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(AY:2025-26) December 2025 (ENDSEM) EXAM

T.Y. (SEMESTER - I)

COURSE NAME: Design of Machine Elements Branch:Mechanical COURSE CODE: ME31233

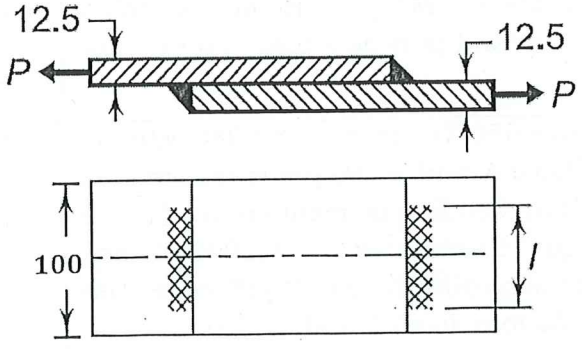
T.Y.B.Tech (Pattern 2023)

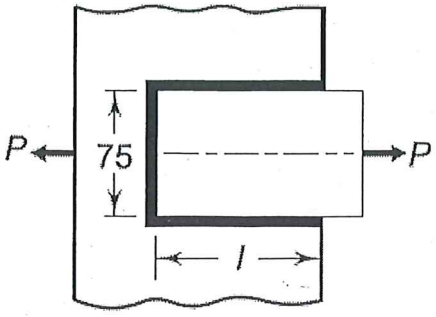
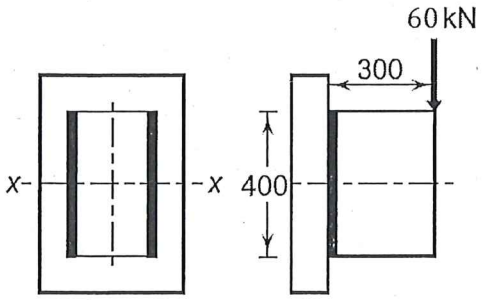
Time: [1Hr 30 Min] **[Max. Marks: 40]**

(*) Instructions to candidates:

1) **Figures to the right indicate full marks. Use of scientific calculator is allowed**
2) **Use suitable data wherever required**
3) **All questions are compulsory. Solve any two sub question each from Questions 1 , 2 ,3 and 4**

Q.No.	Question Description	Max. Marks	CO mapped	BT Level
Q1	a) Two rods are connected by means of a knuckle joint. The axial force P acting on the rods is 50 kN. The rods and the pin are made of plain carbon steel 45C8 (Syt = 380 N/mm^2) and the factor of safety is 3. The yield strength in shear is 57.7% of the yield strength in tension. Calculate: (i) the diameter of the rods, and (ii) the diameter of the pin.	[5]	1	3
	b) Illustrate step-by-step design procedure for a cotter joint to determine its main dimensions for a given axial load, considering failure modes and required calculations.	[5]	1	3
	c) Apply the concept of levers to illustrate the three cases of mechanical advantage (MA > 1, MA = 1, MA < 1) with neat sketches showing how to calculate the MA, and provide a practical example for each case.	[5]	1	3
Q2	a) A plain carbon steel 40C8 (S_{ut} = 650 N/mm^2 and S_{yt}= 380 N/mm^2) shaft supports two keyed pulleys A and B. Power is transmitted such that the maximum resultant bending moment on the shaft is 847703 N-mm and the torque transmitted is 225000 N-mm. Determine the shaft diameter according to the ASME code. Use stress concentration / fatigue factors: k_b =1.5 and k_t =1.0.	[5]	2	3
	b) A rotating shaft, 45 mm in diameter, is made of steel FeE 580 (S_{yt} = 580 N/mm^2). It is subjected to a steady torsional moment of 300 N-m and bending moment of 1600 N-m. Calculate the factor of safety based on, (i) maximum principal stress theory; and (ii) maximum shear stress theory.	[5]	2	3
	c) It is required to design a square key for fixing a gear on a shaft of 25 mm diameter. The shaft is transmitting 15 kW power at 720 rpm to the gear. The key is made of steel 50C4 (Syt = 460 N/mm^2) and the factor of safety is 3. For key material, the yield strength in	[5]	2	3

	compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key.			
Q3	a) Illustrate the concept of overhauling of the screw and self-locking screw with relevant equations	[5]	3	3
	b) The nominal diameter of a triple threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having an outer diameter of 100 mm and inner diameter as 65 mm. The coefficient of friction at the thread surface as well as at the collar surface can be taken as 0.15. The screw is used to raise a load of 20 kN. Using the uniform wear theory for collar friction, calculate: (i) torque required to raise the load; (ii) torque required to lower the load; and (iii) the force required to raise the load, if applied at a radius of 550 mm.	[5]	3	3
	c) A double-threaded power screw, with ISO metric trapezoidal threads is used to raise a load of 200 kN. The nominal diameter is 100 mm and the pitch is 12 mm. The coefficient of friction at the screw threads is 0.15. Neglecting collar friction, calculate (i) torque required to raise the load; (ii) torque required to lower the load; and (iii) efficiency of the screw.	[5]	3	3
Q4	a)) Two steel plates, 100 mm wide and 12.5 mm thick, are joined together by means of **double transverse** fillet welds as shown in Fig. The maximum tensile stress for the plates and the welding material should not exceed 110 N/mm^2. Find the required length of the weld, if the strength of weld is equal to the strength of the plates. 	[5]	4	3
	b) A plate, 75 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. The joint is subjected to a maximum tensile force of 75 kN. The permissible tensile and shear stresses in the weld material are 70 and 50 N/mm^2 respectively. Determine the required length of each parallel fillet weld.	[5]	4	3

	 c) A bracket is welded to the vertical plate by means of two fillet welds as shown in Fig. Determine the size of the welds, if the permissible shear stress is limited to 70 N/mm^2. 	[5]	4	3

Note: [BT Level: 1- Remember; 2-Understand; 3-Apply; 4-Analyse; 5-Evaluate; 6- Create]