FIJI NATIONAL UNIVERSITY

College of Engineering, Science and Technology

School of Mathematical & Computing Sciences

EEE 410- Mathematics for Technicians 2

Semester 2

FINAL EXAMINATION

2015

Programme: Trade Diploma in Electrical Engineering (Electrical and Renewable Energy, Electronics & Instrumentation, Telecommunication & Networking)

Time Allowed: 3 Hours 10 Minutes
100 Marks

Time: **Date:**

Instructions:

1. There are **fifteen questions** in the paper and a total 5 pages. **Answer any 12 questions. Best 10 would be selected.**
2. Start each Question on a new page.
3. Show all working as partly correct answers may be rewarded.
4. Programmable calculators are not allowed.
5. This exam is worth 50% of your overall mark.
6. If you use extra sheets of paper, attach it securely to the Answer Booklet.

1. If $z = 2+2i$ and $w = -1+3i$ then evaluate the following

   i. $z+w$

   ii. $\overline{z+w}$

   iii. $z \times w$

   iv. $Arg(z)$

[2+3+3+2 marks]

2. If $z = 3+2i$ and $w = -1+4i$ then

   i. Convert z and w into polar form

   ii. Using z and w into polar form, find $z \times w$ and leave your answer in $a+bi$ form.

   iii. Using z and w into polar form, find $\frac{z}{w}$ and leave your answer in $a+bi$ form.

[4+3+3 marks]

3.

   i. Given $z = 3+4i$. Find z^8.

   ii. Find the roots of $x^2 + 2x + 10 = 0$

[5+5 marks]

4. Solve for x, y and z using Cramer's rule.

$$2x - y + w = 2$$
$$x + y + 2w = 4$$
$$3x - y - w = 1$$

[10 marks]

5. Using $A = \begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$ find the following

   i. $A+B$

   ii. $2A$

   iii. Det(A)

   iv. AB

[2+2+2+4 marks]

6.

i. Find the derivative of the following functions.

a. $f(x) = e^x \cos 2x$

b. $f(x) = (Sin(2x))^{10}$

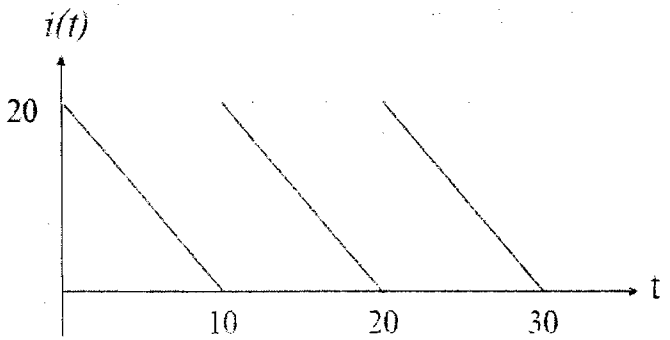
ii. $\int x^3 e^{3x} dx$

[3+3+4 marks]

7.

i. Calculate the voltage across inductor of inductance 0.2H if the current flowing through the inductor is $i_L(t) = 2e^{-3t}$.

ii. Study the wave form and answer the following questions



a. What is the general form of the waveform between t = 0 and t = 10.

b. Calculate the average value.

[4+3+3 marks]

8.

i. Prove that $y = ax^n$ can be written as $\log y = \log a + n \log x$.

ii. Given $y = 3x^{0.5}$ find its gradient when drawn on log-log graph paper.

iii. In a system, the input power is 8W and the output power is 10W. Calculate the power gain in dB.

[4+3+3 marks]

9.

i. For the capacitor having 3mF as it capacitance, compute the current flowing when the voltage across the capacitor is $V(t)_c = e^{-200t}$.

ii. $\int (2\sin 2x + x^2 + \frac{1}{5}e^{5x} + \frac{1}{x} + 1)\, dx$

[5+5 marks]

10.

i. Prove that the Laplace transform of $f(t) = e^{-at}$ is $\frac{1}{s+a}$.

ii. What is the Laplace transform of $f(t) = e^{-5t}$?

[7+3 marks]

11.

i. Find the Laplace transform of $\{2 + 3t + e^{2t}\}$

ii. Use the first shift theorem to find the Laplace transform of $\{t^2 e^{-4t}\}$

[5+5 marks]

12.

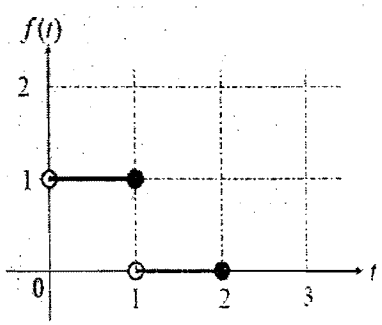
i. The Final Value theorem states that

$$\lim_{s \to 0} sF = \lim_{t \to \infty} f(t)$$

If $f(t) = 5t$ verify whether $f(t)$ follows Final value theorem.

[10 marks]

13. Given below is the graph of a complete wave form of $f(t)$. Using the graph of $f(t)$ answer the following questions:



i. Write the question of $f(t)$.

ii. Determine the Fourier series of $f(t)$.

[3+7 marks]

14.

i. Find the general solution of $2y'' + y' - y = 0$

ii. Find the Laplace inverse of $\{\frac{2}{s} + \frac{4}{s^2} - \frac{72}{s^5}\}$

[6+4 marks]

15. Solve the initial value problem. Use Laplace Transform of derivatives to solve the differential equation

$$y'' + 5y' + 4y = e^{-t} \text{ with initial conditions } y(0) = 1 \text{ and } y'(0) = 0$$

[10 marks]

THE END ☺