

MAKERERE UNIVERSITY JINJA CAMPUS

UBTEB Technical Programs

**PROGRAM: NATIONAL DIPLOMA IN INFORMATION AND COMMUNICATION
TECHNOLOGY**

SEMESTER ONE 2019/2020 INTAKE

MODULE NAME: COMPUTATIONAL MATHEMATICS

MODULE CODE: TDIT 112

Mock Examination

DATE: Saturday, November 23, 2019

TIME: 09:00 hours – 12:00 hours

INSTRUCTIONS TO CANDIDATES:

*This paper consists of **eight** questions. All questions carry **equal** marks.*

*Attempt any **five** questions of your choice. Any additional question(s) answered **will not** be marked.*

*All working must be shown **neatly and clearly** in the answer booklet provided. Therefore no extra answer sheet will be given for **rough work**.*

*Start answering each question on a **fresh page**.*

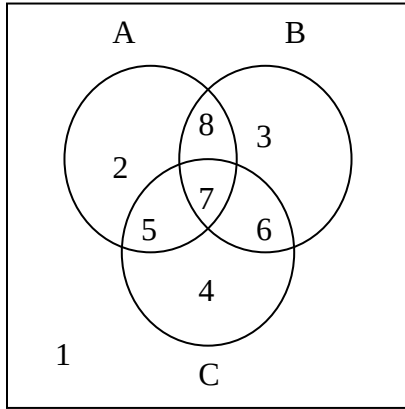
*Silent, non-programmable calculators may be used. Mobile Phones are **prohibited**.*

Graph paper is provided.

Attempt any **five** questions of your choice.

QUESTION 1: SET THEORY

(a) Refer to the diagram to answer the questions below.



What set notation would you use to represent the following regions?

- i) Region 7 only: (1 mark)
- iii) Regions 1 and 4: (1 mark)
- iii) Region 1 only: (1 mark)
- iv) Regions 4, 5, 6, 7 & 8 (1 mark)

(b) Given that set $U = \{1, 2, 3, 4, 5, 6, 7\}$ $S = \{2, 4, 5\}$ $T = \{3, 5, 7\}$
 $V = \{2, 3, 4, 5, 7\}$ $W = \{1, 2, 3, 4, 6\}$, Find $(S \cap V)' \cup (W' \cup T)$ (4 marks)

(c) Let A, B and C be sets. Using set identities or otherwise, show that
 (i) $(A - C) \cap (C - B) = \emptyset$ (4 marks)
 (ii) $(B - A) \cup (C - A) = (B \cup C) - A$ (4 marks)

(d) A survey of used car salesmen revealed the following information:
 24 wear white patent-leather shoes, 28 wear plaid trousers, 20 wear both of these things
 2 wear neither of these things,

- (i). How many were surveyed? (2 marks)
- (ii). How many wear plaid trousers but don't wear white patent-leather shoes? (2 marks)

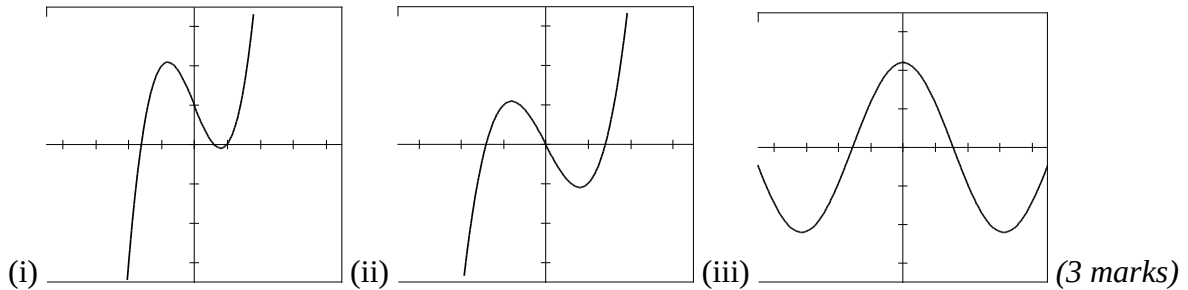
QUESTION 2: RELATIONS, FUNCTIONS AND GRAPHS

- (a) Make a mapping diagram for the relation $\{(-3, 1), (0, 6), (3, 2), (5, -1)\}$ and determine whether it is a function. (5 marks)
- (b) Federal income tax is calculated an individual's annual income. Tax for an annual income of up to \$63,550 is given by the piecewise function below, where T and x are both in

dollars. Use this function to calculate the tax for the incomes given.

$$T(x) = \begin{cases} .10x & 0 \leq x \leq 6000 \\ 600 + .15(x - 6000) & 6000 < x \leq 26,250 \\ 3637.50 + .27(x - 26,250) & 26,250 < x \leq 63,550 \end{cases}$$

- An annual income of \$5200 (2 marks)
- An annual income of \$22,500 (2 marks)
- Determine whether the graphs represent an odd function, an even function, or neither.



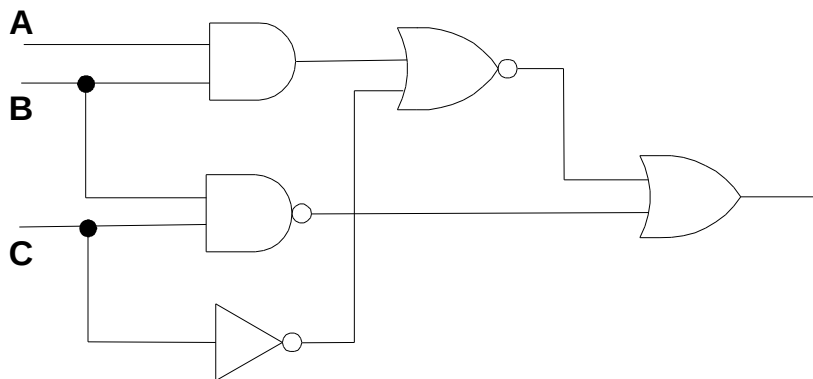
- Find the inverse of the function $f(x) = \sqrt{x} + 1$ and evaluate $f^{-1}f^{-1}(3)$. (4 marks)
- Specialty t-shirts are being sold online for 15000 each, plus a constant one-time handling fee of 10000.. The total cost, $t(x)$, is a function of the number of t-shirts bought, x .
 - What function rule models the cost of the t-shirts $t(x)$ in terms of x ? (2 marks)
 - Evaluate the function for 3 t-shirts. (2 marks)

QUESTION 3: BOOLEAN ALGEBRA AND COMPLEX NUMBERS

(a) Simplify the following equation using the laws and theorems of Boolean algebra:

- $(B+AA)(A+B')$ (2 marks)
- $A'(A+B) (B+AA)(A+B')$ (3 marks)

(b) Show the behavior of the following logic circuit with a truth table:



(6 marks)

- (c) Draw a switching circuit equivalent to the logic circuit in (b) above. (4 marks)
- (d) Given the following equation involving complex numbers:
 $(1 + i)(x + iy) = -2 + i$, where $x, y \in \mathbf{R}$, determine the values of x and y . (5 marks)

QUESTION 4: INDICES AND SURDS

- (a) If $x = 3^P$ and $y = 3^Q$, Express in terms of x and/or y :

- (i) 3^{p-q}
 (ii) 3^{2p}
 (iii) 3^{q+2}

(3 marks)

- (b) Solve the following equation to obtain the value of a :

$$\frac{x \times x^4 \times x^a}{\sqrt{x}} = \sqrt{\frac{(x^a)^8}{\left(\frac{1}{x^4}\right)}}$$

(5 marks)

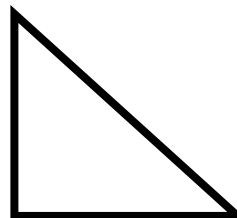
- c) Express $\frac{2}{2-\sqrt{3}}$ in the form $k + a\sqrt{b}$ where k, a and b are positive integers. (4 marks)

The diagram shows a right-angled isosceles triangle.

The length of each of its equal sides is $\frac{2}{2-\sqrt{3}}$ cm.

Find

- (i) the area of the triangle. (4 marks)
 (ii) the length of the hypotenuse of the triangle. (4 marks)



QUESTION 5: MATRICES AND SYSTEMS OF LINEAR EQUATIONS

- (a) Show that $\begin{vmatrix} 5-a & 2 & 1 \\ 2 & 1-a & 0 \\ 1 & 0 & 1-a \end{vmatrix} = a(1-a)(a-6)$ hence determine all possible values of a .

(8 marks)

- (b) Use Matrices to solve the following system of linear equations:

$$\begin{cases} x - 2y = 6 - 4z \\ x + 13z = 6 - y \\ -2x + 6y - z = -1 \end{cases}$$

(7 marks)

- (c) A used book store also started selling used CDs and videos. In the first week, the store sold a combination of 40 CDs and videos. They charged \$4 per CD and \$6 per video and the total sales were \$180. Determine the total number of CDs and videos sold. (5 marks)

QUESTION 5: PROBABILITY THEORY

(a) Consider a fair 6 sided dice where one side is labeled 1, one side is labeled 5, and the others are all labeled 0. The die is rolled twice. The events of the experiment, A, B, and C are as follows: $A = \{\text{The first die is a 1}\}$, $B = \{\text{The first die is a 5}\}$, $C = \{\text{The second die is a 0}\}$

- i. What is the sample space for this experiment? (2 marks)
- ii. Use a tree diagram to determine the probability associated with each of the sample points (5 marks)
- iii. Find the probability of A, B, and C? (3 marks)
- iv. Find $P(A \cup B)$ and $P(A \cap B)$ (2 marks)
- v. Are the events A and B independent, mutually exclusive, or dependent in some other way? (1 mark)

(b) What is the probability of drawing a king and a queen consecutively from a deck of 52 cards, without replacement? (3 marks)

In a class, 25% of the students study both math and science. 60% of the students study math. What is the probability of

- (i) a student studying science given he/she studies math? (2 marks)
- (ii) a student studying math given he/she studies science? (2 marks)

QUESTION 7: PERMUTATIONS AND COMBINATIONS

(a) A club has 20 members.

- (i) In how many different ways could the club choose any three members to be part of the executive committee? (3 marks)
- (ii) In how many different ways could the club choose specific members to fill positions of a president, vice-president, and secretary? (3 marks)

b) Suppose that you have 12 books that are all different from each other.

- (i) If you want to arrange all the books in a row on a shelf, in how many different orders could the books be placed? (3 marks)

(ii) You've decided to let a friend borrow 3 of your 12 books. How many different ways could your friend decide which books to borrow? (3 marks)

c) A restaurant asks to you fill out a customer satisfaction survey. It looks like this:

quality of food	excellent	good	fair	poor
taste of food	excellent	good	fair	poor
variety of food	excellent	good	fair	poor
promptness of service	excellent	good	fair	poor
friendliness of service	excellent	good	fair	poor
restaurant decor	excellent	good	fair	poor
wait time for a table	excellent	good	fair	poor

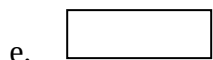
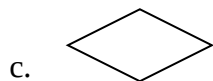
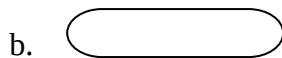
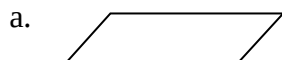
Suppose that you circle one response (excellent/good/fair/poor) for each item.

How many different ways are there to fill out the survey? (4 marks)

d) If you are dealt a hand of five cards from a standard deck of 52 cards, what is the probability that your hand contains four aces? (4 marks)

QUESTION 8: FLOW CHARTS AND DRY RUNS

(a) The following are some symbols used in flowcharts.



Name each symbol and give its purpose.

(6 marks)

- (b) A school uses a simple computerized system to manage students' results. The school administers three examinations namely; beginning of term (BOT), middle of term (MOT) and end of term (EOT). The systems administrator has set the system to get the total of the three examinations and find the average which is used to promote the students to the next class. If the average mark is greater than 70, the student is promoted. If the average mark is from 50 to 70, the student repeats. If the average is below 50 the student is dismissed.
- (a) Draw a flow chart for a program that will capture the student's names and results, compute the average and promote / dismiss the students based on the average. (8 marks)
- (b) Perform a dry run for the following students results:

NAME	BOT	MOT	EOT
ABUR WILLIAM	71	94	96
ISABIRYE NICHOLAS	86	78	93
KATALO ABUBAKER	86	50	97
MASIA BRIDGET BRENDA	86	55	67
TWASIKI JORDAN	71	90	60
SALMA JOSEPHINE	14	1	0

(6 marks)