

*(KNOWLEDGE FOR DEVELOPMENT)*

**KIBABII UNIVERSITY  
(KIBU)**

**UNIVERSITY EXAMINATIONS  
2017/2018 ACADEMIC YEAR**

**END OF SEMESTER EXAMINATIONS  
FIRST YEAR FIRST SEMESTER**

**FOR THE DEGREE IN INFORMATION  
TECHNOLOGY**

**COURSE CODE: BIT 111**

**COURSE TITLE: DISCRETE STRUCTURES  
FOR IT (A)**

**DATE: 10/01 2018      TIME: 2.00PM-5.00 PM**

**INSTRUCTIONS**

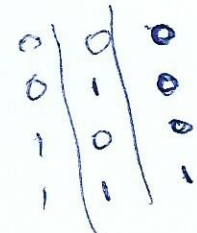
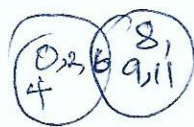
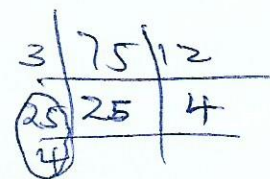
**ANSWER QUESTIONS ONE AND ANY OTHER  
TWO.**

**QUESTION ONE [30 MARKS]**

- a. Differentiate between the following terms and concepts as used in the study of discrete structures in IT.?  
[6 marks]
- Finite and infinite sets
  - A function and a relation
  - Permutation and combination
- b. Given sets:  $A = \{1, 2, 3, 4\}$  and  $B = \{3, 4, 5\}$ . Define the Cross product of A and B  
[3 marks]
- c. Verify that the proposition  $p \vee \neg(p \wedge q)$  is a tautology  
[4 marks]
- d. Evaluate:  
[4 marks]
- ${}_5P_3$
  - ${}_6C_4$
- e. State the *Pigeonhole Principle*. Using this principle, determine the least number of students in a group who have been born in the same month.  
[4 marks]
- f. Use the Euclidean algorithm to compute the greatest common divisor GCD (75; 12). Otherwise, compute the least common multiple LCM (75; 12).  
[4 marks]
- g. Let  $f(x) = 12x^2 - 17$ . Find the inverse  $f^{-1}(x)$  of  $f(x)$ .  
[3 marks]
- h. Using suitable inputs illustrate an OR-gate and AND-gate  
[3 marks]

**QUESTION TWO [20 MARKS]**

- a. List the elements of the following sets, here  $N = \{1, 2, 3, \dots\}$   
[3 marks]
- $A = \{x: x \in N, 3 < x < 12\}$  4, 5
  - $B = \{x: x \in N, x \text{ is even}, x < 13\}$  2, 4
  - $C = \{x: x \in N, 4 + x = 3\}$   $4 + 1 = 5$   
 $4 + 1 = 3$
- b. A universal set U is defined as  $U = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11\}$  and the subjects A, B and C are such that  $A = \{0, 2, 4, 6\}$ ,  $B = \{1, 3, 6, 7, 8, 9\}$  and  $C = \{6, 8, 9, 11\}$ . Find
- $|A \cup B|$  [2 marks]
  - $A \cap C$  [1 mark]
  - $A \cap (C \cup B)$  [2 marks]
  - $(A \cup B \cup C)'$  [2 marks]



$a, b \in \mathbb{R} \quad (1,1) (2,2) (3,3) (4,4) (6,6)$   
 $b, a \notin \mathbb{R} \quad (6,1) (6,2) (6,3) (4,4) (6,4) (6,6)$   
 $\begin{matrix} a & b \\ 1 & 6 \end{matrix}$

Consider the following data for 120 Information Technology Students concerning the languages they study: 65 study Java, 45 study Python, 42 study Ruby, 20 study Java and Python, 25 study Java and Ruby, 15 study Python and Ruby and 8 study all the three languages.

- i. Represent these information on a Venn diagram [4 marks] 20-8
- ii. Find the number of students who study only one Language [1 marks] 28-8
- iii. Find the number of students who study exactly two languages [1 marks]
- iv. Find the number of students who study at least a languages Language [2 marks]
- v. Find the number of students who do NOT study any Language [2 marks]

**QUESTION THREE [20 MARKS]**

- a. i. Explain whether " $1+2 = 6$ ," " $2+1=3$ ," " $x+2=4$ " are prepositions. [3 marks]
- ii. Let  $p$  be "It is cold" and let  $q$  be "It is raining". Give a simple verbal sentence which describes each of the following statements:  $\neg p$ ;  $p \wedge q$ ;  $p \vee q$ ;  $q \vee \neg p$ . [4 marks]
- b. Show that the propositions  $\neg(p \wedge q)$  and  $\neg p \vee \neg q$  are logically equivalent. [4 marks]
- c. i. Using a suitable Example Logic Gates [3 marks]
- ii. Construct a truth table and a logic diagram that implements the following expression.

$$W = \overline{X + Y} + XZ$$

[6 marks]

**QUESTION FOUR [20 MARKS]**

- a. Given the functions  $f(x) = 2x^2 - 3$  and  $h(x) = 3x + 2$ . Find
  - i. The domain and the range of  $h(x)$  [2 marks]
  - ii.  $f(h(x))$  [4 marks]
  - iii.  $f(2)$  [2 marks]
  - iv. whether  $h(x)$  is one-to-one mapping [2 marks]
- b. Let  $A = \{1, 2, 3, 4, 6\}$  and  $R$  be a relation of  $A$  defined by "x divide y" written  $x|y$ , there exist an integer  $z$  such that  $xz=y$ .
  - i. Write  $R$  as a set of ordered pairs. [4 marks]
  - ii. Draw its directed Graph. [3 marks]
  - iii. Find the inverse relation  $R^{-1}$  of  $R$ . can  $R^{-1}$  be described in words. [3 marks]

$\frac{x \times 2 = y}{x} \Rightarrow z = \frac{y}{x}$   
 $xz = y$

$3x(3x+2) + 2(3x+2)$   
 $1 \times 2 = 2$   
 $1 \times 3 = 3$   
 $4 \times \frac{1}{2} = 2$

**QUESTION FIVE [20 MARKS]**

- a. Prove by contradiction that if  $5n + 1$  is an even integer, then  $n$  is even [5 marks]
- b. i. Use the Euclidean Algorithm to show that 34 and 105 are relatively prime. [3 marks]  
ii. Find the inverse of 34 modulo 105. [3 marks]
- c. A class contains 10 students with 6 men and 4 women. Find the number  $n$  of ways to:
- i. Select a 4-member committee from the students. [3 marks]
- ii. Select a 4-member committee with 2 men and 2 women. [3 marks]
- iii. Elect a president, vice president, and treasurer. [3 marks]