BITS, Pilani Dubai Campus

2nd Year, FIRST SEMESTER 2012 – 2013

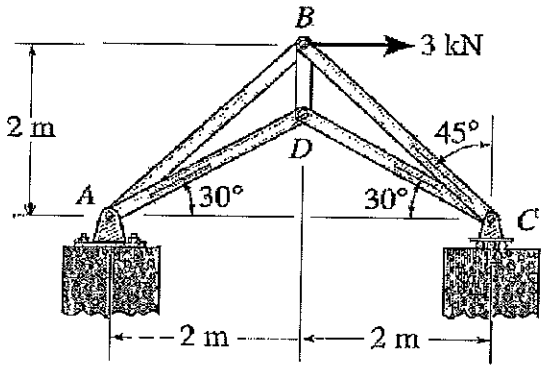
Comprehensive exam (Closed Book)

Course Code:	**MEF 211**	Date:	3.01.13 AN
Course Title:	**Mechanics of Solids**	Maximum Marks:	**80 marks**
Duration:	**3 hours**	Weightage:	**40%**

Instruction : This paper consists of NINE questions. Answer all the questions. Section 1 and Section 2 must be answered in separate booklets.

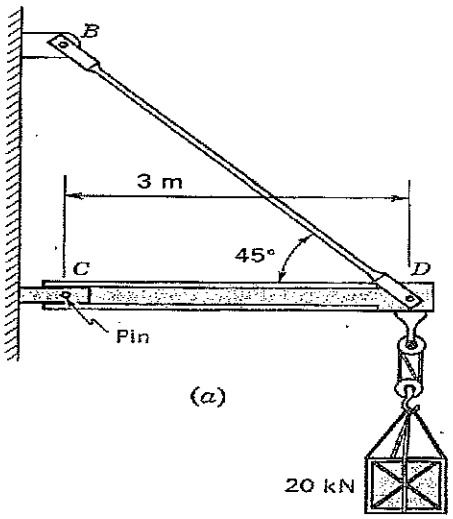
SECTION 1

Q1. Determine the forces acting in all the members of the truss shown below. Mention whether the forces are in tension or in compression. **[10M]**

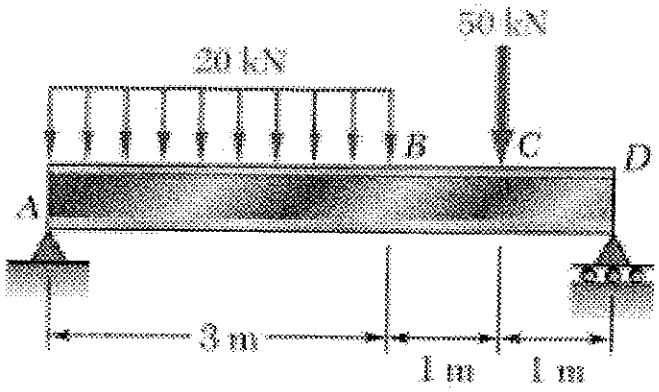


Q2. Using the Castigliano's theorem, determine the horizontal deflection of the joint D in the diagram shown below. The area of cross-sections of CD and BD rods are 3200 mm^2 and 491 mm^2 respectively and the modulus of the material with which the rods are made is 205 GPa.

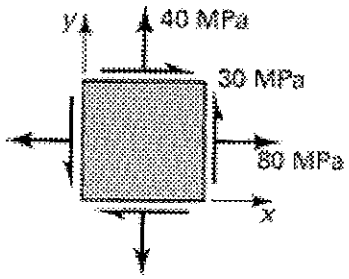
[8M]



Q3. Draw the shear force diagram for the beam shown below with appropriate values of shear force. **[4M]**



Q4. At a point in the structural member, the stresses are represented as shown below. Determine (a) the magnitude and orientation of the principal stresses and (b) the magnitude and orientation of the maximum shearing stresses and associated normal stresses. **[6M]**



Q5. The principal strains in the plane of a flat aluminum plate which is loaded in its plane are $\varepsilon_1 = 3.2\text{x}10^{-4}$, $\varepsilon_2 = -5.4\text{x}10^{-4}$. Determine the principal stresses. Also, find the stresses σ_x, σ_y and τ_{xy} where the X and Y axes are located as shown in figure 1. Take modulus of elasticity as 70 GPa and poisson's ratio as 0.33. **[12M]**

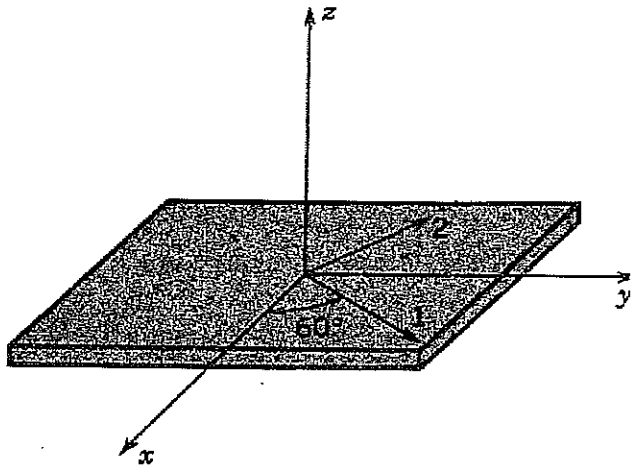


Figure:1

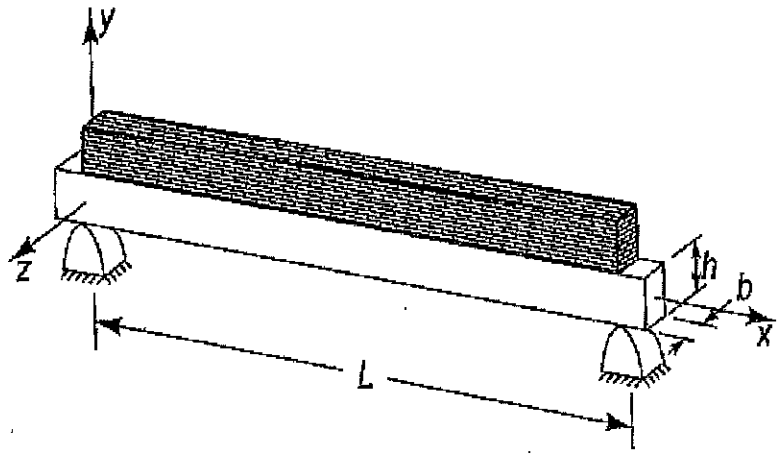
SECTION 2

Q6. A solid circular shaft 200 mm in diameter has the same cross sectional area as a hollow circular shaft of the same material with inside diameter of 150mm. For the same maximum shear stress:

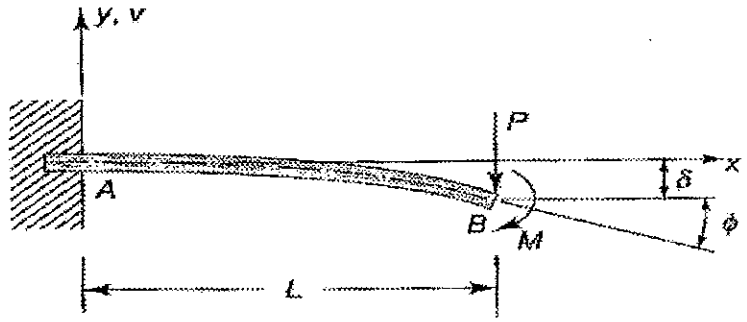
a)Determine the ratio of twisting moment (torque) M_t, transmitted by the hollow shaft to that by the solid shaft.

b)Find the ratio of the angle of twist in the hollow shaft to the angle of twist in the solid shaft. **[10M]**

Q7. A rectangular beam on simple supports has bricks piled uniformly along its length such that there is a total weight w_O of bricks per unit length along the beam. Calculate the maximum bending stress σ_X and maximum shear stress τ_{XY}. Given w_O= 6KN/m, L= 2m, h = 15cm, b =7cm. **[12M]**



Q8. A uniform cantilever beam has bending modulus EI and length L. It is built in at A and subjected to a concentrated force P and moment M applied at B .Calculate the deflection δ and the slope angle ϕ at B due to these loads . **[10M]**



Q9. An ASTM cast iron has minimum ultimate strengths of 320 MPa in tension and 650 MPa in compression. Calculate the factors of safety using maximum normal stress (MNS) theory for the following stress state.

$\sigma_x = 84$ MPa and $\tau_{xy} = -56$ MPa. **[8M]**

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2nd Year, FIRST SEMESTER 2012 – 2013

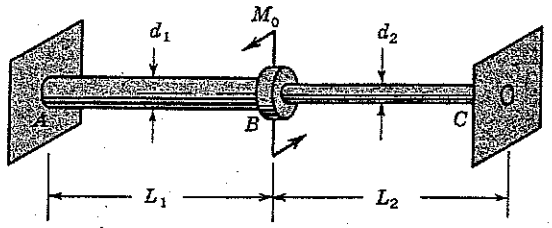
TEST – 2 (Open Book)

Course Code:	**MEF 211**	Date: 25.11.12	
Course Title:	**Mechanics of Solids**	Maximum Marks:	**40 marks**
Duration:	**50 minutes**	Weightage:	**20%**

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

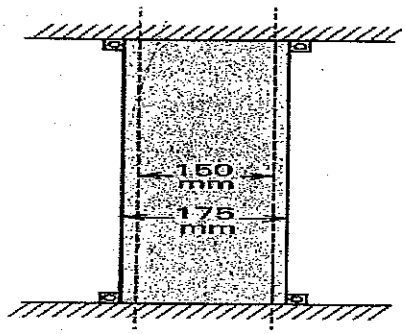
Q 1. Consider a hollow shaft of 20mm outside diameter and of 16 mm inside diameter, twisted about its longitudinal axis with a torque M_t of 40N-m.Calculate the maximum and minimum shear stresses in the shaft. (8)

Q 2. Two shafts AB and BC of the same material but different diameter are welded together at point B. Ends A and C are fastened securely so that the shafts cannot rotate at these points. An external twisting couple M_O is applied to the shafts at point B. Find the twisting couples exerted on the ends of the shafts at A and C. Given: M_O=60 N-m, L_1=60 cm, L_2=75 cm, d_1=10 cm, d_2=6 cm. (12)



Q 3. The stresses in a flat steel plate in a condition of plane stress are σ_x = 130 MPa, σ_y = -70 MPa and τ_{xy} = 80 MPa. If the Poisson's ratio is 0.3 and the modulus of elasticity is 205GPa for this material, find the magnitude and orientation of the principal strains in the plane of the plate. (10)

Q 4. A metal pipe is held by two fixed supports as shown below. When mounted, the temperature of the pipe was 23°C. Due to the flow of cold fluid through the pipe it cools to a temperature of -20°C. If the coefficient of linear expansion of the material of the pipe is 12×10^{-6} /°C and the modulus of elasticity for this metal is 188 GPa, determine the state of stress and strain in the central portion of the pipe as a result of this cooling. Assume the Poisson's ratio as 0.27 for this metal. (10)



BITS, PILANI – DUBAI
2nd Year, FIRST SEMESTER 2012 – 2013

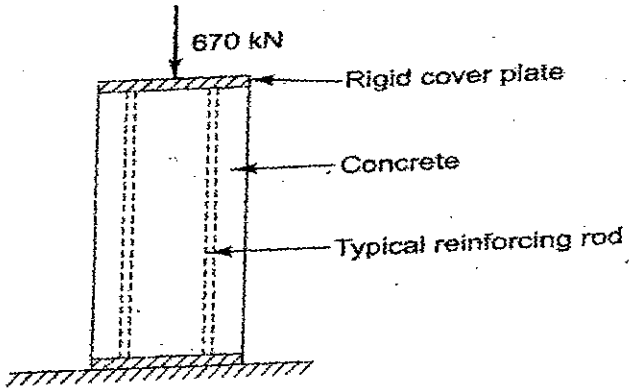
TEST – 1 (Closed Book)

Course Code:	**MEF 211**	Date:	**11.10.2012**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**50**
Duration:	**50 minutes**	Weightage:	**25%**
Name	_____		

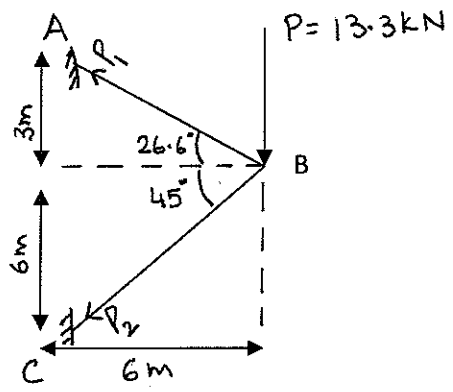
ID No: _____ **Program:** _____ **Section** _____

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

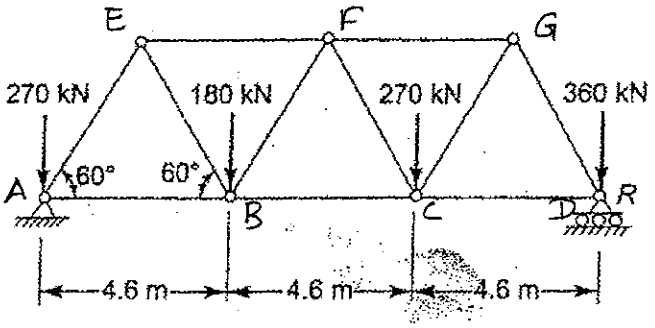
Q1. A square re-inforced concrete pier 0.3x0.3 m in cross section and 1.2m high is loaded as shown in the figure.The concrete is strengthened by the addition of eight vertical 25x25 mm square steel reinforcing bars placed symmetrically about the vertical axis of the pier. Find the stress in the steel and concrete. For concrete, take E = 17GN/m^2 and for steel E = 200 GN/m^2 [10 **M**]



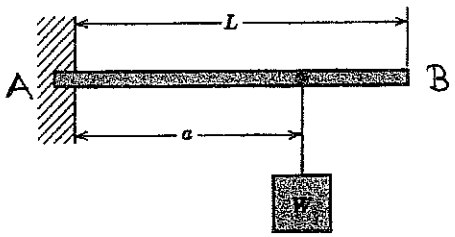
Q2. A bracket is shown in the figure below. Calculate the vertical deflection at point 'B' caused by applied force P=13.3 KN using Castigliano's theorem. Assume that each bar is of constant cross- sectional area , with $A_{AB} = A_1 = 8.06 \times 10^{-5}\ m^2$ and $A_{BC} = A_2 = 1.4 \times 10^{-4}\ m^2$.(Given $E = 200 \times 10^9\ N/m^2$) [**15 M**]



Q3. A small railroad bridge is constructed of steel members, all of which have a cross sectional area of 3250 mm^2 . A train stops on the bridge, and the loads applied to the truss on one side of the bridge are as shown in the figure. Calculate how much the point 'R' moves horizontally because of this loading.Take E= 205 GPa [20 M]



Q4. Sketch the shear force and bending moment diagrams for the following cases. [5 M]



SET A

BITS, PILANI – DUBAI

2nd Year, FIRST SEMESTER 2012 – 2013

QUIZ - 2

Course Code:	**MEF 211**	Date:	**8.11.2012**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**14**
Duration:	**20 minutes**	Weightage:	**7 %**

Name _____

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

Instruction : Draw the Mohr's circle on the graph provided and write your answer in the space provided below

Q1. Construct a Mohr's circle for stress and find the values of principal stresses , maximum shear stress, and orientation of the principal axes of stress for the following case of plane stress:

σ_x = 70 MN/m^2 , σ_y = 30 MN/m^2 and τ_{xy} = 60 MN/m^2 (14M)

Verify your result analytically.

Ans.

SET B

BITS, PILANI – DUBAI

2nd Year, FIRST SEMESTER 2012 – 2013

QUIZ - 1

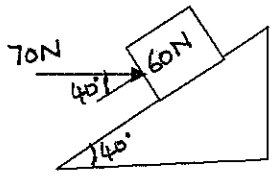
Course Code:	**MEF 211**	Date:	**27.09.2012**
Course Title:	**Mechanics of Solids**	Maximum Marks:	**16**
Duration:	**20 minutes**	Weightage:	**8 %**

Name _____

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

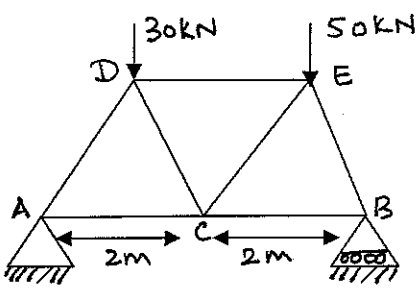
Instruction : ***Answer all the questions .Q1 – Q4 are 3 marks each and Q5 –Q8 are 1 mark each.***

Q1. The block shown in the figure just begins to slide up the incline when the pushing force shown is increased to 70N. Calculate the co- efficient of static friction .



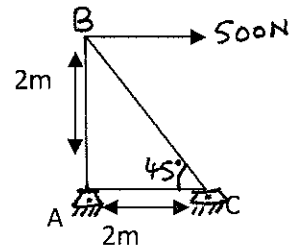
Q2. AB is a rod of length 3m weighing 500N. A force of 100 N acts at A and another force 450 N at B such that the rod can rotate in a clockwise direction about its center of gravity. Calculate the force required to keep the rod in equilibrium and what is its distance from end A ?

Q3. A truss consists of three equilateral triangles each of side 2m. What are the reaction forces at A and B ?



Q4. Consider a simple truss as shown in the figure. The joint B is not moving and is in static equilibrium

What are the forces in the members BC and BA ?



Q5. The simplest form of a rigid truss is:

a) Triangle
b) Rectangle
c) Square
d) None of the above

Q6. The forces which meet at one point but their lines of action do not lie in a plane are called:

a) Coplanar, non-con current forces
b) Non-coplanar , concurrent forces
c) Non coplanar, non concurrent forces
d) Intersecting forces

Q7. In a perfect frame , the number of members should be:

a) More than (2j – 3)
b) Less than (2j – 3)
c) Equal to (2j – 3)
d) Equal to 2j

Q8. A block rests on an inclined plane whose angle of inclination is θ. As the angle θ is increased,

the co-efficient of kinetic friction between the bottom surface of the block and the surface

of the incline will

a) Decrease
b) Increase
c) Remain the same

SET A

BITS, PILANI – DUBAI

2nd Year, FIRST SEMESTER 2012 – 2013

QUIZ - 1

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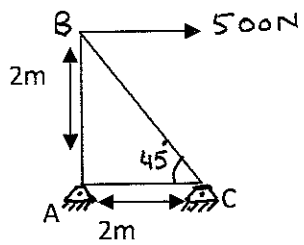

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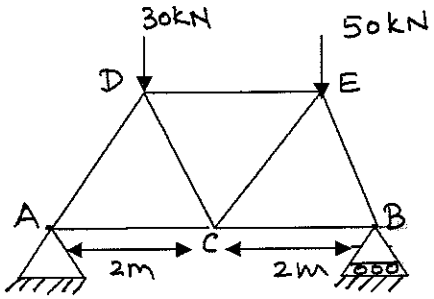

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