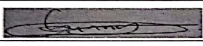## ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE, NIGERIA

DEPARTMENT OF MECHANICAL ENGINEERING

FIRST SEMESTER EXAMINATIONS
2019/2020 ACADEMIC SESSION

COURSE: GNE 415 – Engineering Analysis (3 Units)
CLASS: 400 Level General Engineering
TIME ALLOWED: 3 Hours
INSTRUCTIONS: Attempt question **ONE** and any other **FOUR** questions (125 marks)

Date: February, 2020

HOD'S SIGNATURE

Question 1 (25 marks)

a) A tool is drawn at random from a toolbox containing 6 spanners, 4 hammers, and 5 wrenches. Determine the probability that it is:

   i. Spanner.
   ii. Hammer.
   iii. Wrench.
   iv. Not spanner.
   v. Spanner or hammer.

...5 marks

b) Solve the partial differential equation:

$$\frac{\partial^2 U}{\partial x^2} + \frac{\partial^2 U}{\partial y^2} = x^2 - y^2$$

...20 marks

Question 2 (25 marks)

a) Provide brief answers to the following questions:

   i. What is a **Sample** in relation to population?

ii. Write the Laplace Transform of $f''(t)$ and $f'''(t)$.

...5 marks

b) Given that a function is defined as

$$f(t) = \begin{cases} 0 & \cdots\cdots\cdots & t < -\frac{a}{2} \\ 1 & \cdots\cdots\cdots & -\frac{a}{2} < t < \frac{a}{2} \\ 0 & \cdots\cdots\cdots & \frac{a}{2} < t \end{cases}$$

Show that the Fourier Transform of $f(t)$ is given as

$$F(\omega) = \frac{a}{\sqrt{2\pi}} \operatorname{sinc}\left(\frac{\omega a}{2}\right)$$

where,

$$\operatorname{sinc}\left(\frac{\omega a}{2}\right) = \frac{\sin\left(\frac{\omega a}{2}\right)}{\left(\frac{\omega a}{2}\right)}$$

...20 marks

Question 3 (25 marks)

a) Briefly answer the following:

   i. What is a variable?
   ii. What is a population?

...5 marks

b) Find the Laplace Transform of $f(t) = 8t^8 + 6\cos 8t + 3e^{-t}$. ...10 marks

c) Determine:

   i. $\int \cos az \sin az\, dz$
   ii. $\int \cot(\eta z + \lambda)\, dz$

...10 marks

Question 4 (25 marks)

a) Write short notes on correlation and regression.

...5 marks

b) Given that:

$$\beta(z, \bar{z}) = M(x, y) + iN(x, y)$$

Show from first principles that:

$$2\frac{\partial \beta}{\partial \bar{z}} = \left(\frac{\partial M}{\partial x} - \frac{\partial N}{\partial y}\right) + i\left(\frac{\partial M}{\partial y} + \frac{\partial N}{\partial x}\right)$$

...20 marks

Question 5 (25 marks)
a) What are harmonic functions?

...5 marks

b) Show that $u = e^{-x}(x \sin y - y \cos y)$ is harmonic.

...10 marks

c) Prove the Cauchy's theorem.

...10 marks

Question 6 (25 marks)
a) Write the Cauchy-Riemann equations for the function:
$$f(z) = u(x, y) + iv(x, y)$$

...5 marks

b) Given that $A(x, y) = 2xy - ix^2y^3$. Find:
   i. ∇A
   ii. $|\nabla \times A|$
   iii. $\nabla \cdot A$
   iv. $\nabla^2 A$

...20 marks

Question 7 (25 marks)
a) Briefly answer the following questions:
   i. Define data.
   ii. What is the goal of statistics?

...5 marks

b) Data collected in an experiment is given in Table (7.1). X and Y are independent and dependent variables respectively.

Table 7.1: Experimental data

S/N	X	Y
1	1	3
2	2	1
3	4	4

Answer the following equations:

i. Derive a linear regression model using the given data.

ii. Plot a graph showing the given data and the linear regression model derived in question 7(b)(i).

...20 marks