Q. Code: 505516

Reg. No. | | | | | | | | | | | | | |

B. E / B. TECH DEGREE EXAMINATIONS, MAY 2024

Third Semester

CH22305 – MECHANICS OF SOLIDS FOR CHEMICAL ENGINEERING

(Chemical Engineering)

(Regulation 2022)

TIME:3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Recognize the fundamental concepts of stress and strain in mechanics of solids and structures.	**3**
CO 2	Apply the knowledge on types of beams and loads and investigate the shear force and bending moment diagrams.	**3**
CO 3	Utilizing various techniques to infer the deflection of beams.	**3**
CO 4	Develop the models to analyze the principle stresses in beams and columns.	**3**
CO 5	Apply the knowledge of principle stresses to design the pressure vessels.	**3**

PART- A(20x2=40Marks)

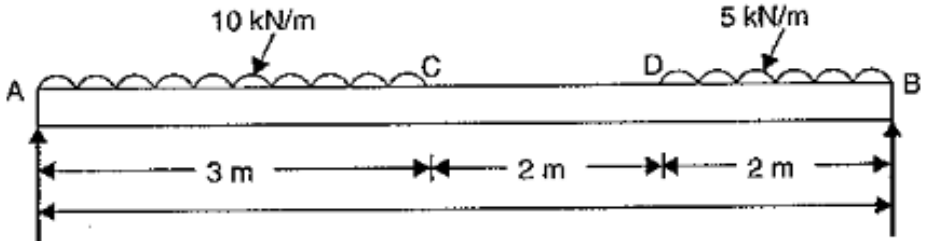
(Answer all Questions)

		CO	RBT LEVEL
1.	Differentiate modulus of rigidity and modulus of elasticity.	**1**	**2**
2.	Relate stress and strain.	**1**	**2**
3.	The safe stress for a hollow steel column varies which carries an axial load of 2.1×10^3 kN is 125 MN/m^2. If the external diameter of the column is 30 cm, calculate the internal diameter.	**1**	**3**
4.	Mention the significance of coefficient of linear expansion.	**1**	**2**
5.	Compare uniformly distributed load and uniformly varying load.	**2**	**2**
6.	Draw the bending moment diagram for a simply supported beam carrying a point load of 'W' at its mid-point.	**2**	**3**
7.	Classify the various types of beams.	**2**	**2**
8.	Summarize about point of contraflexure.	**2**	**2**
9.	A beam 4m long simply supported at its ends, is carrying a point load of 25 KN throughout its entire length. Calculate deflection at the centre of the beam. Take $E = 2\times10^5$ N/mm^2 and $I = 78\times10^6$ N/mm^4	**3**	**3**
10.	Interpret the significance of Macaulay's method.	**3**	**2**
11.	Relate radius of curvature and constant bending moment.	**3**	**2**
12.	A beam 3 m long, simply supported at its ends, is carrying point load 'W' at its centre. If the slope at the ends of the beam should not exceed 0.01745 radians, calculate the deflection of the beam.	**3**	**3**

13.	Compare the bending stresses for symmetrical and unsymmetrical sections.	**4**	**2**
14.	Relate the section modulus of circular solid beam and hollow beam. Take circular solid beam diameter D and Hollow beam internal diameter D_i and external diameter D_o	**4**	**3**
15.	Summarize about strength of a section.	**4**	**2**
16.	Outline the conditions for bending equation.	**4**	**2**
17.	Mention any four important information needed to design a pressure vessel.	**5**	**2**
18.	Classify different types of heads used in pressure vessel.	**5**	**2**
19.	Enlist the safest conditions of stresses of high pressure vessels under radial stresses	**5**	**2**
20.	A pressure vessel having inner diameter of 2 m and height 5 m is subjected to an internal pressure of 15 kg/cm^2.Calcultate the thickness of the vessel for the given condition. Take f = 1120 kg/cm^2, c= 2 mm and the vessel is Class-I type.	**5**	**3**

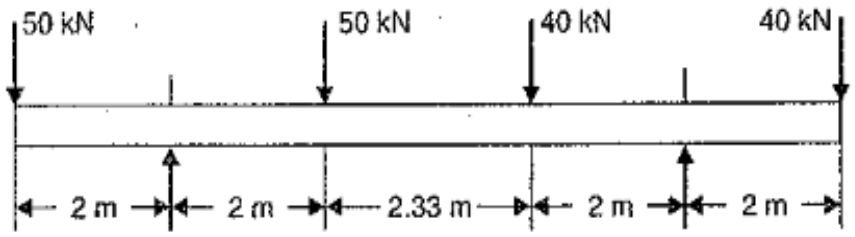
PART- B (5x 10=50Marks)

		Marks	CO	RBT LEVEL
21. (a)	A metallic bar 300 mm × 100 mm × 40 mm is subjected to a force of 5 kN (tensile), 6 kN (tensile) and 4 kN (tensile) along x, y and z directions respectively. Determine the change in volume of the bar. Take E=2×10^{5}N/mm^2 and poison's ratio=0.25.	**(10)**	**1**	**3**
	(OR)			
(b)	A steel rod of 3cm diameter enclosed centrally in a hollow copper tube of external diameter 5 cm and of internal diameter 4 cm. The composite bar is then subjected to an axial pull of 45000 N. If the length of each bar is equal to 15 cm, determine (i) the stresses in the rod and tube, (ii) Load carried by each bar. Take E for steel =2.1×10^5 N/mm^2 and copper =1.1×10^5 N/mm^2	**(10)**	**1**	**3**
22. (a)	Draw the shear force and bending moment diagrams of a simply supported beam of length 7 m carrying uniformly distributed load as shown in figure below.	**(10)**	**2**	**3**



(OR)

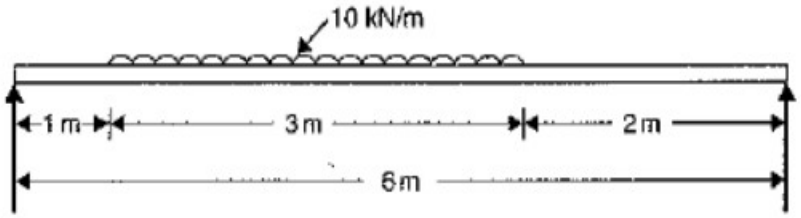
(b) A beam is loaded as shown in figure below. Sketch the shear force and bending moment diagrams and compute (i) Maximum shear force (ii) Maximum bending moment (iii) point of contraflexure. **(10) 2 3**



23. (a) A beam of length 18 m is simply supported at its ends and carries two point loads of 5 kN and 10 kN at a distance of 8 m and 12 m from the left end respectively. Calculate deflection under each load and maximum deflection. Take E $=2\times10^6$ N/mm^2 and I$=1\times10^9$mm^4 **(10) 3 3**

(OR)

(b) A beam of length 6 m is simply supported at its ends. It carries uniformly distributed load of 10 kN/m is shown in figure. Determine the deflection of beam at its midpoint and also the position of maximum deflection. Take EI$= 4.5\times10^8$N/mm^2 . **(10) 3 3**

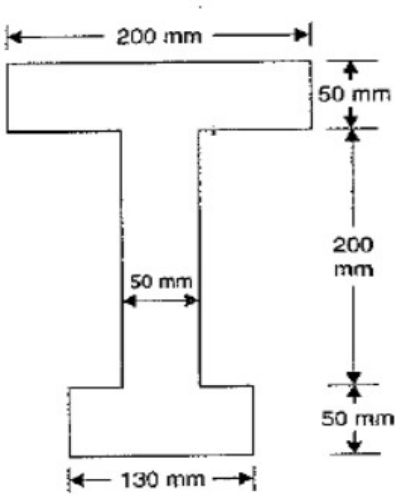


24. (a) A water main of 500 mm internal diameter and 20 mm thick is running full. The water main is of cast iron and is supported at two points 10 m apart. Calculate the maximum stress in the metal. The cast iron and water weight 72000 N/m^3 and 10000 N/m^3 respectively. **(10) 4 3**

(OR)

(b) A cast iron bracket subject to bending has the cross section of I-form with unequal flanges. The dimensions of the section are as shown in figure. Find the position of the neutral axis and moment of Inertia of the section about the neutral axis. If the maximum bending moment on the section is 40 MN mm, determine the maximum bending stress. **(10) 4 3**

Determine the nature of the stress?



25. (a)	A vessel having 1.6 m outer diameter is to be operated at a pressure of 5 kg/cm^2. The permissible stress of the material used for fabrication is 1020 kg/cm^2. Welded joint efficiency is 85%. Calculate the thickness required for a cylindrical and spherical vessel. Suggest which vessel is selected for fabrication.	**(10)**	**5**	**3**
	(OR)			
(b)	A pressure vessel having the design pressure 7 kg/cm^2. Diameter of the vessel is 1.5 m and permissible stress is 1250 kg/cm^2. The vessel is of Class-II type. Take Crown radius and Knuckle radius ratio for Case-I is 100:6 and Case-II is 80:10. Calculate the thickness of Torispherical head and hemispherical head for both the cases.	**(10)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	A tensile load of 40 kN is acting on a rod of diameter 40 mm and of length 4 m. A bore of diameter 20 mm is made centrally on the rod. Estimate length the rod should be bored so that the total extension will increase 30% under the same tensile load. Take E = 2×10^5 N/mm^2	**(10)**	**1**	**5**

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