



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**University Village Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi, Abuja**  
**FACULTY OF SCIENCES**  
**DEPARTMENT OF MATHEMATICS**  
**2022\_2 Examinations**

**Course Code:** MTH311  
**Course Title:** CALCULUS OF SEVERAL VARIABLES  
**Time Allowed:** 3 Hours  
**Total:** 70 Marks  
**Instruction:** Answer Question One (1) and Any Other 3 Questions

1. a. If  $f(x, y) = \frac{xy^2}{x^2+y^2}$  does  $\lim_{x \rightarrow 0, y \rightarrow 0} f(x, y)$  exist? (5 marks)
- b. Find the derivative of  $z = x^2 + 2xy + y^2$  (8 marks)
- c. Define the following functions: (i) constant function. (ii) identity function (iii) modulus function (iv) square root function. (v) trigonometric function. (12 marks)
2. a. If  $f(x, y) = \frac{xy}{(x^2-y^2)}$ , does  $\lim_{(x,y) \rightarrow (0,0)} f(x, y)$  exist (5 marks)
- b. When is  $f_{xy} = f_{yx}$ ? (5 marks)
- c. Using implicit differentiation, find  $\frac{d(x^3+y^3=6xy)}{dx}$  (5 marks)
3. a. Find the first order partial derivatives for  $w = x^2y - 10y^2z^3 + 43x - 7 \tan(4y)$  (5 marks)
- b. Define Curl. (5 marks)
- c. Define a polynomial function of two variables. (5 marks)
4. a. Where is the function continuous?
- $F(x) = \frac{x^2+y^2}{x^2+y^2}$  (7.5 marks)
- b. Define Jacobian matrix (7.5 marks)

5. a. Define Taylors series (7.5 marks)

b. Find  $f_{xxyzz} = z^3 y^2 \ln(x)$  (7.5 marks)

6. a. Differentiate  $x^2 - 2xy + y^3 = c$  (7.5 marks)

b. Prove that  $\frac{d(\tan^{-1} x)}{dx} = \frac{1}{1+x^2}$  (7.5 marks)