

NATIONAL OPEN UNIVERSITY OF NIGERIA Plot 91, Cadastral Zone, Nnamdi Azikwe Expressway, Jabi, Abuja. FACULTY OF SCIENCE AND TECHNOLOGY

April/May Examination 2019

COURSE CODE: MTH381

COURSE TITLE: MATHEMATICAL METHODS III

CREDIT UNIT:

3 HOURS TIME:

Total: 70 Marks

INSTRUCTION: Attempt question One (1), and any other four questions.

Question 1

(a) If $f(x, y) = x^2 - 2xy + y^2$

Find (i) f(1,-1) (ii) f(2,1)

[2 marks each]

(b) If u = x + y + z, $v = x^3 + y^3 + z^3$ and w = xyz

find the Jacobian $J = \frac{\partial(u, v, w)}{\partial(x, y, z)}$

[6 marks]

(c) Determine the Fourier series of the function defined by

$$f(x) = 2x \qquad 0 < x < 2\pi$$

$$f(x+2\pi) = f(x)$$
 [6 marks]

- (d) Express the following in polar from stating the modulus of the vector and argument (the principal) of the vector value:
 - (i) 1+i
- (ii) -5+5i

[3 marks each]

Question 2

(a) Determine whether the following pair of functions are linearly dependent as the case may be

(i)
$$u(x) = x^2$$
, and $v(x) = 3x^2$

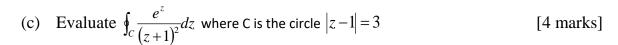
[3 marks]

 $u(x) = \cos 2x$, and $v(x) = \sin 2x$ (ii)

[3 marks]

State the Residue theorem. (b)

[2 marks]



Question 3

Determine the poles of the function (a)

$$\frac{z^3}{(z-1)^3(z+3)}$$

And the residue at each pole.

[3 marks]

Verify divergence theorem for the vector field (b)

$$F = zi + y^2 j + xk$$

over the region bounded by the planes

$$x = 0$$
, $x = 1$, $y = 0$, $y = 1$, $z = 0$ and $z = 1$.

[9 marks]

Question 4

(a) If
$$f(x, y) = \frac{3x + 2y}{4 - 2xy}$$

Find (i) f(0,1)

(ii) f(1,3) [2 marks each]

(b) Using Laplace transformation, solve the initial value problem:

$$y'' - 3y' - 2y = 4t$$
; $y(0) = 1$ and $y'(0) = -1$

[8 marks]

Question 5

(a) Evaluate the double integral

(i)
$$\int_{y=1}^{y=2} \int_{x=0}^{x=3} (x^2 + y) dx dy$$

(ii)
$$\int_{1}^{2} \int_{1}^{3} x^{2} y dx dy$$
 [6 marks each]

Question 6

If $A = (2x^2 + 5y)i - 10yzj + 5xz^2k$ evaluate $\int_C A.dr$ from (0,0,0) to (1,1,1) along (a) the following parts C: x = t, $y = t^2$, and $z = t^3$

The straight lines from (0,0,0) to (1,0,0) then to (1,1,0) and then to (1,1,1). The straight line joining (0,0,0) and (1,1,1).

Given that $z_1 = 3 - 4i$ & $z_2 = -6 + i$; find (i) $z_1 z_2$ (ii) $\frac{z_1}{z_2}$ [3 marks each] (b)

End of Examination questions.