FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

DEPARTMENT OF CHEMICAL ENGINEERING

2018/2019 HARMATTAN SEMESTER ENG 307 - ENGINEERING MATHEMATICS I TEST

INSTRUCTION: ANSWER ALL QUESTIONS; TIME ALLOWED: 1HOURS; DATE: WEDNESDAY APRIL 17, 2019

1) If $h = f(u,v,w) = uv + uw + vw$ where $u = y^2, v = x^2 + 2xy$ and $w = x^2 - 2xy$. Using the chain rule obtain a) $\frac{\partial h}{\partial x}$ and b) $\frac{\partial h}{\partial y}$ (5 marks).

2) Using the Power Series Method, compute the first 5 f_n of the following Z-transform: $F(z) = \frac{0.09z^2 + 0.9z + 0.09}{12.6z^2 - 24z + 11.4}$ (5 marks).

3) Use your knowledge of Gamma and Beta functions to determine this integral $I = \int_0^1 x^5 (2 - x)^4 \, dx$ (5 marks).

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2018/2019 HARMATTAN SEMESTER EXAMINATIONS; ENG 307 - ENGINEERING MATHEMATICS I

INSTRUCTION: ANSWER ANY FIVE QUESTIONS; TIME ALLOWED: THREE (3)HOURS; DATE: June 06, 2019

QUESTION 1a) Find the differential equation of the two-parameter family of conics $ax^2 + by^2 = 1$ where a and b are arbitrary constants. *(10 Marks)*. **1b)** Check exactness and then solve the differential equation $(y^2 - 2xy + 6x)dx - (x^2 - 2xy + 2)dy = 0$ *(10 Marks)*.

QUESTION 2a) Express the following in 'straight line' form and state the variables to be plotted on the x- and y-axes to give a straight line. i) $y = ax^n$, ii) $y = x + Ae^{kx}$ iii) $y = \frac{A}{B + x}$ iv) $x^2(y^2 - 1) = k$ *(8 Marks)*.

2b) The current, I milliamperes, in a circuit is measured for various values of applied voltage V volts. If the law connecting I and V is $I = aV^n$, where a and n are constants, apply the method of least squares to obtain the values of a and n that give the best fit to the given set of values. *(12 Marks)*.

V	8	12	15	20	28	36
I	41.1	55.6	65.8	81.6	105	127

QUESTION 3) Using your knowledge Gamma and Beta functions evaluate the following integrals: a) $\int_0^{1/2} x^4(1 - 2x)^3 dx$ *(10 Marks)*.

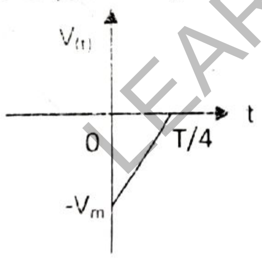
b) $\int_0^{1/\sqrt{2}} x^2\sqrt{(1 - 2x^2)}dx$ *(10 Marks)* given that gamma 3/2 and 3 are $\frac{\sqrt{\pi}}{2}$ *and* 2.0, respectively.

QUESTION 4 The periodic function $v(t)$ shown below is odd and has both half-wave and quarter-wave symmetry.

a) Sketch one full cycle of the function over the interval $-\frac{T}{4} \le t \le \frac{3T}{4}$, and also two full cycles of $f(t)$ over the interval $-\frac{T}{2} \le t \le \frac{3T}{2}$ given that $f(t) = \frac{dv(t)}{dt}$. *(5 marks)*

b) Find the Fourier series for $f(t)$ expressing the series in the alternative trigonometric form. *(10 marks)*

c) Estimate the *rms* value of $f(t)$ using the first five non zero terms in its Fourier series representation. [Take $\frac{V_m}{T} = 0.125$] *(5 marks)*



QUESTION 5:

(a) Enumerate the 4 steps that should be employed in the use of Laplace Transforms for solution of Ordinary Constant Coefficient Linear Differential equations. *(6 Marks)*

(b) Using Laplace Transforms, solve the Engineering system represented by the following set of Ordinary Differential Equation

$$2x' + y = Cos(t), and\ y' - 2x = Sin(t)$$

subject to the initial conditions $x(0) = 0, and\ y(0) = 1$. *(14 Marks)*

QUESTION 6:

(a) Find and classify the stationary points of: $g(x, y) = \frac{1}{2}x^2y - 2xy + \frac{2}{3}y^3$. *(8 marks)*

(b) Find the maximum and minimum values of: $f(x, y) = xy^2$ subject to the circular constraint: $x^2 + y^2 = 1$, using Lagrange multiplier. *(6 marks)*

(c) Find the absolute error in: $V = \sqrt{\frac{3x}{y}}$ due to error of 0.01 in x and 0.03 in y at (x, y) = (1, 2) and compare his with the actual error. *(6 marks)*