**BITS, PILANI- DUBAI**
**DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI**
**First Semester 2008-2009**
**Test 1 (Closed book)**

Class: II Year
Course No.: ES C221
Time duration: 50 min.

Marks: 25

Date:19.10.08
Course title: Mechanics of solids
Weightage: 25%

- Answer all the Questions
- Marks are shown in the brackets against each question.
- Assume relevant data, if essential.

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1. A 150N force is required to operate the foot pedal as shown in Fig.Q1. Determine the force F in the connecting link and the force exerted by the lever on the bearing at O. Neglect the weight of the lever.

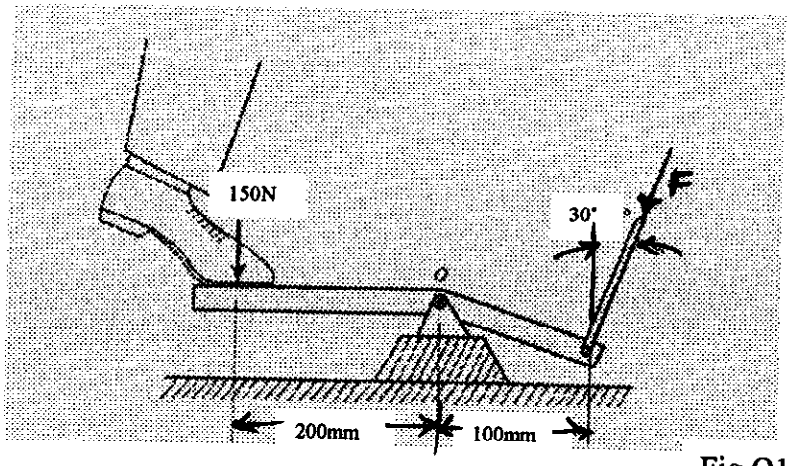


Fig.Q1 [6]

2. A block of weight 712N shown in the Fig.Q2 is resting on a horizontal plane with coefficient of static friction 0.3. Find the maximum weight of block A for which block B remains at rest.

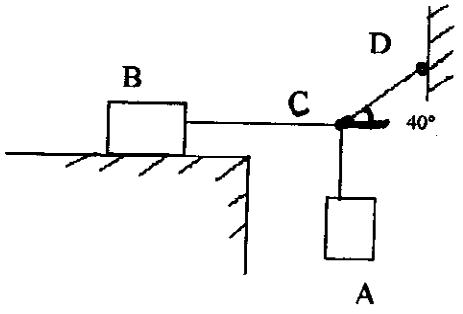


Fig.Q2 [6]

3. A concrete pier of 0.5m x 0.4m cross section and 1.5m high, is loaded as shown in Fig.Q3. The concrete is strengthened by the addition of 6 vertical 20x20mm square steel rods placed symmetrically about the vertical axis of the pier. Find the stress in the steel and concrete and the deflection. Moduli of elasticity for steel and concrete are 200 GPa and 17 GPa respectively and W=700kN.

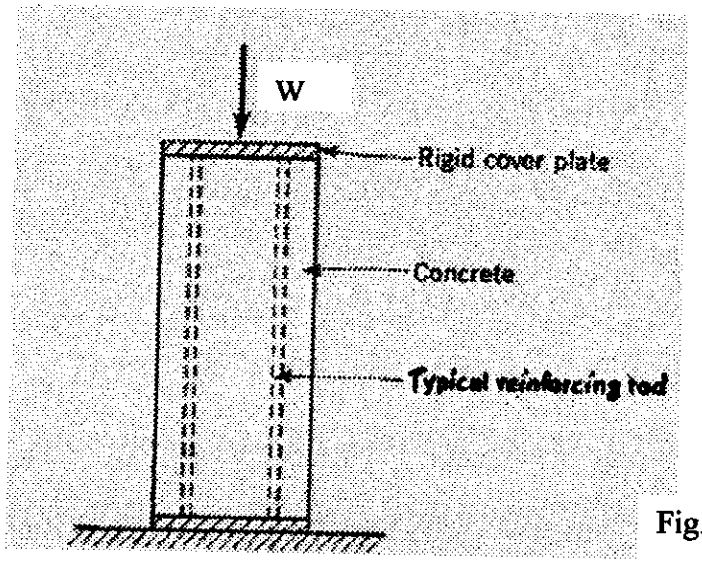


Fig.Q3

[6]

4. Determine the vertical displacement of C of the truss (Fig.Q4) using castigliano's theorem. Area of each member = 400 sq.mm. E = 200 GPa, AD=BC=2m, AB=CD=1.5m.

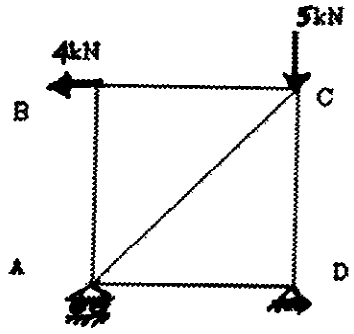


Fig. Q4

[7]

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# BITS, PILANI- DUBAI
# DUBAI INTERNATIONAL ACADEMIC CITY
## First Semester 2008-2009
### TEST 2 (Open book)

Class: II Year
Course No.: ES C221
Time duration: 50 min. Marks: 20

Date:10.12.08
Course title: Mechanics of solids
Weightage: 20%

- Answer all the Questions
- Assume relevant data, if essential.
- Prescribed text book and hand written class notes are only allowed
- Use the attached graph sheet

1 Construct the shear force and bending moment diagram for the loading system given in Fig.Q1. using relevant calculations and sign conventions. [5]

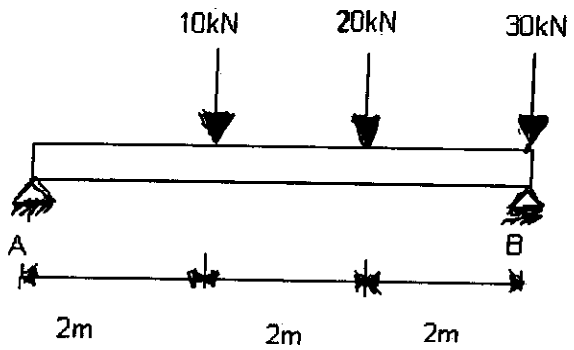



**Fig.Q1**

2. The stresses in a flat steel plate in a condition of plane stress are [5]

$\sigma x = 100\ MN/m^2$
$\sigma y = 30\ MN/m^2$
$\tau xy = 40\ MN/m^2$

Find the magnitude and orientation of the principal stresses in the plane of the plate **using mohr's circle**.

3. A steel pipe is held by two fixed supports as shown in Fig.Q3. When mounted, the temperature of the pipe was 20°C. A fluid moves through the pipe at a temperature of -10°C and if we take the coefficient of linear expansion to be $12 \times 10^{-6}$/°C for this temperature range, determine the state of stress and strain in the centre portion of the pipe as a result of cooling. Neglect the logical end effects, body forces and fluid pressure and drag forces. Take E=205GPa and Poisson's ratio=0.3. [5]

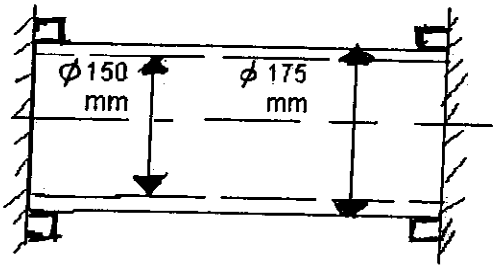



**Fig.Q3**

4. A torque of 20kN-m is applied on a hollow shaft of length 3m. The maximum allowable stress for the shaft is 75 MPa. The angle of twist should not exceed 2°. Determine the dimensions of the shaft. The modulus of rigidity for the shaft material is 80GPa. [5]

*****END****

# BITS, PILANI- DUBAI
# DUBAI INTERNATIONAL ACADEMIC CITY
## First Semester 2008-2009
### Comprehensive Examination (Closed book)

Class: II Year | Date: 06.01.09
Course No.: ES C221 | Course title: Mechanics of solids
Time duration: 3 hrs. | Marks: 80 | Weightage: 40%

- Answer all the Questions
- Answer parts A,B,C and D in separate answer books
- Assume relevant data, if essentlal.
- Marks are shown in brackets against each question

**PART -A**

1 Determine the forces in each bar of the truss shown in Fig.Q1. [10]

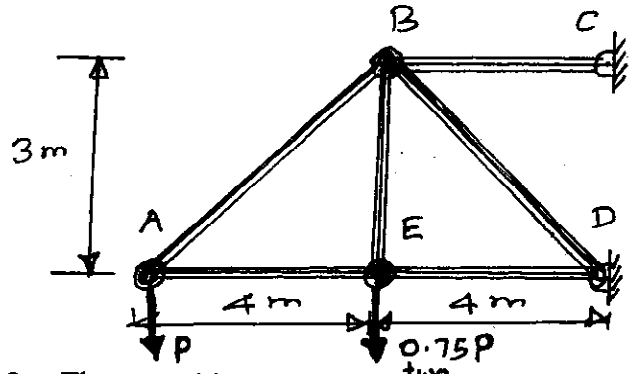



Fig. Q1.

2. The assembly consists of two titanium rods and a rigid bar as shown in Fig.Q2. The cross sectional area of each titanium rod is 45mm$^2$ and that of horizontal rigid bar is 60mm$^2$. If the vertical force of 30kN is applied at G, Determine the vertical displacement of point G. Take E = 350 GPa [10]

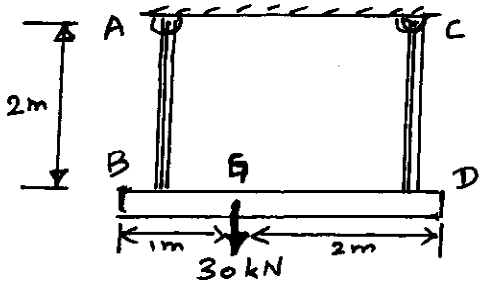



Fig. Q2

**PART -B**

3 Construct the shear force and bending moment diagrams for the following simply supported beam with uniformly distributed load system shown in Fig.Q3. [10]

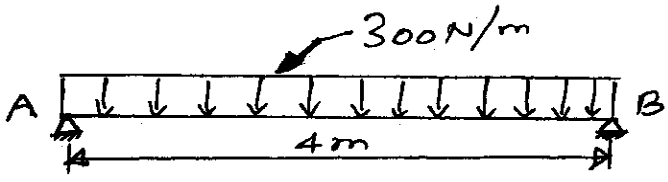



Fig. Q3

4 Determine the principal stresses, maximum shear stress and the orientation of principal plane for the following state of stress. [10]
$\sigma_x = 140MPa$; $\sigma_y = -60MPa$ $\tau_{xy} = 50MPa$

## PART-C

5 A batch of Nickel alloy yields in uniaxial tension at the stress $\sigma_0 = 155$ MN/m$^2$. If this material is subjected to the following state of stress, will it yield according to (a) Mises criterion or (b) Maximum Shear Stress criterion?

$\sigma_x = 100$ MN/m$^2$ $\quad \tau_{xy} = 70$ MN/m$^2$
$\sigma_y = 20$ MN/m$^2$ $\quad \tau_{yz} = 0$
$\sigma_z = 0$ $\quad \tau_{zx} = 0$

[10]

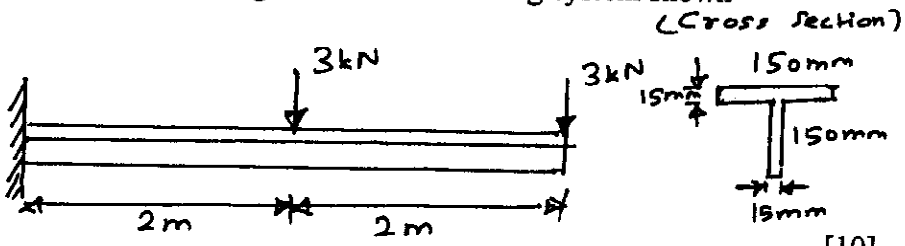
6 Shaft A is a solid shaft of 30 mm diameter and 2 m length. Shaft B is a hollow shaft of the same length with 30 mm inner diameter and 50 mm outer diameter. If both the shafts are subjected to the same twisting moment $M_t$, find the following:

a. ratio of the angle of twist of shaft A to shaft B
b. ratio of the maximum shear stress of shaft A to shaft B [10]

Take G = 80 GN/m$^2$ for both shafts.

## PART-D

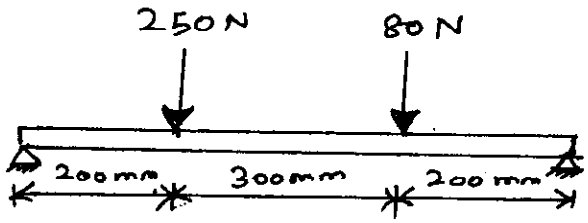
7 Determine the maximum bending stress for the loading system shown in Fig.Q7.




[10]

Fig. Q7

8 Determine the maximum deflection for the loading system shown in Fig.Q8.




$E = 200$ GPa
$I = 1 \times 10^{-7}$ m$^4$

Fig. Q8

[10]

*****END****