CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN APPLIED MATHEMATICS

MATH 831: METHODS OF APPLIED MATHS I

STREAMS: BED (ARTS) **TIME: 3 HOURS**

DAY/DATE: FRIDAY 09/08/2019 **8.30 AM – 11.30 AM**

INSTRUCTIONS:

- **Answer any Four Questions**
- **Adhere to the instructions on the answer booklet**

QUESTION ONE

(a) Find the regular singular points of the differential equation

$x^2(x-2)^2y'' + 2(x-2)y' + (x+3)y = 0$ [6 marks]

(b) Solve in series

(i) $y'' + y = 0$ [3 marks]

(ii) $x(x-1)y'' + (3x-1)y' + y - 0$ about the point $x = 0$ [5 marks]

QUESTION TWO

(a) Given the function $x_n = 3n^2 - 7n + 8$, show that as $n \to \infty$,

(i) $x_n = 0(n^3)$ [2 marks]
(ii) $x_n = \theta(n^2)$ [2 marks]
(iii) $x_n \sim 3n^2$ [2 marks]

(b) Solve the perturbation problem $P(\varepsilon)$: $f(x,\varepsilon) = x^2 + \varepsilon x - 1 = 0$ for $0 < \varepsilon \ll 1$ by binomial theorem. [5 marks]

(c) Prove that $\sum_{ilm} = 2\delta ij$ where ε is the alternate tensor δ is the Kronecker tensor. [4 marks]

Question Three

(a) Determine the poles and the residue at each pole of the function

$f(t) = \frac{Z^2}{(z-1)^2(z+2)}$ [5 marks]

(b) Evaluate $\int_0^{2\pi} \frac{d\theta}{2+cos\theta}$ by contour integration in the complex plane. [8 marks]

(c) Given that $f(t) = 5t^2 = 5t^2 + t + 3$

Show that as $t \to \infty$

(i) $f(t) = 0(t^3)$ [1 mark]

(ii) $f(t) \sim 5t^2$ [1 mark]

QUESTION FOUR

(a) Evaluate by the method of complex variables the integral

$\int_{-\infty}^{\infty} \frac{x^2 dx}{(x^2+1)(x^2+4)}$ [4 marks]

(b) Expand $f(t) = \frac{1}{(t-1)(t-2)}$ for $1 < |2| < 2$ [7 marks]

QUESTION FIVE

(a) Given the differential equation

$xy'' + y' + x^2 y = 0$, obtain

(i) Recurrence relation [3 marks]

(ii) Indicial equation about $x = 0$ [3 marks]

(b) Find the power series solution of $(1 - x^2)y'' - 2xy' + 2y = 0$ about $x = 0$ [7 marks]

(c) Prove that $\sum_{ijk} \sum_{ijk} = 6$ [2 marks]

Where ε →alternate tensor

δ → Kronecker tensor
