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December 2023 (ENDSEM) EXAM

TY MECHANICAL (SEMESTER - I)

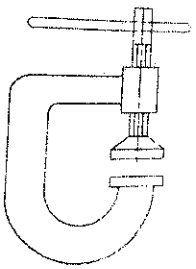
COURSE NAME: DESIGN OF MACHINE ELEMENTS **COURSE CODE: MEUA31204**

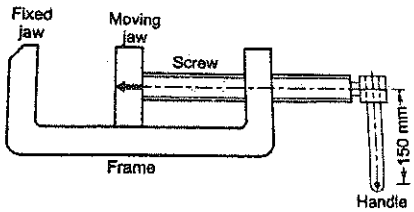
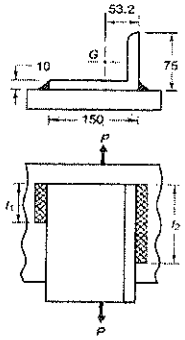
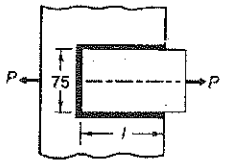
(PATTERN 2020)

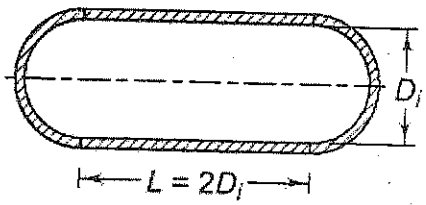
Time: [1Hr. 30 Min] **[Max. Marks: 40]**

(*) Instructions to candidates:

1) **Figures to the right indicate full marks.**
2) **Use of scientific calculator is allowed**
3) **Use suitable data wherever required**
4) **All questions are compulsory. Solve any one sub question from Question 3 and any two sub questions each from Questions 4,5 and 6 respectively.**

Q. No.	Question Description	Max. Marks	CO mapped	BT Level
Q.1	a) Explain the aesthetic and ergonomics considerations in Design.	[2]	1	2
Q2	a) Discuss the bushed pin flexible coupling.	[2]	2	2
Q3.	a) A C-clamp as shown in fig , is used on the shop floor has single start square threads of 22mm Nominal Diameter and 5 mm pitch. The coefficient of friction at the threads and the collar is 0.15. The mean radius of the friction collar is 15mm. The capacity of clamp is 750N. The handle is made of steel 30C8 (S_{yt}= 400MPa). It can be assumed that the operator exerts a force of 20N on the handle. i) Evaluate the torque required to tighten the clamp to its full capacity. ii) Determine the length and diameter of handle such that it will bend with a permanent set, when the rated capacity of the clamp is exceeded. 	[6]	3	3
	b) A machine vice, as shown in fig has single start, square threads with 22 mm nominal diameter and 5 mm pitch. The outer and inner Diameters of the friction collar are 55 and 45 mm respectively. The Coefficients of friction for thread and collar are 0.15 and 0.17 respectively. The machinist can comfortably exert a force of 125N on the handle at a mean radius of 150mm. Assuming uniform wear for the collar, calculate i) the clamping force developed between the jaws. ii)The	[6]	3	3

	overall efficiency of the clamp.  			
Q.4	a) Derive the method of determining the size of bolt when the bracket carries an eccentric load perpendicular to the axis of the bolt.	[5]	4	3
	b) How much length of a 10mm fillet angle 150 x 75 x 10 to a steel plate with side welds only? A static load of 125 KN. acts through the center of gravity of the angle section which is 53.2 mm from the short side as shown in fig.. The allowable load per mm of the weld length is 665 N.  	[5]	4	3
	c) 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 55kN. The permissible tensile and shear stresses in the weld material are 70 and 50 N/mm² respectively. Calculate the required length of each parallel fillet weld.  	[5]	4	3
Q.5	a) Interpret the Surge in Springs.	[5]	5	3
	b) A helical compression spring, made of circular wire, is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends and assume the gap is 0.5 mm between coils The spring is made of patented and cold-drawn steel wire with ultimate tensile strength of 1050 N/mm² and modulus of rigidity of 81370 N/mm². The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate	[5]	5	3

	(i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) total number of coils; (v) solid length of the spring; c) A railway wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500 kg. The springs are compressed by 150 mm in bringing the wagon to rest. The spring index can be taken as 6. The springs are made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Design the spring and calculate: (i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) total number of coils; (v) solid length;	[5]	5	3
Q.6)	a) Demonstrate Thin cylinder with Stresses. b) The piston rod of a hydraulic cylinder exerts an operating force of 10 kN. The friction due to piston packing and stuffing box is equivalent to 10% of the operating force. The pressure in the cylinder is 10 MPa. The cylinder is made of cast iron FG 200 and the factor of safety is 5. Determine the diameter and the thickness of the cylinder. c) An air receiver consisting of a cylinder closed by hemispherical ends is shown in Fig. It has a storage capacity of 0.25 m^3 and an operating internal pressure of 5 MPa. It is made of plain carbon steel 10C4 (Sut = 340 N/mm2) and the factor of safety is 4. Neglecting the effect of welded joints, determine the dimensions of the receiver.  	[5] [5] [5]	6 6 6	3 3 3

Note: [BT level 1: Remember 2: Understand 3: Apply 4: Analyze 5: Evaluate 6: Create]