UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	ELECTRICAL TECHNOLOGY
COURSE CODE	:	BEE 10403
PROGRAMME	:	BACHELOR OF ELECTRONIC ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Discuss **ONE** advantage of alternating current (ac) over direct current is used in distributing the electricity to the industry or domestic.

(2 marks)

(b) For a serial RLC circuit that consists of a resistor of 5 ohm, an inductor of 3mH, and a capacitor of 0.4mF,

(i) Determine the frequency that causes the circuit performs purely resistive.

(3 marks)

(ii) Find the range of frequency that the circuit will be predominantly inductive.

(2 marks)

(c) **Figure Q1 (c)** illustrates a third-order low pass filter that consists of two inductors, one capacitor, and a resistor. The AC source supplies $V_s = 100 \cos (wt - 30^\circ)$ Volts with frequency of 60 Hz. If L1 = 3mH, L2 = 2mH, C1 = 0.7mF, and R1 = 5 ohm,

(i) Find the total impedance of the circuit, Z_{tot},

(4 marks)

(ii) Find the current follows through the Inductor 1, I_{L1},

(2 marks)

(iii) Find the current follows through the Resistor 1, I_{R1},

(2 marks)

(iv) Find the voltage across the Resistor 1, V_{R1},

(2 marks)

(v) Sketch the phasor diagram of I_{R1}, I_{L1},V_s and V_{R1},

(5 marks)

(vi) Describe the relationship between V_s and V_{R1}, V_s and I_{R1}, and I_{R1} and I_{L1}.

(3 marks)

Q2 (a) Three balanced delta loads are connected to a balanced 3-phase delta source with 500-kV rms 50 Hz per phase. Load 1 draws 40kW with a power factor of 0.5 leading, load 2 draws 30 kW with a power factor of 0.6 lagging, while load 3 has a complex power, $S_3 = 30 - j40$ kVA.

(i) Calculate the total complex power, real power, and reactive power for the combination of the three balanced delta loads (combined three loads).

(10 marks)

(ii) Find the power factor of the combined three loads.

(3 marks)

(iii) Decide the component needed to produce a power factor of 0.95 leading.

(2 marks)

(iv) Determine the value of each component that determined from **Q2 (a) (iii)** if they are connected in delta.

(5 marks)

(b) In a wye-delta three phase circuit, the source is a balanced, positive phase sequence with $V_{an} = 120\angle 0^o$ V. It feeds a balanced load $Z_\Delta = 9 + j12\Omega$ per phase. Calculate the phase voltage and phase current in the load a-b.

(5 marks)

Q3 (a) A 500 kVA 30000/240V transformer has the following parameters:

$R_p = 0.1\Omega$ $X_p = 0.4\Omega$ $R_c = 10k\Omega$

$R_s = 1m\Omega$ $X_s = 4m\Omega$ $X_m = 5.55k\Omega$

By using equivalent circuit referred to the primary as that illustrated in **Figure Q3(a)**,

(i) Analyze the primary voltage of the transformer at rated load with 0.9 leading power factor.

(12 marks)

(ii) Produce the voltage regulation of the transformer.

(3 marks)

(b) A closed magnetic circuit of cast steel contains a 6 cm long path of cross-sectional area 1 cm^2 and a 2 cm path of cross-sectional area 0.5 cm^2. A coil of 200 turns is wound around the 6 cm length of the circuit and a current of **0.4 *A*** flows. Determine the flux density in the 2 cm path if the μ_r of cast steel is 750.

(8 marks)

(c) Explain what an electromagnet is.

(2 marks)

Q4 (a) AC machines can be categorized as AC motors and AC generators. Identify

(i) The **differences** between AC motor and AC generator.

(2 marks)

(ii) **TWO (2)** methods to increase the turning force (or torque) of a DC motor.

(2 marks)

(iii) **TWO (2)** disadvantages of a DC machine.

(2 marks)

(b) A 24 V shunt DC motor in **Figure Q4(b)** has an armature resistance of 0.5 Ω and a field resistance of 100 Ω. At no load, the motor takes a line current of 0.5 A while running at 2500 rpm. If the line current at full load is 4 A,

(i) Find the field current and the induced voltage with no load.

(3 marks)

(ii) Find the full load speed and the speed regulation of the DC motor.

(5 marks)

(iii) Determine the relationship between the speed of the DC motor and its load.

(1 marks)

(c) Explain briefly about

(i) The working principle of synchronous motor.

(3 marks)

(ii) The differences between synchronous machine and induction machine.

(2 marks)

(d) A synchronous motor connected to 3980V, 3-phase line develops an excitation voltage *Eo* of 1790V (line to neutral) when the dc exciting current is 25A. The synchronous reactance X_S is 22Ω and the torque angle is 30°.

(i) Sketch the single phase equivalent circuit of the synchronous motor with appropriate labels.

(3 marks)

(ii) Sketch the phasor diagram of the synchronous motor if the terminate voltage V_t is $2297.85\angle 0°$ V, the voltage across the synchronous reactance E_x is $1166.2\angle 50.13°$ V, and line current I_L is $53\angle -39.87°$ A.

(2 marks)

– END OF QUESTION –

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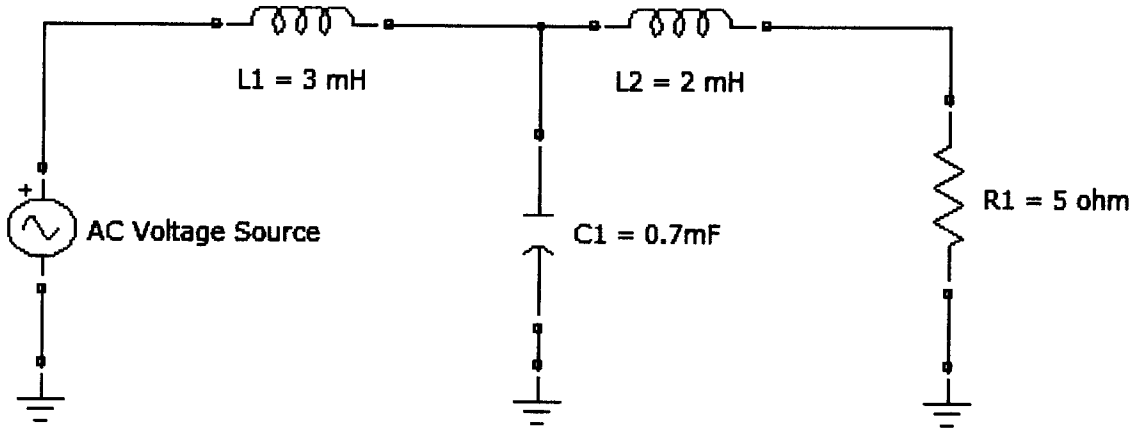

FIGURE Q1 (c)

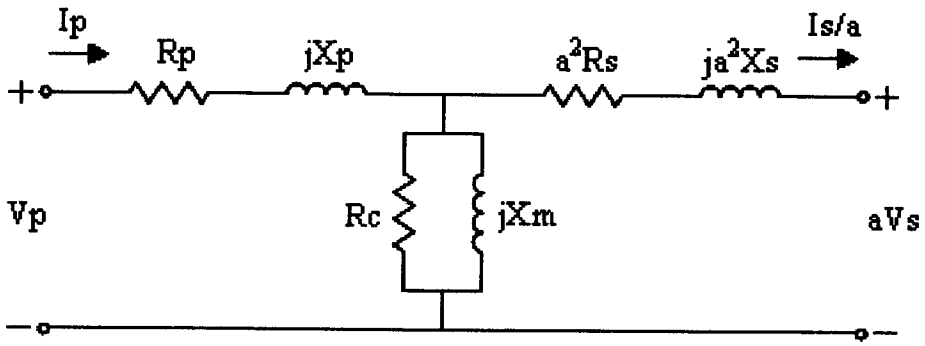

FIGURE Q3(a)

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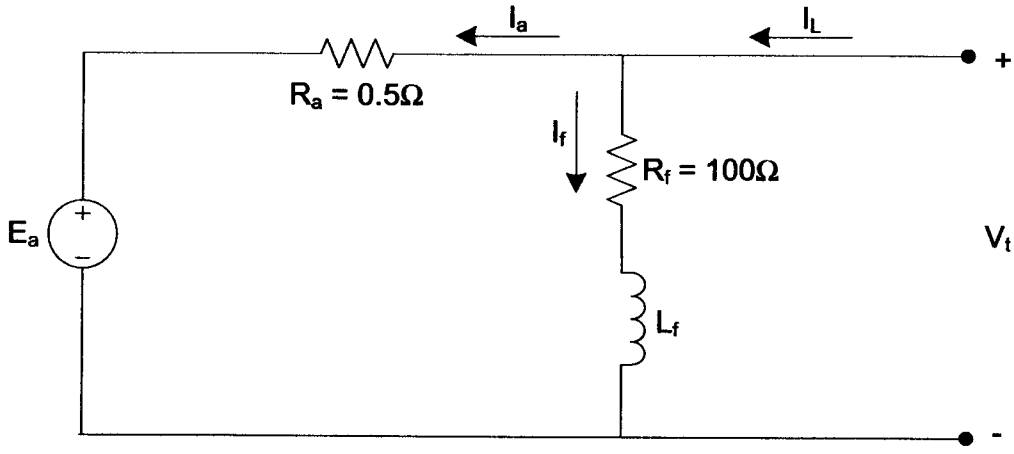

FIGURE Q4(b)

List of Formulae and Constant

1. $\beta = \mu H$ (unit: Tesla, T)

2. mmf (or F_m) = $NI = H/l$ (unit: Ampere-turns, At)

3. S (or R) = $l/\mu A$ = mmf/ϕ (unit: Ampere-turns/weber, At/Wb)

4. $\phi_{max} = B_{max} a_{area}$ (unit: Weber, Wb)

5. $E = 4.44 f N \phi_m$ (unit: Volt, V)

6. $a = \frac{v_p}{v_e} = \frac{e_p}{e_s} = \frac{N_p}{N_s}$ (unit: -)

Permeability of vacuum, $\mu_0 = 4\pi \times 10^{-7}$ Wb/At.m (or H/m)