POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION

(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION

JUNE 2012 SESSION

J5109: Strength of Material 2

DATE: 24 NOVEMBER 2012(SATURDAY)

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

(The CLO stated is for reference only)

ESSAY (100 marks)

INSTRUCTION:

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

QUESTION 1

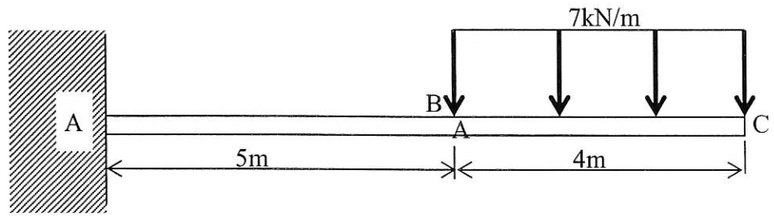

Figure 1

A cantilever beam ($EI = 80x10^3 kNm^2$) as shown in **Figure 1** is subjected to a uniformly distributed load of 7kN/m. Determine:

(a) the bending Moment Equation

(5 marks)

(b) the slope at point B

(10 marks)

(c) the deflection at point C.

(10 marks)

QUESTION 2

A 4 m long built – in beam, carries a combination of uniformly distributed and concentrated loads as shown in **Figure 2** below. Determine:

(a) the end reactions load

(17 marks)

(b) the fixing moments at the built- in supports

(4 marks)

(c) the magnitude of the deflection under 40 kN load

(4 marks)

Given EI = 14 MNm^2

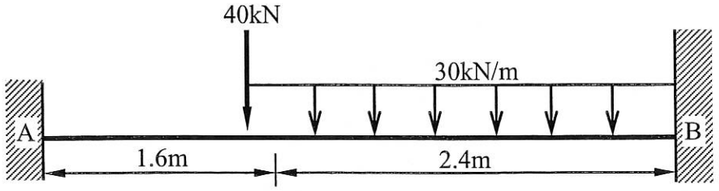

Figure 2

QUESTION 3

(a) An elastic material is subjected to two mutually perpendicular stresses of 80 MPa tensile and 40 MPa compressive. Determine the normal stresses and shear stress which get on a plane 30° to the plane on which the 80 MPa stress acts.

(9 marks)

(b) An element in plane stress is subjected to stresses σ_x = 84 MPa, σ_y = -29 MPa and τ_{xy} = - 32 MPa, as shown in the **Figure 3** below.

i. Determine the principal stresses and show them in a sketch of a properly oriented element.

(8 marks)

ii. Determine the maximum shear stresses and show them on a sketch of a properly oriented element.

(8 marks)

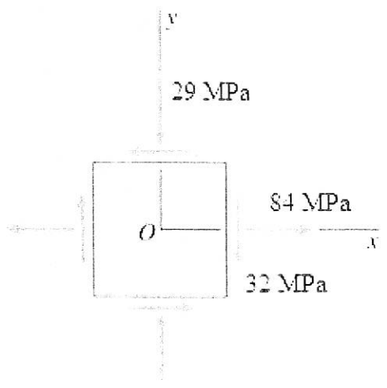

Figure 3

QUESTION 4

A block is loaded at a plane strain as shown below;

$$\varepsilon_x = 200\mu \quad , \quad \varepsilon_y = -56\mu \quad , \quad \gamma_{xy} = 230\mu$$

Determine ;

(a) the principal strains of the block

(10 marks)

(b) the plane of principal axis

(5 marks)

(c) the principal of stresses

(10 marks)

Given E = 200 GPa and $\nu = 0.28$

QUESTION 5

(a) Define strut and name **TWO (2)** types of strut often used in engineering.

(4 marks)

(b) A strut with a diameter of 50 mm and a length of 3 m is used to support load where both ends of the strut are fixed. Determine the stress and load using theory of Rankine Gordon.

Take E = 200 GN/m^2 and ultimate compression stress = 250 MN/m^2

(21 marks)

QUESTION 6

A thin cylinder is 0.75m in diameter, 1.5 m long and 25 mm thick. An air pressure is pumped into the cylinder under internal pressure of 1.35MN/mm^2. Assuming the end plates are rigid, find:-

Given E=250 GN/ m^2 and Poisson ratio, υ =0.25

a) the maximum stress on the cylinder wall.

(7 marks)

b) the circumferential or hoop strain.

(6 marks)

c) the longitudinal strain.

(6 marks)

d) the change in the cylinder volume.

(6 marks)