CBCS SCHEME

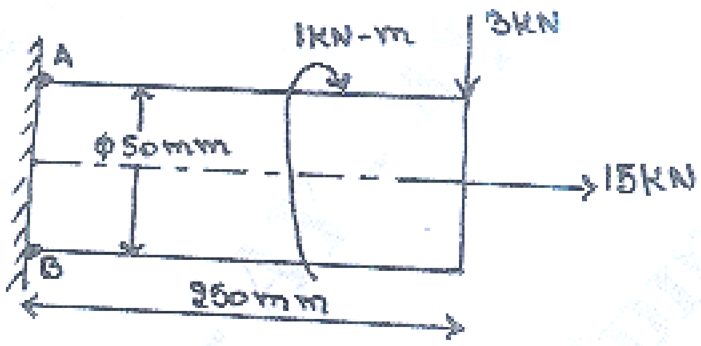
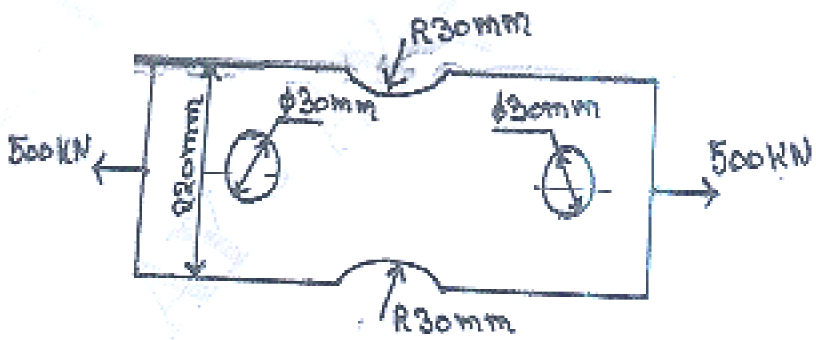
USN

BME602

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Machine Design

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Design Data Hand Book is permitted.

		Module – 1	M	L	C
Q.1	a.	Explain the factors which influence the selection of engineering materials?	5	L2	CO1
	b.	Explain Codes and Standards.	5	L2	CO1
	c.	A circular rod of diameter 50 mm is subjected to an axial, bending and torsional loads as shown in Fig Q1(c). Determine the nature and magnitude of stresses at the critical points.  Fig Q1(c)	10	L3	CO1
		OR			
Q.2	a.	Define Stress concentration and discuss any two methods of reducing stress concentration.	6	L1	CO1
	b.	Explain the following theories of failure i) Maximum Normal Stress Theory ii) Maximum Shear Stress Theory iii) Distortion Energy Theory	6	L2	CO1
	c.	A bar of rectangular section is subjected to an axial pull of 500 kN as shown in Fig Q2(c). Determine the thickness of the plate, if the allowable tensile stress is 200 MPa.  Fig Q2(c)	8	L3	CO1

			Marks	Level	CO
		Module – 2			
Q.3	a.	A shaft is supported by two bearings placed in apart. A 500 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3000N. The pulley weight 1000N. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from the left bearing. This pulley weight 500N. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine suitable diameter of solid shaft, assuming torque on one pulley is equal to torque on other pulley. Choose C15 steel ($\sigma_y = 235.4$ MPa, $\sigma_u = 425$ MPa) as the shaft material and use ASME code for the design of shaft. Assume minor shock condition.	20	L3	CO3
		OR			
Q.4	a.	Prove that a square key is equally strong in shear and compression.	5	L3	CO3
	b.	Design a flange coupling to connect the shafts of a motor and centrifugal pump for the following specification pump output = 3000 liters/minute, Total head = 20 m, Pump speed = 600 rpm, Pump efficiency = 70%, Select C-40 steel ($\sigma_y = 328.6$ MPa) for shaft and C-35 steel ($\sigma_y = 304$ MPa) for bolts with factor of safely 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2.	15	L3	CO3
		Module – 3			
Q.5	a.	Design a triple riveted Lap Joint with zig-zag riveting, for a pressure vessel of 1.5 m diameter. The maximum pressure inside vessel is 1.5 MPa. The allowable stresses in tension, crushing and shear are 100 MPa, 125 MPa and 75 MPa respectively. Take efficiency as 75%.	10	L3	CO3
	b.	A plate of 80 mm wide and 10 mm thick is to be collected to another plate by means of two parallel fillet welds. The plates are subjected to an axial load of 50kN. Find the length of the weld so that maximum stress does not exceed 50 N/mm^2. Consider the joint under static loading and then under dynamic loading.	10	L3	CO3
		OR			
Q.6	a.	A pair of carefully cut spur gears with 20° full depth involute profile is used to transmit 12 kW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium. Carbon steel having allowable stress of 230 MPa. Design the gear completely. Take Number of teeth on pinion as 24.	20	L3	CO4
		Module – 4			
Q.7	a.	Design a pair of bevel gears to transmit 12kW at 300 rpm of gear and 1470 rpm of the pinion. The angle between the shaft axes is 90°. The pinion has 20 teeth and the material for both pinion and gear is cast steel having allowable stress of 188.33 MPa. Take service factor as 1.25. Suggest suitable surface hardness for the gear pair.	20	L3	CO4

		OR			
Q.8		Complete the design and determine the input capacity of a worm gear speed reducer unit which consists of a hardened steel worm and a phosphor bronze gear having 20° stub involute teeth. The center distance is to be 200 mm and transmission ratio is 10 and the worm speed is 2000 rpm.	20	L3	CO4
		Module – 5			
Q.9	a.	In a machine the radial width of the friction material is 0.2 times the maximum radius. Take coefficient of friction as 0.25, maximum diameter of the clutch is 250 mm, axial force is 600 N, power is 60 kW and the speed is 3000 rpm. Find how many discs are required, also find the pressure at the contact surface.	10	L3	CO3
	b.	A simple band brake operates on 600 mm diameter brake down, running at 200 rpm and has a contact angle of 270°. The coefficient of friction is 0.25, one end of the band is connected to a pin and the other end at a distance of 125mm from the pin and 625 mm from the free end of the lever, where the operating force is applied. Find the maximum pull required, if 50 kW power is absorbed and what is the direction of minimum pull, if the maximum tensile stress in the band is limited to 50 MPa. Find width and thickness of the band. Also design the lever if depth is 2 times the width of the lever.	10	L3	CO3
		OR			
Q.10	a.	Derive Petroff's equation for coefficient of friction. Also state the assumption made.	10	L3	CO5
	b.	A turbine shaft 60 mm in diameter, rotates at a speed of 1000 rpm. The load on each bearing is estimated at 2 kN and the length of the bearing is 80 mm. Taking radial clearance as 0.05 mm and SAE – 20 oil for lubrication. Determine the coefficient of friction by Mckee's equation, power loss, minimum oil film thickness and the oil flow rate. The temperature of the bearing is not to exceed 50°C.	10	L3	CO5

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