ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SEMESTER II EXAMINATION, 2016/2017 ACADEMIC SESSION

COURSE TITLE: ENGINEERING MATHEMATICS IV – 3 UNITS

COURSE CODE: GNE 316

EXAMINATION DATE: 25th JULY 2017

COURSE LECTURER: Dr. D. O. Akinyele

HOD's SIGNATURE

TIME ALLOWED: 3 HRS

INSTRUCTIONS:

1. ATTEMPT ANY **FIVE** QUESTIONS OF YOUR CHOICE
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE **NOT** ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS DURING THE EXAMINATION.
4. STATE CLEARLY THE COMBINED STOPPING CONDITIONS USED IN YOUR SOLUTIONS

Question #1

(a) Draw the graph of a periodic function defined by:

$$f(x) = \begin{cases} 5, & 0 < x < 5 \\ 0, & 5 < x < 7 \end{cases}$$

$$f(x+7) = f(x)$$ **(2 marks)**

(b) With appropriate mathematical expressions, state the condition for two functions to be orthogonal. **(2 marks)**

(c) Test if the following functions are orthogonal:

(i) $f(x) = \cos mx$ and $g(x) = \cos nx$ **(4 marks)**

(ii) $f(x) = \cos mx$ and $g(x) = \sin nx$ **(4 marks)**

Question #2

Let $f(x)$ be a function of period 2π such that: $f(x) = x$ is in the range $-\pi < x < \pi$.

(a) Sketch a graph of $f(x)$ in the interval $-3\pi < x < 3\pi$ **(1 mark)**

(b) Show that the Fourier series for $f(x)$ in the range $-\pi < x < \pi$ is given by:

$$2\left(\text{Sin}\, x - \frac{1}{2}\text{Sin}\, 2x + \frac{1}{3}\text{Sin}\, 3x - .....\right)$$ **(9 marks)**

(c) By giving an appropriate value to x, show that:

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + ...$$ **(2 marks)**

Question #3

Determine the power series solution of the ordinary differential equation:

$$\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} + y = 0$$

using the Leibnitz-Maclaurin method, given that at $x = 0, y = 1$ and $\frac{dy}{dx} = 2$ **(12 marks)**

Question #4

(a) Find the 6th derivative of the following:

(i) $y = \cosh 2x$ **(2 marks)**

(ii) $y = 2ln3\Phi$ **(2 marks)**

(b) Determine the power series solution of the Legendre equation:

$$(1 - x^2)y'' - 2xy' + k(k+1)y = 0,$$

when (i) $k = 0$ (ii) $k = 2$, up to and including the term in x^5. **(8 marks)**

Question #5

(a) Find the power series solution of the Bessel function:

$$x^2y'' + xy' + (x^2 - v^2)y = 0\,,$$

in terms of the Bessel function $J_3(x)$. Give the answer up to and including the term in x^4. **(4 marks)**

(b) Evaluate the Bessel functions:

(i) $J_0(x)$ **(5.5 marks)**

(ii) $J_1(x)$, correct to 3 decimal places. **(2.5 marks)**

Question #6

(a) Determine the dot and cross products of the two vectors:

$A = 2i - 3j + 4k$ and $B = i + 2j + 5k$. **(6 marks)**

(b) If $\Phi = x^2yz^3 + xy^2z^2$, determine grad Φ at the point (1, 3, 2). **(4 marks)**

(c) (i) State the condition for a vector to be solenoidal. **(0.5 mark)**

(ii) Determine **div** A of the vector $A = 2x^2yi - 2(xy^2 + y^3z)j + 3y^2z^2k$ **(1.5 marks)**

Question #7

(a) If $= (y^4 - x^2z^2)i + (x^2 + y^2)j - x^2yzk$, find **curl** B at the point (1, 3, -2). **(5 marks)**

(b) Evaluate the line integral of the point V along a curve having parametric equations $x = 3u; = 2u^2$; $z = u^3$ between **A** (0, 0, 0) and **B** (3, 2, 1). **(7 marks)**