BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

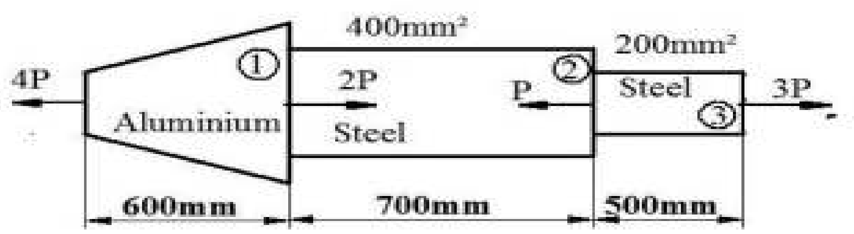
USN | | | | | | | | | | | **Course Code** | 2 | 1 | C | V | 3 | 3 |

Third Semester B.E. Degree Examinations, March/April 2023
STRENGTH OF MATERIALS

Duration: 3 hrs **Max. Marks: 100**

Note: ***1. Answer any* FIVE *full questions, choosing* ONE *full question from each module.***
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO: PI)
		MODULE – 1		
1.	**a.**	With a neat sketch demonstrate stress-strain curve for mild steel	**04**	(1 :1: 1.6.1)
	b.	Derive the expression for extension of rectangular tapering bar subjected to an axial load P.	**06**	(2 :1: 1.6.1)
	c.	A round bar with stepped portion is subjected to the forces as shown in Figure. Determine magnitude of force P such that the net deformation in the bar does not exceed 1mm.Young's modulus for steel is 200 GPa and that for aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40 mm and 12.5 mm respectively.	**10**	(3 :1: 1.7.1)



OR

Q. No		Question	Marks	(RBTL:CO: PI)
2.	**a.**	Derive the relation between modulus of rigidity (shear modulus) and modulus of elasticity	**08**	(2 :1: 1.6.1)
	b.	A steel rod of 18 m long at a temperature of 25 C^{O}. Find the free expansion when the temperature is raised to 85 $C^{O.}$ Also find the temperature stress produced when: i) The expansion is fully prevented. ii) The rod is permitted to expand by 4.5 mm, E = 200 kN/mm^2 and $\alpha = 12X10^{-6}/C^{O}$.	**12**	(3 :1: 1.7.1)
		MODULE – 2		
3.	**a.**	Derive the relationship between load intensity, shear force and bending moment	**06**	(2 :2: 1.6.1)
	b.	A beam AD 20 m long supported on two intermediate supports 12 m apart carries a uniformly distributed load 60 kN/m run together with concentrated loads of 300 kN at, the left end A and 500 kN at the right end D. The supports are so placed that the reaction is same at each support find the position of the supports and draw SFD and BMD. Also indicate the values of maximum bending moment and shear force.	**14**	(3 :2: 1.7.1)

OR

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

4.	**a.**	A simply supported beam AB of span ‘I’ is subjected to an eccentric point load W at a distance of ‘a’ From left support and ‘b’ from right support. Develop the general expressions for shear force and bending moment. Draw BMD and SFD.	**10**	(2 :2: 1.6.1)
	b.	An overhanging beam is of total length 5 m. The supported length AB = 4 m. The length of overhang BC=1m.There is a UDL of 20 kN/m stating from A up to length of 2 m. There is a point load of 40kn at a 2m from A. Another point load of 20 kN is acting at the free end of overlapping portion, Draw SFD and BMD. Find the values of maximum SF and BM. Also locate the point of contraflexure.	**10**	(3 :2: 1.7.1)

MODULE – 3

5.	**a.**	Formulate the general bending equation $\frac{M}{I} = \frac{\sigma\, \sigma}{y} = \frac{E}{R}$ with usual notations	**08**	(1 :3: 1.6.1)
	b.	A T-section is having a flange of 200 mm x 50 mm. The web is also 200 mm x 50 mm. It is subjected to a bending moment of 15 kN-m and shear force of 50 kN. Draw the bending stress and shear stress distribution across the section indicating the salient values.	**12**	(3 :3: 1.7.1)

OR

6.	**a.**	Draw the shear stress diagram for a rectangular beam section and show the maximum shear stress is 1.5 times average shear stress.	**08**	(1 :3: 1.6.1)
	b.	A beam of I section consists of 180 mm x 15 mm flanges and web of 280 mm depth and 15 mm thickness. It is subjected to a bending moment of 120 kN-m and shear force of 60 kN. Sketch the bending and shear stress distribution along the depth of the section.	**12**	(3 :3: 1.7.1)

MODULE – 4

7.	**a.**	Derive the torsion equation in case of a solid shaft with assumption.	**08**	(2 :4: 1.6.1)
	b.	A solid shaft is to transmit 340 kN-m @120rpm.If the shear stress of the material should not exceed 80 MPa. Find the diameter required. what percentage saving in weight would be obtained if this shaft is replaced by a hallow one whose d_i=0.6d_o, the length material and shear stress	**12**	(3 :4: 1.7.1)

OR

8.	**a.**	Derive the expressions for normal and tangential components of stress on 2-D plane.	**08**	(2 :4: 1.6.1)
	b.	In a 2-D stress system compressive stresses of magnitudes 100 MPa and 150 MPa act in two perpendicular directions. Shear stresses on these planes have magnitude of 80 MPa. Use Mohr's circle to find, (i) Principal stresses and their planes (ii) Maximum shears stress and their planes and (iii) Normal and shear stresses on a plane inclined at 45^0 to 150 MPa stress.	**12**	(3 :4: 1.7.1)

MODULE – 5

9.	**a.**	Derive the expression for Euler’s buckling load for a column with both ends fixed.	**08**	(2 :5: 1.6.1)
	b.	A solid round bar 4 m long and 50 mm in diameter is used as a strut with both ends fixed. Compare Euler’s crippling load and Rankine’s crippling load for the bar and also find the length of bar for which both formulas give same load. Take E = 80 GPa.α = 1/1600, σ_c= 550 MPa.	**12**	(3 :5: 1.7.1)

Note: (**RBTL - Revised Bloom’s Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

OR

10.	**a.**	Formulate the equation for slope and deflection for simply supported beam carrying UDL over the entire span.	**08**	(2 :5: 1.6.1)
	b.	A simply supported steel beam having uniform cross section is 6 m long. It carries a concentrated load of 48 kN and 40 kN at two points 1m and 3m from left end support. If the moment of inertia of the section is $85x10^6$ mm^4 and E= 200 GPa calculate (i) Deflection under loads (ii)Maximum deflection (iii)slope at right hand support.	**12**	(3 :5: 1.7.1)

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Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**