BITS PILANI , DUBAI CAMPUS

2nd Year, FIRST SEMESTER 2013 – 2014

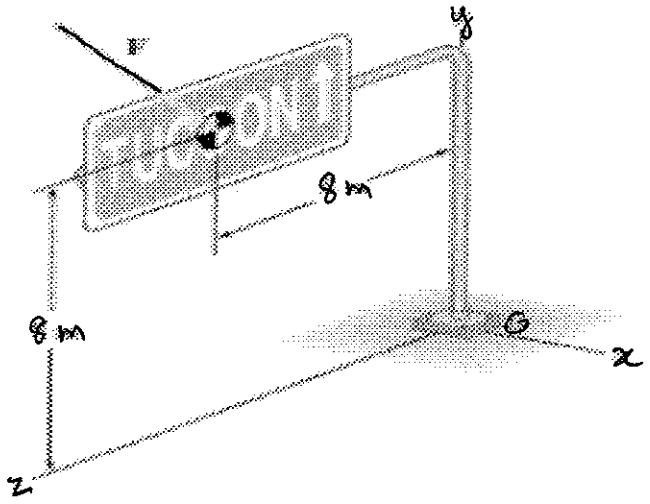
Comprehensive exam (Closed Book)

Course Code:	**ME F211**	Date:	**29.12.13 FN**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**80 marks**
Duration:	**3 hours**	Weightage:	**40%**

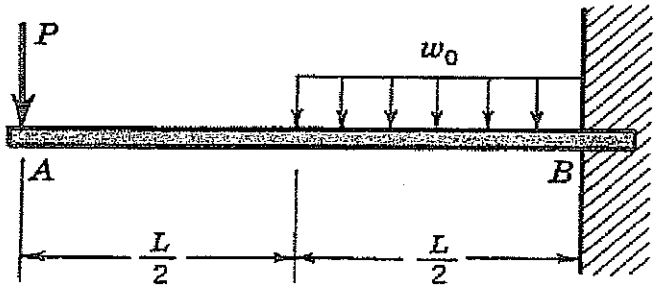
Instruction : This paper consists of TEN questions. Answer all the questions. Section 1 and Section 2 must be answered in separate booklets. Please attach the graph sheet for Mohr's circle to section 1.

SECTION : 1

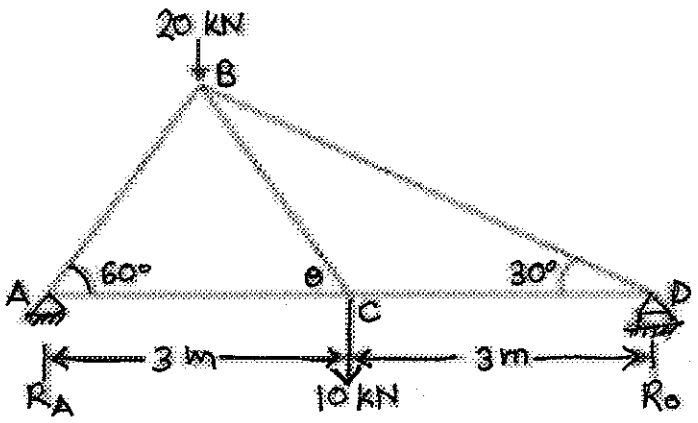
Q1. An engineer estimates that under the most adverse expected weather conditions, the total force on the highway sign will be **F** = ±1.4**i** - 2.0**j** kN. What moment does this force exert about the base O? **[4M]**



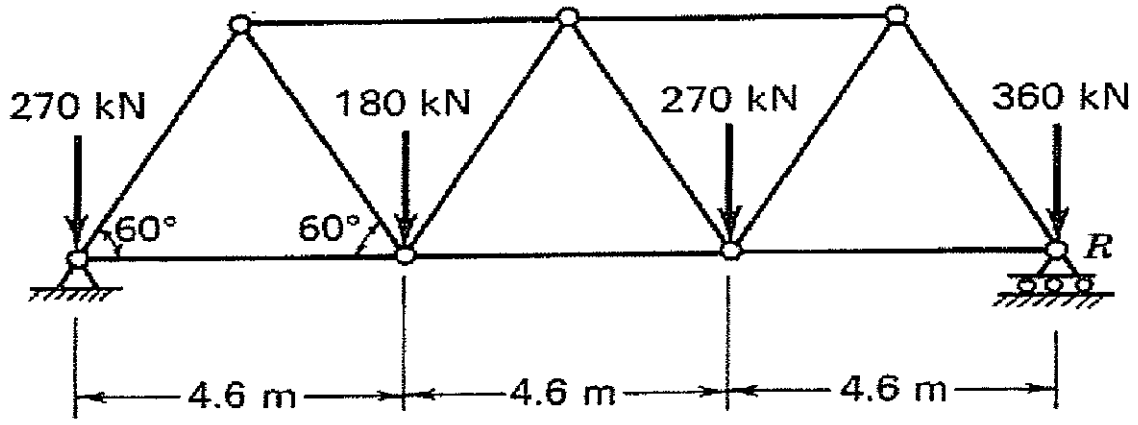
Q2. Sketch the shear force and bending moment diagrams for the cantilever beam which carries a concentrated force P and a distributed load of intensity w_o force per unit length, with the supporting theory. **[6M]**



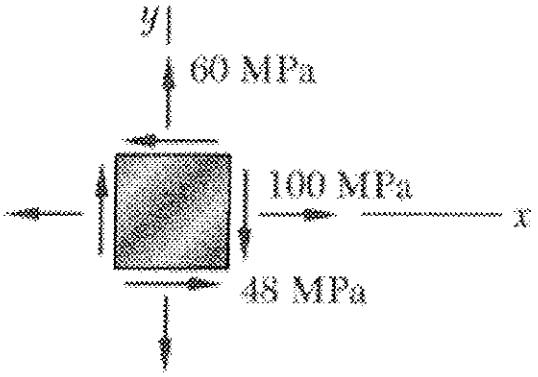
Q3. Determine the forces in all the members of the truss shown below. **[10M]**



Q4. A small railroad bridge is constructed with steel members, all of which have a cross-sectional area of 3250 mm^2. A strain stops on the bridge and the loads applied to the truss on one side of the bridge are shown in the sketch. Estimate how much the point R moves horizontally because of this loading. **[10M]**



Q5. For the state of stress shown, determine (a) the principal planes and principal stresses, (b) the stress components exerted on the element obtained by rotating the given element counterclockwise through 30^0. **[10M]**

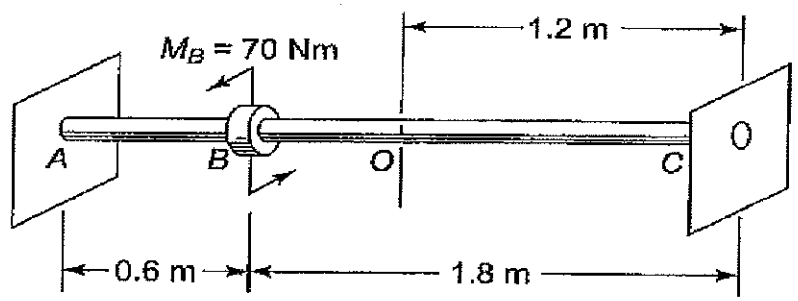


SECTION: 2

Q6. A batch of 2028-TY Al alloy yields in uniaxial tension at the stress σ_o = 330MN/m^2 .If this material is subjected to the following state of stress, will it yield according to a) Mises Criteria b) Maximum shear stress criteria?

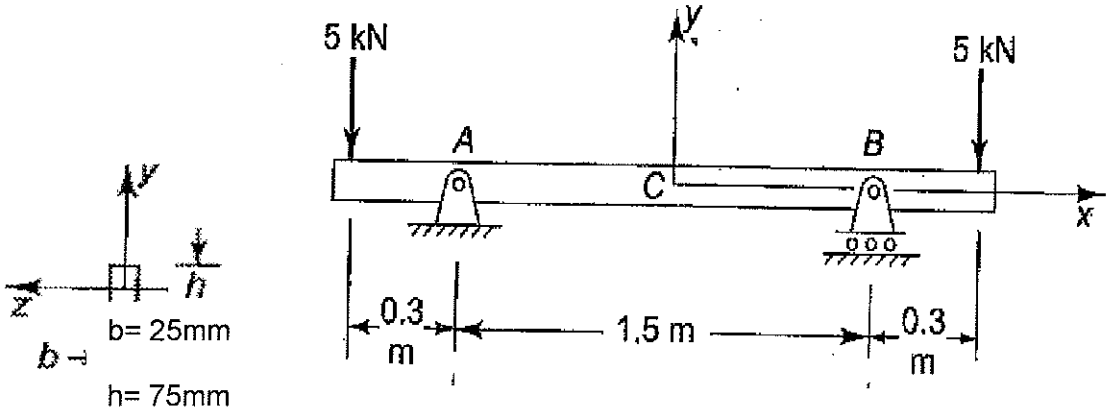
$\sigma_X = 138MN/m^2, \sigma_Y = -69MN/m^2, \sigma_Z = 0, \tau_{XY} = 138MN/m^2, \tau_{YZ} = 0, \tau_{ZX} = 0$ **[8M]**

Q7. A couple of 70Nm is applied to a 25 mm diameter 2024-0 alloy shaft as shown in the figure below. The ends A and C of the shaft are built in and prevented from rotating. What is the angle through which the center cross section O of the shaft rotates? (G= 25.5GN/m^2) **[8M]**

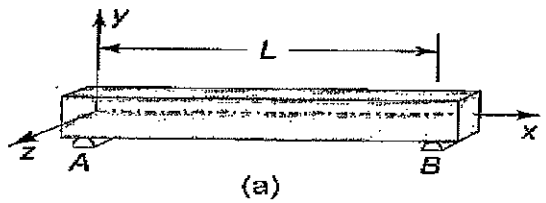


(a)

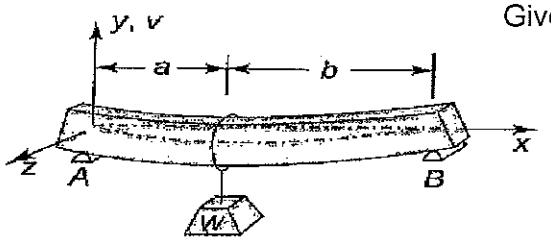
Q8. A steel beam 25mm wide and 75 mm deep pinned to supports A and B as shown in the figure, where the support is on rollers and free to move horizontally. When the ends of the beam are loaded with 5kN loads, find the maximum bending stress at the mid span of the beam and the angle $\Delta\Phi_o$ subtended by the cross sections at A and B in the deformed beam. **[8M]**



Q9. The simply supported beam of uniform cross section shown below is a nominal 50 x 200 mm floor joist spanning 3.7 m and is loaded with a central concentrated load of 1.8 k N . Calculate the slope angle and deflection after application of the load. **[8M]**



(a)



(b)

Given: a=b= 1.85 m, E = 11 GN/m^2

Q10. A) A hollow circular steel column (E=210GPa) of cross section area 3.43x10^3 mm^2 is simply supported over a length of 5m. The inner and outer diameters of the cross section are 75 mm and 100 mm respectively. Determine:

a) The slenderness ratio
b) The critical buckling load.
c) The axial stress at the critical buckling. **[6M]**

B) An ASTM cast iron has minimum ultimate strengths of 210 MPa in tension and 700 MPa in compression. Find the factor of safety using MNS theory for the following state of stress :

$$\sigma_X = 42MPa \quad and\, \sigma_Y = 70MPa$$ **[2M]**

BITS, Pilani Dubai Campus

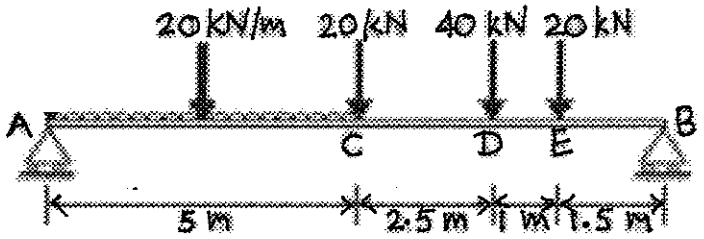
2nd Year, FIRST SEMESTER 2013 – 2014

TEST – 2 (Open Book)

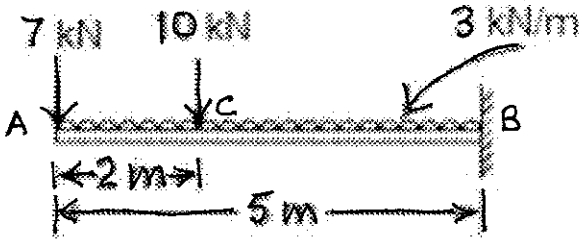
Course Code:	**ME F211**	Date: 06.11.13	
Course Title:	**Mechanics of Solids**	Maximum Marks:	**40 marks**
Duration:	**50 minutes W4**	Weightage:	**20%**
Section:		Faculty name:	

Instruction : This paper consists of FOUR questions. Answer all the questions.

Q1.Draw the shear force and bending moment diagrams for the beam shown in below. Also find out the position and the magnitude of the maximum bending moment. [12]



Q2. A cantilever beam of length 5 m carries a uniformly distributed load 3 kN/m and a concentrated load of 7 kN at the free end and 10 kN at 3 m from the fixed end. Draw the shear force and bending moment diagrams. [8]



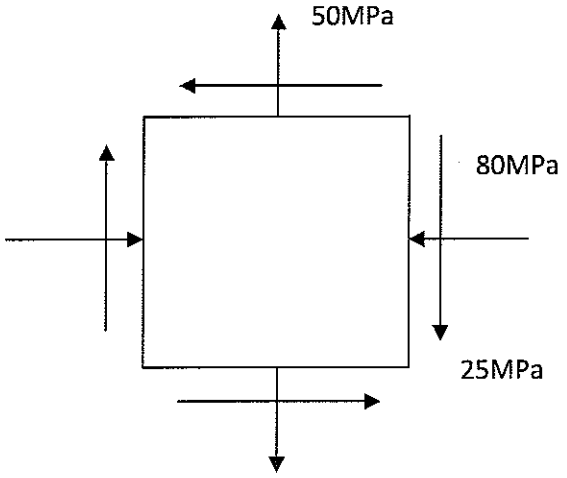
Q3. For a particular point on the oil tank, the local strains were found to be -800×10^{-6} and 400×10^{-6} in the horizontal (x) and vertical (y) directions, respectively. The shear strain was found to be 400×10^{-6}. Construct a Mohr's circle for the strain and find [10]

i) Principal direction θ_P
ii) Principal strains ε_I and ε_{II}
iii) Maximum shear strain direction $\theta_{\gamma max}$
iv) Maximum shear strain. γ_{max}

Q4. The state of plane stress at a point on the surface of the airplane fuselage is represented on the element as shown in the figure. Use the **analytical** method to

i) Determine the principal planes, principal stresses and the maximum shear stress.

ii) Find the stress components on the element after it is rotated 30° clockwise. [10]



BITS, PILANI – DUBAI
2nd Year, FIRST SEMESTER 2013 – 2014

TEST – 1 (Closed Book)

Course Code:	**MEF 211**	Date:	**02 .10.2013**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**50**
Duration:	**50 minutes**	Weightage:	**25%**

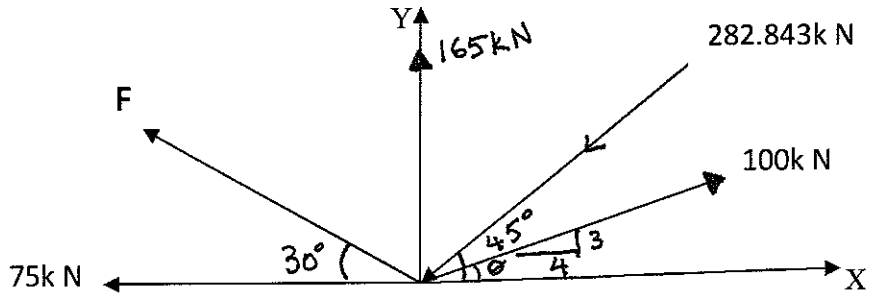
Name _____

ID No: _____ **Program:** _____ **Section** _____

Instruction: ***Answer all the questions.***

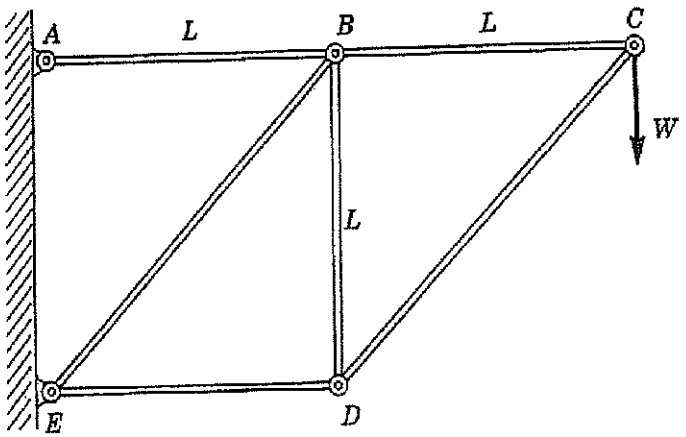
Draw the free body diagrams clearly, wherever necessary.

Q1. Find the magnitude and direction of force **F** and the resultant **R** if $\Sigma F_X = -324.90$ k N for a particle given below. (10)

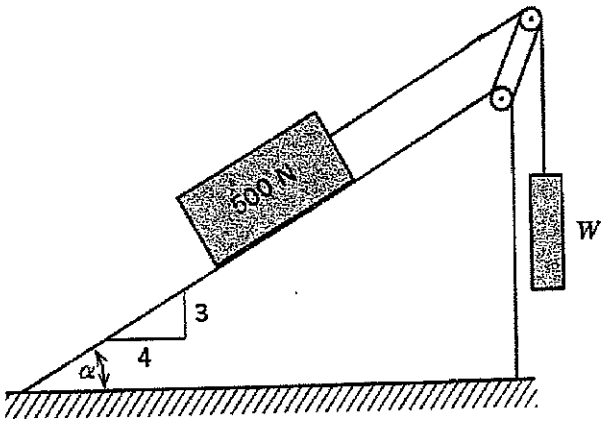


Q2. Determine the forces in the six members of the truss and reactions at A and E as shown below.

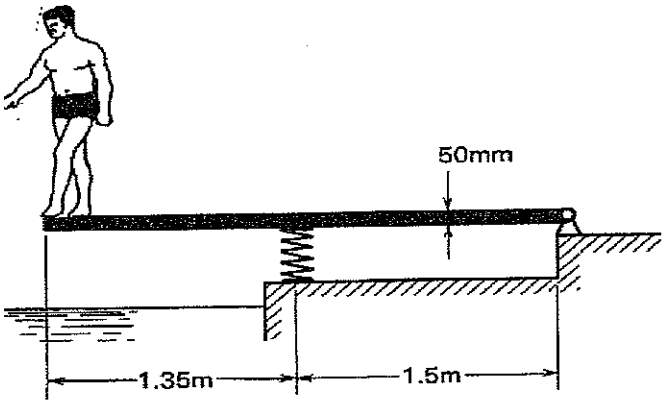
(15)



Q3. Find the range of values of W which will hold the block of weight 500 N in equilibrium on the inclined surface, if the coefficient of static friction is 0.5. (15)



Q4. A wooden diving board is hinged at one end and supported 1.5m from the end by a spring of stiffness 35k N/m. How much will the spring deflect if a young man weighing 600N stands at the end of the board? (10)



SET A

BITS PILANI , DUBAI CAMPUS

2nd Year, FIRST SEMESTER 2013 – 2014

QUIZ - 2

Course Code:	**ME F211**	Date:	**4.12.2013**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**14**
Duration:	**20 minutes W(4)**	Weightage:	**7 %**

Name _____

ID No: _____ **Program:** _____ **Faculty/Section** _____

Instruction : ***Answer all the questions .***

Q1. Draw the stress strain graph that represents the elastic plastic material with strain hardening. [1]

Q2. Draw a typical stress strain graph and mark the following points: [2]

a) Yield strength
b) Ultimate tensile strength
c) Fracture point
d) Elastic limit.

Q3. Von Mises and Tresca criteria give different yield stress for: [1]

a) Uni-axial stress
b) Balanced bi- axial stress
c) Pure shear stress
d) All the above

Q4. Mention the criteria for yield in case of: [2]

a) Von Mises criteria

b) Maximum Shear stress criteria

Q5. The principal strains in the plane of a flat aluminum plate which is loaded in its plane are $\varepsilon_1 = 3.2\text{x}10^{-4}$ and $\varepsilon_2 = -5.4\text{x}10^{-4}$ .Obtain the value of σ_2 .
Given: $\sqrt{}= 0.33$ and E= 70GN/m^2 [2]

Q6. a) Calculate the maximum shear stress and rate of twist of a given solid circular shaft of diameter 75mm if a torque of 10 kNm is applied to it in the ACW direction.
b) If the length of the shaft is 15 m, how much would it rotate by? Given: G= 81GPa. [4]

Q7. What are the assumptions made when a solid circular shaft undergoes torsion. [2]

SET B

BITS PILANI , DUBAI CAMPUS

2nd Year, FIRST SEMESTER 2013 – 2014

QUIZ - 2

Course Code:	**ME F211**	Date:	**4.12.2013**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**14**
Duration:	**20 minutes W(4)**	Weightage:	**7 %**

Name _____

ID No: _____ **Program:** _____ **Faculty/Section** _____

Instruction : ***Answer all the questions .***

Q1. The principal strains in the plane of a flat aluminum plate which is loaded in its plane are $\varepsilon_1 = 3.2\text{x}10^{-4}$ and $\varepsilon_2 = -5.4\text{x}10^{-4}$ .What will be the value of σ_2 ? [2]
Given: $\sqrt{}$= 0.33 and E= 70GN/m^2

Q2. Von Mises and Tresca criteria give different yield stress for: [1]

a) Uni-axial stress
b) Balanced bi- axial stress
c) Pure shear stress
d) All the above

Q3. Draw a typical stress strain graph and mark the following points: [2]

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Q6. Mention the criteria for yield in case of: [2]

a) Von Mises criteria

b) Maximum Shear stress criteria

Q7. Draw the stress strain graph that represents the elastic plastic material with strain hardening. [1]

SET B

BITS, PILANI – DUBAI

2nd Year, FIRST SEMESTER 2013 – 2014

QUIZ - 1

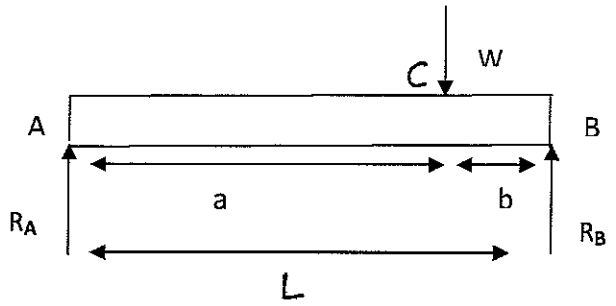
Course Code:	**MEF 211**	Date:	**23.10.2013**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**16**
Duration:	**20 minutes W(4)**	Weightage:	**8 %**

Name _____

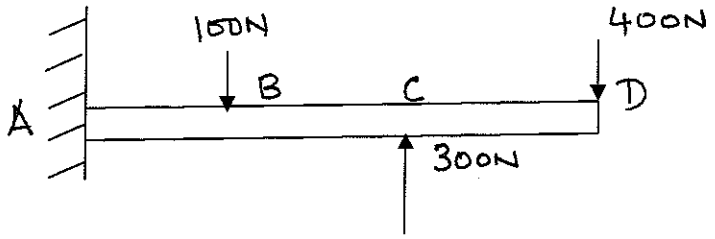
ID No: _____ **Program:** _____ **Section** _____

Instruction : ***Answer all the questions and write the answer in the box.***

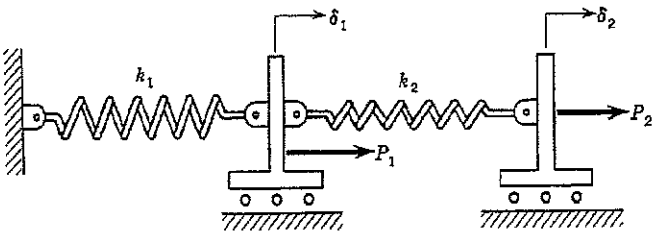
Q1. Draw a bending moment diagram for a simply supported beam with an eccentric point load as shown below. **[2M]**



Q 2.Draw a shear force diagram for a cantilever beam of length 3m having point loads as shown below. **[2M]**



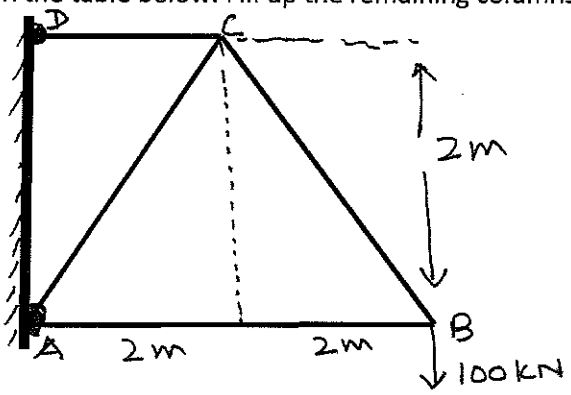
Q3. Determine the deflections δ_1 and δ_2 in the following spring system arrangement. **[4M]**



Q4. Draw the force vs deflection graph for work done and complementary work done for a force F acting on a spring mass system which produces a deflection δ. **[1 M]**

Q5. A couple 10 Nm is acting on a body. What is the work done by the couple in the following cases?
(a) When the body is translated by 1 m. (b) When the body is rotated by an angle 1^0 **[2M]**

Q6. Determine the vertical deflection of joint C of the steel truss shown in the following figure. The cross sectional area of each member is A= 400mm^2 and E = 200 GPa.The force in each member is given in the table below. Fill up the remaining columns and obtain δ_v **[5M]**



Member	Force F (k N)			
AB	-100			
BC	141.4			
AC	- 141.4 - 1.414P			
CD	200 + P			

δ_v = mm

SET A

BITS, PILANI – DUBAI

2nd Year, FIRST SEMESTER 2013 – 2014

QUIZ - 1

Course Code:	**MEF 211**	Date:	**23.10.2013**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**16**
Duration:	**20 minutes W(4)**	Weightage:	**8 %**

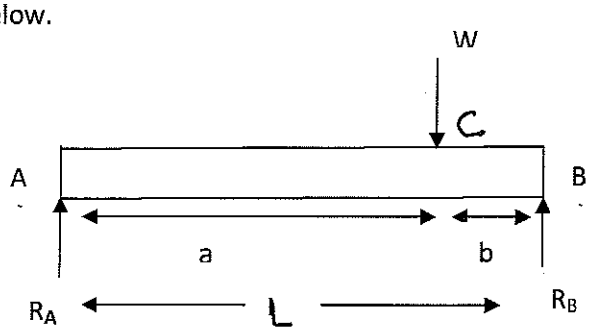
Name _____

ID No: _____ **Program:** _____ **Section** _____

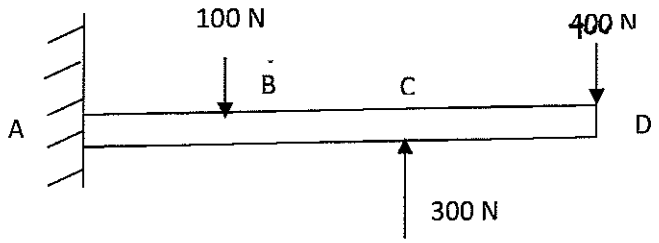
Instruction : ***Answer all the questions and write the answer in the box.***

Q1. Draw the force vs deflection graph for work done and complementary work done for a force F acting on a spring mass system which produces a deflection δ. **[1 M]**

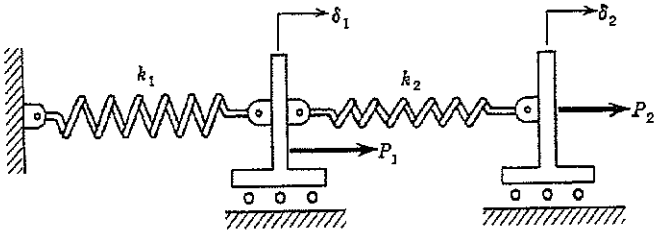
Q2. Draw a bending moment diagram for a simply supported beam with an eccentric point load as shown below. **[2M]**



Q3. Draw a shear force diagram for a cantilever beam of length 3m having point loads as shown below. **[2M]**

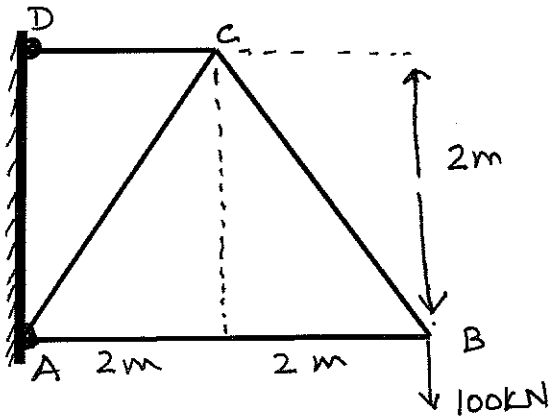


Q4. Determine the deflections δ_1 and δ_2 in the following spring system arrangement. **[4M]**



Q5. A couple 10 Nm is acting on a body. What is the work done by the couple in the following cases?
(a) When the body is translated by 1 m. (b) When the body is rotated by an angle 1^0 **[2M]**

Q6. Determine the vertical deflection of joint C of the steel truss shown in the following figure. The cross sectional area of each member is A= 400mm^2 and E = 200 GPa.The force in each member is given in the table below. Fill up the remaining columns and obtain δ_V **[5M]**



Member	Force F (kN)			
AB	-100			
BC	141.4			
AC	- 141.4 - 1.414P			
CD	200 + P			

δ_V = mm