

UGANDA MARTYRS UNIVERSITY, NKOZI

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

(Bachelor of Science Economics, Financial Mathematics, Bachelor of Science General,
Bachelor of science information Technology)

MTC1101 ELEMENTS OF MATHEMATICS

YEAR 2013/2014

DATE: 13th DEC 2014

TIME: 10 : 00 AM – 1 : 00 PM

Instructions

- (i) *Answer five questions only. Only the first five questions attempted will be marked*
- (ii) *Read carefully the instructions on the answer booklet*
- (iii) *Neat work is highly recommended*
- (iv) *Do not write anything on this question paper*

Question 1

- (a) Define the term tautology (2 marks)
- (b) Use truth tables to check whether the following are tautologies $\sim (p \vee q) \Leftrightarrow (\sim p \wedge \sim q)$ (6marks)
- (c) Classify the following sentences as propositions or not
- (i) Every mathematics student can be able to do other subjects ~~3 + 2 = 8~~ (2 marks)
- (ii) John works in a bank (2 marks)
- (d) Translate the following into formulas of L_p
- (i) John will come and wait or Peter will wait (2 marks)
- (ii) Yesterday was cloudy but today will either be clear or rainy
- (iii) If and only if yesterday was cloudy, will today be clear 3 marks)
- (iv) If either Man United or Newcastle and Everton win, then Arsenal will be out of the first place and moreover Godwin will lose the bet (3 marks)

Question 2

- (a) Define the following;
- (i) a set (2 marks)
- (ii) a subset of a set (2 marks)
- (iii) State two ways of describing a set. (2 marks)
- (iv) Cardinality of a set (2 marks)
- b(i) Define a power set of a set. (1mark)
- (ii) Given set $A = (a, b, c, d)$, state the power set of A hence lists all subsets of A (4 marks)

(c) Rewrite the following statements using set notation

(i) R is a subset of M (01 marks)

(ii) S is a proper subset of set E (01 marks)

(iii) M does not include D (01 marks)

(d) In a BSC 1 class, all 97 students take elements of mathematics, 38 take Calculus 1, 30 take computer science and ²⁹~~24~~ take linear algebra. Of those taking three subjects, ²⁴~~18~~ take computer science and linear algebra, ²⁵ take calculus 1 and ~~elements of mathematics~~, and ²²~~12~~ take Computer science and ~~linear algebra~~ ^{calc 1}. Only 20 students take all the four subjects. How many students take only calculus 1? (4 marks)

Question 3

(a) Define the following terms

(i) Permutation (2 marks)

(ii) combination (2 marks)

(b) How many ways can you arrange 2 letters from the five MATHS. (4 marks)

c(i) How many numbers greater than 40000 can be formed from the digits 2,3,4,5,6 if each digit is used once? (4 marks)

(ii) How many of these end with 2? (4 marks)

(d) Find the value of a in $5C_3 = aC_2 - 5$. (4 marks)

Question 4

(a) Find the determinant of the following matrices

(i) $A = \begin{pmatrix} 9 & 2 \\ 8 & 4 \end{pmatrix}$ (02 marks)

$$(ii) \mathbf{B} = \begin{pmatrix} -3 & 5 \\ -6 & -1 \end{pmatrix} \quad (02 \text{ marks})$$

(b) Find the inverse of the following matrices

$$(i) \mathbf{M} = \begin{pmatrix} 7 & 4 \\ 5 & 3 \end{pmatrix} \quad (03 \text{ marks})$$

$$(ii) \mathbf{N} = \begin{pmatrix} 8 & -2 \\ -11 & 3 \end{pmatrix} \quad (03 \text{ marks})$$

$$(c) \text{ Given that } \mathbf{P} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 1 & 0 & -1 \end{pmatrix}, \mathbf{Q} = \begin{pmatrix} 2 & 1 & 0 \\ 3 & -1 & 4 \\ 1 & 0 & 7 \end{pmatrix}$$

Evaluate the following

$$(i) 4\mathbf{P} + \mathbf{Q} \quad (05 \text{ marks})$$

$$(ii) \mathbf{PQ} \quad (05 \text{ marks})$$

Question 5

(a) Define the following terms and give examples;

(i) Function (2marks)

(ii) Domain (2 marks)

(b) Given that $f(x) = 3x^2 - 5x + 1$ and $g(x) = 5x + 2$

Evaluate the following;

$$(i) f(-3) \quad (02 \text{ marks})$$

$$(ii) g(4) \quad (02 \text{ marks})$$

(iii) $f(g(x))$ (04 marks)

(iv) $g \circ f(2)$ (04 marks)

(c) Determine whether f is odd or even.

(i) $f(x) = x^2 + x$ (2 marks)

(ii) $f(x) = 2x^4 + x^2$ (2 marks)

Question 6

a(i) Express $\frac{-1+2i}{1+3i}$ in the form $a + bi$. (4 marks)

(ii) Represent (i) above on an argand diagram, hence find the complex conjugate (5 marks)

(b) Find the values of a and b given that $(a + ib)(2 - i) = a + 3i$ (5 marks)

(c) Given that $\frac{5}{x+iy} + \frac{2}{1+3i} = 1$, where x and y are real, find x and y (6 marks)

Question 7

Construct the truth table for the following

(i) $[p \wedge (\sim q \rightarrow p)]$ (03 marks)

(ii) $\sim [(p \leftrightarrow \sim q) \rightarrow (q \vee \sim p)]$ (03 marks)

(iii) $(p \leftrightarrow q) \vee r$ (03 marks)

(iv) $\sim (p \wedge q) \rightarrow (p \vee q)$ (03 marks)

(v) $[p \rightarrow (\sim q \vee r)] \wedge \sim [q \vee (p \leftrightarrow \sim r)]$ (08 marks)