Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2024

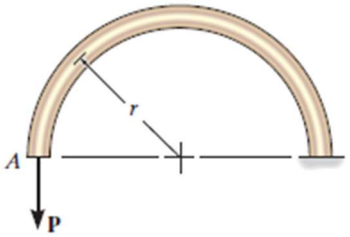
Course: Aircraft Structure I — **Semester: Vth**

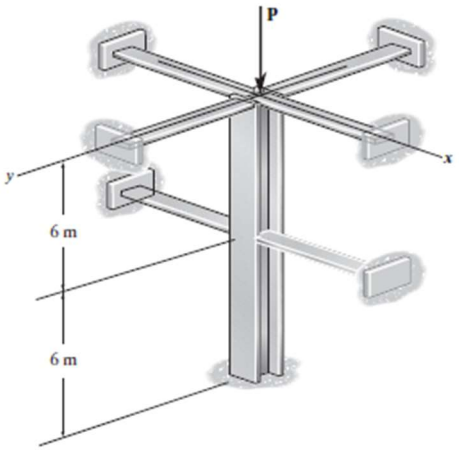
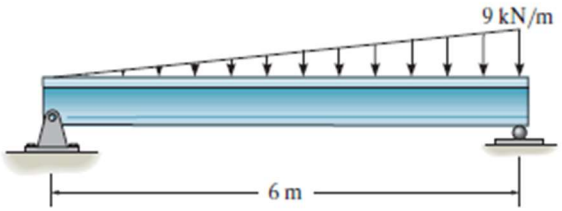
Program: B Tech Aerospace — **Time : 03 hrs.**

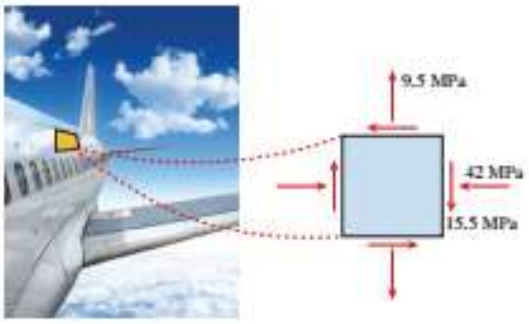
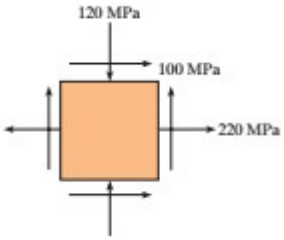
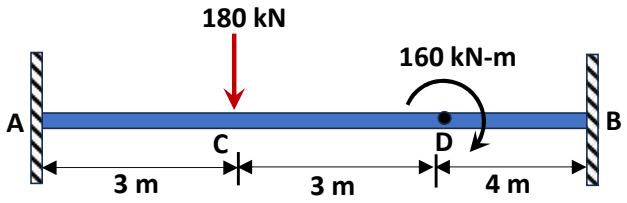
Course Code: ASEG 3018 — **Max. Marks: 100**

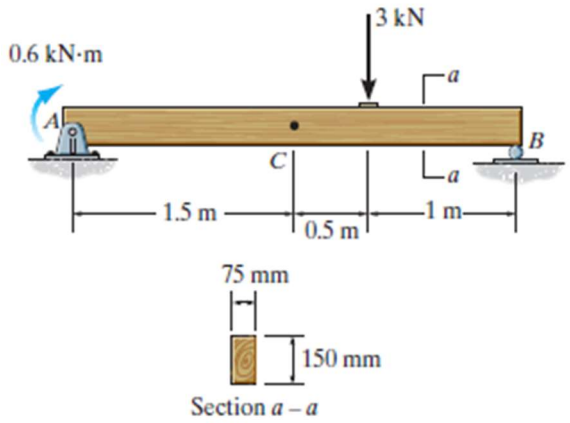
Instructions: Assume suitable right-handed coordinate system.
Assume any suitable value for missing data

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	a) In a Uniaxial state of stress, the normal to the plane across which the normal stress is maximum, makes an angle with the direction of loading, which is equal to --------- b) Principal planes are the planes on which maximum stress is the ------- c) The radius of Mohr's circle gives the values of ---------- d) An iron block of 5cm^2 cross section carries an axial compressive load of 50 kN. The magnitude of the normal stress on a plane, who's normal is inclined at 30° to the axis of the block is ----------	**4**	**CO1**
Q 2	If ρ is the density and A is the area of cross-section of rod of length L, then determine the strain energy of bar of rod due to the self-weight.	**4**	**CO1**
Q 3	The rod has a circular cross section with a moment of inertia I. If a vertical force **P** is applied at A, determine the vertical displacement at this point. Only consider the strain energy due to bending. The modulus of elasticity is E. 	**4**	**CO1**
Q 4	The structural steel column has a length of 12 ft. If its bottom end is fixed supported while its top end is free, determine the largest axial load it can support. Use a factor of safety with respect to buckling of 1.75.	**4**	**CO2**
Q 5	A material is subjected to plane stress. Express the maximum-shear-stress theory of failure in terms of σ_x, σ_y and τ_{xy}. Assume that the principal stresses are of different algebraic signs.	**4**	**CO3**

SECTION B (4Qx10M= 40 Marks)			
Q 6	The steel column can be considered pinned at its top and bottom and braced against its weak axis at the mid-height. Determine the maximum allowable force **P** that the column can support without buckling. Apply a factor of safety F.S.=2 against buckling. Take $A = 7.4(10^{-3})\ m^2$, $I_x = 87.3(10^{-6})\ m^4$, $I_Y = 18.8(10^{-6})\ m^4$. 	**10**	**CO2**
Q 7	Determine the bending strain energy in the steel beam, where flexural rigidity *EI* is constant. 	**10**	**CO1**
Q 8	An element in plane stress on the fuselage of an airplane (figure part a) is subjected to compressive stresses with a magnitude of 42 MPa in the horizontal direction and tensile stresses with a magnitude of 9.5 MPa in the vertical direction (see figure part b). Also, shear stresses with a magnitude of 15.5 MPa act in the directions shown, Determine the stresses acting on an element oriented at a clockwise angle of 40° from the horizontal. Also determine the plane of zero shear stress. Show these stresses on a sketch of an element oriented at this angle.	**10**	**CO4**

	a) b)  **Or** The components of plane stress at a critical point on an aluminum shell are shown.  a) Determine the maximum shear stress, its associated stress and planes. b) Determine yield strength if failure (yielding) has occurred based on the maximum distortion-energy theory.		
Q 9	The solid shaft has a torque of 3.25 kip-in. The shaft has a radius of 0.5 in. and is made of steel having a yield stress of $\sigma_Y = 36$ ksi. Determine if the loadings cause the shaft to fail according to a) Maximum-shear-stress theory, and b) Maximum-distortion-energy theory.	**10**	**CO3**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Determine the fixing moments and the reaction force at the supports and draw the bending moment diagram and shear force diagram for the fixed beam *ACDB* as shown below. Take *EI* is constant.  **Or** A continuous beam *ABCDE* has roller supports at *B*, *C* and *D*, a fixed support at *A* and overhang at *DE*. The span length is $AB = BC = CD =$	**20**	**CO1**

	4 m and $DE = 2$ m. The beam carries a uniformly distributed load of 3 kN/m over a spans *ABCD* and of 1.5 kN/m over *DE*. A point load of 6 kN is also placed midway between *B* and *C*. Calculate the support moments and reactions at the support by using Clapeyron's equation. Draw the bending moment diagram and shear force diagram of the beam.		
Q 11	Determine the slope at point *A* and displacement at point *C* of the simply supported beam.  Section *a* – *a*	**20**	**CO4**