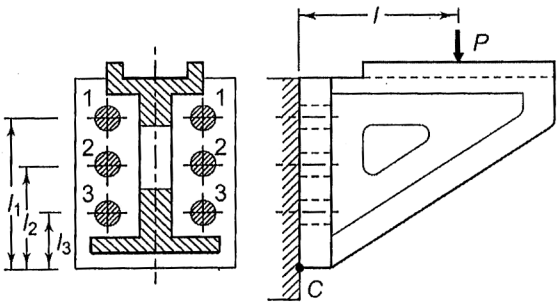

Fig. Q3d

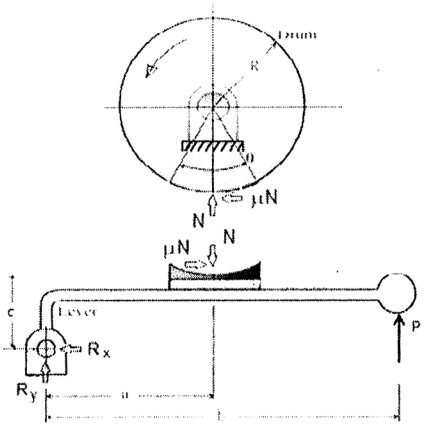

Fig. Q4b

4. (a) State the essential factors for brake design. [2]

(b) For a single block brake (Fig. Q4b) following are some input data: i) torque capacity = 35 Nm, ii) R = 400 mm, iii) a = 250 mm, iv) b = 550 mm, v) c = 80 mm, vi) friction coefficient of lining with steel drum = 0.4 and vii) θ = 14.36°.
If the width of lining is equal to its length, determine i) dimensions of the block, ii) actuating force P, iii) resultant reaction at hinge and iv) rate of heat generated for brake drum rotation of 100 rpm. [8]

c) A single plate clutch consists of only one pair of contacting surfaces. It is used for an engine, which develops a maximum torque of 120 N-m. Assume a factor of safety of 1.5 to account for slippage at full-engine torque. The permissible intensity of pressure is 350 kPa and the coefficient of friction is 0.35. Assuming uniform wear theory, calculate the inner and outer diameters of the friction lining. Assume the clutch is operating at maximum power transmitting capacity. [10]

5. Design and draw a socket and spigot type cotter joint for a load capacity of 20kN. Assume suitable materials and factor of safety for the components. List the dimensions at the end. [15+5]

6. Design and draw a rigid flange coupling for connecting two steel shafts for transmitting power of 30kW at 440 rpm. Assume suitable materials for the shafts, keys and sleeve with proper factor of safety. List the dimensions at the end. [15+5]

7. a) For a flat belt drive, derive the relation between the tight side tension and slack side tension. Consider the effect of centrifugal force. [10]

b) Design a spring for a balance to measure 0 to 1000 N over a suitable scale of length. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85kN/mm^2. Also calculate the maximum shear stress induced. [10]

8. Write short notes on the following (any 4) [4 × 5]
a) Caulking and Fullering
b) Initial tension in belt drive
c) Lozenge joint
d) Surge in springs
e) Stress relieving of welded joints

Data for Reference

Table 1: List of materials and their properties

Grade	Tensile strength (N/mm^2)	Yield strength (N/mm^2)
Cast Iron		
FG 150	150	--
FG 200	200	--
FG 260	260	--
FG 300	300	--
FG 400	400	--
Plain carbon steel		
7C4	320	--
10C4	340	--
30C8	500	400
40C8	580	380
45C8	630	380
50C4	660	460
55C8	720	460

Table 2: Proportions of standard parallel, tapered and gib head keys

Shaft diameter (mm) upto and including	*Key cross-section*		*Shaft diameter (mm) upto and including*	*Key cross-section*	
	Width (mm)	*Thickness (mm)*		*Width (mm)*	*Thickness (mm)*
6	2	2	85	25	14
8	3	3	95	28	16
10	4	4	110	32	18
12	5	5	130	36	20
17	6	6	150	40	22
22	8	7	170	45	25
30	10	8	200	50	28
38	12	8	230	56	32
44	14	9	260	63	32
50	16	10	290	70	36
58	18	11	330	80	40
65	20	12	380	90	45
75	22	14	440	100	50