Higher National Diploma in Information Technology

First Year, First Semester Examination – 2018

HNDIT 1107 – Mathematics for IT

Instructions for Candidates:
Answer four (04) questions only.
All questions carry equal marks.

No. of questions : 05
No. of pages : 03
Time : Two (02) hours

01.

(i). Define the following terms and give an example for each of them.

a) Set
b) Finite set
c) Cardinality of a set
a) Complement of a set (08 Marks)

(ii). State whether each statement given below is true or false, if false correct it.

b) The empty set is a subset of every set.
c) $A' \cap B' = (A \cap B)'$
d) If set F = {1, 2, 3} and set G = {2, 3, 1} then $F \subset G$.
e) If T and L are two disjoint sets, $n(T \cup L) = n(T) + n(L)$. (08 Marks)

(iii). Let U = {1, 2, 3, …., 20}

$A = \{ x : x \in N, 3 < x < 12 \}$
$B = \{ x : x \in N, x \text{ is even}, x < 15 \}$
$C = \{ x : x \in N, 4 - x = 3 \}$

Find elements :

a) $A^c \cap (B \cup C)$ (02 Marks)
b) $A \cup (B - C)$ (02 Marks)
c) $(A \oplus B) \oplus C$ (02 Marks)
d) $P(A \cap B)$ (03 Marks)

(Total 25 Marks)

02.

(i). There were 100 students in the library who responded to how they completed their research paper.

18 students only used the periodicals
29 students used the web and books
15 students used books, the web, and periodicals
40 students used books and periodicals
20 used the web and periodicals

60 students used books
7 students did not use the web, nor books, nor the periodicals.

a) Represent the above information with a Venn diagram. (05 Marks)
b) How many students used the web in their research? (02 Marks)
c) How many students used books and periodicals? (02 Marks)

(ii). Let A = {1, 2, 3, 4} and B = {5, 7, 9}. Determine
a) Is $A \times B = B \times A$? (03 Marks)
b) Is $n(A \times B) = n(B \times A)$? (03 Marks)

(iii). Write the dual of each set equation:
a) $(A \cup B) \cap (A \cup B^c) = A \cup \emptyset$
b) $(A \cap U) \cup (B \cap A) = A$ (04 Marks)

(iv). Prove the following using laws of algebra of sets.(mentioning laws)
$(A \cap B) \cup (A \cup B^c)^c = B$ (06 Marks)

(Total 25 Marks)

03.

(i). Let R be the following relation on A = {p, q, r, s}.
R = {(p, p), (r, s), (s, q), (p, r), (r, q)}
Find:
a) Domain of R. (01 Mark)
b) R^{-1} (02 Marks)
c) Matrix representation M_R of R (02 Marks)
d) The composition relation R_oR using the above M_R (04 Marks)

(ii). Consider the following relations on the set A = {1, 2, 3}.
R = {(1, 1), (1, 2), (1, 3), (3, 3)}
S = {(1, 1), (1, 2), (2, 1), (2, 2), (3, 3)}
Determine whether or not each of the above relations on A is
a) reflexive
b) symmetric
c) transitive (06 Marks)

(iii). Determine whether each set of ordered pairs is a function from A into B. If it is not a function give reasons.
a) {(a,2),(b,3),(c,2),(d,3)} Given A = {a ,b, c ,d} , B = {2,3}
b) {(1,1),(1,2),(2,3),(−3,4)} Given A = {1,2, −3}, B = {1,2,3,4}
(04 Marks)

(iv). Let f(x) = 2x+1 and $g(x) = x^2-2$.
Find the formula defining the composition functions: $g_of(x)$ and $f_og(x)$.
(06 Marks)

(Total 25 Marks)

04.

(i). Define the following matrices with examples:

a) Diagonal matrix

b) Symmetric matrix

c) Lower triangular matrix (06 Marks)

(ii). Let $A = \begin{bmatrix} 1 \\ 0 \\ 3 \end{bmatrix}$ $B = \begin{bmatrix} 4 & 0 & 1 \\ 0 & 2 & -1 \end{bmatrix}$ $D = \begin{bmatrix} 1 & 2 \end{bmatrix}$

Calculate (if possible)

a) AB (02 Marks)

b) $(DB)^T$ (03 Marks)

c) $BA + D^1$ (04 Marks)

d) B^TD^T (04 Marks)

(iii). $\begin{bmatrix} 0 & 2 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 8 \\ 25 \end{bmatrix}$

Find the value of a and the value of b. (06 Marks)

(Total 25 Marks)

05.

(i). State three (03) applications of matrices. (03 Marks)

(ii). If $A = \begin{bmatrix} 3 & 0 & 2 \\ 2 & 0 & -1 \\ 0 & 1 & 5 \end{bmatrix}$

Find:

a) adjoint of A (04 Marks)

b) determinant of A (04 Marks)

c) A^{-1} using adjoint matrix of A (04 Marks)

(iii). Use Cramer's rule to find values for x, y and z in the following system of linear equations:

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

$2x - 3y + z = -13$

$2x - 3z = -11$ (10 Marks)

(Total 25 Marks)

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1)(i) a) Set

* Set is a collection of objects. It usually write with in "{ }" seperated by ",". usually sets are denoted using capital letters X, Y, Z, ---

Ex: X = {2, 3, 5, 7}
Y = {a, e, i, o, u}
Z = {Mango, Apple, Pineapple}

b) Finite set

* In a set if number of elements can count and finish. then it's define as a finite set.

Ex: A = {1, 4, 9, 16,}
B = {10, 20, 30, 40}
C = {2, 3, 5, 7}

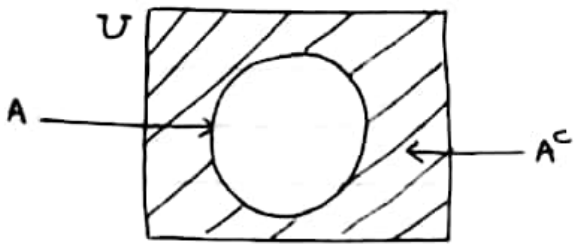
c) Cardinality of a set

Ex:(i) A = {1, 2, 3, 4}
n(A) = 4 , |A| = 4

(ii) B = {3, 6, 9, 12, 15, 18}
n(B) = 6 , |B| = 6

d) Complement of a set

* Let A be any set the element which are not in the universal set is defined as complement of A and It's denoted by A^c or A'



$A^c = \{x / x \notin A \text{ and } x \in U\}$

(ii) b) ✓

c) x

d) ✓

e) ✓

(iii) $U = \{1, 2, 3, \ldots\ldots, 20\}$

$A = \{1, 5, 6, 7, 8, 9, 10, 11\}$

$B = \{2, 4, 6, 8, 10, 12, 14\}$

$C = \{1\}$

$x = 4 - 3 = 1$

$x = 1$

a) $A^c = \{1, 2, 3, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

$B \cup C = \{1, 2, 4, 6, 8, 10, 12, 14\}$

$A^c \cap (B \cup C) = \{1, 2, 12, 14\}$ //

b) $(B - C) = \{2, 4, 6, 8, 10, 12, 14\}$

$A \cup (B - C) = \{2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14\}$

c) $(A \otimes B) = (A - B) \cup (B - A)$

$= \{5, 7, 9, 11\} \cup \{2, 12, 14\}$

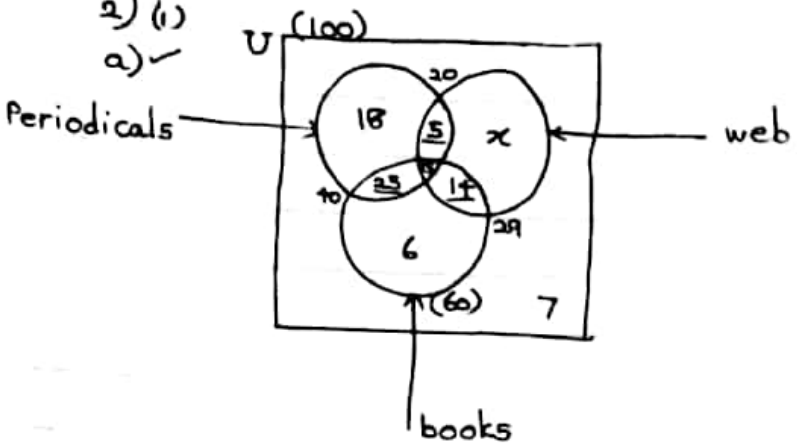
$= \{2, 5, 7, 9, 11, 12, 14\}$ //

d) $(A \cap B) = \{4, 6, 8, 10\}$

$P(A \cap B) = \{\phi, \{4\}, \{6\}, \{8\}, \{10\}, \{4,6\}, \{4,8\}, \{4,10\}, \{6,8\}, \{6,10\}, \{8,10\}, \{4,6,8\}, \{4,6,10\}, \{6,8,10\}, \{4,8,10\}, \{6,8,10\}, \{4,6,8,10\}\}$ //

2) (i)

a)



b) $60 + 18 + 5 + x + 7 = 100$

$90 + x = 100$

$x = 10$ //

to ~~students~~ used the web //

$\therefore 20 + 14 + 10 = 44$

44 students used web

c) to students used books and periodicals

(ii) a) $A = \{1, 2, 3, 4\}$, $B = \{5, 7, 9\}$

$A \times B = \{(1,5), (1,7), (1,9), (2,5), (2,7), (2,9), (3,5), (3,7), (3,9), (4,5), (4,7), (4,9)\}$

$B \times A = \{(5,1), (5,2), (5,3), (5,4), (7,1), (7,2), (7,3), (7,4), (9,1), (9,2), (9,3), (9,4)\}$

$\therefore A \times B \neq B \times A$

b) $n(A \times B) = 12$

$n(B \times A) = 12$

$\therefore n(A \times B) = n(B \times A)$ //

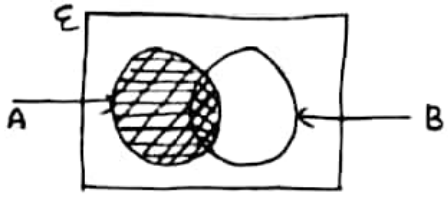
(iii) a) $(A \cup B) \cap (A \cup B^c) = ((A \cup B) \cap A) \cup ((A \cup B) \cap B^c)$

$= (A \cap (A \cup B)) \cup (B^c \cap (A \cup B))$

$= (A \cup (A \cap B)) \cup ((B^c \cap A) \cup (B^c \cap B))$

$= (A \cup (A \cap B)) \cup ((B^c \cap A) \cup \phi)$

$= A$ //



$A \cup \phi = A$ //

$\therefore (A \cup B) \cap (A \cup B^c) = A \cup \phi$ //

b) $(A \cap U) \cup (B \cap A) = ((A \cap U) \cup B) \cap ((A \cap U) \cup A)$

$= (B \cup (A \cap U)) \cap (A \cup (A \cap U))$

$= ((B \cup A) \cap (B \cup U)) \cap (A \cap (A \cup U))$

$= ((B \cup A) \cap U) \cap (A \cap U)$

$= ((B \cup A) \cap U) \cap A$

$= (B \cup A) \cap A \cap U \cap A$

$= (B \cup A) \cap (A \cap A)$

$= (B \cup A) \cap A = A$ //

$= (A \cap B) \cup A$

$= (A \cup A) \cap (B \cup A)$

$= A \cap (A \cup B)$

$=$

(iv) $(A \cap B) \cup (A \cup B^c)^c = (A \cap B) \cup (A^c \cap (B^c)^c)$

$= (A \cap B) \cup (A^c \cap B)$

$= B$ //

L.H.S = R.H.S //