Q. Code: 179656

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

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

Third Semester

CE22303 – STRENGTH OF MATERIALS

(Civil Engineering)

(Regulation 2022)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	The students will be able to solve problems applying the fundamental concepts of stress, strain, principal stresses and principal planes in mechanics of solids and structures.	**3**
CO 2	The students will be able to analyse and determine slope and deflection of determinate beams using appropriate method.	**4**
CO 3	The students will be able to analyse indeterminate beams and draw Shear Force Diagram and Bending Moment Diagram.	**4**
CO 4	The students will be able to design shafts to transmit required power and also design helical springs for its maximum energy storage capacities.	**3**
CO 5	The students will be able to estimate strain energy and deflections of beams, trusses and frames using strain energy principles.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	A square steel rod 20 mm x 20 mm in section is to carry an axial load (compressive) of 100 kN. Calculate the shortening in a length of 50 mm. E=2.14 x 10^8 kN/m^2.	**1**	**2**
2.	A bar of length 1 m is clamped at the ends and is subjected to a rise in temperature of 20^0 C. If the coefficient of linear expansion of the material of the bar is $1.2x10^{-6}/^0C$. Young's modulus $2x10^5$ N/mm^2 and the area of cross section 314 mm^2, find the strain in the bar.	**1**	**2**
3.	The Young's modulus and Bulk modulus of aluminium are 71 GPa and 74 GPa respectively. Find its modulus of rigidity.	**1**	**2**
4.	A circular bar is subjected to an axial pull of 100 kN. If the maximum intensity of shear stress on any oblique plane is not to exceed 60 MN/m^2, determine the diameter of the bar.	**1**	**3**
5.	Write the bending moment expression using Macaulay's method for a simply supported beam of span 5 m subjected to moment 20 kNm at 2m from the left end.	**2**	**2**
6.	A cantilever beam of span 'l' is subjected to a clockwise couple 'M' at the free end. What is the slope at the free end?	**2**	**2**
7.	A beam of span 'L' is simply supported and carries a point load of 'W' at the centre of	**2**	**2**

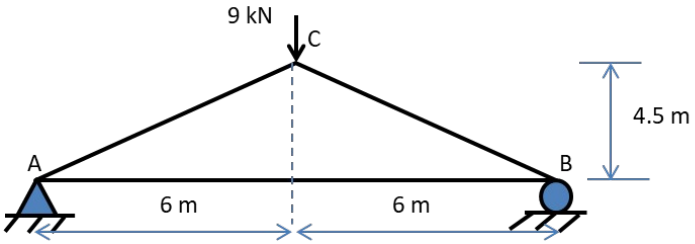
	the beam. What is the maximum slope using moment area method?		
8.	Find the deflection at the free end of a cantilever beam of constant EI and length l carrying a concentrated load W at the free end by conjugate beam method.	**2**	**2**
9.	For the fixed beam subjected to an eccentric point load 'W', write end moments.	**3**	**2**
10.	What is the value of prop reaction in a propped cantilever of span 'L', when it is subjected to a UDL of w/m over the entire length?	**3**	**3**
11.	Explain how it is not possible to analyze the continuous beam using equations of static equilibrium?	**3**	**2**
12.	Write down the Clapeyron's theorem of three moment equation for the two span continuous beam with sinking of left support, if the supports are simply supported.	**3**	**2**
13.	Explain the term torsional rigidity.	**4**	**2**
14.	Why hollow circular shafts are preferred when compared to solid circular shafts?	**4**	**2**
15.	Distinguish between close coiled and open coiled helical spring.	**4**	**2**
16.	A close coiled helical spring of 100 mm mean diameter is made of 10 mm diameter rod and has 20 turns. The spring carries an axial load of 200 N. Determine the shear stress.	**4**	**2**
17.	A cantilever beam of span 4 m is subjected to a concentrated load of 10 kN at free end. Find the total strain energy stored. Take the flexural rigidity is EI.	**5**	**2**
18.	A mild steel bar of uniform cross section 'A' and length 'L' is subjected to an axial load 'W'. What is the strain energy stored in the bar?	**5**	**2**
19.	Explain the Maxwell's reciprocal theorem.	**5**	**2**
20.	Apply the energy principle and solve the maximum deflection in a cantilever beam, when you have a clockwise moment on the beam at the free end?	**5**	**3**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	A solid copper rod of 50 mm diameter is placed inside a steel tube of outside diameter 70 mm and inside diameter 60 mm and lengths are same at 20^0C. The assembly is held between two rigid plates and subjected to compressive force of 100kN. Compute the forces in the two materials if the assembly is heated to 60^0C.E_s=2E_c=208 GPa. α_s=12x10-6/°C and α_c = 18.5x10-6/ °C.	**(10)**	**1**	**3**
	(OR)			
(b)	A rod of length 1 m and diameter 20 mm is subjected to a tensile load of 20 kN. The increase in length of the rod is 0.3 mm and decrease in diameter is 0.0018 mm. calculate the Poisson's ratio and three moduli.	**(10)**	**1**	**3**

22. (a)	A horizontal beam 4m long is supported at the left end A and at B, 1m from the right end C. It carries an uniformly distributed load of 10 kN/m over the span AB and a point load of 5 kN at the free end C. Determine the slope at the support A and the deflection at 1m from left support A in terms of its flexural rigidity.	**(10)**	**2**	**3**
	(OR)			
(b)	A cantilever of length 3 m is carrying a point load of 40 kN at a distance of 2 m from the fixed end. If $I=10^8$ mm^4 and $E=2x10^5$ N/mm^2, find (i) slope at free end and (ii) deflection at free end using conjugate beam method.	**(10)**	**2**	**3**
23. (a)	A fixed beam of 6 m span carries two point loads of 600 kN each at 2 m from each end. Find (i) fixed end moments (ii) Draw the B.M. and S.F. diagrams. Take $E=2x10^8$ kN/m^2 and $I=9x10^8$ mm^4.	**(10)**	**3**	**3**
	(OR)			
(b)	A continuous beam ABCD, 16 m long is continuous over three spans:AB=6 m; BC=5 m and CD = 5 m, the supports being at the same level. There is a uniformly distributed load of 20 kN/m over BC. On AB, there is a point load of 80 kNat 2 m from A and on CD, there is a point load of 60 kN at 3 m from D. Calculate (i) support moments (ii) Draw B.M. Diagram.	**(10)**	**3**	**3**
24. (a)	A hollow shaft whose internal diameter is 3/8 times external diameter is to transmit 600 kW at 90 rpm. Find the permissible diameter if the maximum shear stress is not to exceed 65 MPa and the twist over the length of 3 m is not exceed 1.5 degrees. C=84GPa.	**(10)**	**4**	**3**
	(OR)			
(b)	Design a close coiled helical soring which shall deflect 10 mm under an axial load of 100 N with a shear stress of 90 N/mm^2. The spring is to be made out of round wire of modulus of rigidity $0.8x10^5$ N/mm^2 and the mean diameter of the coils is to be 10 times the diameter of the wire. Find the diameter of the spring wire and the length of the wire.	**(10)**	**4**	**3**

25. (a)	A simply supported beam of span 3 m is carrying a point load of 20 kN at 1m from left support in addition to a u.d.l. of 10 kN/m spread over the right half span. Using castigliano's theorem determine the deflection under the point load. Take EI as constant throughout.	**(10)**	**5**	**3**
	(OR)			
(b)	Find the vertical and horizontal deflection of the joint C of the pin jointed truss shown in the following Figure. The area of the horizontal member is 150 mm^2 and the area of the members AC and BC are 200 mm^2 each. Take E= 200 kN/mm^2.	**(10)**	**5**	**3**



PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	The normal stresses acting on two perpendicular planes at a point in a strained material are 70 MN/m^2 tensile, 35 MN/m^2 compressive. In addition, shear stress of 40 N/mm^2 act on these planes. Calculate the following: (i) Determine the normal stress, shear stress and resultant stress on an oblique plane inclined at an angle of 30^0 with the axis of minor compressive stress. (ii) The magnitude of the Principal stresses (iii) The direction of Principal planes and (iv) The magnitude of the maximum shear stress.	**(10)**	1	**3**

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