(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER

SPECIAL/SUPPLIMENTARY EXAMINATION

FOR THE DEGREE BACHELOR OF SCIENCE

COURSE CODE: **MAT 351**

COURSE TITLE: **ENGINEERING MATHEMATICS III**

DATE: 11/01/2022 **TIME:** 8:00 A.M-10:00 A.M.

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

a) Define the following terms as used in engineering mathematics. (2 Marks)
   i) Engineering Mathematics
   ii) Fourier Series

b) State one importance of Laplace Transforms. (1 Marks)

c) Write down the solutions of the following Laplace transform formulas giving relevant conditions for each. (4 Marks)

   (i) $L(1)$ (ii) $L(t^n)$ (iii) $L(t^{at})$ (iv) $L[Cosh(at)]$

d) Prove that $L[Cos(at)] = \frac{s}{s^2 - a^2}$ (6 Marks)

e) Prove that $L[af_1(t) + bf_2(t)] = aL[f_1(t)] + bL[f_2(t)]$ (3 Marks)

f) Write down the solutions for the following inverse Laplace transforms. (4 Marks)

   i) $L^{-1}\left(\frac{1}{s}\right)$ (ii) $L^{-1}\left(\frac{1}{s^n}\right)$ (iii) $L^{-1}\left(\frac{1}{s-a}\right)$ (iv) $L^{-1}\left(\frac{s}{s^2 - a^2}\right)$ (4 Marks)

g) Derive a divergence of a vector function. (5 Marks)

h) Stare Green's Theorem. (1 Mark)

QUESTION TWO (20 MARKS)

a) State three components of Fourier series. (3 Marks)

b) Find the Fourier series expansion representing function $f(x) = x$ in the interval $0 \le x \le 2\pi$ (10 Marks)

c) Find the Laplace transform of $f(t)$ as $f(t) = \begin{cases} \frac{t}{k}, when,,0 < t < k \\ 1, when t > k \end{cases}$ (7 Marks)

QUESTION THREE (20 MARKS)

a) State five Dirichlete's conditions for a Fourier series. (5 Marks)

b) If $z(x + y) = x^2 + y^2$ show that

$$\frac{\partial z}{\partial x} - \frac{\partial z}{\partial y} = 4\left[1 - \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right]$$ (10 Marks)

c) If $u = x^2 + y^2 + z^2$ and $\vec{r} = xi + yj + zk$ then find $div.\left(u \cdot \vec{r}\right)$ in form of u (5 Marks)

QUESTION FOUR (20 MARKS)

a) Show that gradient field describing a motion in irrational. (9 Marks)

b) If $\vec{F} = 2zi - xj + yk$, evaluate $\iiint_V \vec{F} \cdot dv$ where V is the region bounded by the surface

$x = 1, y = 0, y = 4, x = 2, z = x^2, z = 2$ (7 Marks)

c) Using Green's Theorem, evaluate $\int_C (x^2 ydx + x^2 dy)$ where C is the boundary

describing counter-clockwise vertices $(0,0),(1,0),(1,1)$

(4 Marks)

Question Five (20 Marks)

a) Obtain the complex form of the Fourier series of the function

$$f(x) = \begin{cases} 0,..when,..-\pi \leq x \leq \pi \\ 1,..when,...0 \leq x \leq \pi \end{cases}$$ (12 Marks)

b) If $u = x^2 + y^2$ where $x = aCost, y = bS\text{int}$ find $\frac{du}{dt}$, verify the result. (5 Marks)

c) State any three advantages of Fourier series. (3 Marks)