POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION

DISEMBER 2011 SESSION

BAHARU

J5109 : KAJIDAYA ~~MESIN~~ 1

DATE : 26 APRIL 2012 (THURSDAY)
DURATION : 2 HOURS (11.15 AM - 1.15 PM)

This paper consists of **SEVEN (7)** pages including the front page.
Essay (6 questions – **answer 4** questions)

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DO NOT OPEN THIS QUESTION PAPER UNTIL INSTRUCTED BY THE CHIEF INVIGILATOR

This section consists of **SIX (6)** structured questions. Answer **FOUR (4)** questions only.

QUESTION 1

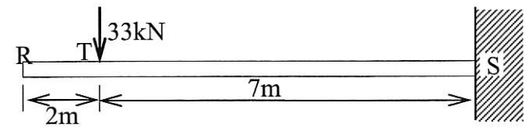

Figure 1

Figure 1 shows a beam subjected to a concentrated load of 33kN at point T. Given that $EI = 49x10^4 kNm^2$, determine:

(a) The deflection at point T from the right of the beam.

(15 marks)

(b) The deflection at point T from the left of the beam.

(10 marks)

QUESTION 2

Figure 2 below shows the loads carried by a cantilever beam. By using Macaulay's Method, determine the:

(a) Fixing moment and reaction at point B

(3 Marks)

(b) Slope and deflection at the load of 20kN

(22 Marks)

Given $E = 200kN/mm^2$ and $I = 5 \times 10^{-4}m^4$

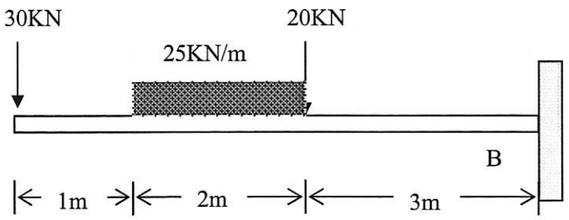

Figure 2

QUESTION 3

A metal element is applied with two perpendicular stresses which are tensile stress of 120MPa and compression stress of 80MPa with a 50MPa shear stress as shown in **Figure 3**. Calculate:

(a) The principal stress magnitude.

(6 marks)

(b) The principal plane and sketch the diagram.

(9 marks)

(c) The maximum shear stress magnitude.

(4 marks)

(d) The normal stress value at 20^o plane counter clockwise.

(6 marks)

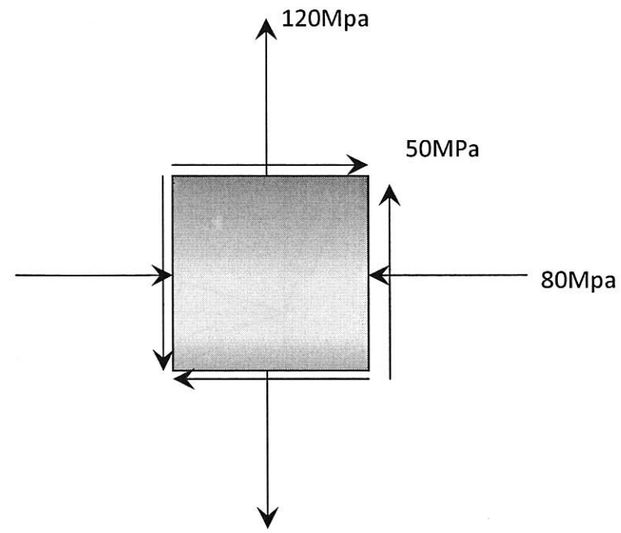

Figure 3

QUESTION 4

Figure 4 shows value of a strain for every single rosette arm. A differential element of a material is subjected to a state of plane strain defined by;

$$\varepsilon_{\theta 1} = 150\ \mu \quad , \quad \varepsilon_{\theta 2} = 300\ \mu \quad , \quad \varepsilon_{\theta 3} = -100\ \mu$$

Determine :

(a) The principal Strains , ε_1 and ε_2

(15 Marks)

(b) The shear maksimum strain γ_{max}

(2 Marks)

(c) The principal stress in xy axis when given E = 90 GPa and poisson ratio, $\nu = 0.35$

(8 Marks)

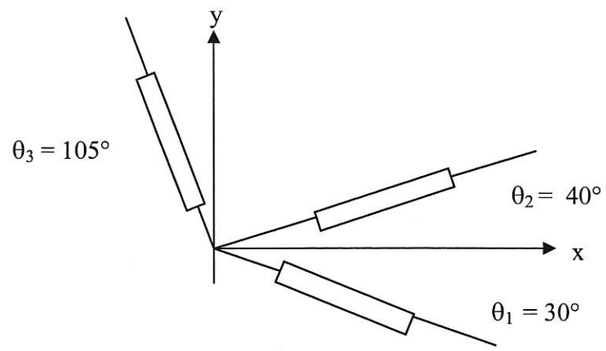

Figure 4

QUESTION 5

Differentiate the critical load between Euler and Rankine formula for a hollow strut with the length of 2.5m, an external diameter of 38mm and an internal diameter of 33mm. Both ends are pinned and loaded. Given below are details:

σ = 325 MPa a = 1/7500 E = 200 GPa

Calculate the minimum length of the strut subjected to similer loading that makes the Euler theory inapplicable.

(25 marks)

QUESTION 6

(a) A thin-wall spherical vessel ($E = 174GPa, \nu = 0.4$) has an internal diameter of 1.8m, and thickness of 13mm. If the cylinder is subjected to an internal pressure of 12MN/m², determine:

i. The change in diameter

(5 marks)

ii. The change in volume

(5 marks)

iii. The safety factor if ultimate tensile stress 1.08GPa

(5 marks)

(b) A thin-sphere has an internal diameter of 0.3m and 1.5mm thickness, is filled with water ($K = 2.5GN/m^2$) at atmosphere pressure of 1 bar. Determine internal pressure when 30000mm^3 is the increase in volume owing to the internal pressure in the sphere. (take $E = 100GPa, \nu = 0.33$)

(10 marks)