MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

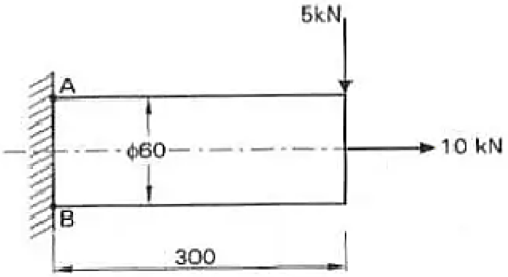
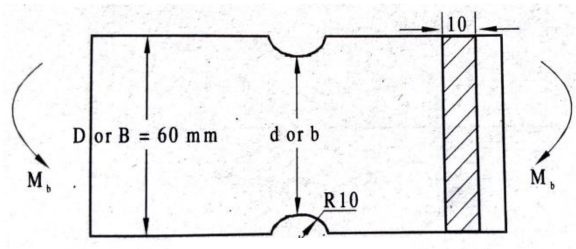
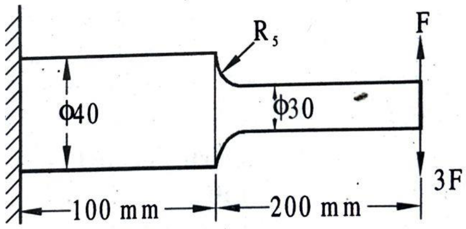
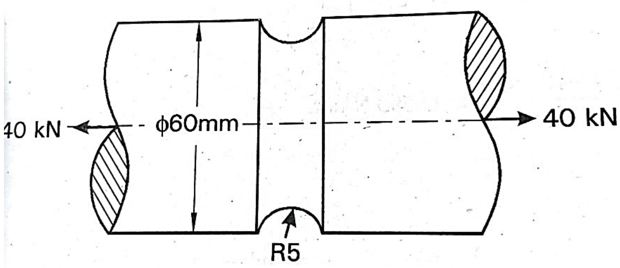
Fifth Semester BE Degree Examination

Mechanism and Design of Machine Elements

Time: 3 Hours (180 Minutes) **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.
3. Use of design data handbook is permitted.

		Module -1	M	L	C
Q1	a.	Explain in brief the following terms: (i) Mechanism (ii) Machine (iii) Degrees of freedom (iv) Kinematic Pair (v) Inversion	10	L2	CO1
	b.	Explain with a neat diagram the Whitworth Quick Return mechanism.	10	L2	CO1
		OR			
Q2	a.	Explain any two inversions of a four-bar kinematic chain with a neat sketch.	10	L2	CO1
	b.	Explain intermittent motion mechanisms with any two relevant examples.	10	L2	CO1
		Module- 2			
Q3	a.	Two pulleys of diameters 450 mm and 150 mm are mounted on two parallel shafts 2 m apart and are connected by a flat belt drive. Determine the power that can be transmitted by the belt when the larger pulley rotates at 180 rpm. The maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and the pulley is 0.25.	10	L3	CO2
	b.	A flexible belt wraps around a pulley with a contact angle of 160°. The coefficient of friction between belt and pulley is 0.3. If the slack-side tension is $T_2 = 200\ N$, (a) derive the expression for the ratio T_1/T_2, and (b) calculate the tight-side tension T_1.	10	L3	CO2
		OR			
Q4	a.	A cam of base circle 50 mm is to operate a roller follower of 20 mm diameter. The follower is to have SHM. The angular speed of the cam is 360 rpm. Draw the cam profile for the cam lift of 40 mm. Angle of ascent=60°, angle of dwell=40°, and angle of descent=90°, followed by dwell again.	20	L3	CO2
		Module – 3			
Q5	a.	A rod of circular section is to sustain a torsional moment of 300 KN-m and a bending moment of 200 kN-m. Selecting C45 steel ($\sigma_{yt} = 353\ MPa$) and assuming a factor of safety of 3, determine the diameter of the rod as per the following theories of failure: (i) Maximum Shear Stress Theory (ii) Distortion Energy Theory	10	L3	CO3
	b.	A beam of uniform rectangular cross section is fixed at one end and carries a load of 100N at a distance of 300 mm from the fixed end. The maximum bending stress in the beam is 80 N/mm^2. Calculate the width of the beam if the depth is twice as that of the width.	10	L3	CO3
		OR			
Q6	a.	A plate of 45C8 steel $\left(\sigma_{yt} = 353\ MPa\right)$ is subjected to the following stresses: $\sigma_x = 150 N/mm^2$, $\sigma_y = 100 N/mm^2$, and $\tau_{xy} = 50 N/mm^2$. Determine the	10	L3	CO3

		factor of safety of the design by (i) Maximum Principal Stress Theory (ii) Maximum Shear Stress Theory			
	b.	A circular rod of 60 mm diameter is subjected to the loads as shown in Fig. 6b below. Determine the nature and magnitude of stresses at the critical points.  Fig. 6b	10	L3	CO3
Module - 4					
Q7	a.	A notched plate shown in Fig. 7a is subjected to the bending moment of 10 Nm. Determine the maximum stress induced in the member by taking the stress concentration into account.  Fig. 7a	10	L3	CO4
	b.	A cantilever beam shown in Fig. 7b is subjected to load variation from -F to 3F. Determine the maximum load that this member can withstand for an infinite life, using a factor of safety of 2. The material of the beam is SAE 105 water quenched steel ($\sigma_u = 620.8\ MPa$; $\sigma_y = 400.1\ MPa$; $\sigma_{-1} = 345.2\ MPa$)  Fig. 7b	10	L3	CO4
OR					
Q8	a.	Determine the maximum stress induced in the semi-circular grooved shaft shown in Fig. 8a, if it is subjected to an axial load of 40 kN.  Fig. 8a	10	L3	CO4

	b.	A steel rod of ultimate strength 600 N/mm^2 and yield strength 400 N/mm^2 is subjected to a cyclic torque ranging from 350 Nm to -100 Nm. Calculate the diameter of the rod. Torsional yield stress = 70% σ_y, Average endurance limit = 50% σ_u, shear stress concentration factor = 1.3, and factor of safety = 1.8.	10	L3	CO4
Module – 5					
Q9	a.	Design a pair of spur gear to transmit 40 kW at 4000 rpm of pinion to the gear at 800 rpm. Assume number of teeth on pinion as 20.	10	L3	CO5
	b.	A pair of helical gears are used to transmit 15 kW. The teeth are 20° FDI in the normal plane and having helix angle 30°. Pinion has 24 teeth and operates at 10000 rpm. The velocity ratio is 5:1. Pinion is made of cast steel, $\sigma_d = 50\ MPa$ and gear of bronze, $\sigma_d = 40\ MPa$. Check for dynamic and wear strength. Assume precision gear.	10	L3	CO5
OR					
Q10	a.	A cast steel 24 teeth spur pinion operating at 1150 rpm transfers 2 kW to a cast steel 56 teeth spur gear. The gears have the following specifications: m = 3 mm, phase width = 35 mm, $\sigma_{allowable}$=100 MPa, tooth form $-$ 14½° FD profile, factor of dynamic loading = 350, wear load factor = 0.28. Determine the induced stress in the weaker gear. Also, determine the dynamic and wear load and comment on the results.	10	L3	CO5
	b.	A helical gear transmits 34 kW at a pinion speed of 2800 rpm. The speed reduction ratio is 4.5, and the helix angle is 45°. Material for both pinion and gear is medium carbon steel ($\sigma_d = 230\ MPa$). The pinion diameter is 120 mm. Using the given data, evaluate and justify the suitability of the gear design with respect to wear considerations.	10	L3	CO5

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