MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

FIRST YEAR **FIRST** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN SOFTWARE ENGINEERING

SCS 102 – DISCRETE STRUCTURES

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question one and any other TWO Questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Using an illustration of a graph, explain the concept of discrete and continuous. (3 marks)

b) On a straight line two points are given (4,8) and (10,6). Determine the value of 'b' where the value of a = 8 using linear extrapolation. (2 marks)

c) Consider the following sentences
   i. ½ is a rational number
   ii. 2 + 4 = 1
   iii. How are you doing?
   iv. $X^2 = 36$
   v. This sentence is false

d) Let P be 'Kenya is an island' and let Q be 'sea water contains salt'. Discuss P^Q, PvQ and ~ P. (3 marks)

e) Let P, Q and be propositions. Write down truth table of the propositional form
   ((PΛQ) V (PV ~R)) (3 marks)

f) Let P be "π is an irrational number". Find the negation of P, and give some examples of denials of P.
   (3 marks)

g) Show that ((**PVQ) V (C**~ P) Λ (~ P)) is a tautology for any proposition P and Q. (3 marks)

h) For any proposition P and Q, use have
   i. P→ Q is equivalent to (~ Q)→ (~ P) and
   ii. P→ is not equivalent to Q →P.
   Prove both results using truth table. (4 Marks)

i) Let P, Q and R be propositions. Then proof using a truth table that
   i. $P \leftrightarrow Q \equiv (p \rightarrow Q) \cap (Q \rightarrow P)$
   ii. $P \cap (Q \cup R) \equiv (P \cap Q) \cup (P \cap R)$ (6 Marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) In a survey of 500 students of a college, it was found that 49% liked watching football, 53% liked watching hockey and 62% liked watching basketball. Also, 27% liked watching football and hockey, 29% liked watching both basketball and hockey and 28% liked watching both football and basketball and 5% liked watching none of these games. (5 marks)
   i. How many students like watching all the games?
   ii. Find the ratio of number of students who like watching only football to those who like watching only hockey.
   iii. Find the number of students who like watching only one of the three given games
   iv. Find the number of students who like watching at least two of the given games

   Use venn diagram for implementation of your solution. (7 Marks)

b) Let A, B and C be sets. Proof that A∩ (BUC) = (A∩B) U(A∩C) (4 marks)

c) Show that P(A)UP(B) ≤P(AUB) is P (A) UP(B) = P(AUB) in general. Explain.
   (4 marks)

d) Let A and B be two sets. Use Venn diagram to illustrate the following operations on sets. (5 marks)

i. Union
ii. Intersection
iii. Difference
iv. Complement
v. Disjoint

QUESTION THREE (20 MARKS)

a) Let X,Y, $\in z$. If x and y are both odd, then XY is odd. (6 marks)

Proof using

i. Direct method
ii. Contradiction method
iii. Contraposition

b) Show that for all "n" ∈N, 1 + 2+ 3 + ………… + n = $\frac{n(n+1)}{2}$ (6 marks)

c) Show that for all INSRET $\frac{n^3}{3} + \frac{n^5}{5} + \frac{7n}{15}$ is an integer. (8 marks)

QUESTION FOUR (20 MARKS)

a) Let A = {1,2,3} and B={a,b}. find AxB and BXA. (2 marks)

b) Let A = [0,1] and B= {1} U [2,3] find AxB. (2 marks)

c) Proof that if A and B are nonempty set, then AXB = BXA iff A=B. (2 marks)

d) Let A, B, C and D be sets, then proof that (6 marks)

i. AX (BUC) = (AXB) U (AXC)
ii. (AUB) X C = (A X C) U (BXC)
iii. AX(B∩C) = (A X B) ∩ (B X C)
iv. (A∩B) XC = (AXC) ∩ (BXC)
v. (AXB) ∩ (CXD) = (A∩C) X B∩D)
vi. (AXB) U(CXD) ≤ (AUC) X(BUD)

e) Let A= {1,2, {3}, 4} and B = {a, b, c, d}. find the domain and range of {, where R = {C1, C), ({3}, a), (1, d} ≤ A X B. (2 marks)

f) Let A = {1,2,3,4} and R_1 = {(1,2), (2,3), (1,3)} R_2 = {(1,1), (1,2)} R_3 = {(3,4)}, R_4 = {(1,2), (2,1)} and R_5 = {(1,1), (2,2), (3,3), (4,4)}. Decide which relation is reflective, symmetric and transitive. (4 marks)

g) Let A be the relation on Z given by x R y. iff X-Y is even, show that is an equivalence relation on Z. (2 marks)