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**UNIVERSITY EXAMINATIONS  
2017/2018 ACADEMIC YEAR  
THIRD YEAR FIRST SEMESTER  
SPECIAL/ SUPPLEMENTARY EXAMINATION  
FOR THE DEGREE OF BACHELOR OF SCIENCE**

**COURSE CODE:** MAT 351

**COURSE TITLE:** ENGINEERING MATHEMATICS III

**DATE:** 19/10/18

**TIME:** 8 AM -10 AM

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**INSTRUCTIONS TO CANDIDATES**

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

### QUESTION ONE (30 MARKS)

- a) Write down how Fourier coefficients  $a_0, a_n$  and  $b_n$  can be obtained. (3 Marks)
- b) Define Fourier Series as used in Engineering mathematics. (1 Mark)
- c) State any four properties of Laplace Transforms. (4 Marks)
- d) Prove that (i)  $L(1) = \frac{1}{s}$  (4 Marks)
- (ii)  $L[\text{Sinh}(at)] = \frac{a}{s^2 + a^2}$  (6 Marks)
- e) Write down the solutions to the following inverse Laplace transforms. (4 Marks)
- i)  $L^{-1}\left(\frac{1}{s^2 - a^2}\right)$  (ii)  $L^{-1}\left(\frac{1}{s^2 + a^2}\right)$  (iii)  $L^{-1}(1)$  (iv)  $L^{-1}\left(\frac{s}{s^2 + a^2}\right)$
- f) Evaluate  $\lim_{\substack{x \rightarrow 0 \\ y \rightarrow 0}} \frac{2xy}{3x^2 + y^2}$  (2 Marks)
- g) Find the unit vector normal to the surface  $3x^2 + y^2 + 2z^2 = 8$  at  $p(2,0,1)$  (5 Marks)

### QUESTION TWO (20 MARKS)

- a) Compute  $\int_C F \cdot dr$  where  $F = \frac{iy - jx}{x^2 + y^2}$  and  $C$  is the circle  $x^2 + y^2 = 1$  traversed counter-clockwise. (12 Marks)
- b) If  $\phi = x^2y - 2y^3z^2$ . Find  $\text{grad} \cdot \phi$  at point  $(-1, 2, 1)$  (8 Marks)

### QUESTION THREE (20 MARKS)

- a) Use Green's Theorem to evaluate  $\int_C (x^2 + xy)dx + (x^2 + y^2)dy$  where  $C$  is the square formed by the lines  $y = \pm 1, x = \pm 1$  (8 Marks)
- b) Find the Fourier half range even expression of the function  $f(x) = \left(-\frac{\pi}{L}\right) + 1, \dots, 0 \leq x \leq L$  given that  $a_0 = \frac{1}{\pi} \int_0^{2\pi} f(x)dx$  (12 Marks)

### QUESTION FOUR (20 MARKS)

- a) State five advantages of Fourier series. (5 Marks)
- b) Find  $\frac{\partial u}{\partial r}$  and  $\frac{\partial u}{\partial \theta}$  if  $u = e^{r \cos \theta} \cdot \text{Cos}(r \text{Sin} \theta)$  (9 Marks)
- c) Find the directional derivative of the scalar function  $f(x, y, z) = x^2 + xy + z^2$  at the point  $A(-1, -1, 1)$  in the direction of the line  $AB$  where  $B$  has coordinated  $(-3, 2, 1)$  (6 Marks)

**QUESTION FIVE (20 MARKS)**

- a) What are the differences between:
- (i) Partial and Total Differential Equations. (2 Marks)
  - (ii) Vector and Scalar Quantity (1 Mark)
- b) Find the Fourier Series for the function  $f(x) = x^2$  in the interval  $0 \leq x \leq 2\pi$  (10 Marks)
- c) Find the Laplace transform of  $t \cos(at)$  (7 Marks)