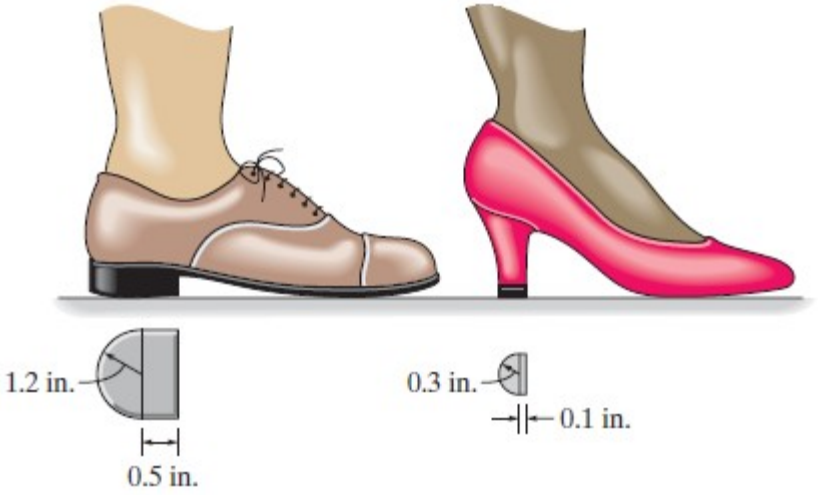
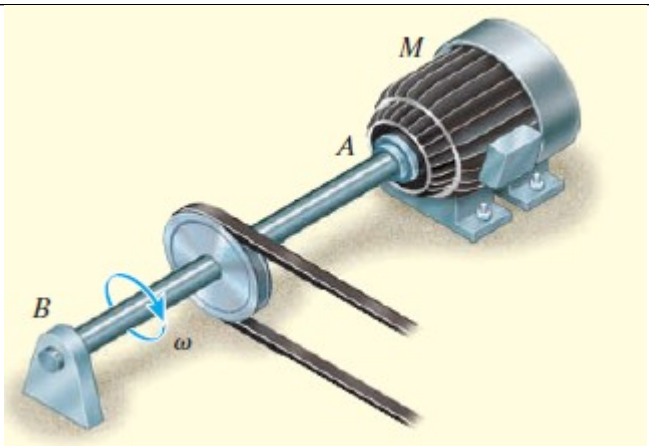
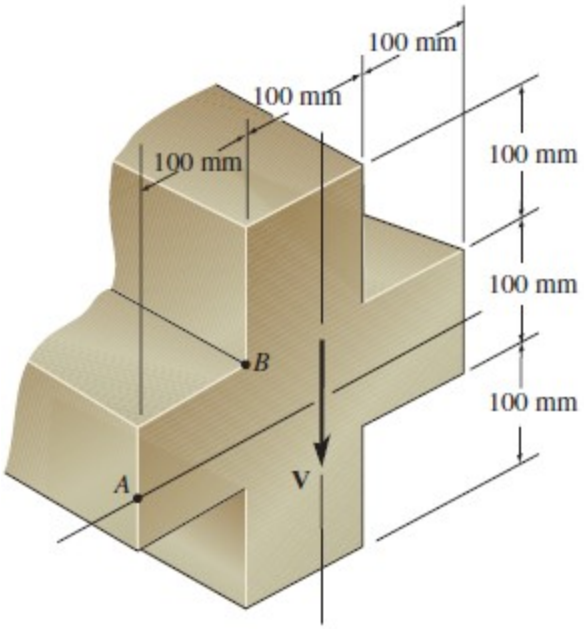
Name: **Enrolment No:**	UPES

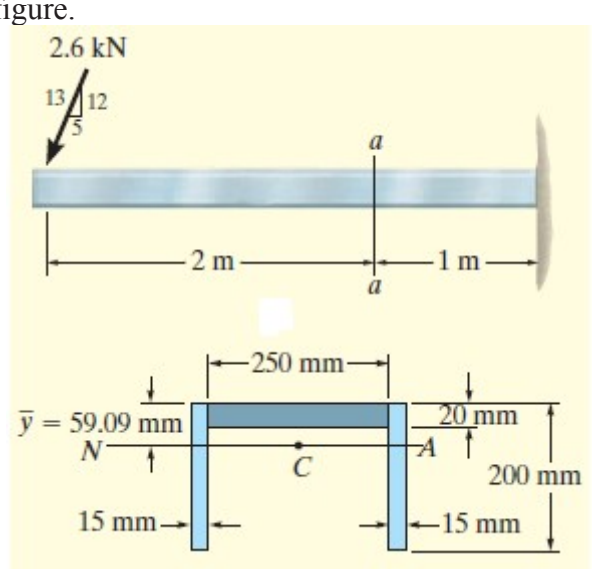
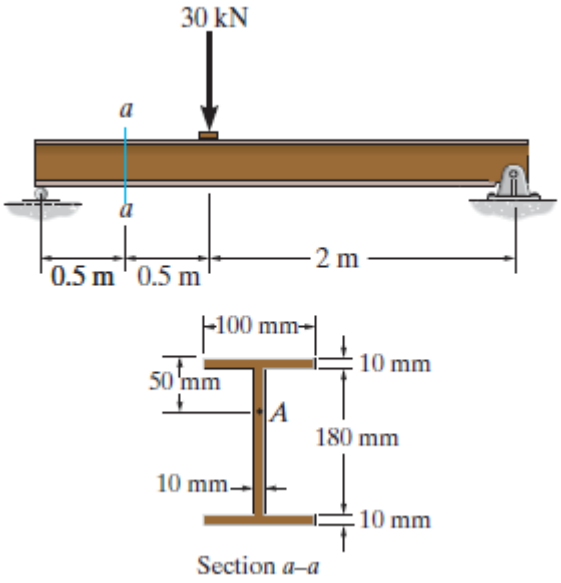
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

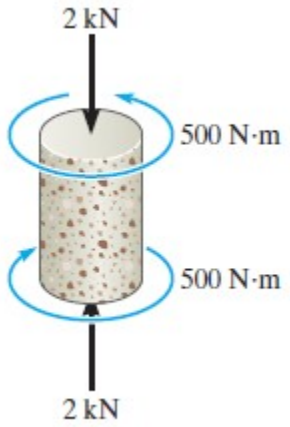
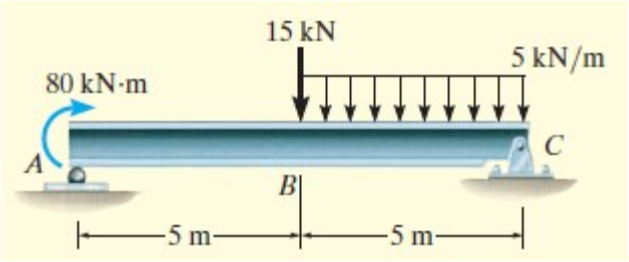
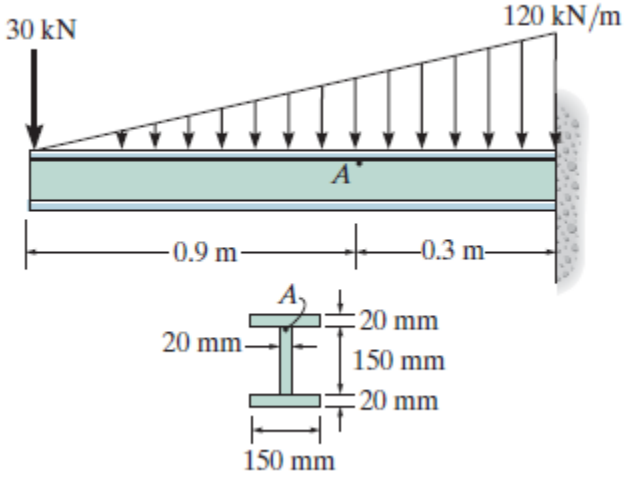
Course: MECHANICS OF SOLIDS –CIVL 2005 **Semester: III**
Programme: B TECH IN CIVIL ENGINEERING
Time: 03 hrs. **Max. Marks: 100**
Instructions: ATTEMPT **ALL QUESTION** IN **SECTION A**, **ANY FOUR** QUESTION IN **SECTION B** AND **ANY TWO** QUESTION **SECTION C**

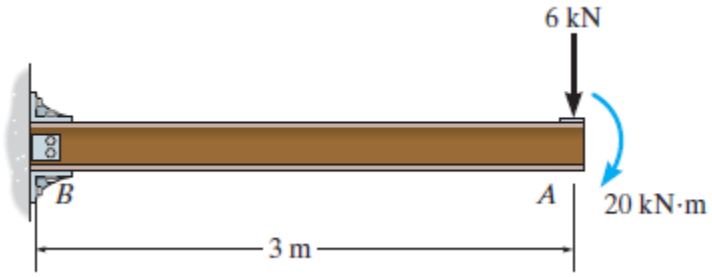
SECTION A

S. No.		Marks	CO
Q1	A 175-lb woman stands on a vinyl floor wearing stiletto high-heel shoes. If the heel has the dimensions shown, determine the average normal stress she exerts on the floor and compare it with the average normal stress developed when a man having the same weight is wearing flat-heeled shoes. Assume the load is applied slowly, so that dynamic effects can be ignored. Also, assume the entire weight is supported only by the heel of one shoe. 	**5**	**CO1**
Q2	An aluminum specimen shown in figure has a diameter of 25 mm and a gauge length of 250 mm. If a force of 165 kN elongates the gauge length 1.20 mm, determine the modulus of Elasticity assuming elastic deformation. Also, determine by how much the force causes the diameter of the specimen to contract. Take G = 70 GPa.	**5**	**CO1**
Q3	A solid steel shaft *AB* shown in figure is to be used to transmit 5 hp (Given 1 hp = 550 lb.ft/s) from the motor *M* to which it is attached. If the shaft rotates at ω = 175 rpm and the steel has an allowable shear stress of τ_{all} = 14.5 ksi, determine the required diameter of the shaft.	**5**	**CO4**

			
Q4	A spherical gas tank has an inner radius of 1.5 m. If it is subjected to an internal pressure of 300 kPa, determine its required thickness if the maximum normal stress is not to exceed 12 MPa.	**5**	**CO4**
	SECTION B		
Q5	A steel plus section beam has the dimensions shown in figure. If it is subjected to a shear of V = 600 kN, plot the shear-stress distribution acting over the beam's cross-sectional area. 	**10**	**CO3**
Q6	A 2014-T6 aluminum tube having a cross-sectional area of 600 mm^2 is used as a sleeve for an A-36 steel bolt having a cross-sectional area of 400 mm^2. When the temperature is $T_1 = 15^oC$, the nut holds the assembly in a snug position such that the axial force in the bolt is negligible. If the temperature increases to $T_2 = 80^oC$, determine the force in the bolt and sleeve. $E_{al} = 73.1$ GPa, $E_{st} = 200$ GPa, $\alpha_{al} = 23$ x	**10**	**CO1**

	$10^{-6}/^{o}C$ and $\alpha_{st} = 12 \times 10^{-6}/^{o}C$		
Q7	The beam shown in figure has a cross-sectional area in the shape of a channel. Determine the maximum bending stress that occurs in the beam at section *a–a*. The centroid shown in figure. 	**10**	**CO3**
Q8	Determine the state of stress at point *A* on the cross section of the beam at section *a–a*. 	**10**	**CO2** **CO3**
Q9	The short concrete cylinder having a diameter of 50 mm is subjected to a torque of 500 Nm and an axial compressive force of 2 kN. Determine if it fails according to the maximum-normal-stress theory. The ultimate stress of the concrete is $\sigma_{ult} = 28$ MPa.	**10**	**CO4**

			
	SECTION-C		
Q10	Draw the shear force diagram and bending moment diagrams for the beam shown in figure. 	**20**	**CO3**
Q11	The wide-flange beam is subjected to the loading shown. Determine the principal stress in the beam at point *A*, which is located at the top of the web. Although it is not very accurate, use the shear formula to determine the shear stress. Show the result on an element located at this point. Hint – Shear stress will be width corresponding to web width. 	**20**	**CO2**

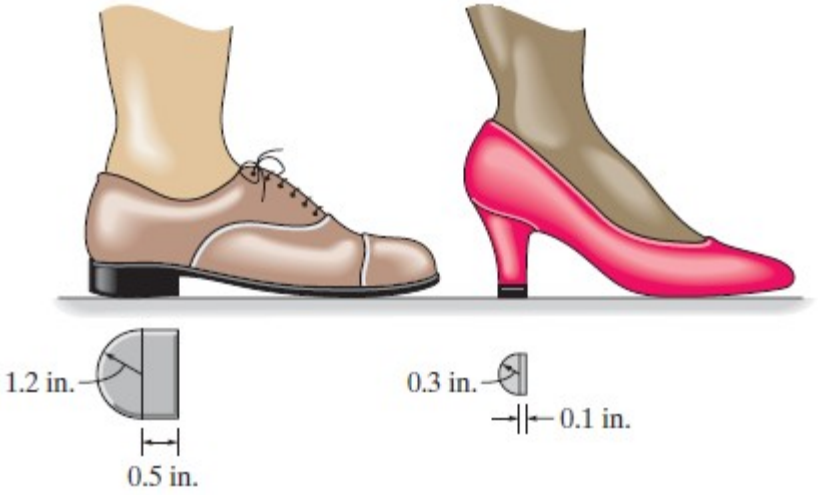
Q12	Determine the slope and deflection of end *A* of the cantilevered beam by Moment Area Method. E = 200 GPa and I = 65.0(10^{-6}) m^4.  	**20**	**CO5**

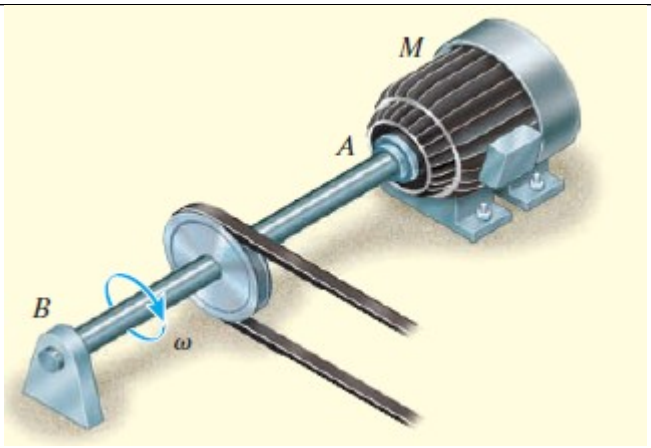
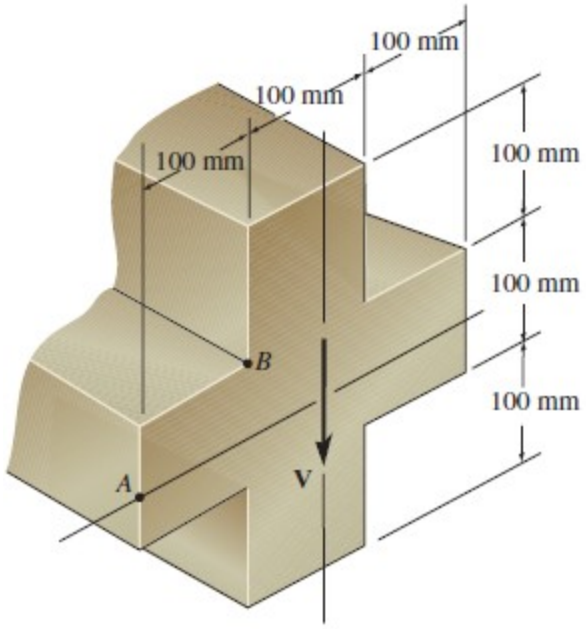
Name: **Enrolment No:**	UPES

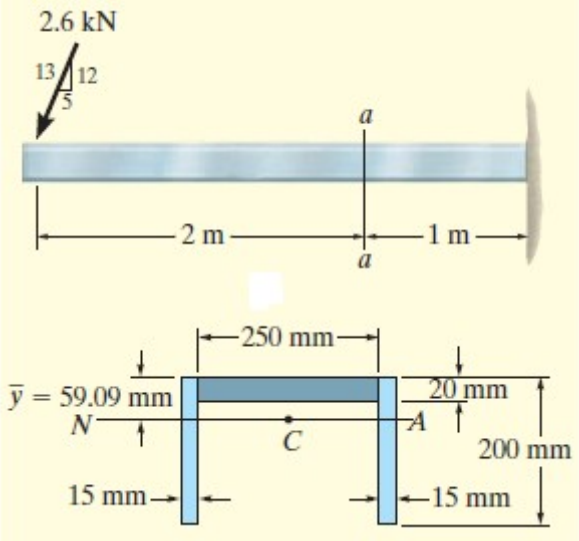
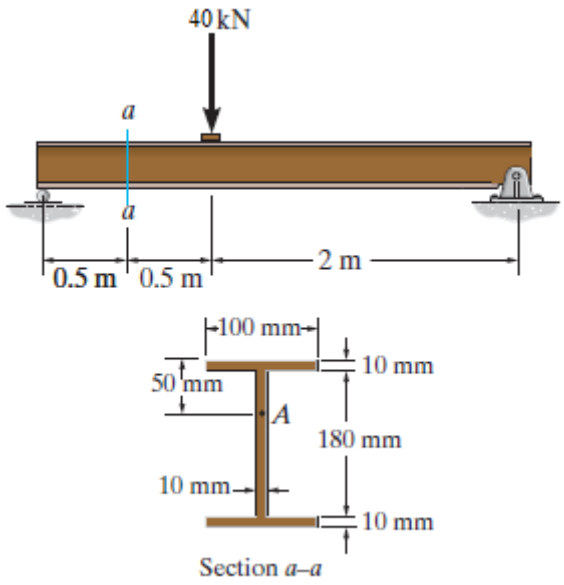
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

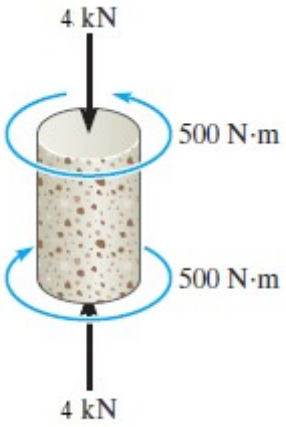
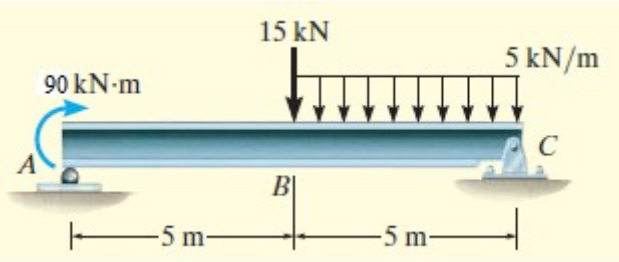
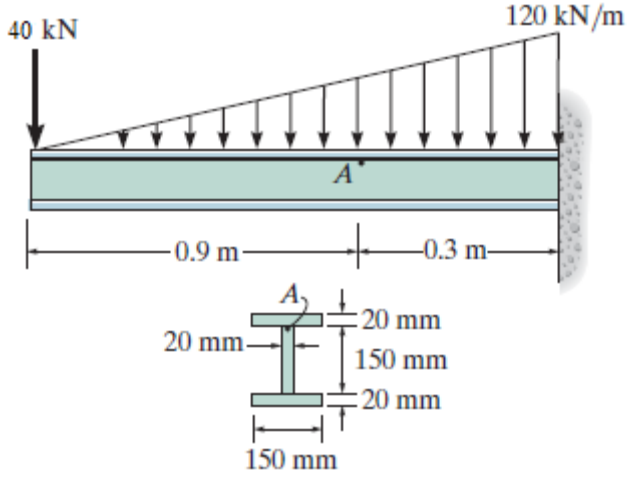
Course: MECHANICS OF SOLIDS –CIVL 2005 **Semester: III**
Programme: B TECH IN CIVIL ENGINEERING
Time: 03 hrs. **Max. Marks: 100**
Instructions: ATTEMPT **ALL QUESTION** IN **SECTION A**, **ANY FOUR** QUESTION IN **SECTION B** AND **ANY TWO** QUESTION **SECTION C**

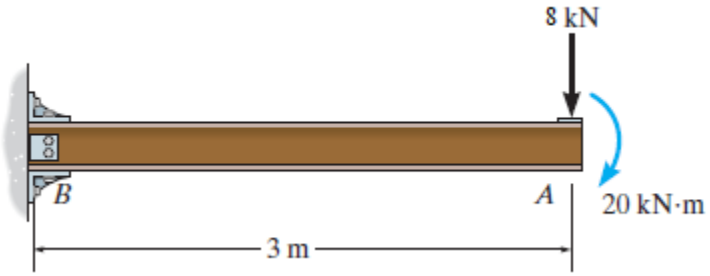
SECTION A

S. No.		Marks	CO
Q1	A 190-lb woman stands on a vinyl floor wearing stiletto high-heel shoes. If the heel has the dimensions shown, determine the average normal stress she exerts on the floor and compare it with the average normal stress developed when a man having the same weight is wearing flat-heeled shoes. Assume the load is applied slowly, so that dynamic effects can be ignored. Also, assume the entire weight is supported only by the heel of one shoe. 	5	CO1
Q2	An aluminum specimen shown in figure has a diameter of 25 mm and a gauge length of 250 mm. If a force of 175 kN elongates the gauge length 1.20 mm, determine the modulus of Elasticity assuming elastic deformation. Also, determine by how much the force causes the diameter of the specimen to contract. Take G = 70 GPa.	5	CO1
Q3	A solid steel shaft *AB* shown in figure is to be used to transmit 5 hp (Given 1 hp = 550 lb.ft/s) from the motor *M* to which it is attached. If the shaft rotates at ω = 175 rpm and the steel has an allowable shear stress of τ_{all} = 15 ksi, determine the required diameter of the shaft.	5	CO4

			
Q4	A spherical gas tank has an inner radius of 1.5 m. If it is subjected to an internal pressure of 400 kPa, determine its required thickness if the maximum normal stress is not to exceed 12 MPa.	**5**	**CO4**
	SECTION B		
Q5	A steel plus section beam has the dimensions shown in figure. If it is subjected to a shear of V = 700 kN, plot the shear-stress distribution acting over the beam's cross-sectional area. 	**10**	**CO3**
Q6	A 2014-T6 aluminum tube having a cross-sectional area of 600 mm^2 is used as a sleeve for an A-36 steel bolt having a cross-sectional area of 400 mm^2. When the temperature is $T_1 = 25^oC$, the nut holds the assembly in a snug position such that the axial force in the bolt is negligible. If the temperature increases to $T_2 = 80^oC$, determine the force in the bolt and sleeve. $E_{al} = 73.1$ GPa, $E_{st} = 200$ GPa, $\alpha_{al} = 23 \times 10^{-6}/^oC$ and $\alpha_{st} = 12 \times 10^{-6}/^oC$	**10**	**CO1**

Q7	The beam shown in figure has a cross-sectional area in the shape of a channel. Determine the bending stress at the **top fiber** that occurs in the beam at section *a–a*. The centroid shown in figure. 	**10**	**CO3**
Q8	Determine the state of stress at point *A* on the cross section of the beam at section *a–a*. 	**10**	**CO2** **CO3**
Q9	The short concrete cylinder having a diameter of 50 mm is subjected to a torque of 500 Nm and an axial compressive force of 4 kN. Determine if it fails according to the maximum-normal-stress theory. The ultimate stress of the concrete is σ_{ult} = 28 MPa.	**10**	**CO4**

			
	SECTION-C		
Q10	Draw the shear force diagram and bending moment diagrams for the beam shown in figure. 	**20**	**CO3**
Q11	The wide-flange beam is subjected to the loading shown. Determine the principal stress in the beam at point *A*, which is located at the top of the web. Although it is not very accurate, use the shear formula to determine the shear stress. Show the result on an element located at this point. Hint – Shear stress will be width corresponding to web width. 	**20**	**CO2**

Q12	Determine the slope and deflection of end *A* of the cantilevered beam by Moment Area Method. E = 200 GPa and I = 65.0(10^{-6}) m^4.  	**20**	**CO5**