

PRN No.	
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PAPER CODE	<b>V313-2114 (RE)</b>
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December 2023 (REEXAM)

TY MECHANICAL (SEMESTER - I)

COURSE NAME: DESIGN OF MACHINE ELEMENTS

COURSE CODE: MEUA31204

(PATTERN 2020)

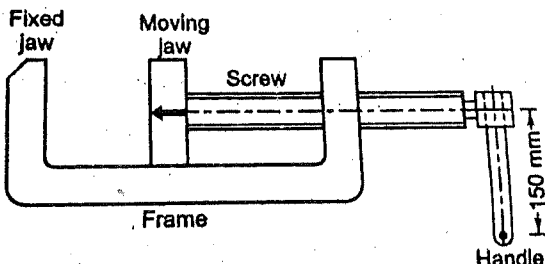
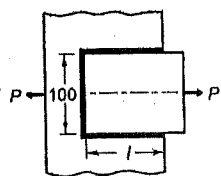
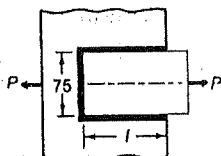
Time: [2 Hrs]

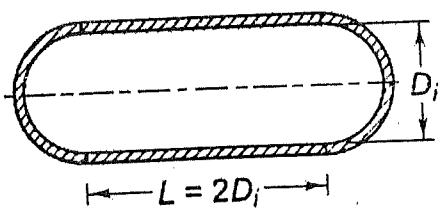
[Max. Marks: 60]

(\*) 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 two sub questions each from each Question 1 ,2, 3,4,5,and 6 respectively

Q. No.	Question Description	Max. Marks	CO mapped	BT Level
Q.1	a) Interpret the Standards in Design.	[5]	1	3
	b) Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter of the socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 ( $S_{yt} = 400 \text{ N/mm}^2$ ) and the factor of safety is 4. The width of the cotter is five times of thickness. Determine: (i) width and thickness of the cotter on the basis of shear failure; and (ii) width and thickness of the cotter on the basis of bending failure.	[5]	1	3
	c) Solve the numbers of R5 basic series from 1 to 10.	[5]	1	3
Q2	a) The armature shaft of a 40 kW, 720 rpm electric motor, mounted on two bearings A and B where the Maximum bending moment is 1200000 N-mm.. The shaft is made of steel with an ultimate tensile strength of 770 N/mm <sup>2</sup> and yield strength of 580 N/mm <sup>2</sup> . Determine the shaft diameter using the ASME code if, $k_b = 1.5$ and $k_t = 1.0$ Assume that the pulley is keyed to the shaft.	[5]	2	3
	b) A shaft is transmitting 97.5 Kw at 180 r.p.m. If the allowable shear stress in the material is 60 Mpa, Determine the suitable diameter for the shaft on the basis of strength and stiffness. The shaft is not to twist more than $1^\circ$ in a length of 3 meters. Take $G = 80 \text{ GPa}$ .	[5]	2	3
	c) It is required to design square key for fixing a pulley on the shaft, which is 50 mm in diameter. The pulley transmits 10 Kw power at 200 rpm to the shaft. The key is made of steel 45C8 ( $S_{yt} = S_{yc} = 380 \text{ N/mm}^2$ and FOS is 3. Solve the dimension of the key. Assume $S_{sy} = 0.577 S_{yt}$ .	[5]	2	3

Q3.	<p>a) Interpret the expression for Torque required for raise the load.</p> <p>b) Derive the equation for efficiency of the square threaded screw and also determine the expression for maximum efficiency.</p> <p>c) 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 overall efficiency of the clamp.</p> 	[5]	3	3
Q.4	<p>a) Interpret the welded joints.</p> <p>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. 8.12. 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 the weld material and the plates are 70 and 50 N/mm<sup>2</sup> respectively. Find the length of each parallel fillet weld. Assume the tensile force acting on the plates as static</p>  <p>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/mm<sup>2</sup> respectively. Calculate the required length of each parallel fillet weld.</p> 	[5] [5]	4 4	3 3

Q.5	a) Interpret the different types of 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/mm <sup>2</sup> and modulus of rigidity of 81370 N/mm <sup>2</sup> . The permissible shear stress for the spring wire should 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;	[5]	5	3
	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/mm <sup>2</sup> and modulus of rigidity of 81 370 N/mm <sup>2</sup> . 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;	[5]	5	3
Q.6)	a) Interpret the Autofrettage with three Methods?	[5]	6	3
	b) An air receiver consisting of a cylinder closed by hemispherical ends is shown in Fig. It has a storage capacity of 0.25 m <sup>3</sup> and an operating internal pressure of 5 MPa. It is made of plain carbon steel 10C4 (Sut = 340 N/mm <sup>2</sup> ) and the factor of safety is 4. Neglecting the effect of welded joints, determine the dimensions of the receiver. 	[5]	6	3
	c) 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.	[5]	6	3

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

