Patuakhali Science and Technology University

Mid Term Examination-2017

Course Code: CIT-121; Course Title: Discrete Mathematics

Full Time: 30 minutes | Full Marks: 15

1. Draw the difference between Continuous Mathematics and Discrete Mathematics. 2
2. Illustrate DeMorgan's Law $(A \cup B)^C = A^C \cap B^C$ using Venn diagrams. 3
3. Brieflydescribe types of Relation. 5
4. Let $A = \{a, b, c\}$, $B = \{x, y, z\}$, $C = \{r, s, t\}$. Let $f: A \to B$ and $g: B \to C$ be defined by: $f = \{(a, y)(b, x), (c, y)\}$ and $g = \{(x, s), (y, t), (z, r)\}$. Find the composition function $gof: A \to C$. 5

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Patuakhali Science and Technology University

2nd Semester (Level-1, Semester-II), Final Examination of B.Sc. Engg.in (CSE)
July-December: 2019, Session: 2018-19
Course Code: CIT-121 Course Title: Discrete Mathematics
Credit Hour: 3.00 Full Marks: 70 Duration: 03Hours

[Figures in the right margin indicate full marks. Split answering of any question is not recommended]

Answer any 7 of the following questions.

1. a) Rewrite the following statements using set notation: 2
(i) The element 1 is not a member of A.
(ii) The element 5 is a member of B.
(iii) A is a subset of C.
(iv) A is not a subset of D.
(v) F contains all the elements of G.
(vi) E and F contain the same elements.
b) List the elements of the following sets; here $z = (integers)$. 3
(i) $A = \{x: x \in Z, 3 < x < 9\}$
(ii) $B = \{x: x \in Z, x^2 + 1 = 10\}$
(iii) $C = \{x: x \in Z, x \text{ is odd}, -5 < x < 5\}$
c) Given that $U = N =$ (positive integers), identify which of the following sets are identical to {2,4}: 2
$A = \{even\ numbers\ less\ than\ 6\}$, $B = \{x: x < 5\}$, $C = \{x: (x-2)(x-4)(x+2) = 0\}$
d) Define the set operations of: 2
(i) absolute complement or, simply, complement of a set, (ii) the relative complement or difference of two sets.
e) Describe a situation where the universal set U may be empty. 1

2. a) Find the number of elements in each finite set: 3
(i) $A = \{2, 4, 6, 8, 10\}$ (iv) $D = \{x: x \text{ is a positive integer}, x \text{ is a divisor of } 15\}$
(ii) $B = \{x: x^2 = 4\}$ (v) $E = \{letters\ in\ the\ alphabet\ preceding\ the\ letter\ m\}$ 13
(iii) $C = \{x: x > x + 2\}$ (vi) $F = \{x: x \text{ is a solution to } x^3 = 27\}$
(b) In a survey of 60 people, it was found that 25 read Newsweek magazine, 26 read Time, and 26 read Fortune. Also 9 read both Newsweek and Fortune, 11 read both Newsweek and Time, 8 read both Time and Fortune, and 8 read no magazine at all. 7
(i) Find the number of people who read all three magazines.
(ii) Fill in the correct number of people in each of the eight regions of the Venn diagram of Fig. 1-1(x). Here N, T, and F denote the set of people who read Newsweek, Time and Fortune respectively.
(iii) Determine the number of people who read exactly one magazine.

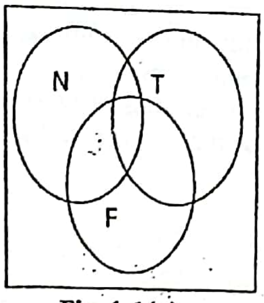

Fig. 1-1(x).

1, 3, 5
3|15
5|5
1

$x > x+2$

3, 4

3. a) Prove Theorem $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$ 2
(b) One hundred students were asked whether they had taken courses in any of the three areas, sociology, anthropology, and history. The results were: 8
45 had taken sociology 18 had taken sociology and anthropology
38 had taken anthropology 9 had taken sociology and history
21 had taken history 4 had taken history and anthropology
And 23 had taken no courses in any of the areas.
(i) Draw a Venn diagram that will show the results of survey.
(ii) Determine the number k of students who had taken classes in exactly (1) one of the areas, and (2) two of the areas

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4. a) Find the power set $P(A)$ of $A = \{1, 2, 3, 4, 5\}$. 2

b) Prove the following propositions: $P(n): \frac{1}{1(3)} + \frac{1}{3(5)} + \frac{1}{5(7)} + \cdots + \frac{1}{(2n-1)(2n+1)} = \frac{n}{2n+1}$ 3

c) Determine the validity of the argument: 2

S_1: *All red meat contains cholesterol.*
S_2: *No expensive food contains cholesterol.*

S: *Read meat is not expensive.*

d) Given $A = \{1,2\}, B = \{x,y,z\}$, and $C = \{3,4\}$. Find $A \times B \times C$ and $n(A \times B \times C)$. (tree diagram) 3

5. a) Let $A = \{1,2,3\}$ and $R = \{(1,1),(2,1),(3,2),(1,3)\}$ be a relation on A (i.e., a relation from A to A). Determine whether each of the following is true or false: 3
(i) $1R1$, (ii) $1\not R2$, (iii) $2R3$, (iv) $2\not R1$, (v) $3R2$, (vi) $3\not R1$.

b) Let S be the relation on $X = \{a,b,c,d,e,f\}$ defined by $S = \{(a,b),(b,b),(b,c),(c,f),(d,b),(e,a),(e,b),(e,f)\}$ Draw the directed graph of S 2

c) Let R and S be the relations on $X = \{a,b,c\}$ defined by $R = \{(a,b),(a,c),(b,a)\}$ and $S = \{(a,c),(b,a),(b,b),(c,a)\}$ Find the matrices M_R and M_S representing R and S respectively. 3

d) Consider functions $f: A \to B$ and $g: B \to C$; that is, where the codomain of f is the domain of g. Define the composition function of f and g. 2

6. a) Sketch the graph of the function $g(x) = x^2 + x - 6$. 3

b) Define an one-to-one (or injective) function and an onto (or surjective) function. 4

c) Let $A = \{a,b,c,d,e\}$. and let B be the set of letters in the alphabet. Let the function f, g and h from A into B be defined as follows: 3

(i)	(ii)	(iii)
$a \xrightarrow{f} r$	$a \xrightarrow{g} z$	$a \xrightarrow{h} a$
$b \to a$	$b \to y$	$b \to c$
$c \to s$	$c \to x$	$c \to e$
$d \to r$	$d \to y$	$d \to r$
$e \to e$	$e \to z$	$e \to s$

7. a) Define a graph and a multigraph. 2

b) Draw the complete graphs K_5, K_6 and also draw the complete bipartite graphs $K_{2,3}, K_{3,3}$ and $K_{2,4}$. 5

c) Define a Hamiltonian graph and draw a graph with six vertices which is Hamiltonian but not eulerian. 3

8. a) What does logically equivalent of two compound propositions mean? 2

b) Verify that the proposition $(p \wedge q) \wedge \sim (p \vee q)$ is a contradiction. 2

c) Prove that disjunction distributes over conjunction: that is, prove the distributive law $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$. 4

d) Prove the theorem "If n is a composite integer, then n has a prime divisor less than or equal to $\sqrt{n}$". 2

9. a) Define the terminologies with example: (i) Rooted tree (ii) Ancestors of vertices (iii) Full m-ary tree. 6

b) Prove that a full m-ary tree with i internal vertices contain $n=mi+1$ vertices. 2

c) What is the postfix form of the expression $((x + y) \uparrow 2) + ((x - 4)/ 3)$? 2

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Patuakhali Science and Technology University

Mid Term Examination-2018

Course Code: CIT-121; Course Title: Discrete Mathematics

Full Time: 20 minutes Full Marks: 15

1. Describe various types of set. 5
2. Differentiate between function and relation. Explain One-to-one function, Onto function and Inverse of a Function with example. 5
3. Illustrate DeMorgan's law $(A \cup B)^C = A^C \cap B^C$ using Venn diagram. 5

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Patuakhali Science and Technology University

Faculty of Computer Science and Engineering

2^{nd} Semester (Level-1, Semester-II) Final Examination of B.Sc.Engg.(CSE) July-December- 2015

Session: 2014-2015, Course Code: CIT-121, Course Title: Discrete Mathematics

Credit Hour: 03 Full Marks: 70 Duration: 3 Hours

[Figure in the right margin indicates full marks. Split answering of any questions is not recommended.] Answer any 7 of the following question.

1. (a) Re-write the following statements using set notation: 3
   - (i) The element 2 is not a member of G.
   - (ii) The element 7 is a member of F.
   - (iii) B is a subset of C.
   - (iv) D is not a subset of C.
   - (v) A contains all the elements of H.
   - (vi) J and F contain the same elements.

   (b) List the elements of the following sets; 3
   - (i) $A=\{x: x \in N, 3< x <9\}$
   - (ii) $B=\{x: x \in N; x^2+1=10\}$
   - (iii) $C=\{x: x \in N, x \text{ is odd}, -5< x <5\}$

   (c) Define the set operation of: (i) Union and (ii) intersection 2

   (d) $U=\{1, 2, 3,\ldots,8, 9\}$, $A=\{1, 2, 3, 4\}$, $B=\{2, 4, 6, 8\}$, $C=\{3, 4, 5, 6\}$

   Find: (i) $(A \cap B)\backslash C$ and (ii) $(A\backslash B)^c$ 2

2. (a) Find the number of elements in each finite set: 4
   - (i) $A=\{2,4,6,8,10,12,14\}$
   - (ii) $B=\{x: x^2=16\}$
   - (iii) $C=\{x: x > x+2\}$
   - (iv) $D=\{x: x$ is a positive integer, x is a divisor of $16\}$
   - (v) E= {Letters in the alphabet preceding the letter n }
   - (vi) $F=\{x: x$ is a solution to $x^3=27\}$

   (b) Prove $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$ 2

   (c) Shade the set $(A \cup B) \cap (A \cup C)$. 4

3. a) Consider the following assumptions: 2

   S_1: All dictionaries are useful.

   S_2: Mary owns only romance novels.

   S_3: No romance novel is useful.

   Determine the validity of each of the following conclusions:
   - (x) Romance novels are not dictionaries.
   - (y) Mary does not own a dictionary.
   - (z) All useful books are dictionaries.

   b) One hundred students were asked whether they had taken courses in any of the three areas, Sociology, Authropology, and History. The results were: 8

45 had taken sociology	18 had taken sociology and anthropology
38 had taken anthropology	9 had taken sociology and history
21 had taken history	4 had taken history and anthropology

   and 23 had taken no courses in any of the areas.
   - (x) Draw a Venn diagram that will show the results of the survey.
   - (y) Determine the number k of students who had taken classes in exactly (1) one of the areas, and (2) two of the areas.

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4. (a) Define the composition of relations and give examples with diagram.

(b) Let A={a, b, c, d, e}, and let B be the set of letters in the alphabet. Let the functions f, g and h from A into B be defined as follows: 5

(i) $a \xrightarrow{f} r$, $b \to a$, $c \to s$, $d \to r$, $e \to e$

(ii) $a \xrightarrow{g} z$, $b \to y$, $c \to x$, $d \to y$, $e \to z$

(iii) $a \xrightarrow{h} a$, $b \to c$, $c \to e$, $d \to r$, $e \to s$

Are any of these functions one-to-one?

5. (a) What is meant by a recursively defined function? Calculate 8! Using the recursive definition. 5

(b) Let a and b denote positive integers. Suppose a function Q is defined recursively as follows: 5

$$Q(a,b) = \begin{cases} 0 & if\ a < b \\ Q(a-b,b)+1 & if\ b \le a \end{cases}$$

(i) Find the value of $Q(2,3)$ and $Q(14,3)$.

(ii) What does this function do? Find $Q(5861,7)$.

6. (a) Give two methods to fine the truth table of the proposition $\sim(p \wedge \sim q)$. 5

(b) Prove that disjunction distributes over conjunction; that is, prove the distributive law 5

$$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$$

7. (a) Define the truth table of the biconditional $p \leftrightarrow q$, that is "p if and only if q" and also define the truth value of the compound statement $p \to q$, that is "if p then q". 6

(b) Prove that the conditional operation distributes over conjunction; that is, 4

$$p \to (q \wedge r) \equiv (p \to q) \wedge (p \to r)$$

8. (a) Define a Hamiltonian graph. Draw a graph with six vertices which is Hamiltonian but not Eulerian. 4

(b) What is a complete graph and regular graph? Draw the complete bipartite graph $K_{2,3}$, $K_{3,3}$, $K_{2,4}$, $K_{2,5}$ and Draw all trees with six vertices. 6

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Patuakhali Science and Technology University

B.Sc. Engg. (CSE) Level-1, Semester-II, Final Examination Jul-Dec/16, Session: 2015-16

Course code: CIT-121

Credit hours: 3.00 Course Title: Discrete Mathematics

Full marks: 70 Duration: 3 hours

[Figures in the right margin indicate full marks.]

Answer any 7 of the following questions. Split answering is not recommended.

1. a. Define finite set and infinite set with examples. 2
   b. Compare ϕ and $\{\phi\}$ with an example from a computer. 2
   c. Determine whether the following functions are one-to-one or onto or both or none. 1+1
      i. To each person on the earth assign the number corresponding his/her age
      ii. To each country of the world assign the latitude and longitude of its capital

      Justify your answer with some sample/hypothetical values.
   d. Consider the following number of students of a class taking different languages. 2

65 study French	20 study French and German
45 study German	25 study French and Russian
42 study Russian	15 study German and Russian
	8 study all three languages.

1.17

Now find out the number of students taking at least one the above languages.

   e. Draw the Venn Diagram for the question 1.d. showing the numbers of student inside the diagram. 2

2. a. Find out the Cartesian product of A x B x C where A = {1,2,3}, B = {a,b,c}, C = {ক, খ} 2
   b. Consider the following SQL command for students of a university taking Computer Science and Mathematics major. 2

      select * from csMajor, mathMajor

      where csMajor.studentID = mathMajor.studentID

      hint: ***select**** means selecting all students, ***csMajor*** is the table of students who takes Computer Science as their major and ***mathMajor*** is the table of students who takes Mathematics as their major.

      Now, interpret this using set theory.
   c. Let A = {2,3,4} and B = {3,2,4,3,2,3,2,4,2} are two sets. Are they equal? Justify your answer. 2
   d. Determine which of the following declarative sentences are proposition. 0.5x8

i. x=2 is the solution of $x^2=4$	ii. 1+1 = 2	iii. 2+2 = 3	iv. London is in Denmark
v. Where are you going?	vi. 9 < 6	vii. Do your Homework.	viii. Paris is in France

3. a. Consider the propositions p such that "Roses are red" and q such that "violets are blue". What will be the declarative sentence for $\neg(p \wedge q)$? 1
   b. Prove that $\neg(p \wedge q) \equiv \neg p \vee \neg q$ using a truth table. What will be the declarative sentence for $\neg p \vee \neg q$ where p and q mean the same as stated in 3.a. 2+1
   c. Write the following sentences in propositional symbolic form 1x6
      i. If I am not in a good mood or I am busy, do not disturb me.
      ii. A program is readable only if it is well structured.
      iii. There will be no exam tomorrow if the professor is out of the town or there is a strike.
      iv. If the user enters a wrong password, his access is not granted even though he has paid his fees.
      v. Driving over 65 miles per hour is sufficient for getting a speeding ticket.
      vi. If berries are ripe in the trail, hiking is safe if and only if grizzly bears have not been seen in the area.

4. a. There are two signboards in front of a shoppin mall. One says, "Good items are not cheap". The other one says, "Cheap items are not good". Do the signboards say the same proposition? Justify your answer using truth tables. 3
   b. Use De Morgan's law to find the negation of the statement "Kim study well and obtained good grades". 2
   c. Which rules of inference is used in each argument below? 5
      i. Alice is a Math major. Therefore, Alice is either a Math major or a CSE major.
      ii. Jerry is a Math major and a CSI major. Therefore, Jerry is a Math major.
      iii. If it is rainy, then the pool will be closed. It is rainy. Therefore, the pool is closed.
      iv. If it snows today, the university will close. The university is not closed today. Therefore, it did not snow today.

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v. I go swimming or eat an ice cream. I did not go swimming. Therefore, I eat an ice cream

5. a. Use rules of inference to prove the conclusion from the premises below. 3
If I go swimming, then I will stay in the sun too long. If I stay in the sun too long, then I will sunburn. Therefore, if I go swimming, then I will sunburn.

b. Test the validity of the following argument using rules of inference. 3
If two sides of a triangle are equal, then the opposite angles are equal. Two sides of a triangle are not equal. Therefore, the opposite angles are not equal.

c. Consider the statement: "If two angles are congruent, then they have the same measure." Write the propositional symbolic for for this statement. Find the converse, contrapositive and inverse for this statement both in symbolic form and English statement. 4

6. a. Find the value of F(A,B,C) where A = 101101, B = 100101, C = 111000 for the following 2x3
i. F(A,B,C) = ABC ii. F(A,B,C) = A+B+C iii. F(A,B,C) = A(B+C)

b. What values of A,B,C,D satisfy the following simultaneous Boolean equations? 2
$\bar{A} + AB = 0, \quad AB = AC, \quad A\bar{C} + AB + CD = \overline{CD}$

c. What do sum-of-product and product-of-sum mean? Explain with example. 2

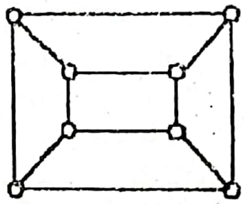
7. a. Define simple graph, multigraph and pseudo-graph with realistic examples. 1x3

b. Relate directed graphs with computer networks between different cities. 2

c. What is Handshaking theorem? Explain with an example. 2

d. Is it possible to construct a graph with 102 vertices such that exactly 49 vertices have degree 5 and the remaining 53 vertices have degree 6? Justify your answer. 3

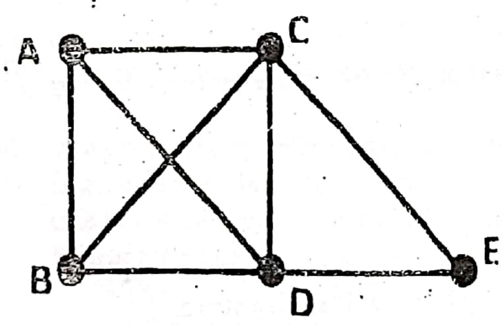
8. a. Determine if the graph on the right hand side is bipartite or not using graph coloring. 4
Label the nodes with numbers starting from the top left node.



b. Represent the graph of 8.a using adjacency list, adjacency matrix and incedence matrix 2x3

9. a. Discuss the trade-offs between adjacency lists and adjacency matrices. 2

b. Show step by step whether the two graphs shown in the following figure are isomorphic or not using adjacency matrices. 5



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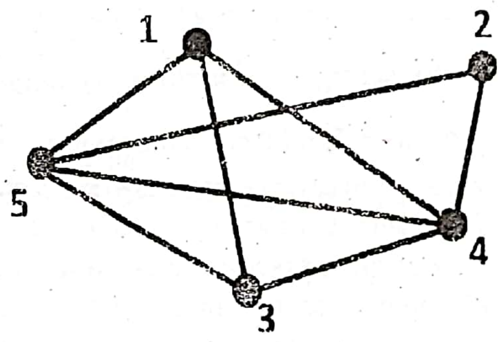

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c. Compare BFS and DFS using example. 3

Patuakhali Science and Technology University

2nd Semester (Level-1, Semester-II) Final Examination of B.Sc. Engg. (CSE) July-Dec.: 2017, Session 2016-17

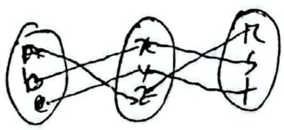
Course Code: CIT-121 Course Title: Discrete Mathematics

Credit Hour: 3.0 Full Marks: 70 Duration: 3 Hours

[Figures in the right margin indicate full marks. Split answering of any question is prohibited]

Answer any 5 of the following questions.

1. (a) List the elements of each set where $N = \{1, 2, 3, \ldots\}$. 2
   (i) $A = \{x \in N \mid 2 < x < 7\}$ (ii) $B = \{x \in N \mid x \text{ is odd}, x < 11\}$
   (iii) $C = \{x \in N \mid 5 + x = 4\}$ (iv) $D = \{x \in N \mid x \text{ is even}, 2 + x = 4\}$.
   (b) Explain the partitioning of a set. 2
   (c) In a survey of 120 people, it was found that: 65 read Newsweek magazine, 20 read both Newsweek and Time, 45 read Time, 25 read both Newsweek and Fortune, 42 read Fortune, 15 read both Time and Fortune, 8 read all three magazines. 4
   (i) Draw a Venn diagram and fill in the correct number of people in each region.
   (ii) Find the number of people who read at least one of the three magazines.
   (iii) Find the number of people who read exactly one magazine.
   (d) Briefly describe various types of set. 6
2. (a) Let $A = \{a, b, c\}$, $B = \{x, y, z\}$, $C = \{r, s, t\}$. Let $f: A \to B$ and $g: B \to C$ be defined by: $f = \{(a, z)(b, x), (c, y)\}$ and $g = \{(x, s), (y, t), (z, r)\}$. Find composition function $g \circ f: A \to C$. 2
   (b) Given $A = \{1, 2, 3, 4\}$ and $B = \{x, y, z\}$. Let R be the following relation from A to B: $R = \{(1, y), (1, z), (3, y), (4, x), (4, z)\}$. 2
   (i) Find the inverse relation R^{-1} of R. (ii) Determine the domain and range of R.
   (c) Given: $A = \{1, 2\}$, $B = \{x, y, z\}$, and $C = \{3, 4\}$. Find: $A \times B \times C$. 4
   (d) Distinguish between function and relation. Explain One-to-one function, Onto function and Inverse of a Function with example. 6
3. (a) Let p be "It is cold" and let q be "It is raining". For each of the following statements make simple verbal sentence: (a) $\neg p$; (b) $p \wedge q$; (c) $p \vee q$; (d) $q \vee \neg p$. 2
   (b) Verify that the proposition $(A \vee B) \wedge [(\neg A) \wedge (\neg B)]$ is a contradiction. 2
   (c) Briefly describe Normal Forms. 4
   (d) State and explain the following rules of inference with example: (i) Modus ponens, (ii) Hypothetical Syllogism, (iii) Destructive Dilemma and (iv) Conjunction. 6
4. (a) In how ways can the letters of the word 'ORANGE' be arranged so that the Consonants occupy only the even positions? 2
   (b) A box contains 8 blue socks and 6 red socks. Find the number of ways two socks can be drawn from the box if: (a) They can be any color. (b) They must be the same color. 2
   (c) In a certain college town, 25% of the students failed mathematics (M), 15% failed chemistry (C), and 10% failed both mathematics and chemistry. A student is selected at random. 4
   (i) If he failed chemistry, find the probability that he also failed mathematics.
   (ii) If he failed mathematics, find the probability that he also failed chemistry.
   (iii) Find the probability that he failed mathematics or chemistry.
   (iv) Find the probability that he failed neither mathematics nor chemistry.
   (d) State and prove Pascal's Identity. 3
   (e) A history class contains 8 male students and 6 female students. Find the number n of ways that the class can elect: (a) 1 class representative; (b) 2 class representatives, 1 male and 1 female; (c) 1 president and 1 vice president. 3
5. (a) Explain BFS algorithm for graph traversal with example. 4
   (b) Consider three pen-stands. The first pen-stand contains 2 red pens and 3 blue pens; the second one has 3 red pens and 2 blue pens; and the third one has 4 red pens and 1 blue pen. There is equal probability of each pen-stand to be selected. If one pen is drawn at random, what is the probability that it is a red pen? 4
   (c) Minimize the following Boolean expression using Boolean identities: 6
   $$F(A, B, C) = A'B + BC' + BC + AB'C'$$
6. (a) Explain Euler graph. 2
   (b) Discuss representation of graphs. 4
   (c) What is minimum spanning tree? State and explain Kruskal's algorithm with example. 8



$g \circ f(a) = g(f(a))$
$= g(f(z))$
$= g(r)$

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Mid-Term Examination of 2nd Semesters, July-December 2021, Session: 2020-21

Course Code: CIT 12 **Course Title: Discrete Mathematics**

Time: 1.00 Hour *[Answer all the following questions]* **Marks – 15**

1. What is propositional logic? Show that $\neg(p \rightarrow q)$ and $p \wedge \neg q$ are logically equivalent. Formulate satisfiability problem. How to solve a 9×9 Sudoku puzzle problem? 5

2. What is the truth value of $\exists x P(x)$, where $P(x)$ is the statement "$x^2 > 10$" and the universe of discourse consists of the positive integers not exceeding 4? Show that $\neg \forall x(P(x) \rightarrow Q(x))$ and $\exists x(P(x) \wedge \neg Q(x))$ are logically equivalent. 3

3. What are the applications of set theory? Shade the set $(A \cup B) \cap (A \cup C)$. 2

4. A survey on a sample of 25 new cars being sold at a local auto dealer was conducted to see which of three popular options, air-conditioning (A), radio (B), and power windows (W), were already installed the survey found: 5

   15 had air-conditioning, 12 had radio, 5 had air-conditioning and power windows, 9 had air-conditioning and radio, 4 had radio and power windows, 3 had all three options, and 2 had no options. Find the number of cars that had: (a) only power window, (b) only air-conditioning, (c) only radio, (d) radio and power windows but air-conditioning, (e) air-conditioning and radio but not power windows, (f) only one of the options. not

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