INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500043

CIVIL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**STRENGTH OF MATERIALS**				
Course Code	ACEB07				
Programme	B.Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	2	1
Chief Coordinator	Mr. G. Venkateswarulu, Assistant Professor, MECH				
Course Faculty	Mr. G. Venkateswarulu, Assistant Professor, MECH				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components;
II	Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods;
III	Analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams; and
IV	Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members;

COURSE OUTCOMES (COs):

CO 1	Understand the basics of material properties, stress and strain.
CO 2	Apply knowledge of various kinds of beams for engineering applications.
CO 3	Gain the knowledge to identify, formulate, and solve engineering &real life problems.
CO 4	Design and conduct experiments, as well as to analyze and interpret data
CO 5	Understand to design a component to meet desired needs within realistic constraints of safety.

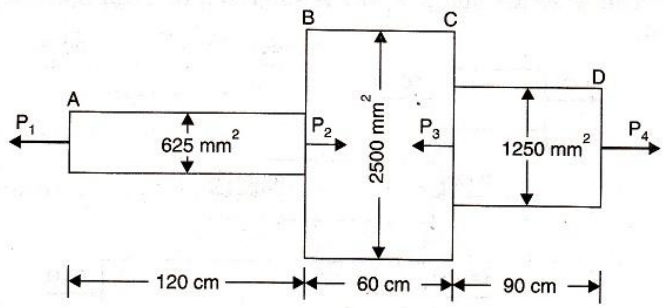
COURSE LEARNING OUTCOMES (CLOs):

ACEB07.01	Calculate the stress strain relations in conjunctionwith elasticity and material properties
ACEB07.02	Describe the resistance and deformation in members which are subjected to axial, flexural and torsion loads.
ACEB07.03	Discuss thermal explanations in solid bars andinduced thermal stresses
ACEB07.04	Solve for bending and shear parameters of beamsunder loading conditions
ACEB07.05	Explain for deflections of beams under loadingwith various approaches.
ACEB07.06	Determine the deflections of different beams underdifferent loading conditions.
ACEB07.07	Compute the bending stresses developed in varioussections of beams of real field problems.
ACEB07.08	Apply the bending equation on various sections
ACEB07.09	Determine the shear stresses developed in varioussections of beams
ACEB07.10	Calculate the stability of structural elements anddetermine buckling loads.
ACEB07.11	Discuss critical buckling load for column withvarious loading and end conditions
ACEB07.12	Apply theories and to predict the performance ofbars under axial loading including buckling.
ACEB07.13	Understand the theory of beam column &determine buckling loads on it.
ACEB07.14	Solve the principal stress problems by graphicalmethods.
ACEB07.15	Explain the stress transformation and concept ofprinciple plane and principle stresses
ACEB07.16	Evaluate principal stresses, strains and apply the concept of failure theories for design
ACEB07.17	Acquire knowledge to solve real time problems in Aircraft structure subjected loading conditions

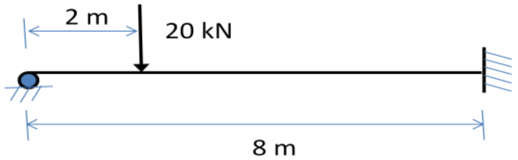
TUTORIAL QUESTION BANK

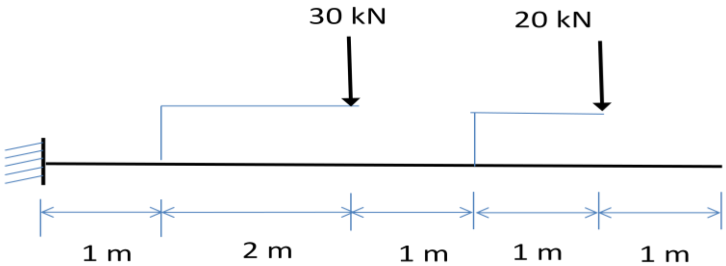
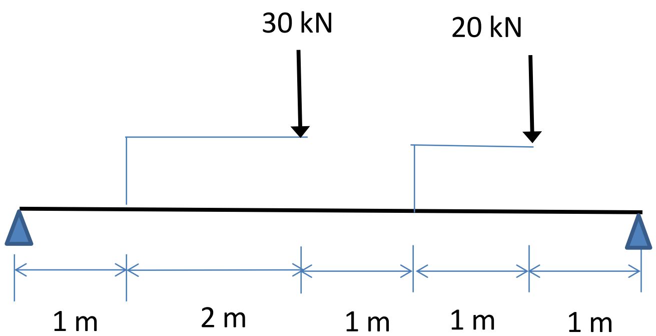
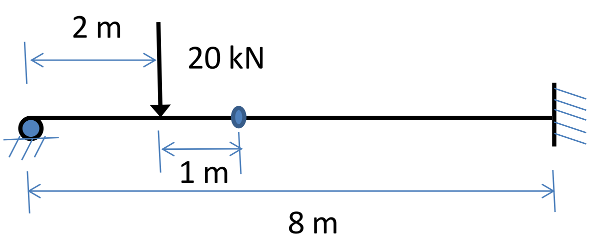
MODULE- I				
STRESSES AND STRAINS				
Part - A (Short Answer Questions)				
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	Distinguish between the terms (a) Elasticity and (b) Plasticity with examples.	Remember	CO 1	ACEB07.2
2	Define the following properties of engineering materials: (a) Ductility (b) Brittleness (c) Malleability	Remember	CO 1	ACEB07.2
3	Define the following properties of engineering materials: (a) Toughness (b) Hardness (c) Strength	Remember	CO 1	ACEB07.2
4	Define Stress at a point in a material, and mention its units.	Remember	CO 1	ACEB07.2
5	Distinguish between different types of stress using illustrations	Remember	CO 1	ACEB07.2
6	Define Strain in a material and give its units	Remember	CO 1	ACEB07.2
7	State Hooke's law and give its equation	Remember	CO 1	ACEB07.2
8	Distinguish between different types of strain	Remember	CO 1	ACEB07.2
9	Define modulus of elasticity and give its units.	Remember	CO 1	ACEB07.2
10	Draw stress-strain diagram for mild steel indicating all critical points	Understand	CO 1	ACEB07.2
11	Define longitudinal strain and lateral strain.	Remember	CO 1	ACEB07.3
12	Define Poisson's ratio and its range of values	Remember	CO 1	ACEB07.4
13	Define Volumetric strain and bulk modulus	Remember	CO 1	ACEB07.2
14	Give the relationship between Young's modulus, Rigidity Modulus and Bulk Modulus.	Remember	CO 1	ACEB07.3
15	Define rigidity modulus and give its units	Remember	CO 1	ACEB07.3
16	What is meant by strain energy?	Understand	CO 1	ACEB07.3
17	Distinguish between modulus of resilience and modulus of toughness.	Understand	CO 1	ACEB07.2
18	Define resilience and proof resilience.	Understand	CO 1	ACEB07.3
19	What is working stress?	Understand	CO 1	ACEB07.3
20	Define factor of safety and state why it is used?	Understand	CO 1	ACEB07.2
Part - B (Long Answer Questions)				
1	Explain with illustrations and stress-strain diagrams, the phenomenon of strain-hardening.	Understand	CO 1	ACEB07.3
2	Explain with illustrations and stress-strain diagrams, the phenomenon of necking.	Understand	CO 1	ACEB07.2
3	Define and explain the terms: slip and creep.	Remember	CO 1	ACEB07.3
4	Explain the off-set method of locating the yield point for a material on its stress-strain curve.	Understand	CO 1	ACEB07.3
5	Explain the concept of fatigue failure. Define endurance limit and fatigue limit.	Understand	CO 1	ACEB07.2
6	A tensile test was conducted on a mild steel bar. The following data was obtained from the test: Diameter of steel bar = 2.5 cm; Gauge length of the bar = 24 cm; Diameter of the bar at rupture = 2.35 cm; Gauge length at rupture = 24.92mm Determine (a) percentage elongation (b) percentage decrease in area	Remember	CO 1	ACEB07.2
7	A tensile test was conducted on a mild steel bar. The following data was obtained from the test: Diameter of steel bar = 3cm; Gauge length of the bar = 20cm Load at elastic limit = 250kN; Extension at load of 150kN = 0.21mm Maximum load = 380kN; Determine: (a) Young's modulus (b) Yield strength (c) Ultimate Strength (d) Strain at the elastic limit	Remember	CO 1	ACEB07.1
8	A steel bar of 25 mm diameter is tested in tension and following is observed: Limit of Proportionality = 196.32 kN; Load at yield = 218.13 kN, Ultimate load = 278.20 kN. Compute the stresses in the specimen at various stages. If the factor of safety is 1.85, determine the permissible stress in the material.	Understand	CO 1	ACEB07.2
9	A steel bar of 25 mm diameter was tested in tension and following were observed: Limit of Proportionality = 196.32 kN; Load at yield = 218.13 kN, Ultimate load	Remember	CO 1	ACEB07.3

	= 278.20 kN. At the proportional limit, the elongation measured over a gauge length of 100 mm was 0.189 mm. After fracture, the length between the gauge points was 112.62 mm and the minimum diameter was 23.64. Determine the Young's modulus and measures of ductility (percentage elongation and percentage contraction),			
10	A 3.5 m long steel column of cross-sectional area 5000 mm^2, is subjected to a load of 1.6 MN. Determine the factor of safety for the column, if the yield stress of steel is 550 MPa. Determine the allowable load on the column, if the deformation of the column should not exceed 5.0 mm. Assume Young's modulus of steel as 195 GPa.	Remember	CO 1	ACEB07.3
11	A 2.0 m long steel tie bar is subjected to force of 150 kN. Determine its cross-section so that (i) the stress does not exceed 140 MPa (ii) the extension is not more than 1.2 mm. Assume Young's modulus of 210 GPa. If steel bars are available in increments of 5 mm from 30 mm diameter onwards, choose the appropriate diameter for both cases.	Understand	CO 1	ACEB07.2
12	A tensile test was conducted on a mild steel bar. The following data was obtained from the test: Diameter of steel bar = 5cm; Gauge length of the bar = 30cm Load at elastic limit = 250kN; Extension at load of 200kN 0.25mm Maximum load = 420kN; Determine: (a) Young's modulus (b) Yield strength (c) Ultimate Strength (d) Strain at the elastic limit	Remember	CO 1	ACEB07.2
13	Derive the constitutive relationship between stress and strain for three dimensional stress systems.	Remember	CO 1	ACEB07.2
14	A rod whose ends are fixed to rigid supports, is heated so that rise in temperature is T^o C. Derive the expression for thermal strain and thermal stresses set up in the body if α is co-efficient of thermal expansion.	Understand	CO 1	ACEB07.2
15	Derive the expression for volumetric strain of a body in terms of its linear strains in orthogonal directions.	Understand	CO 1	ACEB07.5
16	Derive relationships between Young's modulus, rigidity modulus and bulk modulus, including Poisson's ratio into the relationships.	Understand	CO 1	ACEB07.5
17	Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is $1.2x10^5$ N/mm^2 and modulus of rigidity is $4.5x10^4$ N/mm^2	Understand	CO 1	ACEB07.2
18	Prove that maximum strain energy stored per unit volume in a body is given by $$U = \left(\frac{\sigma^2}{2E}\right)$$	Understand	CO 1	ACEB07.5
19	Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is $1.5x10^5$ N/mm^2 and modulus of rigidity is $4.8x10^4$ N/mm^2	Understand	CO 1	ACEB07.2
20	Prove that the stress developed in a body due to load P when it is applied suddenly is given by $$\sigma = 2\frac{P}{A}$$	Understand	CO 1	
Part - C (Problem Solving and Critical Thinking Questions)				
1	A tensile test was conducted on a mild steel bar. The following data was obtained from the test: Diameter of steel bar = 3 cm Gauge length of the bar = 20 cm Load at elastic limit = 250 kN Extension at load of 150 kN = 0.21 mm Maximum load = 380 kN Total extension = 60 mm Diameter of rod at failure = 2.25 cm Determine: (a) Young's modulus (b) stress at elastic limit (c) percentage elongation (d) percentage decrease in area	Understand	CO 1	ACEB07.1, ACEB07.2
2	A member ABCD is subjected to point loads P1, P2, P3 and P4 as shown in figure below. Calculate the force P2 necessary for equilibrium, if P1 = 45kN, P2 = 450kN and P4 = 130kN. Determine the total elongation of the member, assuming the modulus of elasticity to be $2.1x10^5$ N/mm^2.	Understand	CO 1	ACEB07.2, ACEB07.3

				
3	A compound tube consists of a steel tube 140mm internal diameter and 160mm external diameter and an outer brass tube 160mm internal diameter and 180mm external diameter. The two tubes are of the same length. The compound tube carries an axial load of 900kN. Find the stresses and the load carried by each tube and the amount it shortens. Length of each tube is 140mm. Take E for steel as $2x10^5$ N/mm^2 and for brass as $1x10^5$ N/mm^2.	Understand	CO 1	ACEB07.2, ACEB07.3
4	A steel rod of 3cm diameter and 5m long is connected to two grips and the rod is maintained at a temperature of 95^{o}C. Determine the stress and pull exerted when the temperature falls to 30^{o}C, if (i) the ends do not yield, and (ii) the ends yield by 0.12cm. Take E = $2x10^5$ MN/m^2 and $\alpha = 12x10^{-6}/^oC$.	Understand	CO 1	ACEB07.3
5	Determine the value of Young's modulus and Poisson's ratio of a metallic bar of length 25cm, breadth 3cm and depth 2cm when the bar is subjected to an axial compressive load of 240kN. The decrease in length is given as 0.05cm and increase in breadth is 0.002cm.	Understand	CO 1	ACEB07.2, ACEB07.3
6	A metallic block 250mm x 80mm x 30mm is subjected to a tensile force of 20kN, 30kN and 15kN along x, y and z directions respectively. Determine the change in volume of the block. Take E= $2x10^5$ N/mm^2 and Poisson's ratio = 0.30.	Understand	CO 1	ACEB07.2, ACEB07.3
7	Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is $1.2x10^5$ N/mm^2 and modulus of rigidity is $4.5x10^4$ N/mm^2	Understand	CO 1	ACEB07.2, ACEB07.3
8	A bar of 30mm in diameter was subjected to tensile load of 54kN and the measured extension on 300mm gauge length was 0.112mm and change in diameter was 0.0036mm. Calculate the Poisson's ratio and three Modulii.	Understand	CO 1	ACEB07.2, ACEB07.3
9	A bar of uniform cross-section 'A' and length 'L' hangs vertically, subjected to its own weight. Prove that the strain energy stored within the bar is given by $U = \frac{A \times \rho^2 \times L^3}{6E}$	Understand	CO 1	ACEB07.2, ACEB07.3
10	A vertical round steel rod 1.82m long is securely held at its upper end. A weight can slide freely on the rod and its fall is arrested by a stop provided at the lower end of the rod. When the weight falls from a height of 30mm above the stop, the maximum stress reached in the rod is estimated to be 157N/mm^2. Determine the stress if the load has been applied gradually and also the maximum stress if the load had fallen from a height of 47.5mm. Take E = $2.1x10^5$ N/mm^2.	Understand	CO 1	ACEB07.4, ACEB07.5
11	A bar of length *l* has its diameter increasing from *d* at one end to D at the other. Determine the deformation of the member subjected to a tensile force of P.	Understand	CO 1	ACEB07.4
12	A prismatic bar of length l and unit weight w is suspended freely from its end. Determine the elongation of the member under gravity.	Understand	CO 1	ACEB07.4
13	A concrete column is reinforced with steel bars comprising 6 percent of the gross area of the column section. What is the fraction of the compressive load sustained by steel bars, if the ratio of Young's modulii of steel and concrete is 12.5?	Understand	CO 1	ACEB07.4
14	A bar of 100mm in diameter was subjected to tensile load of 80kN and the measured extension on 300mm gauge length was 0.112mm and change in diameter was 0.0036mm. Calculate the Poisson's ratio and three Modulii.	Understand	CO 1	ACEB07.3
15	A steel rod of tapered square cross-section with larger side 40 mm and smaller side 20 mm and length 650 mm is rigidly held between its end by fixed supports. Assuming $\alpha = 12.5 \times 10^{-6}$ per K and E = 150.0 GPa, determine the force in the rod when it is subjected to (i) rise in temperature of 85 K and (ii) fall in temperature of 65 K?	Understand	CO 1	ACEB07.4
16	A steel rod of tapered circular cross-section with larger end diameter 65 mm	Understand	CO 1	ACEB07.4

	and smaller end diameter 33 mm and length 810 mm is rigidly held between its end by fixed supports. Assuming α = 12.5 x 10^{-6} per K and E = 150.0 GPa, determine the force in the rod when it is subjected to (i) rise in temperature of 85 K and (ii) fall in temperature of 65 K?			
17	A compound bar comprises of a 12.5 mm diameter aluminum rod and a copper tube of inner diameter 14.5 mm and outer diameter 25 mm. If the Young'dmodulli of aluminum and copper are 80 GPa and 120 GPa, respectively, then determine the stress in the assembly when subjected to (i) a temperature rise of 95 K, and (ii) a temperature fall of 35 K. Take α = 14.6 x 10^{-6} per K for aluminum and α = 16.8 x 10^{-6} per K for copper.	Understand	CO 1	ACEB07.4
18	Compute the strain energy in a steel bar (E = 200 GPa) of length 2.5 m and 20 mm diameter under a load of 45 kN. What is the resilience modulus of the bar, if the yield stress is 240 MPa?	Understand	CO 1	ACEB07.5
19	A mass of 250 kg falls through a height of 300 mm on a concrete column of 230 x 500 mm section. Determine the maximum stress and deformation in the 4.5m long column, if the Young's modulus of concrete is 20 GPa.	Understand	CO 1	ACEB07.5
Z20	Compute the strain energy in a steel bar (E = 200 GPa) of length 2.7 m and 22 mm diameter under a load of 50 kN. What is the resilience modulus of the bar, if the yield stress is 240 MPa?	Understand	CO 1	ACEB07.5
MODULE-II				
BENDING MOMENT AND SHEAR FORCE DIAGRAMS				
Part – A (Short Answer Questions)				
1	What are the different types of beams?	Remember	CO 2	ACEB07.6
2	Differentiate between a simply supported beam and a cantilever.	Understand	CO 2	ACEB07.6
3	Differentiate between a fixed beam and a cantilever.	Understand	CO 2	ACEB07.7
4	Show by proper diagram, positive and negative shear forces at a section of a beam.	Remember	CO 2	ACEB07.7
5	Draw shear force diagrams for a cantilever of length L carrying a point load W at the free end.	Understand	CO 2	ACEB07.8
6	Draw shear force diagrams for a cantilever of length L carrying a point load W at the mid-span.	Understand	CO 2	ACEB07.8
7	Draw shear force diagram for a cantilever of length L carrying a uniformly distributed load of w per unit length over its entire span.	Understand	CO 2	ACEB07.8
8	Draw shear force diagrams for a simply supported beam of length L carrying a point load W at its mid-span.	Understand	CO 2	ACEB07.7
9	Draw shear force diagram for a simply supported beam of length L carrying a uniformly distributed load of w per unit length over its entire span.	Understand	CO 2	ACEB07.8
10	Explain what information we obtain from shear force diagram and bending moment diagram.	Understand	CO 2	ACEB07.7
11	Draw bending moment diagrams for a cantilever of length L carrying a point load W at the free end.	Understand	CO 2	ACEB07.6
12	Draw bending moment diagram for a cantilever of length L carrying a point load W at the mid-span.	Understand	CO 2	ACEB07.6
13	Draw bending moment diagram for a cantilever of length L carrying a uniformly distributed load of w per unit length over its entire span.	Understand	CO 2	ACEB07.7
14	Draw bending moment diagram for a simply supported beam of length L carrying a point load W at its mid-span.	Understand	CO 2	ACEB07.7
15	Draw bending moment diagram for a simply supported beam of length L carrying a uniformly distributed load of w per unit length over its entire span.	Understand	CO 2	ACEB07.8
16	Draw bending moment diagram for a cantilever beam of length L with a positive moment M applied at its free end.	Understand	CO 2	ACEB07.8
17	Draw bending moment diagram for a simply supported beam of length L with an anti-clockwise moment M applied at the mid-span.	Understand	CO 2	ACEB07.8
18	Give the mathematical relationship between rate of loading, shear force and bending moment at a section in a beam.	Remember	CO 2	ACEB07.6
19	What do you mean by point of contraflexure?	Understand	CO 2	ACEB07.7
20	How many points of contraflexure you will have for simply supported beam overhanging at one end. Explain with a neat sketch.	Understand	CO 2	ACEB07.7
Part - B (Long Answer Questions)				

1	Derive the relation between rate of loading, shear force and bending moment for a beam carrying a uniformly distributed load of w per unit length over whole span.	Understand	CO 2	ACEB07.6
2	Derive the shear force and bending moment diagrams for a cantilever beam carrying a uniformly distributed load of w per unit run over half its span staring from the free-end.	Understand	CO 2	ACEB07.7
3	Draw the shear force diagrams for a cantilever beam of length 12 m carrying a uniformly distributed load of 12 kNm^{-1} over half its span staring from the free-end.	Understand	CO 2	ACEB07.7
4	Draw the bending moment diagrams for a cantilever beam of length 12 m carrying a uniformly distributed load of 12 kNm^{-1} over half its span staring from the free-end.	Understand	CO 2	ACEB07.8
5	Derive the shear force and bending moment diagrams for a cantilever beam carrying a uniformly varying load from zero at free end to w per unit length at the fixed end.	Understand	CO 2	ACEB07.6
6	Draw the shear force and bending moment diagrams for a cantilever beam of length 4 m if two anti-clockwise moments of 15 kNm and 10 kNm are applied at the mid-span and the free end, respectively.	Understand	CO 2	ACEB07.7
7	Draw the shear force and bending moment diagrams for a cantilever beam of length 7 m with a uniformly varying load from zero at fixed-end to 10 kN/m at 4m from the fixed end.	Understand	CO 2	ACEB07.7
8	Draw the shear force and bending moment diagrams for a simply supported beam of length 12 m with an eccentric point load at a distance '3 m' from the left end and at a distance of '4m' from the right end.	Understand	CO 2	ACEB07.8
9	Derive the shear force and bending moment diagrams for a simply supported beam with an eccentric point load at a distance 'a' from left end and at a distance 'b' from right end.	Understand	CO 2	ACEB07.7
10	Derive the shear force and bending moment diagrams for a simply supported beam carrying a uniformly distributed load of *w* per unit run over whole span.	Understand	CO 2	ACEB07.8
11	Derive the shear force and bending moment diagrams for a simply supported beam carrying a uniformly varying load from zero at each end to *w* per unit length at the centre.	Understand	CO 2	ACEB07.6
12	Derive the shear force and bending moment diagrams for a simply supported beam carrying a uniformly varying load from zero at one end to *w* per unit length at the other end.	Understand	CO 2	ACEB07.7
13	Draw the shear force and bending moment diagrams for a simply supported beam of length 12 m with an eccentric point load of 20 kN at a distance '3 m' from the left end and of 20 kN at a distance of '3m' from the right end.	Understand	CO 2	ACEB07.7
14	Draw the shear force and bending moment diagrams for a simply supported beam of length 12 m with an eccentric point load of 25 kN at a distance '3 m' from the left end and 20 kN at a distance of '4m' from the right end.	Understand	CO 2	ACEB07.7
15	Draw the shear force and bending moment diagrams for a simply supported beam of length 10 m with a point load of 15 kN at the mid-span, and a uniformly varying load from zero at 5m from left end to 10 kN/m at the right end.	Understand	CO 2	ACEB07.8
16	Draw the shear force and bending moment diagrams for the following beam 	Understand	CO 2	ACEB07.6

17	Draw the shear force and bending moment diagrams for the following beam.  	Understand	CO 2	ACEB07.7
18	Draw Shear Force and Bending Moment Diagram for a simply supported beam of length 20 m, with a triangular load on it full-span, the maximum value being 16 kN/m at the mid-point of the beam.	Understand	CO 2	ACEB07.8
19	Draw the shear force and bending moment diagrams for the following beam.  	Understand	CO 2	ACEB07.8
20	Draw the shear force and bending moment diagrams for the following beam.  	Understand	CO 2	ACEB07.8
Part – C (Problem Solving and Critical Thinking)				
1	A cantilever beam of length 4m carries point loads of 1kN, 2kN and 3kN at 1, 2 and 4m from the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.7
2	A cantilever of length 4m carries a uniformly distributed load of 2kN/m run over the whole span and a point load of 2kN at a distance of 1m from the free end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.8
3	A cantilever of length 6m carries two point loads 2kN And 3kN at a distance of 1m and 6m from fixed end respectively. In addition to this the beam also carries a uniformly distributed load of 1kN/m over a length of 2m at a distance of 3m from the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.6
4	A cantilever of length 4m carries a uniformly distributed load of 3kN/m run over a length of 1m from the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.7
5	A cantilever of length 6m carries a gradually varying load, zero at the free end to 2kN/m at the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.7
6	A simply supported beam of length 8m carries point loads of 4kN and 6kN at a distance of 2m and 4m from the left end. Draw the S.F and B.M diagrams for the beam.	Understand	CO 2	ACEB07.8
7	A simply supported beam of length 6m is carrying a uniformly distributed load of 2kN/m from the right end. Draw the S.F and B.M diagrams for the beam.	Understand	CO 2	ACEB07.6

8	A beam of length 10m is simply supported and carries point loads of 5kN each at a distance of 3m and 7m from the left end and also a uniformly distributed load of 1kN/m between the point loads. Draw the S.F and B.M diagrams for the beam.	Understand	CO 2	ACEB07.7
9	A beam of length 6m is simply supported at its ends. It is loaded with gradually varying load of 750N/m from left support to 1500N/m to the right support. Construct the S.F and B.M diagrams and find the amount and position of maximum B.M over the beam.	Understand	CO 2	ACEB07.8
10	A simply supported beam of length 8m rests on supports 6m apart, the right hand end is overhanging by 2m. The beam carries a uniformly distributed load of 1500N/m over the entire length. Draw S.F and B.M diagrams and find the point of contraflexure, if any.	Understand	CO 2	ACEB07.8
11	A cantilever beam of length 8m carries point loads of 2kN, 4kN and 6kN at 2, 4 and 8m from the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.8
12	A cantilever of length 8m carries a uniformly distributed load of 4kN/m run over the whole span and a point load of 6 kN at a distance of 2m from the free end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.7
13	A cantilever of length 12 m carries two point loads 4 kN and 6 kN at a distance of 2m and 6m from fixed end respectively. In addition to this the beam also carries a uniformly distributed load of 2kN/m over a length of 4m at a distance of 6m from the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.8
14	A cantilever of length 8m carries a uniformly distributed load of 4kN/m run over a length of 2m from the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.7
15	A cantilever of length 16m carries a gradually varying load, zero at the free end to 20 kN/m at the fixed end. Draw the S.F and B.M diagrams for the cantilever.	Understand	CO 2	ACEB07.8
16	A simply supported beam of length 12 m carries point loads of 6 kN and 8 kN at a distance of 4m and 8m from the left end. Draw the S.F and B.M diagrams for the beam.	Understand	CO 2	ACEB07.6
17	A simply supported beam of length 10 m is carrying a uniformly distributed load of 2kN/m for 4m from the right end. Draw the S.F and B.M diagrams for the beam.	Understand	CO 2	ACEB07.7
18	A beam of length 20m is simply supported and carries point loads of 10 kN each at a distance of 6m and 14m from the left end and also a uniformly distributed load of 2 kN/m between the point loads. Draw the S.F and B.M diagrams for the beam.	Understand	CO 2	ACEB07.8
19	A beam of length 12m is simply supported at its ends. It is loaded with gradually varying load of 1500N/m from left support to 3000N/m to the right support. Construct the S.F and B.M diagrams and find the amount and position of maximum B.M over the beam.	Understand	CO 2	ACEB07.6
20	A simply supported beam of length 16m rests on supports 12m apart, the right hand end is overhanging by 4m. The beam carries a uniformly distributed load of 3000N/m over the entire length. Draw S.F and B.M diagrams and find the point of contraflexure, if any.	Understand	CO 2	ACEB07.7
MODULE –III				
DEFLECTIONS IN BEAMS, TORSION				
Part - A (Short Answer Questions)				
1	Define bending stress in a beam with a diagram.	Remember	CO 3	ACEB07.9
2	Define pure bending and show an example by a figure.	Remember	CO 3	ACEB07.9
3	Define neutral axis and where is it located in a beam.	Remember	CO 3	ACEB07.9
4	What are the assumptions made in theory of simple bending?	Understand	CO 3	ACEB07.10
5	Write the bending equation, defining all the terms in the equation.	Understand	CO 3	ACEB07.11
6	Explain the terms: moment of resistance and section modulus	Understand	CO 3	ACEB07.10
7	Explain the role of section modulus in defining the strength of a section.	Understand	CO 3	ACEB07.10
8	Write the section modulus for a solid rectangular section.	Understand	CO 3	ACEB07.11
9	Write the section modulus for a hollow rectangular section.	Understand	CO 3	ACEB07.11
10	Write the section modulus for a solid circular section.	Understand	CO 3	ACEB07.12

11	Of the following sections: rectangular, circular, triangular, I, T sections, which is most efficient for withstanding bending? Why?	Understand	CO 3	ACEB07.13
12	Under which conditions is the simple bending theory valid in practical applications?	Understand	CO 3	ACEB07.11
13	What do you mean by shear stress in beams?	Understand	CO 3	ACEB07.10
14	Write the expression for shear stress in a section of beam and explain the terms.	Understand	CO 3	ACEB07.10
15	Draw the bending stress and shear stress profiles for a rectangular beam section.	Understand	CO 3	ACEB07.12
16	Draw the bending stress and shear stress profiles for a circular beam section.	Understand	CO 3	ACEB07.11
17	Draw the bending stress and shear stress profiles for a hollow rectangular beam section.	Understand	CO 3	ACEB07.10
18	Draw the bending stress and shear stress profiles for a hollow circular beam section.	Understand	CO 3	ACEB07.10
19	Explain the concept of complimentary shear in longitudinal section of a beam which is transversely loaded.	Understand	CO 3	ACEB07.12
20	Of the following sections: rectangular, circular, triangular, I, T sections, which is most efficient for withstanding shearing stresses in beams? Why?	Understand	CO 3	ACEB07.12
	Part – B (Long Answer Questions)			
1	Derive the bending equation for a beam.	Understand	CO 3	ACEB07.11
2	For a given stress, compare the moments of resistance of a beam of a square section, when placed (i) with its two sides horizontal and (ii) with its diagonal horizontal. Which is more suitable?	Understand	CO 3	ACEB07.10
3	Three beams have the same length, the same allowable stress and the same bending moment. The cross-section of the beams are a square, a rectangle with depth twice the width and a circle. If all the three beams have the same flexural resistance capacity, then find the ratio of the weights of the beams. Which beam is most economical?	Understand	CO 3	ACEB07.11
4	A rectangular beam 60 mm wide and 150 mm deep is simply supported over a span of 6 m. If the beam is subjected to central point load of 12 kN, find the maximum bending stress induced in the beam section.	Understand	CO 3	ACEB07.12
5	A rectangular beam 300 mm deep is simply supported over a span of 4 m. What uniformly distributed load the beam may carry, if the bending stress is not to exceed 120 MPa. Take I = 225 x 10^6 mm^4 .	Understand	CO 3	ACEB07.13
6	A cantilever beam is rectangular in section having 80 mm width and 120 mm depth. If the cantilever is subjected to a point load of 6 kN at the free end and the bending stress is not to exceed 40 MPa, find the span of the cantilever beam.	Understand	CO 3	ACEB07.11
7	A hollow square section with outer and inner dimensions of 50 mm and 40 mm respectively, is used as a cantilever of span 1 m. How much concentrated load can be applied at the free end, if the maximum bending stress is not exceed 35 MPa?	Understand	CO 3	ACEB07.10
8	A cast iron water pipe of 500 mm inside diameter and 20 mm thick is supported over a span of 10 m. Find the maximum stress in the pipe metal, when the pipe is running full. Take density of cast iron as 70.6 kN/m^3, and that of water as 9.8 kN/m^3.	Understand	CO 3	ACEB07.11
9	Two wooden planks 150 mm x 50 mm each are connected to form a T-section of a beam. If a moment of 6.4 kNm is applied around the horizontal neutral axis, find the bending stresses at both the extreme fibres of the cross-section.	Understand	CO 3	ACEB07.11
11	Prove that shear stress at any point in the cross-section of a beam which is subjected to a shear force F, is given by $\tau = F\frac{A\bar{y}}{bI}$	Understand	CO 3	ACEB07.11
12	Show that for a rectangular section of the maximum shear stress is 1.5 times the average stress.	Understand	CO 3	ACEB07.10
13	Prove that the shear stress distribution in a rectangular section of beam which is	Understand	CO 3	ACEB07.11

	subjected to a shear force F is given by $\tau = \frac{F}{2I}(\frac{d^2}{4} - y^2)$			
14	Prove that maximum shear stress in a circular section of beam is 4/3 times the average shear stress.	Understand	CO 3	ACEB07.12
15	Prove that the maximum shear stress in a triangular section of a beam is given by $\tau_{max} = \frac{3F}{bh}$ where b is base width and h is height.	Understand	CO 3	ACEB07.13
16	Show that the ratio of maximum shear stress to mean shear stress in a rectangular cross-section is equal to 1.50when it is subjected to a transverse shear force F. Plot the variation of shear stress across the section.	Understand	CO 3	ACEB07.11
17	Sketch the distribution of shear stress across the depth of the beams of the following cross-sections: (i) T-section; (ii) square section with diagonal horizontal.	Understand	CO 3	ACEB07.10
18	A rectangular beam section 100 mm wide is subjected to a maximum shear force of 50 kN. Find the depth of the beam, if the maximum shear stress is 3 MPa.	Understand	CO 3	ACEB07.11
19	A circular beam of 100 mm diameter is subjected to a shear force of 30 kN. Calculate the value of maximum shear stress and sketch the variation of shear stress along the depth of the beam.	Understand	CO 3	ACEB07.12
20	An I section with rectangular ends, has the following dimensions: Flanges = 150 mm x 20 mm, Web = 300 mm x 10 mm. Find the maximum shearing stress developed in the beam for a shear force of 50 kN.	Understand	CO 3	ACEB07.13

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