FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY

School of Electrical & Electronics Engineering

Trade Diploma in Electrical Engineering (Electrical and Renewable Energy)

EEE410 – Mathematics for Technician 2

FINAL EXAMINATION

Semester 1, 2019

Date: As per Exam Time Table

Time: As per Exam Time Table (3 hours)

Venue: As per Exam Timetable

Instructions to Students

1. You are allowed an extra ten (10) minutes of reading time during which you are NOT allowed to write.
2. Attempt ALL questions in this examination booklet
3. Write your answers in the answer booklet provided.
4. Write your Student ID number on each page used.
5. Begin each Section on a fresh page and use both sides of the answer sheet.
6. You may use calculators provided they are non-programmable.
7. Clearly number the questions in your answer paper in their correct sequence and write legibly. Show all working.
8. Attach any extra sheets used to your answer booklet securely with the string provided.

Section A: Answer all questions. There are a total of 5 questions.
[10 marks]

1. An alternating current is given by i=4 sin 150t amperes, where t is the time in seconds. The rate of change of current at t =0.025s is:
   A. 3.99A/s
   B. −492.3A/s
   C. −3.28A/s
   D. 598.7A/s

2. The turning point on the curve $y = x^2 - 4x$ is at:
   A. (2, 0)
   B. (0, 4)
   C. (−2, 12)
   D. (2, −4)

3. The argument of the number -1+ i is :
   A. 90°
   B. 135°
   C. 180°
   D. 45°

4. Let $A = \begin{matrix} 1 & -3 & -4 \\ 2 & 1 & 0 \\ 3 & -2 & 5 \end{matrix}$. Which of the following is true?

   A. det (A) = 3
   B. det (A) = 63
   C. det (A) = 7
   D. det (A) is undefined

5. A Laplace Transform exists when

A. The function is piece-wise continuous

B. The function is of exponential order

C. The function is piecewise discrete

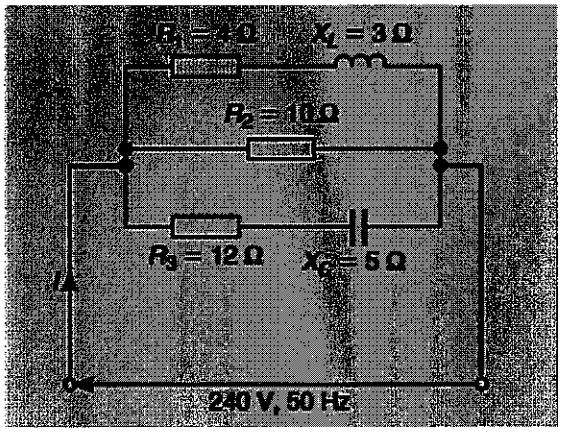
D. The function is of differential order

   A. A&B
   B. C&D
   C. A&D
   D. B&C

Section B: Answer all questions. There are a total of 5 questions.
[90 marks]

Question 1 [20 marks]

a. For the parallel circuit shown below, determine the value of current *I*, and its phase relative to the 240V supply, using complex numbers



[10 marks]

b. An alternating voltage of 240V, 50 Hz is connected across an impedance of (60–*j*100). Determine
   i. the resistance
   ii. the capacitance
   iii. the magnitude of the impedance and its phase angle and
   iv. the current flowing. **[5 marks]**

c. The voltage across the plates of a capacitor a many time t seconds is given by $v=Ve^{-t/CR}$, where V, C and R are constants. Given V = 300 volts, $C = 0.12 \times 10^{-6}$ farads and $R = 4 \times 10^{6}$ ohms find
   i. the initial rate of change of voltage, and
   ii. the rate of change of voltage after 0.5 s. **[5 marks]**

Question 2 [20 marks]

a. A DC circuit comprises three closed loops. Applying Kirchhoff's laws to the closed loops gives the following equations for current flow in milliampere :

$2I_1 + 3I_2 - 4I_3 = 26$
$I_1 - 5I_2 - 3I_3 = -87$
$-7I_1 + 2I_2 + 6I_3 = 12$

Use Cramer's rule to solve for I_1, I_2 and I_3 **[8 marks]**

b. Solve the following simultaneous equations using determinants:

$3x - 4y = 12$
$7x + 5y = 6.5$ **[5 marks]**

c. Experimental values of quantities x and y are believed to be related by a law of the form $y = ab^x$, where a and b are constants. The values of x and corresponding values of y are:

x	0.7	1.4	2.1	2.9	3.7	4.3
y	18.4	45.1	111	308	858	1850

Verify the law and determine the approximate values of a and b. Hence evaluate:

i. the value of y when x is 2.5, and
ii. the value of x when y is 1200 **[7 marks]**

Question 3 [15 marks]

a. The instantaneous value of voltage in an a.c. circuit at any time t seconds is given by $v = 340 \sin(50\pi t - 0.541)$ volts. Determine the:

i. amplitude, periodic time, frequency and phase angle (in degrees) **[4 marks]**
ii. value of the voltage when $t = 0$ **[2 marks]**
iii. value of the voltage when t =10 ms **[2 marks]**
iv. time when the voltage first reaches 200V **[2 marks]**
v. time when the voltage is a maximum **[2 marks]**
vi. Sketch one cycle of the waveform **[3 marks]**

Question 4 [15 marks]

a. Find the **Laplace transform** of

i. $f(t) = e^{3t} + 5t^3$ **[3 marks]**
ii. $g(t) = 4\cos(4t) - 9\sin(4t)$ **[3 marks]**

b. Find the **inverse Laplace transform** of $F(s) = \frac{6}{s} - \frac{1}{s+8} + \frac{4}{s-3}$ **[3 marks]**

c. Write the *iv* relation of a resistor, inductor and capacitor in the time domain and determine their Laplace transform in s domain. **[6 marks]**

Question 5 [20 marks]

a. Consider the function,

$$f(x) = \begin{cases} L, & for -L \leq x \leq 0; \\ 2x, & for\ 0 \leq x \leq L; \end{cases} on -L \leq x \leq L$$

i. Draw the piece wise function. **[4 marks]**

ii. Determine the coefficient a_0, a_n, b_n. **[9 marks]**

iii. Hence, determine the Fourier Series of $f(x)$. **[3 marks]**

b. Evaluate: $\int_0^{\frac{\pi}{3}} 2\sin\theta - 5\cos\theta \ d\theta$ **[4 marks]**

The End

Linear Log Graph Paper