Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	M	E	3	4

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

MECHANICS 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.**	Define (i) Hooke's Law (ii) Poisson's Ratio	**04**	(1 :1: 1.6.1)
	b.	Draw the Stress-Strain diagram for ductile material and explain its salient features.	**06**	(2 :1: 1.6.1)
	c.	A stepped bar is subjected to an external loading as shown in Fig. 1(c). Calculate the change in length of the bar. Take E = 200 GPa for steel, 70 GPa for aluminium, 100 GPa for copper.	**10**	(3 :1: 1.7.1)

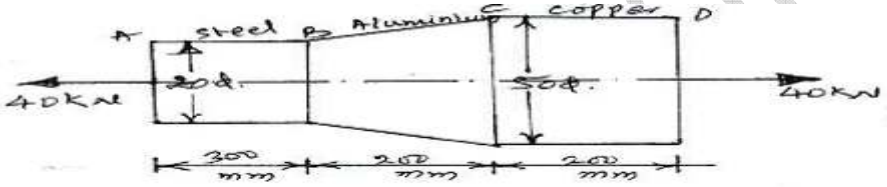

Fig. 1 (c)

OR

2.	**a.**	Derive the relation between E, G and K.	**10**	(2 :1: 1.6.1)
	b.	The composite bar shown in Fig. 2(b) is subjected to tensile load of 30KN, extension observed is 0.74 mm, Find the Young's Modulus of Brass if Young's Modulus of steel is $2x10^5$ MPa.	**10**	(3 :1: 1.7.1)

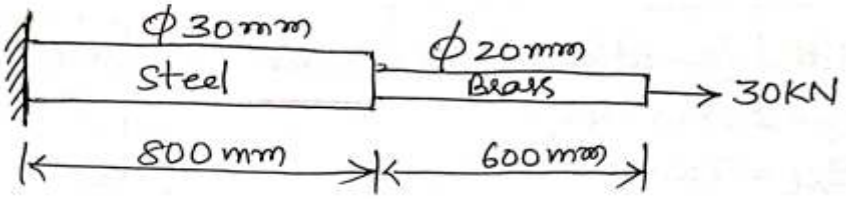

Fig. 2 (b)

MODULE – 2

3.	**a.**	Derive the expressions for normal and tangential components of stress on 2-D plane.	**10**	(2 :2: 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.	**10**	(3 :2: 1.7.1)

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

OR

4.	**a.**	Derive the expression for hoop stress and longitudinal stress in case of thin cylinder?	**10**	(2 :2: 1.6.1)
	b.	A water pipe 800 mm diameter contains water at a pressure head of 100 meters. If the specific weight of water is 9810 N/m^3. Find the thickness taking permissible stress as 20 MPa.	**10**	(3 :2: 1.7.1)

MODULE – 3

5.	**a.**	Define (i) Sagging Moment (ii) Hogging Moment	**06**	(1 :3: 1.6.1)
	b.	Draw the SFD and BMD for the overhanging beam shown in Fig. 5 (b).	**14**	(3 :3: 1.7.1)

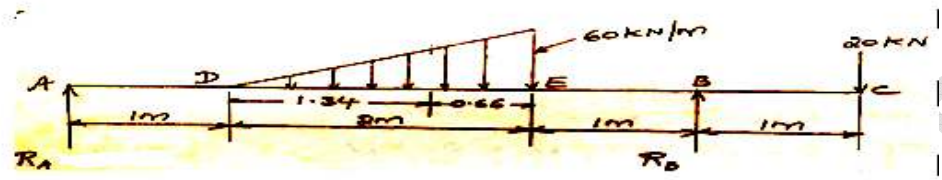

Fig. 5 (b)

OR

6.	**a.**	List the assumptions made in the derivation of Euler's buckling load	**10**	(1 :3: 1.6.1)
	b.	Determine the buckling load for a T- section shown in Fig. 6(b) having 3 m long and hinged at both ends. Take E = 200 GPa	**10**	(3 :3: 1.7.1)

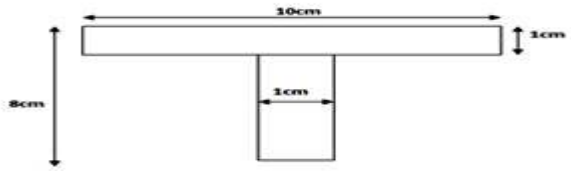

Fig. 6 (b)

MODULE – 4

7.	**a.**	Derive and expression for deflection and slope of a beam subjected to Uniform bending moment?	**10**	(2 :4: 1.6.1)
	b.	A beam of length 5 m and of uniform rectangular section is supported at its ends and carries UDL over entire length. Calculate the depth of section if the maximum permissible bending stress is 8 N/mm^2 and central deflection is not to exceed 10 mm.	**10**	(3 :4: 1.7.1)

OR

8.	**a.**	Derive the torsion equation in case of a solid shaft with assumption.	**10**	(2 :4: 1.6.1)
	b.	A stepped shaft is subjected to a torque as shown in Fig. 8(b). Determine the angle of twist at free end. Take G = 80 kN/mm^2. Also find the maximum shear stress in all steps.	**10**	(3 :4: 1.7.1)

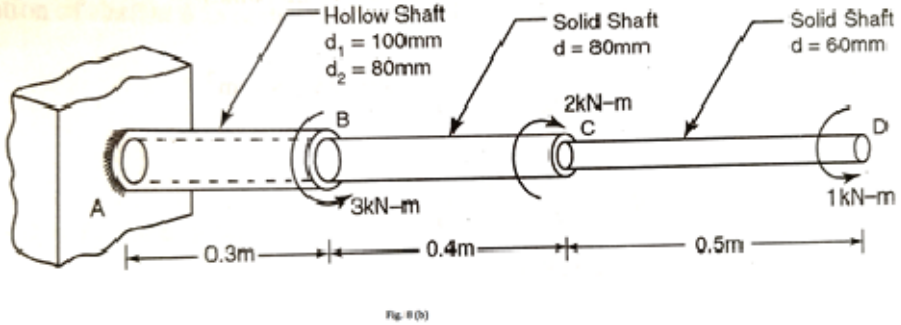

Fig. 8 (b)

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

MODULE – 5

9.	**a.**	Derive the Euler's expression for a column subjected to an axial compressive load. Consider both ends of column as hinged.	**10**	(2 :5: 1.6.1)
	b.	A 2 m long pin ended column of square section is made of a material with E = $12x10^3$ MPa and allowable stress of 12 N/mm^2. Determine the dimension of column using Euler's equation for the loads 95 KN. Use a factor of safety of '3'.	**10**	(3 :5: 1.7.1)

OR

10.	**a.**	Derive an expression for strain energy stored in a body when the load is applied gradually.	**12**	(2 :5: 1.6.1)
	b.	A weight of 10 kN falls by 30 mm on a collar rigidly attached to a vertical bar 4 m long and 1000 mm^2 in section. Find the instantaneous expansion of the bar. Take E = 210 GPa.	**08**	(3 :5: 1.7.1)

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