UNIVERSITY OF JOHANNESBURG

PROGRAM	**:**	BACHELOR OF ENGINEERING TECHNOLOGY: *ELECTRICAL/MECHANICAL/INDUSTRIAL* ENGINEERING
MODULE	:	**ELECTROTECHNOLOGY 1A**
MODULE CODE	:	**ELTELA1**
DATE	:	SSA EXAMINATION 2019
DURATION	:	(3 HOURS)
WEIGHT	:	40: 60
TOTAL MARKS	:	100

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MODERATOR	:	DR P. BOKORO
NUMBER OF PAGES	:	5 PAGES (INCLUDING THIS PAGE)

INSTRUCTIONS TO STUDENTS

WORK IN PENCIL WILL NOT BE MARKED.
ALL WORK WITH THE EXCEPTION OF DIAGRAMS MUST BE IN BLUE OR BLACK INK.
ONE MARK EQUALS ONE PERCENT.
NO UNITS NO MARKS.
QUESTIONS MAY BE ANSWERED IN ANY ORDER.
ANSWER ALL QUESTIONS.
USE UP TO FIVE DECIMAL PLACES.
ONLY ONE POCKET CALCULATOR PER STUDENT MAY BE USED.

QUESTION 1 (25 MARKS)

1.1 Capacitor is made of two plates with an area of 10 cm^2, which are separated by a 2 mm thick mica sheet. If for mica ε_r = 6, find the capacitance (4)

Given: $\boldsymbol{\varepsilon_o} = 8.854 \times 10^{-12}$

1.2 An aluminium overhead cable has a resistance of 100Ω, when the effective daytime ambient temperature is 68 ºC. During night, the effective ambient temperature falls to 20ºC. Calculate the night time resistance if the temperature coefficient of resistance of aluminium at 20ºC is 0.0038 /ºC (5)

1.3 A wire of length 8 m and cross-sectional area 3 mm^2 has a resistance of 0.16Ω. If the wire is drawn out until its cross-sectional area is 1 mm^2, determine the resistance of the wire (4)

1.4 A coil of 100 turns is wound uniformly over a wooden ring having a mean circumference of 500 mm and a uniform cross sectional area of 500 mm^2. If the current through the coil is 2.0A, calculate the:

1.4.1 magnetic field strength, (3)

1.4.2 magnetic flux density, (3)

1.4.2 magnetic flux. (3)

1.4.2 mmf. (3)

Given: $\boldsymbol{\mu_o} = 4\pi \times 10^{-7}$

QUESTION 2 (15 MARKS)

2.1 The following two sinusoidal signals are given:

$$I_1 = 3\sin(35t + 135°)\,A$$

$$I_2 = 8.5\cos(35t + 50°)\,A$$

2.1.1 What is the period of the current I_1? (2)

2.1.2 If I_1 is subtracted from I_2, determine the polar form expression of the result ($I_t = I_1 + I_2$). The answer should be in the form: $I_t = X\angle\theta\ \ A$ (3)

2.2 In the circuit given in **FIGURE 1** below, after some time the switch moves to the position as indicated at time $t = 0$. Given that $R = 3k\Omega, L = 2\ mH$, answer the following:

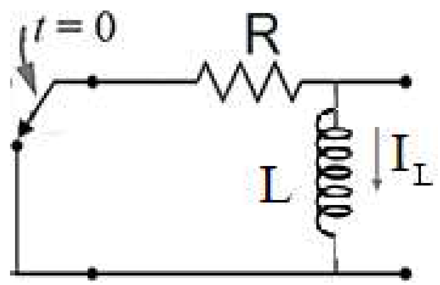

FIGURE 1

2.2.1 Write an expression for $I_L(t)$, given that the initial current is 1.5A (4)

2.2.2 What is the final current through inductor – i.e. $I_L(t = \infty)$ (2)

2.2.3 Calculate the current at the time constant – i.e. $I_L(t = \tau)$ (4)

<u>QUESTION 3</u> (31 MARKS)

3.1 For the network given in **FIGURE 2**, apply the Thevenin theorem and answer the following questions:

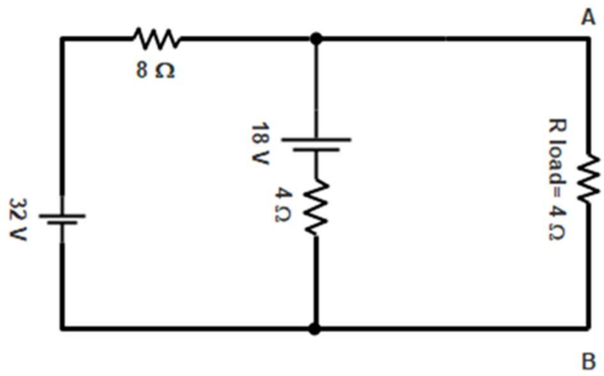

FIGURE 2

3.1.1 Determine the Thevenin equivalent impedance. (5)

3.1.2 Determine the Thevenin Voltage. (6)

3.1.3 Determine the current through the load impedance. (4)

3.2 Using mesh analysis, calculate the current in the 5 Ω and 22 Ω resistors in the circuit given in **FIGURE 3.** (16)

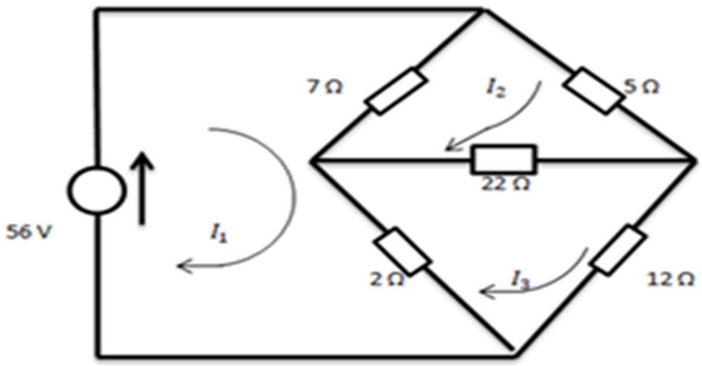

FIGURE 3

QUESTION 4 (19 MARKS)

The impedances indicated in **FIGURE 4** are connected in series across a 70 V/5kHz supply. Determine:

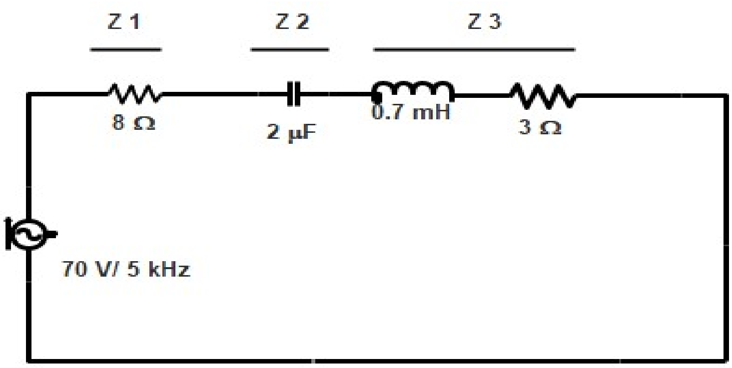

FIGURE 4

4.1 The inductive and capacitive reactances. (4)

4.2 The magnitude and phase angle of the total circuit impedance. (4)

4.3 Is the circuit (according to reactance) inductive or capacitive? (1)

4.4 The magnitude and phase angle of circuit current. (4)

4.5 Compute the magnitude of the voltages across all impedances (Z1, Z2 and Z3). (6)

QUESTION 5 (10 MARKS)

5.1 Two impedances, $Z_1 = 20\angle 50^\circ\ \Omega$ and $Z_2 = 5\angle 27^\circ\ \Omega$ are connected in series and have a total reactive power of 1870 var lagging. Determine

5.1.1 The apparent power (4)

5.1.2 The average power (4)

5.1.3 The power factor. (3)

END