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MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

(MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA IN INFORMATION TECHNOLOGY AND BUSINESS INFORMATION

COURSE CODE: DIT 063

COURSE TITLE: BASIC MATHEMATICS

DATE: 12/04/2023 **TIME: 2:00-4:00PM**

INSTRUCTIONS TO CANDIDATES

- Answer questions in section A and any TWO questions in section B.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This paper has 3 printed pages PLEASE turn over

SECTION A: Answer all questions (30 Marks)

QUESTION ONE

a) If $\tan\theta = \frac{3}{4}$ and $\cos\theta = \frac{1}{2}$, find $\sin\theta$ (3mks)

b) Find the sum of geometric series $9, 3, 1, \ldots, \frac{1}{6561}$ (4mks)

c) The volume of the closed cylindrical tank is 30 cubic meters. If the total surface area is a minimum, what is its base radius, in m? (6mks)

d) Evaluate $\lim_{x \to -3} \frac{\sqrt{2x+22}-4}{x+3}$ if it exists (4mks)

e) Find the integral of $x + \frac{2}{3}x^2 + 9x^{-1} + 0.5$ (2mks)

f) Proof that the quadratic formula is given by $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ (4mks)

g) Find y' given $y = (4x + x^{-1})^{\frac{1}{3}}$ (4mks)

h) Show that $|A \cup B| = |A| + |B| - |A \cap B|$ (3mks)

SECTION B: Answer any two questions (40 marks)

QUESTION TWO

a) Find the fourth derivative of $f(x) = x + 36x^3 + 29x^5$ (3mks)

b) A computer company has realized that its annual profit (P) is given by the equation $P = -134x - \frac{7}{2}y^2 + 2.5 + \frac{9}{2}x^2 - 48y + 8xy$. Determine the maximum value of x and y that will maximize the profit. Hence find the maximum profit. (8mks)

c) Given that A is a singular matrix where $A = \begin{pmatrix} x & -2 \\ 1 & x+2 \end{pmatrix}$ determine the value of x using quadratic formula (6mks)

d) Find AB if $A = \begin{pmatrix} 1 & 3 & 6 \\ 4 & 1 & 0 \\ 1 & 2 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 0 & 0 \\ 3 & 2 & 2 \\ 0 & 1 & -1 \end{pmatrix}$ (3mks)

QUESTION THREE

a) Find the maximum point of x in the expression $x^3 + 2x^2 - 4x + 2$ (4mks)

b) Differentiate the following $y = (x^2 + x + 1)^2$ (4mks)

c) Proof that Pythagoras theorem is given by $b^2 = a^2 + c^2$ (3mks)

d) Solve the equation and find all the solutions for $0 \leq \Theta \leq 2\pi$

i) $\tan\theta = 2\sin\theta$ (3mks)

ii) $1 + \sin\theta = 2\cos^2\theta$ (4mks)

e) Show that $\tan\theta + \cot\theta = \frac{1}{\sin\theta\cos\theta}$ (2mks)

QUESTION FOUR

a) Find the inverse of the following matrix (7mks)

$$A = \begin{pmatrix} -1 & 0 & 2 \\ 0 & 4 & 7 \\ 3 & -4 & -2 \end{pmatrix}$$

Hence solve the following system of linear simultaneous equations using matrix method (3mks)

$-x + 2z = 3$

$4y + 7z = 4$

$3x - 4y - 2z = 8$

b) In a class of 1000 students, let M, P and C be sets of students doing Mathematics, Physics and Computer courses respectively. Assume $|M| = 300$, $|P| = 350$, $|C| = 450$, $|M \cap P| = 100$, $|M \cap C| = 150$, $|P \cap C| = 75$,

i) Represent this information on a Venn diagram (2mks)

ii) How many students do all three courses (3mks)

iii) How many students do Mathematics and Physics but not Computer courses (2mks)

iv) How many students do only two courses (3mks)

QUESTION FIVE

a) If $y = 0$ and $y = 9x^2 - 6x + 1$ find the value of x (3mks)

b) Evaluate $\lim_{x \to -5} \frac{x^2-25}{x^2+2x-15}$, if it exists (4mks)

c) Find all eigenvalues and corresponding eigenvectors for the matrix A if (10mks)

$$A = \begin{pmatrix} 2 & -3 & 0 \\ 2 & -5 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

d) Write down the 11th term of a geometric progression $\frac{1}{3}, \frac{1}{6}, \frac{1}{12}, \ldots$ (3mks)