NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

FSCS, Midterm Examinations Spring 2024

Time: 90 minutes **CT162 – Discrete Structures Paper A** **Max Marks: 20**

Note: Attempt all questions.

Question 1 [CLO 2 – 09 Marks]

a. Let $U = \{x \mid x$ is a positive integer less than 10$\}$, $A = \{x \mid x$ is an odd positive integer less than 7$\}$ & B= $\{x \mid x$ is an even positive integer less than 6$\}$, **Find** (i) $A \cap \bar{B}$, (ii) $A \oplus B$, (iii) Power Set of A (03 Marks)

b. Let f be the function from $\{A,B,C,D\}$ to {x1,x2,x3,x4,x5} defined by $f(A)$ = x2, $f(B)$ = x3, $f(C)$ = x1, and $f(D)$ = x5. Is f an on-to function or one-to-one or both? (02 Marks)

c. Construct truth table for the compound proposition $(p \leftrightarrow q) \rightarrow (\neg r \rightarrow s)$ (02 Marks)

d. Find the value of $\sum_{j=0}^{8}(1 + (-1)^j)$ (02 Marks)

Question 2 [CLO 3 – 07 Marks]

a. **What** is the converse and contrapositive of the statement "If it rains heavily, the streets get flooded" (01 Mark)

b. Is $(p \rightarrow q) \rightarrow [(p \rightarrow r) \rightarrow q]$ a tautology? **Why** or why not? (01 Mark)

c. **Translate** "There is a student in the class who does not understand English" into logical expressions using predicates, quantifiers, and logical connectives (0.5 Mark)

d. **Translate** "$\forall x(C(x) \rightarrow F(x))$" into English, where $C(x)$ is "x is a comedian" and $F(x)$ is "x is funny" and the domain consists of all people (0.5 Mark)

e. **Write** complexity of Binary Search and Bubble Sort Algorithms in terms of Big Θ notation. (1 Mark)

f. **Use** mathematical induction to prove that the formula is true for all Natural numbers (03 Marks)

$$3 + 7 + 11 + \cdots + (4n - 1) = n(2n + 1)$$

Question 3 [CLO 4 – 04 Marks]

a. **Justify** using truth table if the following system specifications are consistent? "If the file system is not locked, then new messages will be queued. If the file system is not locked, then the system is functioning normally, and conversely. If new messages are not queued, then they will be sent to the message buffer. If the file system is not locked, then new messages will be sent to the message buffer. New messages will not be sent to the message buffer." (02 Marks)

b. **Construct** the validity of the argument using Rules of Inferences (02 Marks)

$$\begin{array}{l} p \rightarrow \neg q \\ \neg r \rightarrow p \\ \underline{\quad q \quad} \\ \therefore r \end{array}$$