



(Knowledge for Development)

KIBABII UNIVERSITY (KIBU)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

SPECIAL/SUPPLEMENTARY EXAMINATION

2021 /2022 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATION

**FOR THE DEGREE OF BACHELORS OF SCIENCE IN
(INFORMATION TECHNOLOGY/ COMPUTER SCIENCE)**

COURSE CODE: BIT 111/CSC 112

COURSE TITLE: DISCRETE STRUCTURES I /FOR IT

DATE: 22/07/2022

TIME: 8.00 A.M. – 10.00 A.M.

2HRS

INSTRUCTIONS TO CANDIDATES:

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

Paper Consists of 5 Printed Pages. Please Turn Over ►

QUESTION ONE (COMPULSORY)**[30 MARKS]**

- a. List the elements of each set where $N = \{1, 2, 3, 4, \dots\}$.
- $A = \{x \in N \mid 3 < x < 11\}$ [1 mark]
 - $B = \{x \in N \mid x \text{ is even, } x < 15\}$ [1 mark]
 - $C = \{x \in N \mid 2 + x = 0\}$ [1 mark]
- b. Given that set $A = \{x_1, x_2, x_3\}$ and set $B = \{y_1, y_2\}$. Define the cross product of A and B and show that Cartesian product is not commutative. [3 marks]
- c. Let $U = \{1, 2, \dots, 9\}$ be the universal set, and let $A = \{1, 2, 3, 4, 5\}$, $C = \{5, 6, 7, 8, 9\}$, $E = \{2, 4, 6, 8\}$, $B = \{4, 5, 6, 7\}$, $D = \{1, 3, 5, 7, 9\}$ and $F = \{1, 5, 9\}$.
Find:
- $|A \cup B|$ [2 marks]
 - $A \cap C$ [2 marks]
 - $(D \cup F)'$ [2 marks]
- d. Let the function $f: X \rightarrow R$ be defined by $f(x) = x^3 + 3x + 2$. If $X = \{-1, 0, 1, 2\}$ then find range of f . [2 marks]
- e. Find a counterexample for each statement where $U = \{3, 5, 7, 9\}$ is the universal set:
- $\forall x, x + 3 \geq 7$ [2 mark]
 - $\forall x, |x| = x$ [2 mark]
- f. 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: $p \wedge q$; $q \vee \neg p$
[2marks]
- g. Evaluate the following
- $C_{(11, 5)}$ [2 marks]
 - $P(15, 8)$ [2 marks]
- h. A survey of 60 car owners shows that 18 own a foreign-made car and 55 own a domestic-made car. Find the number of them who own:
- only a foreign made car; [2 marks]
 - only a domestic made car. [2 marks]
 - both domestic and foreign made car [2 marks]

QUESTION TWO

[20 MARKS]

a. Given the statements p: I wake up early in the morning, q: I study hard, and r: I will score an A in discrete. The statement: it is not the case that when I wake up early in the morning and study hard, I will score an A in discrete. Formalize the statement and construct its truth table.

[3 marks]

b. Give the universal set U representing the set of English alphabets, A a set of distinct elements of the word "juxtaposition", B a set of distinct elements of the word "continuous" and C a set of distinct elements of the word "myogenic". Find:

i. $A \setminus C$

[1 mark]

ii. $(A \cup B) \setminus C$

[2 marks]

iii. $|A \cup B|$

[1 mark]

iv. $A \cap B$

[1 mark]

c. Of 100 students in a university department, 45 are enrolled in English, 30 in History, 20 in Geography, 10 in at least two of three courses and just 1 student is enrolled in all three courses.

i. Represent these information on a Venn diagram

[4 marks]

ii. How many students take none of these courses?

[2 marks]

d. In a class of 30 students, 10 got A on the first test, 9 got A on a second test, and 15 did not get an A on either test.

Find: the number of students who got:

i. an A on both tests

[2 marks]

ii. an A on the first test but not the second

[2 marks]

iii. an A on the second test but not the first.

[2 marks]

QUESTION THREE

[20 MARKS]

a. Let p denote "Henry eats halibut," q denote "Catherine eats kippers," and r denote "I'll eat my hat."

i. Write a proposition that reads "If Henry eats halibut but Catherine does not eat kippers, then I'll eat my hat."

[2 marks]

- ii. Write the converse, inverse, and contrapositive of the statement "If Sally finishes her work, she will go to the basketball game." [2 marks]
- b. i. Using Euclidean algorithm find the GCD and LCM of 1215 and 4551. [4 marks]
 ii. Find the value of x and y in $x(1215) + y(4551) = \text{gcd}(1215, 4551)$. [4 marks]
- c. Suppose the only clothes you have are 2 t-shirts, 4 pairs of jeans and 6 pairs of shoes. In how many combinations you can choose a t-shirt, a pair of jeans and a pair of shoes? [4 marks]
- d. Prove by the principle of mathematical induction that:

$$\frac{1}{3 \cdot 4 \cdot 5} + \frac{2}{4 \cdot 5 \cdot 6} + \frac{3}{5 \cdot 6 \cdot 7} + \dots + \frac{n}{(n+2)(n+2)(n+3)} = \frac{1n(n+1)}{6(n+3)(n+4)}$$
 for all n such that n is a member of N. [4 marks]

QUESTION FOUR

[20 MARKS]

- a. Explain the situation that predicate logic will be preferred over propositional logic. [2 marks]
- b. Write the predicate notation for the following statements: Let $A = \{1, 2, 3, 4, 5\}$. Determine the truth value of each of the following statements:
 i. $(\exists x \in A)(x + 3 < 5)$ [2 marks]
 ii. $(\forall x \in A)(x + 3 \leq 7)$ [2 marks]
- c. Give the $f(x) = \frac{2x+1}{3x^2}$, $g(x) = 5x^2+7$ and $h(x) = \frac{x^2-1}{2(x+1)}$ find:
 i. Domain and range of f(x) and h(x) [2 marks]
 ii. The inverse $g^{-1}(x)$ of g(x) [3 marks]
 iii. Is g(x) bijective? Explain. [2 marks]
 iv. $f(g(h(x)))$ [4 marks]
 v. $g(h(2))$ [3 marks]

QUESTION FIVE

[20 MARKS]

- a. Using relevant examples differentiate between a function and a relation. [2 marks]
- b. Let $A = \{2, 3, 4, 5\}$ and let $R = \{(2, 3), (3, 3), (4, 5), (5, 1)\}$. Is R symmetric, asymmetric or antisymmetric? [2 marks]

- c. Let $A = \{1, 2, 3\}$, $B = \{a, b, c\}$, and $C = \{x, y, z\}$. Consider the following relations R and S from A to B and from B to C , respectively. $R = \{(1, b), (2, a), (2, c)\}$ and $S = \{(a, y), (b, x), (c, y), (c, z)\}$. Find the composition relation $R \circ S$. **[3 marks]**
- d. Let R be the relation on N defined by $x + 3y = 12$, i.e. $R = \{(x, y) \mid x + 3y = 12\}$.
- i. Write R as a set of ordered pairs. **[2 marks]**
 - ii. Find the domain and range of R . **[2 marks]**
- e. A women student is to answer 10 out of 13 questions. Find the number of her choices where she must answer:
- i. the first two questions **[2 marks]**
 - ii. exactly 3 out of the first 5 questions **[2 marks]**
 - iii. at least 3 of the first 5 questions. **[2 marks]**