FNU FIJI NATIONAL UNIVERSITY

College of Engineering, Science & Technology

School of Mathematical and Computing Sciences

EEE 401: Mathematics for Technicians I

Trade Diploma in Electrical & Electronics Engineering

Final Examination

Semester 1, 2017

Time: 3 hours, 10 Minutes

Instructions:

1. **There are total of 12 questions in the paper. Answer any 10. Each question is worth 10 marks.**
2. You are permitted 10 minutes of reading time in which you are NOT allowed to write.
3. **Answer each question on a new page in the answer booklet provided. Clearly number each problem you attempt. All relevant working must be shown.**
4. Students may use a calculator, provided it cannot be programmed. Phones, notes and other study aids are not permitted.
5. If you use extra sheets of paper, attached them securely to the answer sheet.
6. Write your student identity number at the top of every page used.
7. There are total of five pages.

Question 1

a. A piece of steel, 3.38m long is cut into three pieces in the ratio **2 to 5 to 6**. Determine, in **centimeters**, the **lengths of the three pieces**. [3m]

b. Evaluate $\frac{586.29}{19.3}$ correct to 1 decimal place. [1m]

c. Express 54.7mm as a percentage of 1.15m, correct to 3 significant figures. [2m]

d. Simplify the following:

i. $\frac{8a^2\, b\, \sqrt{c^3}}{(2a)^2\, \sqrt{b}\sqrt{c}}$ [2m]

ii. $4ab - [3(2(4a - b) + b(2 - a))]$ [2m]

Question 2

a. Solve the following equations:

i. $3t - 2 = 5t + 4$ [2m]

ii. A rectangular football pitch has its length equal to twice its width and a perimeter of 360m. Find its length and width. [3m]

b. Determine the value of the following, giving the **answer both in standard form and engineering notation:**

i. $4.9 \times 10^2 + 7.31 \times 10^3$ [1m]

ii. $2.65 \times 10^{-2} - 2.75 \times 10^{-3}$ [1m]

c. Solve $2^x = 5.5$ correct to **3 significant figures**: [3m]

Question 3

a. The current i flowing through an electric device is given by: $i = 0.005v^2 + 0.014v$, where v is the voltage. Calculate the values of v when $i = 3 \times 10^{-3}$. [5m]

b. The passage of sound waves through walls is governed by the equation:

$$v = \sqrt{\frac{K + \frac{4}{3}G}{\rho}}$$

Make the shear modulus G the subject of the formula. [5m]

Question 4

a. Two quantities x *and* y are related by the equation $y = ae^{-kx}$, where a *and* k are constants. Determine, correct to 1 decimal place, the value of y when $a = 2.114$, $k = -3.20$ *and* $x = 1.429$. [4m]

b. If $\theta_f - \theta_i = \frac{R}{J}\ln\left(\frac{U_2}{U_1}\right)$ find the value of U_2 given that $\theta_f = 3.5$, $\theta_i = 2.5$, $R = 0.315$, $J = 0.4, U_1 = 50$. [6m]

Question 5

a. Determine the volume (in cubic meters) and the total surface area(in square meters) of a solid metal cone of base radius 0.5m and perpendicular height 1.20m. Give answers correct to 2 decimal places. [5m]

b. Calculate the total surface area of a 10cm by 15cm rectangular pyramid of height 20 cm. [5m]

Question 6

a. The results in the table below show how the length of a wire, $l\ cm$ depends on a load Wg applied to it. Show by drawing a suitable graph that the law $l = aW + b$ is approximately true and establish from graph values for the constants a and b.

$l(\ cm)$	12.2	12.85	13.47	14.1	14.75	15.35
$W\ (g)$	80	90	100	110	120	130

[5m]

b. An alternating current is given by $i = 30\ sin\ (100\pi t + 0.27)$ amperes. Find:

i. amplitude, periodic time, frequency and [3m]

ii. phase angle (in degrees and minutes). [2m]

Question 7

a. An electricity pylon stands on horizontal ground. At a point 80 m from the base of the pylon, the angle of elevation of the top of the pylon is 23°. Calculate the height of the pylon to the nearest metre. [3m]

b.

i. Add $13°52'$ and $26°29'$ [1m]

ii. Subtract $15°11'18"$ from $24°33'27"$ [1m]

c. Solve for x: $2\sin(x + 60°) = \sqrt{3}$, where $0° \leq x \leq 360°$. [5m]

Question 8

a. An oscillating mechanism has a maximum displacement of $2.5m$ and a frequency of $60\ Hz$. At time $t = 0$ the displacement is $90cm$.Express the displacement in the general form $A\ sin\ (\omega t \pm \alpha)$. [5m]

b. Convert $(\sqrt{3}, 1)$ into polar form. [5m]

Question 9

a. Find the limit:

$$\lim_{x \to -4} \frac{x^2 + 7x + 12}{x + 4}$$

[5m]

b. Differentiate the following with respect to x:

i. $f(x) = 2x^2 + 8x + 12$ [1m]

ii. $f(x) = \frac{x}{x+3}$ [3m]

iii. $f(x) = -\frac{1}{x^5}$ [1m]

Question 10

a. Use the definition of the derivative to find the derivative of $f(x) = 2x + 5$. [4m]

b. $v = 50\ sin\ 40t$ volts represents an alternating voltage where t is the time in seconds. At a time of 20×10^{-3} seconds, find the rate of change of voltage, $v'(t)$. [3m]

c. Find the area under the graph $y = x + 3$ for the interval $[1, 3]$. [3m]

Question 11

a. Find the differential coefficient of: $y = \sec x - \ln(x^2 + 1) + 3\pi^2 e^{-2} + e^x$. [5m]

b. Evaluate: $\int [2 \sin x - 2 \sec^2 x]\, dx$. [5m]

Question 12

a. Evaluate: $\int x^2 \sin x\, dx$. [5m]

b. Evaluate $\int x^2 \sqrt{1 + x}\, dx$. [*Hint: Use* $u = 1 + x$] [5m]

THE END