



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
University Village Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi, Abuja

**FACULTY OF SCIENCES**  
**DEPARTMENT OF MATHEMATICS**  
**2021\_1 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 4 Questions

1. a. Define a real value function (4 marks)  
b. Given  $u = x^2 + 2y$  where  $x = r \sin(t)$  and  $y = \sin^2(t)$ , determine the value of  $\frac{\partial u}{\partial r}$  and  $\frac{\partial u}{\partial t}$  using the chain rule. (6 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. Function  $f$  is defined by  $f(x) = -2x^2 + 6x - 3$ . find  $f(-2)$ . (4 marks)  
b. Find  $\lim_{(x,y)} \frac{x^2 - y^2}{x^2 + y^2}$  if it exist (4 marks)  
c. Define Curl (4 marks)
3. a. If  $f(x, y) = \frac{xy}{(x^2 - y^2)}$ , does  $\lim_{(x,y) \rightarrow (0,0)} f(x, y)$  exist (4 marks)  
b. When is  $f_{xy} = f_{yx}$ ? (4 marks)  
c. Using implicit differentiation, Find  $\frac{d(x^3 + y^3 = 6xy)}{dx}$  (4 marks)
4. a. Define a polynomial function of two variables (6 marks)  
b. Evaluate  $\lim_{(x,y) \rightarrow (1,2)} (x^2y^3 - x^3y^2 + 3x + 2y)$ . (6 marks)
5. a. Where is the function continuous?

$$F(x) = \frac{x^2 + y^2}{x^2 + y^2} \quad (6 \text{ marks})$$

- b. Define Jacobian matrix (6 marks)

6. a. Define Taylors series (6 marks)

b. Find  $f_{xyzz} = z^3 y^2 \ln(x)$  (6 marks)