



FIJINATIONAL UNIVERSITY

College of Engineering, Science and Technology
School of Electrical and Electronics Engineering
Trade Diploma in Electrical and Electronics Engineering

EEE410 Mathematics for Technicians 2

FINAL EXAMINATION

Semester 1, 2018

Time Allowed: 3 Hours plus 10 minutes reading

100 marks

Instructions:

1. There are total of five questions. All are compulsory.
2. This exam is worth 50% of your overall mark. The minimum exam mark is 50/100.
3. **Answer each question neatly on a new page in the Answer Booklet provided. Clearly number the question attempted. All relevant working must be shown.**
4. Students may use a calculator, provided it is silent & non- programmable. Phones, notes and other study aids are not permitted.
5. If you use extra sheets of paper, attach it securely to the answer booklet.
6. Write your student identity number at the top of every page used.
7. There are a total of 5 pages in this Examination.

Question 1

(25 marks)

a. If $z = 1 + 2j$ and $w = 4 - 3j$ then evaluate the following:

- i. $|w|$ (1 mark)
- ii. $\text{Arg}(z)$ (1 mark)
- iii. \bar{w} (1 mark)
- iv. $z \times w$ (2 marks)
- v. $\frac{w}{z}$ (3 marks)

b. If $z = 2 + 3j$ and $w = -3 + 4j$ then:

- i. Convert z and w into polar form. (3 marks)
- ii. Using z and w into polar form, find $\frac{z}{w}$. (3 marks)
- iii. Convert z into the exponential form of a complex number. (2 marks)
- iv. Solve $2x^2 + 3x + 5 = 0$ (2 marks)
- v. Use De Moivre's Theorem to evaluate $(-2 + 3j)^6$. (3 marks)
- vi. Find the square root of $(5 + 3j)$ in rectangular form, correct to 4 significant figures. (4 marks)

Question 2

(20 marks)

- a. Find the Laplace transform of $f(t) = t^3 - 2e^{3t}$ (3 marks)
- b. Find the inverse Laplace transform of $F(s) = \frac{24}{s^3} - \frac{3}{s+4}$ (5 marks)
- c. Use the s-shift theorem to find $L\{e^t \sin t\}$. (3 marks)

d. Solve the second order differential equation given below using Laplace transform:

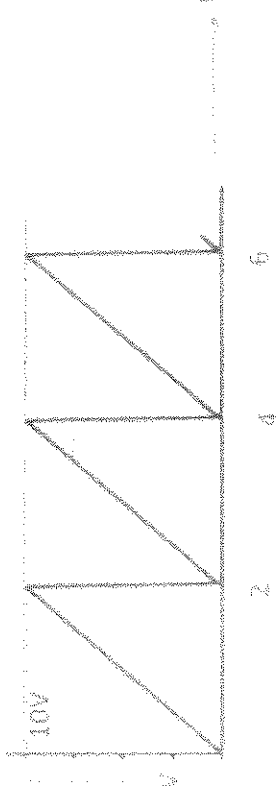
$$y'' + 5y' + 6y = 2e^{-t} \text{ with } y(0) = 0 \text{ and } y'(0) = 0$$

(9 marks)

Question 3

(20 marks)

a. Calculate the waveform and answer the questions that follow.



i. What is the general form of the wave between $t = 0$ and $t = 2$?

(1 mark)

ii. Calculate the average value.

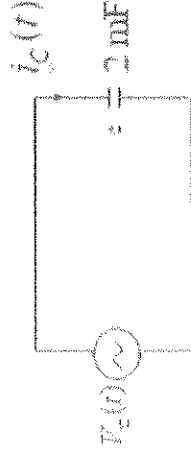
(3 marks)

iii. Calculate the RMS value.

(3 marks)

b. Calculate the current flowing when the voltage across the capacitor is

$$V_c(t) = e^{-500t} \text{ for } t > 0.$$



(5 marks)

c. Find $\frac{dy}{dx}$, given $x = -13 - y^2$

(3 marks)

d. Evaluate the definite integrals:

i. $\int_0^{\pi} \sin 3t \, dt.$

(3 marks)

ii. $\int_0^{\pi} t^4 \, dt$

(2 marks)

Question 4**(20 marks)**

- a. A d.c circuit comprises three closed loops. Applying Kirchhoff's laws to the closed loops gives the following equations for current flow in amperes:

$$1I_1 + 8I_2 + 3I_3 = -31$$

$$3I_1 - 2I_2 + I_3 = -5$$

$$2I_1 - 3I_2 + 2I_3 = 6$$

Use Cramer's rule to find the currents I_1, I_2 and I_3 .

(8 marks)

- b. Determine the rate of change of voltage, given $v = 5t \sin 2t$ volts, when $t = 0.2$ in radians. Write your answer to 3 significant figures.

(4 marks)

- c. In an experiment the following data were recorded:

Mass, m(kg)	0	1	2	3	4	5	6	7	8
Extension, e(mm)	0	13	28	44	58	74	89	105	120

- Plot the points and draw the graph. **(3 marks)**
- Find the gradient of the line. **(3 marks)**
- Find the vertical intercept. **(1 mark)**
- What is the relationship between mass and extension? **(1 mark)**

Question 5**(15 marks)**

Consider the function,

$$f(t) = \begin{cases} 1, & \text{for } 0 < t < \pi; \\ 0, & \text{for } t = 0, \pm\pi; \\ -1, & \text{for } -\pi < t < 0; \end{cases}$$

- Draw the graph for the function $f(t)$ for one period. **(2 marks)**
- Determine whether the function in part (a) is even, odd or neither. **(1 mark)**
- Determine the coefficients a_0, a_n, b_n . **(9 marks)**
- Hence, determine the Fourier Series of $f(t)$. **(3 marks)**

The End

Table 1: Laplace Transforms

	$f(t)$	$\mathcal{L}\{f(t)\} = \mathcal{L}\{f\}$
1.	1	$\frac{1}{s}$
2.	t	$\frac{1}{s^2}$
3.	t^2	$\frac{2!}{s^3}$
4.	t^N	$\frac{N!}{s^{N+1}}$
5.	e^{at}	$\frac{1}{s-a}$
6.	$\cos wt$	$\frac{s}{s^2+w^2}$
7.	$\sin wt$	$\frac{w}{s^2+w^2}$
8.	$\cosh at$	$\frac{s}{s^2-a^2}$
9.	$\sinh at$	$\frac{a}{s^2-a^2}$
10.	$e^{at} \cos wt$	$\frac{s-a}{(s-a)^2+w^2}$
11.	$e^{at} \sin wt$	$\frac{w}{(s-a)^2+w^2}$
12.	$t^a (a > 0)$	$\frac{\Gamma(a+1)}{s^{a+1}}$