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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2013/2014**

COURSE NAME : STRESS ANALYSIS  
COURSE CODE : BDC 40203  
PROGRAMME : 4 BDD  
EXAMINATION DATE : JUNE 2014  
DURATION : 2 HOURS 30 MINUTES  
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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- Q1** (a) Prove the equation below:-

$$l^2 + m^2 + n^2 = 1$$

(10 marks)

- (b) At a point in a stressed body, the cartesian components of stress are:-

$$\begin{array}{ll} \sigma_{xx} = 75 \text{ MPa} & \tau_{xy} = 25 \text{ MPa} \\ \sigma_{yy} = 60 \text{ MPa} & \tau_{yz} = -25 \text{ MPa} \\ \sigma_{zz} = 50 \text{ MPa} & \tau_{zx} = 30 \text{ MPa} \end{array}$$

Determine the normal and shear stresses on a plane whose outer normal has the direction of cosines as:-

$$\begin{array}{l} \cos(n, x) = 15/35 \\ \cos(n, y) = 18/35 \\ \cos(n, z) = 26/35 \end{array}$$

(15 marks)

- Q2** (a) Explain the importance of strain gauge. State the example of its application in engineering and explain the concept to obtain the data.

(7 marks)

- (b) The strain rosette has two strain gauges *a* and *b* which are attached to the surface of the plate and subjected to the uniformly load,  $w_x = 700 \text{ kN/m}$  and  $w_y = -175 \text{ kN/m}$  as shown in **FIGURE Q2**. If the gauges give the readings as below:-

$$\begin{array}{l} \varepsilon_a = 450 (10^{-6}) \\ \varepsilon_b = 100 (10^{-6}) \end{array}$$

- i. Determine the modulus of elasticity, *E*.
- ii. Shear modulus, *G*.
- iii. Poisson's ratio, *v* for the material.

(18 marks)

- Q3** (a) (i) Prove that the strain sensitivity can be written by:-

$$S_A = \frac{dR/R}{\varepsilon} = 1 + 2\nu + \frac{d\rho/\rho}{\varepsilon}$$

- (ii) Explain the factors influencing the sensitivity of strain gauge. (7 marks)

- (b) State and describe the application of this strain code is:-

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(8 marks)

- (c) A tension bar is loaded with P and strain gauges are mounted on the bar surface as shown in **FIGURE Q3(a)**. This strain gauge is connected to the Wheatstone bridge as **FIGURE Q3(b)**. Determine the load P if  $V_{out} = 4\text{mV}$  and if the data are given as  $R_1 = R_2 = R_3 = R_4 = 120\Omega$ ,  $V_{in} = 3\text{V}$ , Gauge Factor,  $G.F = 2.2$  and modulus Young,  $E = 70\text{ GPa}$ .

(10 marks)

- Q4** (a) Sketch and state the types of Wheatstone bridge. If the full bridge is connected to the cantilever beam, draw a complete circuit diagram from the bridge to the beam and list out the sensitivity parameters that influenced during measurement. (13 marks)

- (b) Two strain gauges are mounted on a cantilever beam and connected to Wheatstone bridge as shown in **FIGURE Q4**. If a load,  $P = 2.5\text{ kN}$  is applied at the free end, determine the distance  $X$ . Given  $V_{out}/V_{in} = 10 \times 10^{-6}$ , Gauge Factor,  $G.F = 2.0$  and the Young's modulus,  $E = 200\text{ GPa}$ .

(12 marks)

**Q5** A soda can is attached with the electrical strain gauges as shown in **Figure Q5**.

(a) Why the strain gauges is used in this test?

(2 marks)

(b) Describe the concept for the test.

(3 marks)

(c) List **FIVE (5)** parameters required for test

(5 marks)

(d) Describe the important factor and the procedure should be followed during the tests to obtain accurate results.

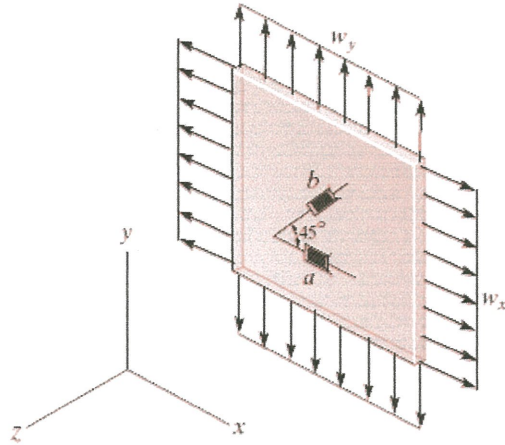
(15 marks)

**QUESTIONS END**

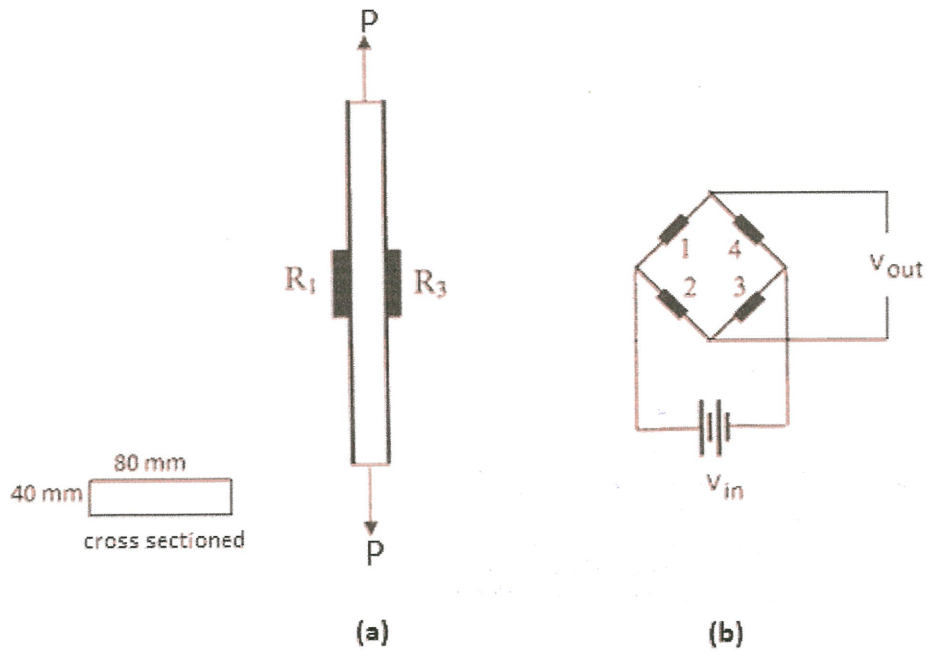
**FINAL EXAMINATION**

SEMESTER / SESSION : SEM 2 / 2013/2014  
 COURSE NAME : STRESS ANALYSIS

PROGRAMME : BDD  
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**FIGURE Q2**

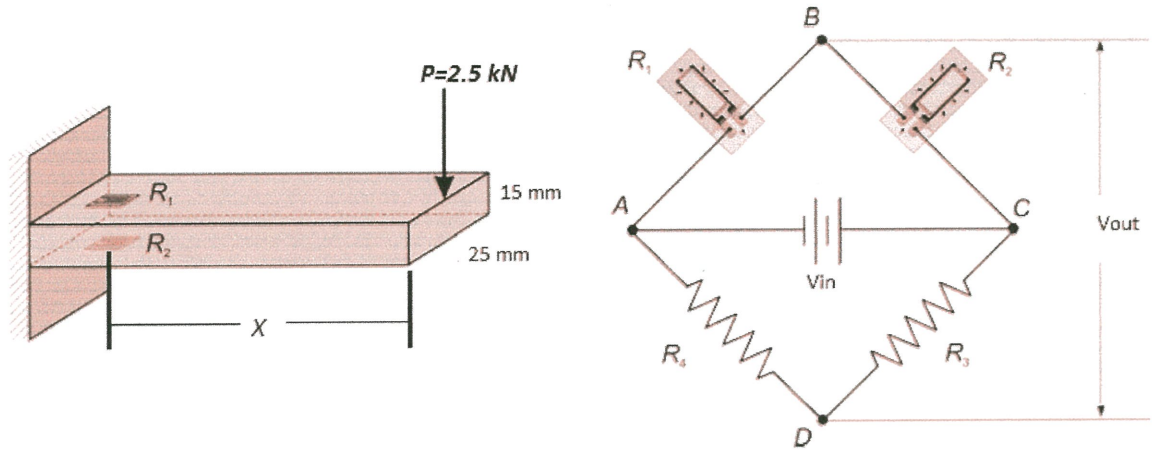


**FIGURE Q3**

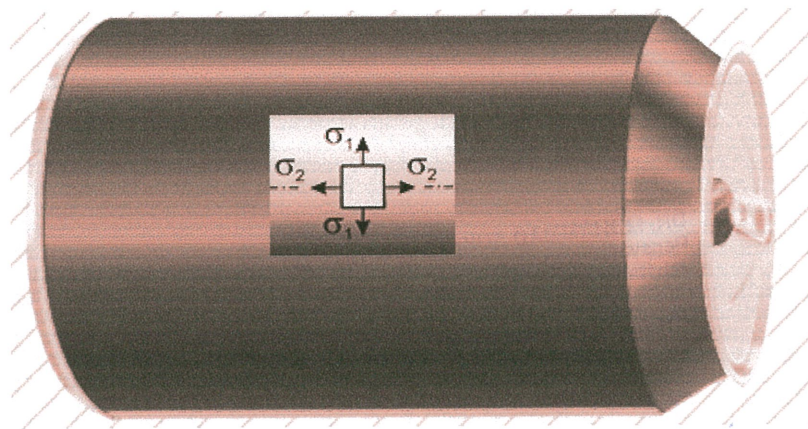
# FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 / 2013/2014  
COURSE NAME : STRESS ANALYSIS

PROGRAMME : BDD  
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**FIGURE Q4**



**FIGURE Q5**