Q. Code: 104002

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

B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Third Semester

CH18303 – MECHANICS OF SOLIDS FOR CHEMICAL ENGINEERING

(Chemical Engineering)

(Regulation 2018)

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	Distinguish between elastic and plastic deformation of a material.	1	U
2.	If a steel bar of dimensions 1m × 20mm × 10mm is subjected to an axial tensile load of 2kN, what is the length of the material after deformation? The Young's modulus of steel is 200GPa.	1	AP
3.	Give two examples of uniformly distributed external load on a beam.	2	U
4.	Calculate the support reactions for a cantilever beam of length 2m subjected to a point load of 1kN at its free end.	2	AP
5.	State the mathematical relationship between bending moment experienced when a beam is subjected to transverse loading and the resulting deformation of the beam.	3	AP
6.	Which method of determining to slope and deflection of a beam is suitable for analyzing simply supported beams with asymmetric loading and why?	3	U
7.	Sketch the bending stress profile of a hollow cylindrical beam subjected to downward acting external loads.	4	AP
8.	State the conditions under which a beam is said to be undergoing "pure bending".	4	U
9.	Write the significance of polar modulus of a power transmitting shaft.	4	U
10.	List the stresses induced in a thick cylindrical shell used for storage of high pressure steam.	4	U

PART B - (5 X16 = 80 Marks)

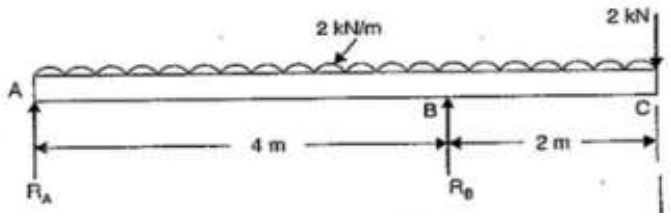
11.	(a)	A concrete column of dimensions 2m × 20cm × 10cm is reinforced with 4 steels rods of diameter 10 mm each and set in winter when the temperature was 25°C. Calculate the stresses and strains in steel and concrete on a summer day when the temperature is 40°C. Given E_{steel}=2.1×10^5 MPa; $E_{concrete}$= 25 GPa; α_{st}=11.7×10^{-6}/°C; $\alpha_{concrete}$=10×10^{-6}/°C; .	(16)	1	AP

(OR)

(b) (i) Derive the relationship between volumetric strain and material properties of a bar of circular cross section subjected to uniaxial tensile load along the axis of the bar. **(8)** **1** **U**

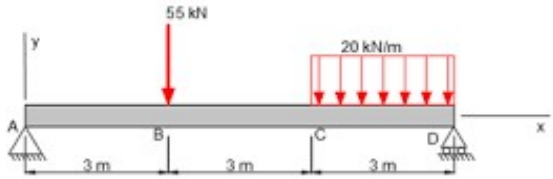
(ii) Derive the relationship between bulk modulus and Young's modulus of a ductile material. **(8)** **1** **U**

12. (a) Draw the shear force and bending moment diagram for an overhanging beam shown in the figure below. Determine the location of point of contraflexure if it occurs under these loading conditions. **(16)** **2** **AP**



(OR)

(b) Draw the shear stress and bending moment diagram for the simply supported beam subjected to transverse loading as shown in the figure. Determine the location of maximum bending moment and its value. **(16)** **2** **AP**



13. (a) A cantilever beam of length 6 m is subjected to an uniformly distributed load of 3 KN/m throughout its length. Derive an expression for slope and deflection of the beam. Using the expression evaluate the maximum deflection and slope and the location in the beam. The beam is of circular cross section of diameter 20 cm and the Young's Modulus of the material is 110 GPa. **(16)** **3** **AP**

(OR)

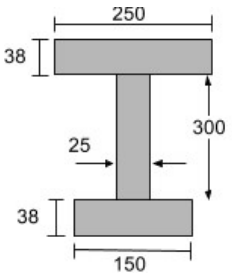
(b) Determine the maximum slope and deflection of a simply supported beam is of length 3m and of square cross section with sides 10 cm subjected to two point loads of 1 kN and 2 kN acting at a distance 1 m and 2 m respectively from the left end of the beam. The Young modulus of the material of the beam is 210 GPa. **(16)** **3** **AP**

14. (a) A timber beam of reactangular cross section is to support a load of 20kN uniformly ditributed over a span of 4m when the beam is simply supported. The maximum stress in the beam is not to exceed 7 N/mm^2. Determine the dimensions of the beam if (a) the cross **(16)** **4** **AP**

section of the beam is rectangular and the depth of the section is twice that of its breadth, (b) the cross section of the beam is circular. Compare the cost of the rectangular and circular beams and find which is prefered for economic design of the beam.

(OR)

(b) An 'I' beam of length 4m and cross-section depicted in the figure below experiences a maximum shear force of 20 kN. Calculate and sketch the shear stress distribution in the section of the beam in which the maximum shear stress occurs. Note: All dimensions are in mm. **(16) 4 AP**



15. (a) A hollow circular shaft has external diameter of 100 mm, thickness 10 mm and length 2 m. Find the safe power transmitted if the maximum allowable shear stress is 100 MPa and the maximum angle of twist is 4° for 2m length. Take the speed of the torque to be 2.5 revolutions per second and the maximum torque is to exceed the mean torque by 10% and the modulus of rigidity of the material is 80 GPa. **(16) 4 AP**

(OR)

(b) (i) Derive the expressions for stresses and strains induced in a thin cylindrical shell subjected to an internal pressure of P kN. **(10) 4 U**

(ii) A steel propane tank for a BBQ grill has a 25 cm diameter and a wall thickness of 5 mm. The tank is pressurised to 1.2 MPa. Determine the longitudinal and circumferential stresses in the cylindrical body of the tank. **(6) 4 AP**