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Daffodil International University

Faculty of Science & Information Technology

Department of Computer Science & Engineering

Midterm Examination, Fall 2026

Course Code: CSE212, Course Title: Discrete Mathematics

Level: 2 Term: 1 Batch: 70

Time: 01:30 Hrs **Marks: 25**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	A bank vault has three managers. Let p, q and r stand for "Manager 1 has inserted a key", "Manager 2 has inserted a key" and "Manager 3 has inserted a key". The vault door unlocks (U) if and only if at least two of the three keys are inserted.			**CO1**
	a)	Construct the truth table of U, and use it to write U in disjunctive normal form (DNF).	**[2]**	
	b)	Apply the laws of logical equivalence to simplify your DNF from Q1(a) to $(p \wedge q) \vee (p \wedge r) \vee (q \wedge r)$. Write the law used in each step.	**[3]**	
2.	Let T(x, y) mean "student x has completed course y". The domain of x is {Rafi, Mim, Tanvir}, and the domain of y is {CSE212, CSE214, MAT211}. The table below shows true instances (✓) of T.			**CO1**

Student	CSE212	CSE214	MAT211
Rafi	✓	✓	✗
Mim	✓	✗	✓
Tanvir	✓	✓	✓

	a)	Use the table to find the truth value of each statement, and support each answer with an example or a counterexample. i. $\exists y \forall x\ T(x, y)$ ii. $\forall x \exists y \neg T(x, y)$ iii. $\forall x\ (T(x, CSE214) \rightarrow T(x, MAT211))$	**[3]**
	b)	Let P(z, y) mean "course z is a prerequisite of course y", where z and y range over all courses. Apply predicates and quantifiers to construct a logical expression, using T(x, y) and P(z, y), for the following sentence: "Every student who has completed CSE214 has completed all of its prerequisites, and some course has no prerequisite."	**[2]**
3.	During a lab exam, the online exam portal stopped working, and the IT officer reported the following. If the database server is up (D), then the exam portal loads (E). The exam portal did not load. If the database server is down, then either the backup server is activated (B) or the lab exam is postponed (L). If the backup server is activated, then an alert email is sent to the admin (A). No alert email was sent to the admin. If the lab exam is postponed, then the students are informed by SMS (S). Therefore, the lab exam is postponed. Apply the rules of inference to prove whether the argument is valid or not. Write the rule used in each step.	**[5]**	**CO1**

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4.	a)	A survey of 120 CSE students covered three clubs: the Coding Club (C), the Robotics Club (R) and the Sports Club (S). Of these students, 50 are in C, 40 are in R and 45 are in S; 15 are in both C and R, 12 are in both C and S, and 10 are in both R and S; 5 are in all three clubs. Illustrate this data with a Venn diagram that shows the number of students in each region. Then interpret the diagram to find: i. The number of students who are members of exactly two clubs; ii. The number of students who are not members of more than one club.	[3]	CO2
	b)	Let A = {a, {b}, ∅}. Explain the values of the cardinalities |P(A)| and |P(P(A))|.	[2]	
5.		A weather app converts a temperature c from °C to °F using the function: $f: \mathbb{R} \to \mathbb{R}, f(c) = 1.8c + 32.$ Classify f as injective, surjective, both, or neither, with reasons. Then explain whether f has an inverse function or not. If it does, write the formula for f^{-1}, and interpret $f^{-1}(98.6)$.	[5]	CO2