Course Code: 2040312 Roll No: MLRS-R20

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

II B.Tech II Sem Regular End Examination, July 2022

Mechanics of Solids

(MECH)

Time: 3 Hours. **Max. Marks: 70**

Note: 1. Question paper consists: Part-A and Part-B.
2. In Part – A, answer all questions which carries 20 marks.
3. In Part – B, answer any one question from each unit.
Each question carries 10 marks and may have a, b as sub questions.

PART- A

(10*2 Marks = 20 Marks)

1.	a)	What are the constraints of Euler's formula for buckling column?	2M	CO1	BL1
	b)	What is the difference between elastic limit and elasticity?	2M	CO1	BL1
	c)	Draw shear force and bending moment diagrams for cantilever beam acted upon by point load.	2M	CO2	BL3
	d)	What are different types of beams in engineering mechanics?	2M	CO2	BL1
	e)	What are the assumptions of simple bending theory?	2M	CO3	BL1
	f)	Derive Relationship between Bending Stress and Radius of Curvature?	2M	CO3	BL3
	g)	What are the different methods of analysis in truss?	2M	CO4	BL1
	h)	What is Macaulay's method of beam deflection analysis?	2M	CO4	BL1
	i)	Differentiate between thin cylindrical and spherical shells?	2M	CO5	BL3
	j)	Write torsion formulae and discuss all parameters?	2M	CO5	BL2

PART- B

(10*5 Marks = 50 Marks)

2	a)	Draw a stress strain diagram for mild steel and mark critical points on it with proper explanation.	5M	CO1	BL3
	b)	Calculate the strain energy stored in a bar 2 m long, 50 mm wide and 40 mm thick when it is subjected to a tensile load of 60kN. Take E as 200 GPa	5M	CO1	BL3

OR

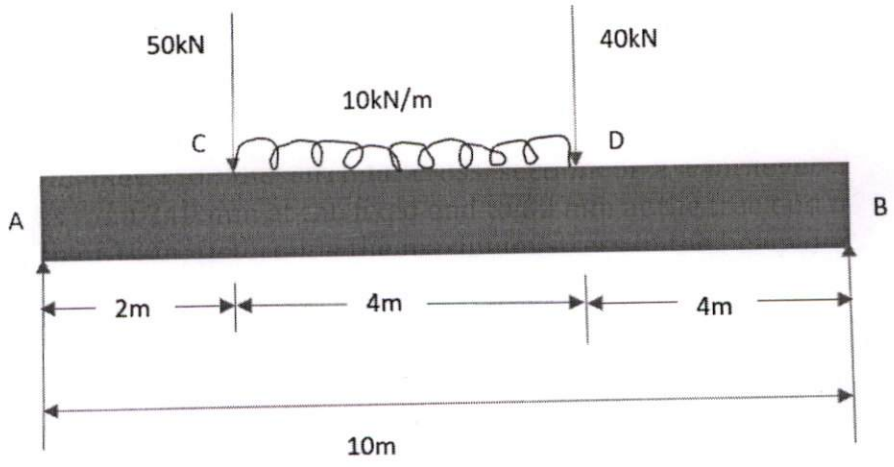
3		The following data refers to a tensile stress conducted on a mild steel bar diameter of steel bar = 30 mm gauge length = 200 mm extension at a load of 100KN is 0.139mm load at elastic limit = 230KN maximum load (ultimate load) = 360 KN total extension = 56 mm diameter of the rod at failure = 22.25 mm determine	10M	CO1	BL4

(i) young's modulus (ii) the stress at elastic limit
(iii) ultimate stress(iv) percentage elongation and
(v) percentage reduction in area.

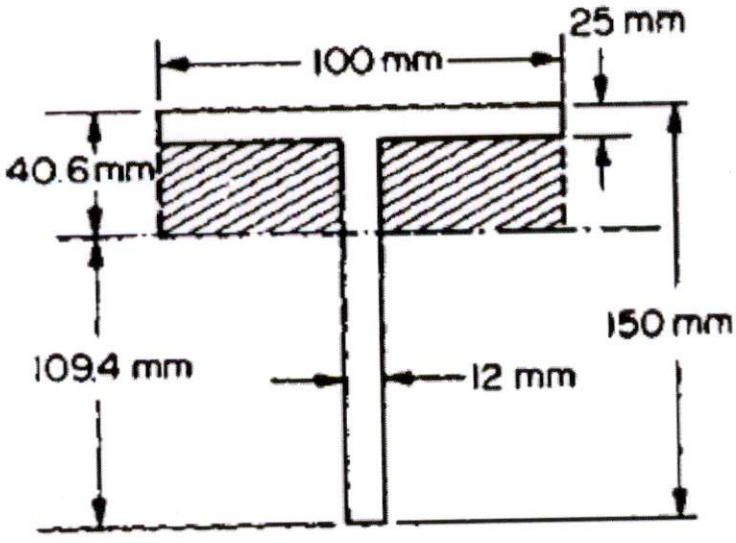
4	a)	A beam of 10 m long is simply supported and carries a load of uniformly varying from 50kN/m at the left end to 150 kN/m at the right end. Draw the shear force and bending moment diagrams	5M	CO2	BL4
	b)	The diameter of the circular cross section of a cantilever beam varies from 240 mm at the fixed end to 60 mm at the free end over a length of 12 m. Determine the maximum stress in the beam due to a uniform distributed load of 1.5 kN/m	5M	CO2	BL4

OR

5		A simply supported beam of length 10m, carries the uniformly distributed load and two point loads as shown in below fig. Draw the SF and BM diagrams for the beam. Also calculate the maximum bending moment.	10M	CO2	BL4



6	a)	A uniform T-section beam is 100 mm wide and 150 mm deep with a flange thickness of 25 mm and a web thickness of 12 mm. If the limiting bending stresses for the material of the beam are 80 in compression and 160 in tension, find the maximum u.d.l. that the beam can carry over a simply supported span of 5 m.	10M	CO3	BL4

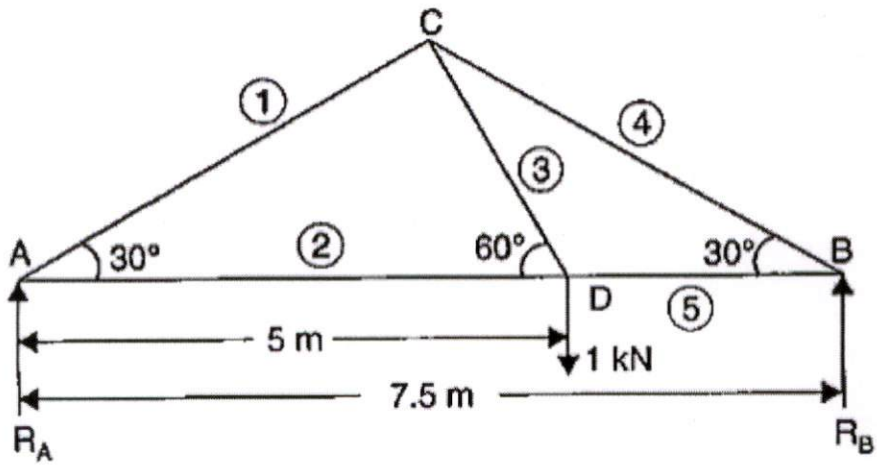


OR

7		How you can find out bending stresses using section modulus of rectangular and circular cross section?	10M	CO3	BL3
8	a)	Prove the relation: $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ Where; M = Bending Moment, σ = *Bending stress* E = young's Modulus I = Moment of Inertia y = Distance from neutral axis R = Radius of curvature	10M	CO4	BL4

OR

9		Explain Relationship between shear force, bending moment and deflection.	10M	CO4	BL3
10	a)	A truss of span 7.5m carries a point load of 1 KN at joint D as shown in the below figure. Find the reactions and forces in the members of the truss?	10M	CO5	BL4



OR

11		Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to with stand an internal pressure of 10 N/mm^2. The maximum hoop stress in the section is not to exceed 45 N/mm^2.	10M	CO5	BL4

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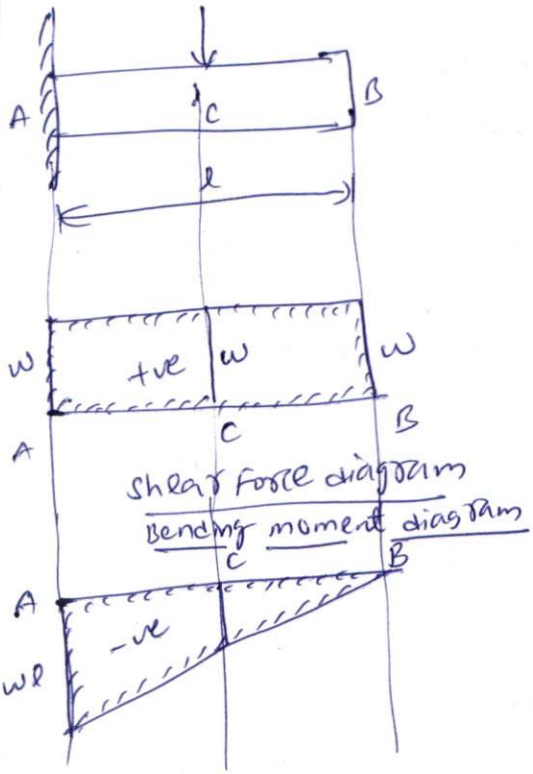
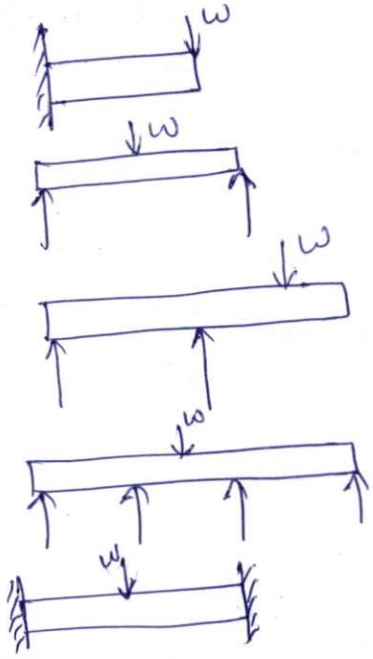
EXAMINATION BRANCH

Academic Year	2021 - 2022
Year & Semester	II B.Tech & II Sem
Regulation	MLRS-R20
Branch	Mechanical
Course Code	2040312
Course Name	Mechanics of solids
Course Faculty's	U. Sudhakar
Course Moderator	U. Sudhakar
Date of Exam	04/07/2022
Reporting Time & Sign	8:45Am & U.F.

KEY PAPER

QNO	ANSWER	MARKS
1)	PART-A	
a)	There is always crookedness in the column and the load may not be exactly axial.	2M
	out of syllabus.	
b)	Elastic limit: It is defined as the maximum stress that a material can withstand before the permanent deformation	
	Elasticity: The material regain its original shape after removal of force acting on it.	2M

QNO	ANSWER	MARKS
1) c)		2M
1) a)	Types of beams (i) cantilever beam → (ii) simply supported beam → (iii) overhanging beam → (iv) continuous beam → (v) Fixed beam → 	2M

QNO	ANSWER	MARKS
1) e)	Assumptions of simple bending theory:- (i) The beam is initially straight (ii) The beam has constant cross-section (iii) perfectly homogeneous (iv) Isotropic material (v) young's modulus is same in Tension and compression	2M
f)	Bending Eqn. $\frac{M}{I} = \frac{G}{R} = \frac{f}{y}$	2M
g)	method of Joints method of sections	2M
h)	macaulay's method is used in finding slopes and deflections at any point of beam. In this method (i) Brackets are to be integrated as a whole (ii) constants of integrations are written after the first term (iii) The section, for which B.M., equation is to be written should be taken in the last part of the beam.	2M

QNO	ANSWER	MARKS
1 i)	$\frac{t}{d} < \left(\frac{1}{10}\right)$ → thin shell (or) $\frac{d}{t} > 20$ → thin shell $\frac{t}{d} > \frac{1}{10}$ → thick shell $\frac{d}{t} < 20$ → thick shell	2m
1 j)	$\frac{T}{J} = \frac{C\theta}{l} = \frac{f_s}{R}$	2m
	PART-B	
2 a)	Stress - strain diagram → 3m and marking critical points Explanation → 2m	5m
b)	Given data → 1m $l = 2m$ $b = 50mm$ $t = 40mm$ $P = 60KN$ $E = 200GPa$ $U = \frac{1}{2} \times \frac{\sigma^2}{E} \times V$ → 2m simplification & answer → 2m	5m

QNO	ANSWER	MARKS

3. $d = 30mm = 0.3m$

$l = 200mm = 0.2m$

$W = 100 \times 10^3 N$, $\delta l = 0.139\ mm = 0.139 \times 10^{-3} m$ — 2m

$W_{elastic} = 230\ kN = 230 \times 10^3 N$

$W_{max} = 360\ kN = 360 \times 10^3 N$

TOTal elongation $= 56mm = 56 \times 10^{-3} m$ (δl)

final dia. $d_1 = 22.25mm = 0.02225m$

(i) Young's modulus, $E = \frac{Wl}{A\delta l}$

$E = 2.036 \times 10^{11}\ N/m^2$ — 2m

(ii) f_e (or) $\sigma_e = \frac{We}{A} = 325.3 \times 10^6\ N/m^2$ — 2m

(iii) f_{max} (or) $\sigma_{max} = \frac{W_{max}}{A} = 509.2 \times 10^6\ N/m^2$ — 2m

(iv) % elongation $= \frac{\delta l}{l} \times 100$

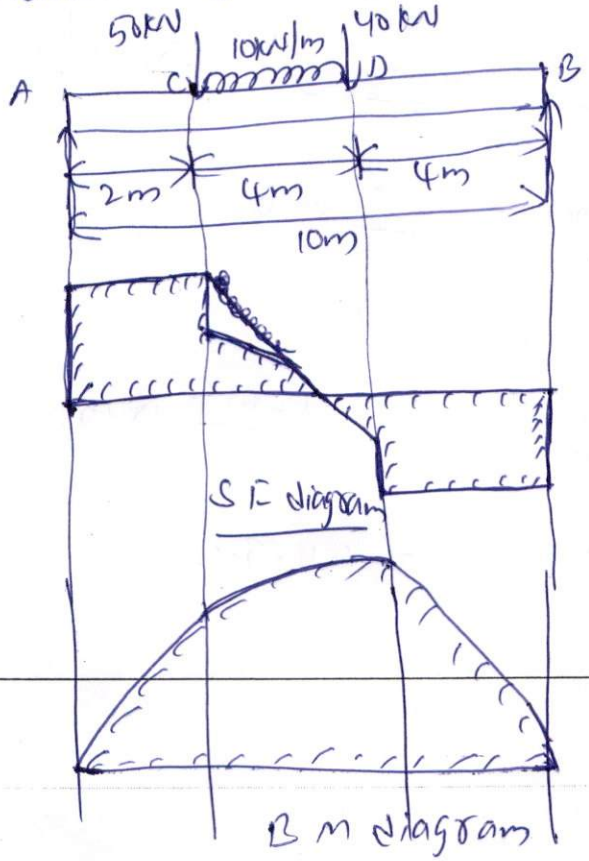
$= 28\%$

(v) % reduction in Area $= \left(\frac{d^2 - d_1^2}{d^2}\right) \times 100$ — 2m

$= 44.9\%$

10M

QNO	ANSWER	MARKS
4. a)	given data — 1m Formula — 2m simplification & answer — 2m	5m
b)	given data — 1m Formula — 2m simplification & ANSWER — 2m	5m
5.	Reactions — 1m Shear force values — 2.5 m Bending moment values — 2.5m Shear force diagram — 2m Bending moment diagram — 2m	10M



QNO	ANSWER	MARKS
6.	given data — 1m T-section diagram — 1m Formulas — 3m Simplification & Answer — 5m	10m
7.	section modulus — 2m Rectangular cross section — 4m circular cross section — 4m	10m
8.	derivation of $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$	10m
9.	Relation between shear force, bending moment and deflection $\frac{d^2M}{dx^2} = -\frac{dF}{dx} = -W$	10M
10. a)	Figure — 2m Reactions — 2m Forces in members — method of Joints — 5m Force Table — 1m	10M

QNO	ANSWER	MARKS
11.	$d = 160\ mm$ $p = 10\ N/mm^2$ (2m) $f_1 = 45\ N/mm^2$ $f_1 = \frac{pd}{2t}$ (2m) $t = \frac{pd}{2f}$ $= \frac{10 \times 160}{2 \times 45} = \frac{1600}{90}$ (5m) $= 17.77\ mm$ (1m)	10m