Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

AU3CO19 / FT3CO25 / ME3CO19

Mechanics of Materials

Programme: B.Tech. Branch/Specialisation: AU/FT/ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. The unit of young's Modulus is- **1**

(a) N/mm^2 (b) N/mm (c) N/mm^3 (d) None of these

ii. The relationship between Young's modulus (E), Bulk modulus (K) and Poisson's ratio (μ) is given by-s **1**

(a) E=2K(1-2μ) (b) E=3K(1-2μ)

(c) E=2K(1-2μ) (d) E=2K(1-3μ)

iii. If the principal stresses in a plane stress problem are σ_1= 120 MPa, σ_2= 60 MPa, the magnitude of the maximum shear stress (in MPa) will be- **1**

(a) 60 (b) 50 (c) 30 (d) 20

iv. On principal plane the value of shear stress is- **1**

(a) Zero (b) Maximum (c) Minimums (d) None of these

v. The neutral axis of the cross-section a beam is that axis at which the bending stress is- **1**

(a) Zero (b) Minimum (c) Maximum (d) Infinity

vi. Macaulay's method is used to determine _____. **1**

(a) Deflection (b) Strength (c) Toughness (d) None of these

vii. The torsional stiffness of a shaft is given by- **1**

(a) T/J (b) T/r (c) T/θ (d) T/G

viii. Calculate the torque which a shaft of 300 mm diameter can safely transmit, if the shear stress is 48 N/mm^2. **1**

(a) 356 kN-m (b) 254 kN-m (c) 332 kN-m (d) None of these

P.T.O.

ix. Euler's formula is applicable to- **1**
(a) Short columns (b) Medium columns
(c) Long column (d) None of these

x. According to Euler's column theory, the crippling load for a column of length (*l*) with one end fixed and the other end free is _____ the crippling load for a similar column hinged at both the ends. **1**
(a) Equal to (b) Less than (c) More than (d) None of these

Q.2 i. Define Poissons ratio. Also states its physical significance. **2**

ii. Derive the relation between Young's modulus (E) and bulk modulus (K). **8**

OR iii. A compound tube consists of a steel tube 170 mm external diameter and 10 mm thickness and an outer brass tube 190 mm external diameter and 10 mm thickness. The two tubes are of same length. The compound tube carries an axial load of 1 MN. Find the stresses and the load carried by each tube and the amount by which it shortens. Length of each tuber is 0.15 m. Assume E_s = 200 GPa and E_b = 100 GPa. **8**

Q.3 i. Define principal plane and principal stresses. **4**

ii. Obtain an expression for the major and minor principal stress on a plane, when body is subjected to direct stress in two mutually perpendicular directions followed by a shear stress **6**

OR iii. The tensile stresses at a point across two perpendicular planes are 120 MPa and 60 MPa. Find the normal, tangential and the resultant stresses on a plane inclined at 30^o to axis of the minor stress. **6**

Q.4 i. Write the name of methods used to determine slope and deflection. **3**

ii. Find an expression for the maximum slope and deflection of a simply supported beam, carrying a point load at the centre. **7**

OR iii. Derive bending equation with usual notations and proper assumptions. **7**

Q.5 i. Define torsional rigidity and polar moment of inertia. **3**

ii. Derive torsion equation with usual notations and proper assumptions. **7**

OR iii. A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 rpm. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 MPa. **7**

Q.6 i. Define the terms column, strut and crippling load. **3**

ii. Find the expression with proper assumptions for Crippling load P at which a column of length l with both the ends of the column is hinged. **7**

OR iii. The external and internal diameter of a hollow cast iron column are 5 cm and 4 cm respectively. If the length of this column is 3 m and both of its ends are fixed, determine the crippling load using Rankine's formula. Take the value of σ_c = 550 MPa and α = 1/1600 in Rankine's formula. **7**

******

Scheme of Marking

Faculty of Engineering
End Sem (Odd) Examination Dec-2022
AU3CO19-FT3CO25-ME3CO19-Mechanics of Material

Programme: B.Tech. | Branch/Specialisation:AU/FT/ME

Note: The Paper Setter should provide the answer wise splitting of the marks in the scheme below.

Q.1	i)	(a)N/mm^2	1
	ii)	(b) E=3K(1-2μ)	1
	iii)	(c) 30	1
	iv)	(a) Zero	1
	v)	(a) Zero	1
	vi)	(a) Deflection	1
	vii)	(c) T/θ	1
	viii)	(c) ~~332 KN-m~~ 254 KN-m	1
	ix)	(c) Long Column	1
	x)	(b) Less than	1
Q.2	i.	Poissons ratio definition- 01 Marks Physical Significance- 01 Marks	2
	ii.	Derivation- 08 Marks	8
OR	iii.	3 Marks for stress in steel 127.34 MPa and in brass 63.67 MPa 3 Marks for load in steel 0.64 MN and in brass 0.36 MN 2 Marks for deformation 0.096 mm	8
Q.3	i.	Principal Plane- 02 Marks Principal Stresses- 02 Marks	4
	ii.	Derivation- 06 Marks	6
OR	iii.	Normal Stress- 105 N/mm^2 02 Marks Tangential Stress- 25.98 N/mm^2 02 Marks	6
		Resultant Stress- 108.16 N/mm^2 02 Marks	
Q.4	i.	Each- 01 Marks	3
	ii.	Max Slope- 3.5 Marks Max. Deflection – 3.5 Marks	7
OR	iii.	Assumptions- 03 Marks Derivation- 04 Marks	7
Q.5	i.	Each – 1.5 Marks	3
	ii.	Assumptions- 03 Marks Derivation- 04 Marks	7
OR	iii.	2 Mark for Torque calculation = 14323900 N-mm 6 Marks for internal dia = 88.5 mm	7
Q.6			
	i.	Each – 1 Marks	3
	ii.	Assumptions- 03 Marks Derivation- 04 Marks	7
	iii.	2 Mark for calculating I = 57656π mm4 2 Mark for calculating k = 25.625 mm 3 Marks for calculating P = 123750 N	7