UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ELECTRICAL AND ELECTRONIC TECHNOLOGY
COURSE CODE	:	BEE 1803/BEX 17003
PROGRAMME	:	BDD
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE** (5) QUESTIONS ONLY.

THIS PAPER CONSISTS OF **ELEVEN** (11) PAGES

Q1 (a) By using an appropriate diagram, describe the relationship of voltages on different branches in parallel circuit.

(3 marks)

(b) An experiment based on the circuit diagram in **Figure Q1(b)** is carried out in the laboratory. You are asked to assist the group by calculating the necessary variables to compare them with the results.

(i) Determine the total resistance of the circuit.

(4 marks)

(ii) By using current division rule, solve for the current, i_0.

(Hint: The circuit comprises of 5 branches including the one with the current source).

(3 marks)

(iii) Use Ohm's law to determine the voltage, v_0 across the 24 Ω resistor.

(2 marks)

(iv) By using voltage division rule, solve for the voltage, v_1 at the 30 Ω resistor.

(3 marks)

(v) If a resistor is added in series with the current source, depict the effect of this resistor on the value of voltage, v_0 across the 24 Ω resistor.

(5 marks)

Q2 (a) (i) State a reason why Thevenin equivalent circuit or Norton equivalent is used in circuit analysis.

(1 mark)

(ii) Explain the steps in transforming a network consists of both dependent and independent sources to its Thevenin equivalent. Please provide diagram(s) where necessary.

(5 marks)

(b) A Thevenin equivalent circuit can also be determined from measurements made at the pair of terminals of interest. Assume the following measurements were made at the terminals a-b of the circuit in **Figure Q2(b)**. When a 20 Ω resistor is connected to the terminals *a-b*, the voltage v_{ab} is measured and found to be 10 V. When a 50 Ω resistor is connected to the terminals *a-b*, the voltage v_{ab} is measured and found to be 20 V.

(i) Determine the Thevenin equivalent of the network with respect to the terminals *a-b*.

(7 marks)

(ii) Transform the Thevenin equivalent circuit in part Q2(b)(i) to its Norton equivalent circuit.

(3 marks)

(iii) A load is connected at terminals *a-b*. What is the suitable load to ensure the maximum power is transferred? Calculate the maximum power transfer for this load.

(4 marks)

Q3 (a) State two energy storage elements and briefly describe how the energy is stored in these elements.

(4 marks)

(b) The current in a 10 mH inductor is given by the graph in **Figure Q3(b)**.

(i) Determine the voltage and power expressions for $t \geq 0$ ms.

(6 marks)

(ii) Figure out the duration in which the inductor is releasing the energy to the other part of network. State the reason why.

(2 marks)

(c) Three capacitors, $C_1 = 45\ \mu F$, $C_2 = 15\ \mu F$ and $C_3 = 14\ \mu F$, are in parallel to each other and also to a 120 V DC source. Determine:

(i) the total capacitance

(2 marks)

(ii) the charge on each capacitor

(3 marks)

(iii) the total energy stored in the parallel combination of the capacitors.

(3 marks)

Q4 (a) Diode is a device that has two terminals, called anode and cathode. It is commonly used in AC to DC conversion. Sketch the graph for typical current-voltage (I-V) characteristic of diode and briefly explain the graph.

(5 marks)

(b) A transformer has 1600 turns in its primary winding and 400 turns in its secondary winding. Given the primary current, $I_P = 200$ mA and the primary voltage, $V_P = 240$ V rms, determine:

(i) the type of transformer and its turns ratio

(2 marks)

(ii) the secondary current, I_S and the secondary voltage, V_S

(2 marks)

(iii) the primary power, P_P and the secondary power, P_S

(2 marks)

(c) The Karnaugh map in **Figure Q4(c)** shows the operation of a logic circuit that has not been optimised yet.

(i) Derive the simplest Boolean expression of this logic circuit.

(4 marks)

(ii) Based on your answer in part Q4(c)(i), draw its schematic diagram.

(5 marks)

Q5 (a) State the definition of magnetic flux density.

(3 marks)

(b) A coil of 600 turns is wound uniformly on a ring of non-magnetic material with the relative permeability of 200. The ring has a uniform cross-sectional area of 200 mm^2 and a mean circumference of 500 mm. If the current in the coil is 4 A, determine

(i) the magnetic field strength

(2 marks)

(ii) the reluctance

(2 marks)

(iii) the total magnetic flux in the ring

(2 marks)

(iv) the magnetic flux density

(2 marks)

(Note: The permeability of a vacuum, $\mu_O = 4\pi \times 10^{-7}$ Wb/Atm.)

(c) **Figure Q5(c)** shows the hysteresis loops (*B-H* curve) of three different materials, namely Material A, Material B and Material C.

(i) Briefly explain the significance of hysteresis loop.

(3 marks)

(ii) Based on the hysteresis loops given, select the appropriate material for the AC motors and magnetic tape applications. Please justify your answer.

(6 marks)

Q6 (a) State whether the following operations could be solved by using phasor. If yes, determine the result as a single sinusoidal function.

(i) $4\cos(20t+10°)-6\cos(200t-30°)$

(ii) $50\sin(50t)+30\cos(50t-45°)$

(4 marks)

(b) A current source in a linear circuit is $i_s(t)=35\sin(2000\pi t+75°)$ A.

(i) Express $i_s(t)$ in cosine form.

(1 mark)

(ii) State the amplitude and angular frequency of the current.

(1 mark)

(iii) Determine the phase angle.

(0.5 mark)

(iv) Calculate the frequency and period of the current.

(1.5 marks)

(v) Calculate current, $i_s(t)$ at t = 5 ms.

(1 mark)

(vi) Obtain the phasor transform of the current in rectangular form.

(1 mark)

(c) **Figure Q6(c)** shows a time domain circuit that is used to operate the motor.

(i) Sketch its frequency domain circuit.

(2 marks)

(ii) Determine voltage, $v_o(t)$ and current, $i_o(t)$.

(8 marks)

Q7 (a) Consider the magnetic circuit illustrated in **Figure Q7(a)**. Given the following parameters:

$I = 2.5$ A, $a = 10$ cm, $b = 20$ cm, $l = 0.25$ m, $H = 210$ At/m, $\mu_r = 400$ and $\mu_o = 4\pi \times 10^{-7}$ Wb/(At.m).

Solve for the following:

(i) the number of turns, N

(2 marks)

(ii) the magnetic flux density, B

(2 marks)

(iii) the magnetic flux, ϕ

(2 marks)

(iv) the magnetomotive force (mmf), F_m

(2 marks)

(v) the reluctance, $\Re$ of the circuit

(2 marks)

(b) Solenoid control is normally used to control things such as valves, switches and clutch mechanisms. Explain the operation of this solenoid with the aid of suitable diagram.

(6 marks)

(c) Briefly explain what is meant by electric motor. Name **TWO (2)** types of electric motor.

(4 marks)

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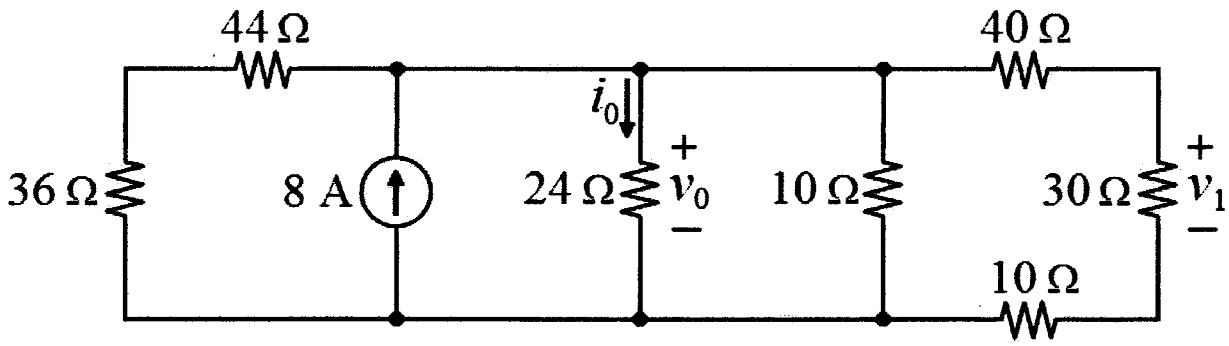

FIGURE Q1(b)

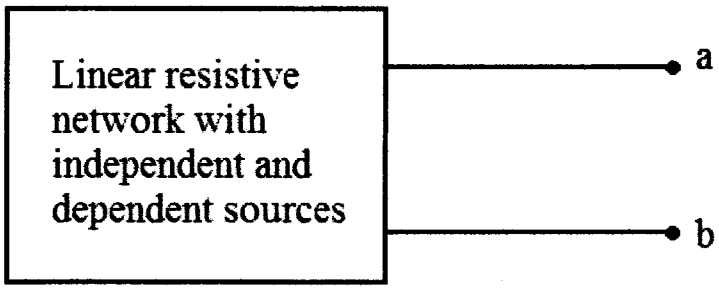

FIGURE Q2(b)

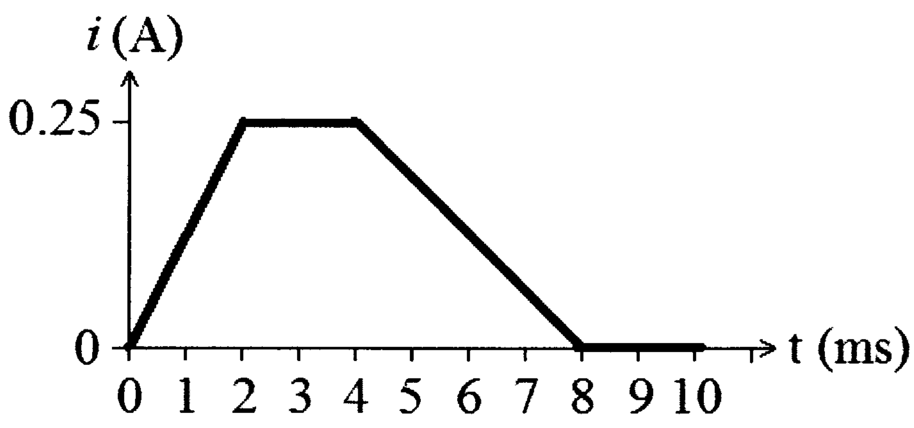

FIGURE Q3(b)

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00	0	1	0	0
01	0	1	0	0
11	1	1	0	0
10	0	1	0	0

FIGURE Q4(c)

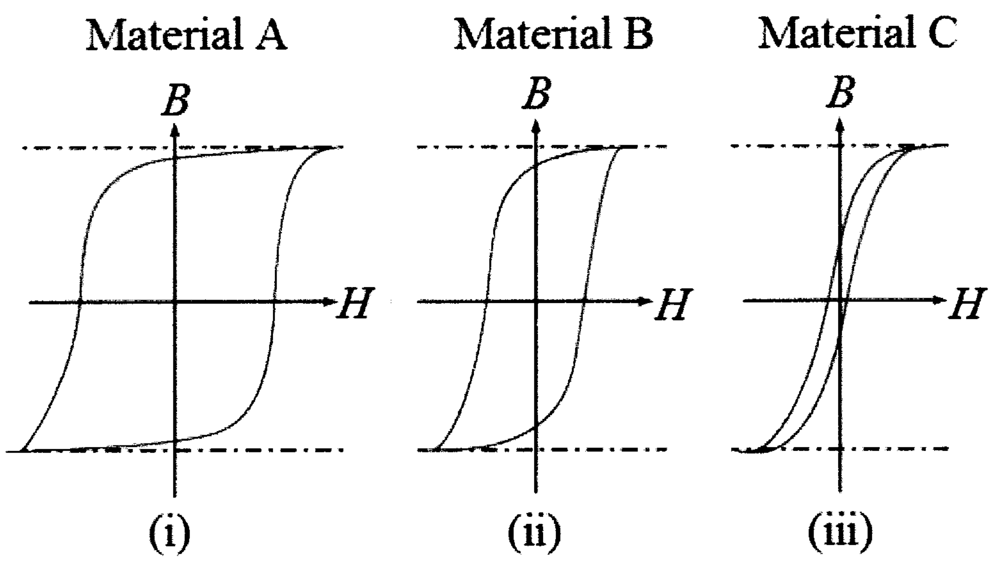

FIGURE Q5(c)

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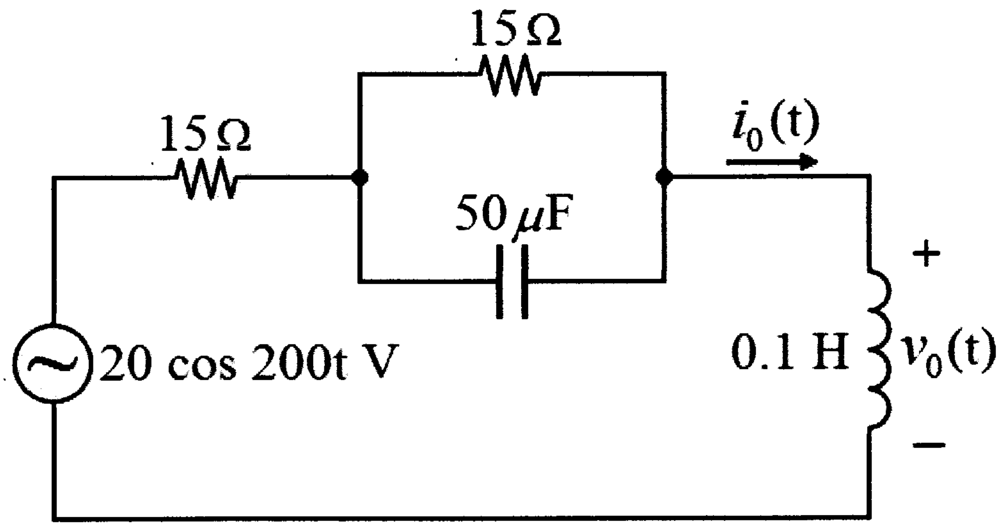

FIGURE Q6(c)

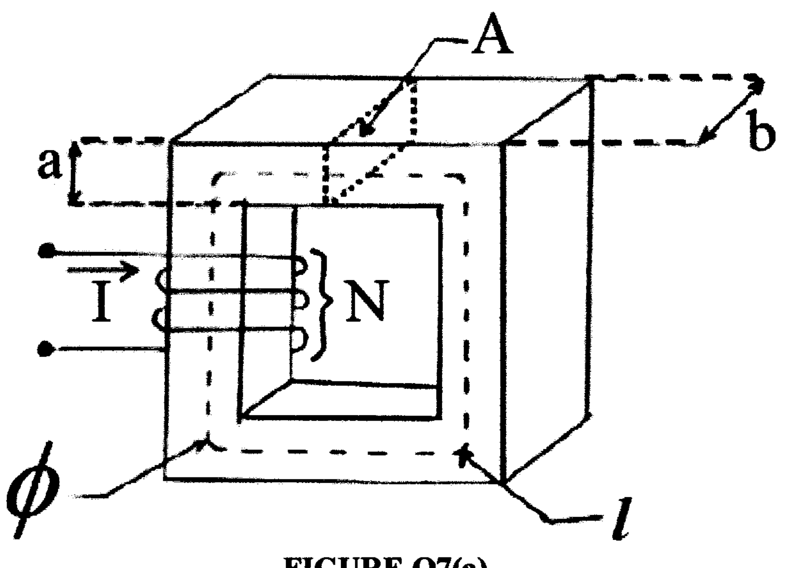

FIGURE Q7(a)

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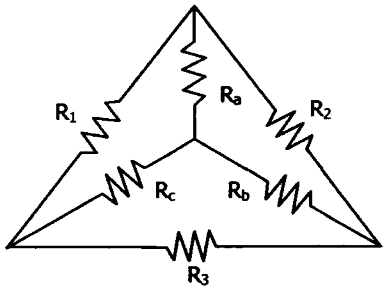
LIST OF FORMULAE

1. Delta-Wye Transformation

$$R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

$$R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3}$$



2. Maximum Power Transfer

$$P = \left(\frac{V_{TH}}{R_{TH} + R_L} \right)^2 R_L$$

3. Conversion rectangular to polar form:

$z = x + jy, \quad \theta = \tan^{-1} \frac{y}{x},$ (1st quadrant)

$z = -x + jy, \theta = 180° + \tan^{-1} \frac{y}{-x},$ (2nd quadrant)

$z = -x - jy, \theta = -180° + \tan^{-1} \frac{-y}{-x},$ (3rd quadrant)

$z = x - jy, \quad \theta = \tan^{-1} \frac{(-y)}{x}$ (4th quadrant)

4. Trigonometric Identities:

$\sin(-x) = -\sin x$

$\cos(-x) - \cos x$

$\sin(x \pm 90°) = \pm \cos x$

$\cos(x \pm 90°) = \mp \sin x$

$\sin(x \pm 180°) = -\sin x$

$\cos(x \pm 180°) = -\cos x$

5. Impedance:

$Z_R = R$; $Z_C = \frac{1}{j\omega C}$; $Z_L = j\omega L$