23RIPC211

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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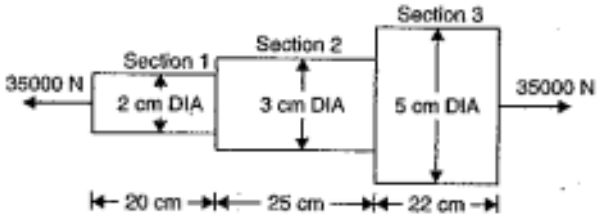
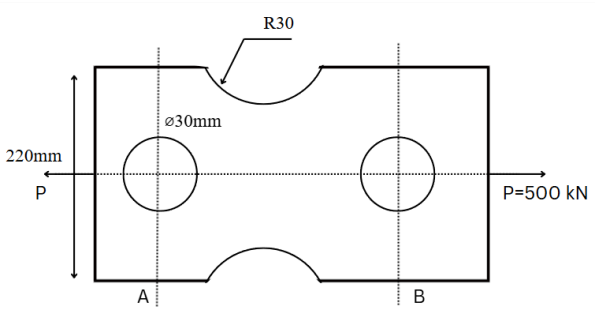
Model Question Paper
Fourth Semester BE Degree Examination
Design of Machine Elements

Time: 3 Hours **Max. Marks: 100**

Note: ***1. Answer any FIVE full questions, choosing ONE full question from each module.***
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	M	L	C
Q1	a.	Explain the following terms with examples: (i) Kinematic chain (ii) Inversion (iii) Degree of freedom (iv) Kinematic Pair	10	L2	CO1
	b.	Explain with a neat sketch the working of (i) Four bar mechanism (ii) Slider Crank Mechanism	10	L2	CO1
		OR			
Q2	a.	Explain with a neat sketch the working of (i) Pendulum Pump (ii) Double Lever Mechanism	10	L2	CO1
	b.	Explain with a neat sketch the working of (i) Beam Engine (ii) Pantograph	10	L2	CO1
		Module- 2			
Q3	a.	The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine: ▪ The linear velocity and acceleration of the midpoint of the connecting rod, and ▪ The angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.	10	L3	CO2
	b.	In a four bar chain ABCD, AD is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 RPM, clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°.	10	L3	CO2
		OR			
Q4	a.	A four-bar chain of links PQ, QR and RS are 62.5 mm, 175 mm and 120 mm long respectively, the link PS of chain is fixed and having length of 200mm.The link PQ makes an angle of 60° with PS and rotates at 10 rad/s clockwise. Determine (i) Angular velocity of links QR and RS. (ii) Angular acceleration of links QR and RS.	10	L3	CO2

	b.	In a pin-jointed four-bar mechanism as shown in the figure, AB = 300 mm, BC = CD = 360 mm, and AD = 600 mm, with ∠BAD = 60°. The crank AB rotates at 100 rpm. Locate all the instantaneous centres of the mechanism and determine the angular velocity of link BC and the linear velocity of point C.	10	L3	CO2
Module – 3					
Q5	a.	Derive the expression for the extension of uniformly tapering circular bar subjected to axial load.	10	L3	CO4
	b.	An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in Fig. 1.6 (b). If the Young's modulus = 2.1×10^5 N/mm², determine: (i) stresses in each section and (ii) total extension of the bar.  Fig. Q5(b)	10	L3	CO4
OR					
Q6	a.	Derive the expression for volumetric strain in a rectangular and circular bar subjected to axial loading.	10	L3	CO4
	b.	A bar of 20 mm diameter is tested in tension. It is observed that when a load of 37.7 kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and the contraction in diameter is 0.0036 mm. Find the Poisson's ratio and elastic constants E, G, and K.	10	L3	CO4
Module – 4					
Q7	a.	A plate of 45C8 steel (σ_{yt}=353MPa) is subjected to the following stresses. σ_x=150N/mm², σ_y=100N/mm² and τ_{xy}=50N/mm². Find the factor of safety by ▪ Maximum principal stress theory ▪ Maximum shear stress theory ▪ Distortion energy theory	10	L3	CO3
	b.	A rod of circular section is to sustain a torsional moment of 300kN-m and bending moment 200kN-m. Selecting 45C8 steel (σ_{yt}=353MPa) and assuming factor of safety=3, determine the diameter of rod as per following of failure, ▪ Maximum shear stress theory ▪ Distortion energy theory or shear energy theory	10	L3	CO3
OR					

Q8	a.	Derive Soderberg's equation and Goodman's equation for failure under fatigue loading.	10	L3	CO3
	b.	A machine element is loaded as shown in fig-8b. Determine a safe value for the thickness of the plate. Material selected for the machine element has design stress of 200MPa.  Fig-8b	10	L3	CO3
		Module – 5			
Q9	a.	A shaft running at 200 rpm drives another shaft at 400 rpm. It transmits 75kw through an open belt The smaller pulley is of 500 mm diameter and the distance between the centers is 4m. Assuming the coefficient of friction between the belt and pulley to be 03, calculate the tension in the tight and slack side of the belt.	10	L3	CO5
	b.	A leather belt is required to transmit 8kw from a pulley 1.5m diameter running at 240rpm. The angle of contact is 160° and the coefficient of friction between belt and pulley is 0.25. The safe working stress for leather is 15 MPa and density of leather is 1000 kg/m^3. Determine The width of the belt if its thickness is 10mm. Take into account, the effect of centrifugal tension.	10	L3	CO5
		OR			
Q10	a.	Specify the details of a spur gear to transmit 20 kW at 1200 rpm. The teeth are of 20° full depth involute system, having 16 teeth on pinion and a speed ratio of 3:1. Assume that the starting torque is 20% more than the mean torque. Assume material-C45 Untreated steel, Check whether the material is safe against wear or not. If not, mention the design corrections to be made for safer operations.	20	L3	CO5