CBCS SCHEME

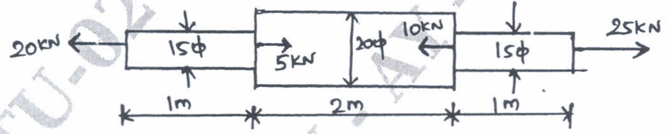
USN 1 A 4 2 1 A E 0 0 5

BAE304

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Mechanics of Materials

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.

		Module – 1	M	L	C
Q.1	**a.**	With help of neat sketches, explain the stress-strain diagram for ductile and brittle material.	10	L1	CO1
	b.	Derive the 3-D equilibrium equations for the state of stress.	10	L1	CO1
		OR			
Q.2	**a.**	A steel bar ABCD 4 m long is subjected to forces as shown in Fig.Q.2(a). Find the elongation of the bar. Take E for steel as 200 GPa.  Fig.Q.2(a)	10	L3	CO1
	b.	A plane element in a rotary machine is subjected to tensile stresses of 400 MPa on one plane and 150 MPa on the other at right angles to the former. Each of the above stresses is accompanied by a shear stress of 100 MPa such that when associated with the minor tensile stress tends to rotate the element in anticlockwise direction. Find: i) Principal stresses and their directions ii) Maximum shearing stresses and the directions of the plane on which they act.	10	L3	CO1
		Module – 2			
Q.3	**a.**	Derive the relation between shear force and bending moments.	6	L2	CO2
	b.	A beam is freely supported over a span of 6 m. It carries a UDL of 3 kN/m over 1.5 m from the left hand support and also from the center upto the right hand support. It has besides, two point loads of 2 kN and 5 kN at 1.5 m and 4.5 m from left hand support. Construct the SF and BM diagrams. Find the maximum bending moment.	14	L3	CO2
		OR			
Q.4	**a.**	Elucidate the implications of Euler-Bernoulli assumptions.	8	L1	CO2
	b.	A 400 mm × 150 mm I girder has 20 mm thick flanges and 30 mm thick web. Calculate maximum intensity of shear stress when the shear force at the cross section is 1.6 MN. Also sketch the shear stress distribution across the depth of beam.	12	L4	CO2

		Module – 3			
Q.5	**a.**	Derive the equations for slope, deflection and bending moment in differential form.	**10**	**L2**	**CO2**
	b.	A steel cantilever 6 m long carries two point loads, 15 kN at the free end and 25 kN at a distance of 2.5 m from the free end. Find : i) Slope at the free end ii) Deflection at the free end Take $I = 1.3 \times 10^8\ mm^4$ and $E = 2 \times 10^5\ N/mm^2$ using double integration method.	**10**	**L4**	**CO2**
		OR			
Q.6	**a.**	A solid shaft of diameter 100 mm is required to transmit 150 kW at 120 rpm. If the length of the shaft is 4 m and modulus of rigidity for the shaft is 75 GPa. Find the angle of twist.	**10**	**L3**	**CO2**
	b.	List the assumptions made in the theory of pure torsion and derive the equation for torque transmitted by a solid circular shaft.	**10**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Explain the principle of virtual work for a particle with relevant equations.	**10**	**L1**	**CO2**
	b.	Describe the work done by internal force systems with relevant equations and explain the sign conventions of internal virtual work.	**10**	**L2**	**CO2**
		OR			
Q.8	**a.**	State and derive the Maxwell's Reciprocal Theorem.	**10**	**L2**	**CO2**
	b.	State and derive the Castigliano's Energy Theorems.	**10**	**L2**	**CO2**
		Module – 5			
Q.9	**a.**	Define fracture. Explain the three types/modes of fracture with neat sketch.	**10**	**L1**	**CO3**
	b.	Define creep. Illustrate the stages of creep and explain.	**10**	**L1**	**CO3**
		OR			
Q.10	**a.**	Define fatigue. With the help of S-N diagram explain the fatigue in detail.	**10**	**L1**	**CO3**
	b.	With neat sketch, explain anyone methods of fatigue testing.	**10**	**L1**	**CO3**

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