UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

END OF SEMESTER II EXAMINATIONS

DEPARTMENT	:	**ICT**
YEAR	:	**ONE**
SEMESTER	:	**TWO**
PROGRAM	:	**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING**
	:	**DIPLOMA IN ELECTRONIC COMMUNICATION ENGINEERING**
COURSE	:	**ENGINEERING MATHEMATICS II**
COURSE CODE	:	**EMT121**
DATE	:	**SATURDAY, JUNE 29, 2024**
TIME	:	**09:00 AM – 12:00 NOON**
DURATION	:	**3 Hours**

INSTRUCTIONS

- The paper consists of two Sections A and B
- Answer **ALL** questions in Section A and **ANY THREE** questions in Section B
- Credit will be given to relevant examples and illustrations
- Don Not Write anything on this question paper

SECTION A [40 MARKS]
Attempt ALL the Questions in this Section.
Question 1

(a) On the same polar grid using arrows, show that the points $A\left(2, \frac{\pi}{3}\right)$ and

$\mathrm{B}\left(-2, \frac{4\pi}{3}\right)$ are equivalent. **(2 marks)**

(b) Convert:

(i) Cartesian $x^2 = 2y$ to polar

(ii) Polar $r = 4cos^2\theta$ to Cartesian **(6 marks)**

(c) A parabola has equation $9x^2 - 8x - y + 1 = 0$.

(i) Put the equation in standard form.
(ii) Find its centre, eccentricity and foci. **(8 marks)**

(d) The third term of arithmetic sequence is 14 and its fifth term is 24. Find:
(i) its first term a and common difference d.
(ii) the sum of the first 20 terms. **(6 marks)**

(e) Find the general solutions of the differential equations:

(i) $\frac{dy}{dx} = ye^x$ (ii) $\frac{dy}{dx} + y = e^x$ **(6 marks)**

(f) A frequency distribution of ages of 200 of students in a selected Kampala school is shown in table below:

Age	14	16	18	28	22
Frequency	10	40	80	50	20

(i) Find the mode and median of the ages.
(ii) Determine mean age using coding method. **(6 marks)**

(g) A random variable X has a binomial distribution X~B(6, 0.25). Calculate:

(i) P(X = 4) (ii) P(3 ≥X> 5) **(6 marks)**

SECTION B [60 MARKS]
Attempt only Three Questions in this Section.
Question 2

(a) An ellipse has equation

$$\frac{(y+2)^2}{9} + \frac{(x-3)^2}{4} = 1$$

(i) Determine its centre, eccentricity and foci.
(ii) Sketch the ellipse. **(6 marks)**

(b) A conic has equation $y^2 - 5x^2 + 4y + 30x - 46 = 0$.

(i) Put the equation in standard form.
(ii) Find its centre, eccentricity and foci. **(7 marks)**

(c) A conic has polar equation $r = \frac{4}{2-5cos\theta}$

(i) Put the equation in standard form.

(ii) Determine its eccentricity, the type of conic and its directrix.

(iii) Plot the conic on polar grid. **(7 marks)**

Question 3

(a) Evaluate the series

$$\sum_{n=1}^{6}(3n^2-2)$$

(2 marks)

(b) Geometric sequence has first term a and common ratio $r < 1$.
Determine the nth term a_n and the sum to infinity S_∞. **(6 marks)**

(c) A series is given as:
$\frac{1}{2}+\frac{1}{4}+\frac{1}{6}+\cdots$

(i) Write the series in sigma notation.
(ii) Use divergence test on the series. **(4 marks)**

(d) A series is given as:

$$\sum_{n=0}^{\infty}\frac{n!}{5^n}$$

Use ratio test on the series. **(4 marks)**

(e) (i) Express $\frac{1}{2x-1}$ as sum of power series.

(ii) State the range for validity. **(4 marks)**

Question 4

(a) Find the general solution of the differential equations:

(i) $\frac{dy}{dx} = ycosx$ (ii) $\frac{dy}{dx} = e^x$ **(6 marks)**

(b) Find the particular solution of the differential equations:

(i) $\frac{dy}{dx} = 2xy; y(0) = 1$ (ii) $x\frac{dy}{dx} - y = x^2; y(1) = 0$ **(8 marks)**

(c) Find the general solution of the differential equations:

(i) $y'' + y' - 6y = 0$ (ii) $y'' - 4y' + 4y = 0$ **(6 marks)**

Question 5

(a) A frequency distribution of marks of 20 students is shown in the table below:

Marks	20-29	30-39	40-49	50-59	60-69
Frequency	2	3	8	6	1

(b) Construct:

(i) a cumulative frequency curve and use it to determine median mark.

(ii) a histogram and use it to determine modal mark. **(10 marks)**

(c) The coursework marks in Engineering Mathematics for DEEE and DECE programs at UICT are normally distributed with mean 24 and standard deviation 4. Find the probability that a student scored a mark:

(i) greater than 30

(ii) between 25 and 35 **(10 marks)**

Question 6

(a) Write expression for $f(-x)$ given $f(x)$ is:
(i) even (ii) odd **(2 marks)**

(b) Show whether the function is even or odd:
(i) $f(x) = x^2$ (ii) $f(x) = sinx$ **(4 marks)**

(c) A periodic function is given as

$$f(x) = \begin{cases} 0, & -1 < x \leq 0 \\ 1, & 0 < x \leq 1 \end{cases}$$

(i) Sketch the function.
(ii) Determine its period.
(iii) State whether it is even or odd. **(6 marks)**

(d) A periodic function is given as:

$$f(x) = \begin{cases} 0, & -\pi \leq x \leq 0 \\ 1, & 0 < x \leq \pi \end{cases}$$

Determine its Fourier Series. **(8 marks)**

Hint:

Fourier Series formula is given as:

$$f(x) = \frac{1}{2}a_0 + \sum_{n=1}^{\infty} a_n cosnx + \sum_{n=1}^{\infty} b_n sinx$$

Where,

$$a_0 = \frac{1}{n}\int_{-\pi}^{\pi} f(x)dx, \quad a_n = \frac{1}{n}\int_{-\pi}^{\pi} f(x)cosnxdx\ ,\ b_n = \frac{1}{n}\int_{-\pi}^{\pi} f(x)sinnxdx$$

END