Pabna University of Science and Technology

Department of Computer Science and Engineering

B.Sc. Engineering 1st Year 2nd Semester Examination -2021

Course Code: CSE-1203 Course Title: Discrete Mathematics

Time: 3:00 hours (For PART-A and PART-B)

N.B: Answer any Three (03) questions from PART-A and Answer another three (03) questions from PART-B
Figures in the right margin indicate marks.

PART-A

1\. a. What is Discrete Mathematics? What kind of problems are solved using discrete mathematics? Explain. 4

b. Define Proposition, Tautology, Contradiction and Contingency. Show that $q \vee (p \wedge \neg q) \vee (\neg p \wedge \neg q)$ is a Tautology. 4

c. Sate the converse contrapositive and Inverse of each of the following conditional statement (i) If it is snows tonight, then I will stay at home (ii) I go to the beach whenever it is a sunny. $3\frac{2}{3}$

2\. a. What do you understand by Conditional Statements? 4
Let p, q, and r be the propositions.
p: You have the flu. q: You miss the final examination. r: You pass the course.
Express each of these propositions as an English sentence.
(i) $\neg q \leftrightarrow r$ (ii) $p \vee q \vee r$ (iii) $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$

b. Show that $p \leftrightarrow q$ and $(p \rightarrow q) \wedge (q \rightarrow p)$ are logically equivalent 4

c. Given $(\neg p \vee q) \rightarrow (r \vee \neg q)$. Rewrite it as a statement using only $\neg$ and $\wedge$. $3\frac{2}{3}$

3 a. What is Quantification? Write the following statement in symbolic form using quantifiers: 4
All students have taken a course in mathematics.
Some students are intelligent, but not hardworking.
There is no one in this class who knows French and Russian.

b. Translate the statement $\exists x \forall y \forall z \left((F(x,y) \wedge F(x,z) \wedge (y \neq z)) \rightarrow \neg F(y,z) \right)$ into English, where $F(x,y)$ means x and y are friends and the domain for x, y and z consists of all students in your class. 4

c. What do you mean by recursion? Explain with proper example $3\frac{2}{3}$

4\. a. What is rules of inference? Show that the hypothesis "If you send me an email message, then I will finish writing the program," "If you do not send me an email message, then I will go to sleep early" and "If I go to sleep early then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." 4

b. What is Mathematical Induction? Show that if n is a positive integer, then 4
$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

c. What is Permutation and Combination? Explain each of them. $3\frac{2}{3}$

PART-B

5. a. Define Set and Power Set with example. Describe the techniques of computer representation of sets. 4

b. Define function. Let $f: R \to R$ be defined by $f(x) = x^2 - 1$. 4

(a) Find domain, target (or codomain), and range of f.

(b) Is f one-to-one? Justify your answer.

(c) Is f onto? Justify your answer.

c. Let A, B and C are sets. Prove the following identity, stating carefully which of the set laws you are using at each stage of the proof. $(C \cup A) \cap (B \cup A) = A \cup (B \cap C)$ $3\frac{2}{3}$

6. a. What is Relation? Let R be the relation on the set $A = \{1,2,3,4,5,6,7\}$ defined by the rule $(a, b) \in R$ if the integer $(a - b)$ is divisible by 4. List the elements of R and its inverse. 4

b Write down the properties of Relations. Let $A = \{1, 2, 3, 4\}$, give an example of a relation for each of the followings: 4

(i) neither symmetric nor antisymmetric.

(ii) anti-symmetric and reflexive but not transitive.

(iii) transitive and reflexive but not anti-symmetric.

c. Let f and g be the functions from the set of integers to the set of integers defined by f(x)=2x+3 and g(x)=3x+2. What is the composition of (i) f and g? (ii) g and f? $3\frac{2}{3}$

7. a. Given that the graph Kn has 21 edges. 4

a) Find the number of vertices that Kn is composed of.

b) Determine the degree of each vertex.

c) Calculate the sum of the degrees of all its vertices.

b. Graph G is represented by the following adjacency matrix 4

$$A = \begin{pmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{pmatrix}$$

i) Draw the graph G.

ii) Determine whether G is a tree. Justify your answer.

iii) Determine whether G is Eulerian graph. Justify your answer.

iv) Determine whether G is Hamiltonian graph. If it is so, provide a Hamiltonian cycle on G.

c. Prove that an undirected graph has an even number of vertices of odd degree. $3\frac{2}{3}$

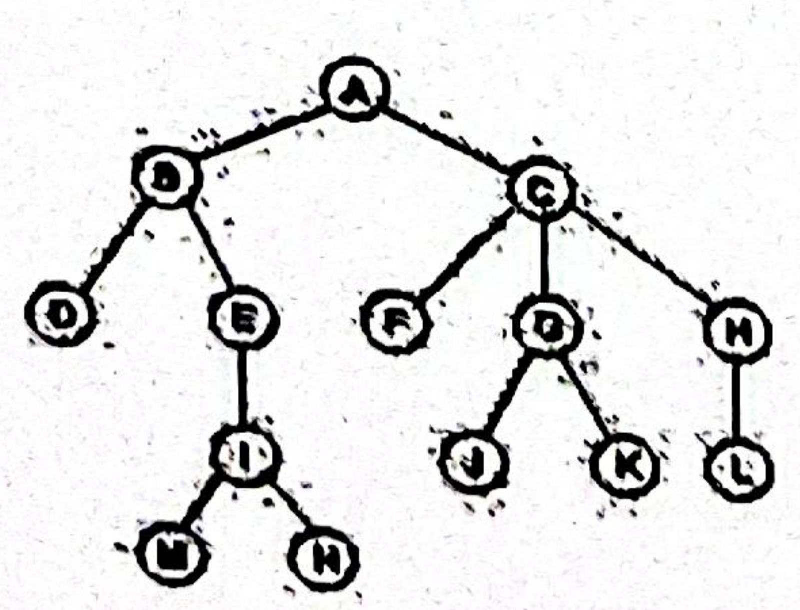
8. a. Define the following terms with proper figures. 4

i. Full Binary Tree

ii. Complete Binary Tree

iii. Binary Search Tree

b. What do you mean by tree traversal? How many ways a tree can be traversed? Traverse the following tree. 4



c. Convert the expression $3\ 2 * 2 \uparrow 5\ 3 -\ 8\ 4\ / * -$ in to infix form and draw a binary tree for the resultant expression $3\frac{2}{3}$

Pabna University of Science and Technology

Department of Computer Science and Engineering

B.Sc. Engineering 1st Year 2nd Semester Examination -2022

Course Code: CSE-1203 Course Title: Discrete Mathematics

Time: 3:00 hours (For PART-A and PART-B)

N.B: Answer any Three (03) questions from PART-A and Answer another three (03) questions from PART-B Figures in the right margin indicate marks.

PART-A

1. a. What is Discrete Mathematics? Explain the goals of discrete mathematics course. 4

   b. Define Propositional calculus, Tautology, Contradiction and Contingency. Construct a truth table for the proposition: $(p \wedge \neg q) \leftrightarrow (\neg p \wedge q)$ 4

   c. Sate the converse, contrapositive and Inverse of each of the following conditional statement: $3\frac{2}{3}$

   (i) If it snows today, I will ski tomorrow (ii) A positive integer is a prime only if it has no divisors other than 1 and itself.

2. a. What do you understand by Conditional Statements? 4

   Let p, q, and r be the propositions.
   p: You have the flu. q: You miss the final examination. r: You pass the course.
   Express each of these propositions as an English sentence.
   (i) $\neg q \leftrightarrow r$ (ii) $p \vee q \vee r$ (iii) $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$

   b. Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent by developing a series of logical equivalences. 4

   c. Given $(\neg p \vee q) \rightarrow (r \vee \neg q)$. Rewrite it as a statement using only $\neg$ and $\wedge$. $3\frac{2}{3}$

3. a. What is Quantification? Express the statements "Some student in this class has visited Mexico" and "Every student in this class has visited either Canada or Mexico" using predicates and quantifiers 4

   b. Translate these specifications into English where F(p) is "Printer p is out of service," B(p) is "Printer p is busy," L(j) is "Print job j is lost," and Q(j) is "Print job j is queued." 4

   a) $\exists p(F(p) \wedge B(p)) \rightarrow \exists j L(j)$ b) $\forall p B(p) \rightarrow \exists j Q(j)$

   c. What do you mean by recursion? Explain with proper example $3\frac{2}{3}$

4. a. What is rules of inference? Show that the premises "It is not sunny this afternoon and it is colder than yesterday," "We will go swimming only if it is sunny," "If we do not go swimming, then we will take a canoe trip," and "If we take a canoe trip, then we will be home by sunset" lead to the conclusion "We will be home by sunset." 4

   b. What is Mathematical Induction? Show that if n is a positive integer, then 4

$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

   c. What is Permutation and Combination? Explain each of them. $3\frac{2}{3}$

PART-B

5. a. Define Set and Power Set with example. Describe the techniques of computer representation of sets. 4

b. Define function. Show that the function $f: R \rightarrow R$ be defined by $f(x) = 2x+3$ is both one-one and onto. Here R is the set of all rational numbers. 4

c. Let A, B and C are sets. Prove the following identity, stating carefully which of the set laws you are using at each stage of the proof. $(C \cup A) \cap (B \cup A) = A \cup (B \cap C)$ $3\frac{2}{3}$

6. a. What is Relation? Let R be the relation on the set $A = \{1,2,3,4,5,6,7\}$ defined by the rule $(a, b) \in R$ if the integer $(a - b)$ is divisible by 4. List the elements of R and its inverse. 4

b Write down the properties of Relations. Let $A = \{1, 2, 3, 4\}$, give an example of a relation for each of the followings: 4

(i) neither symmetric nor antisymmetric.

(ii) anti-symmetric and reflexive but not transitive.

(iii) transitive and reflexive but not anti-symmetric.

c. Let f and g be the functions from the set of integers to the set of integers defined by f(x)=2x+1 and g(x)=3x+1. What is the composition of (i) f and g? (ii) g and f? 3

7. a. Define graph. Find the set of vertices and the set of edges. Also find the degree of each node for the following graph. $3\frac{2}{3}$

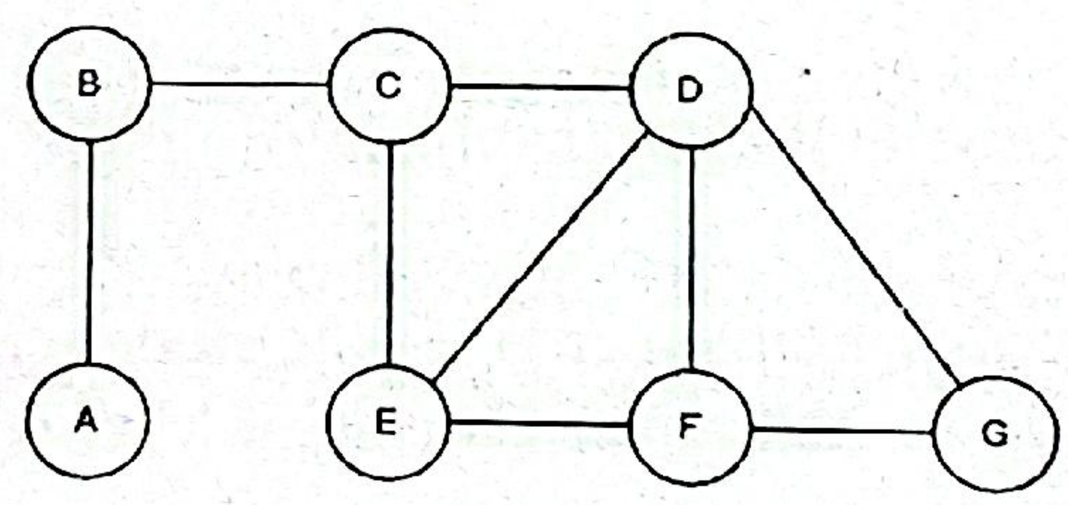


Fig: 7(a)

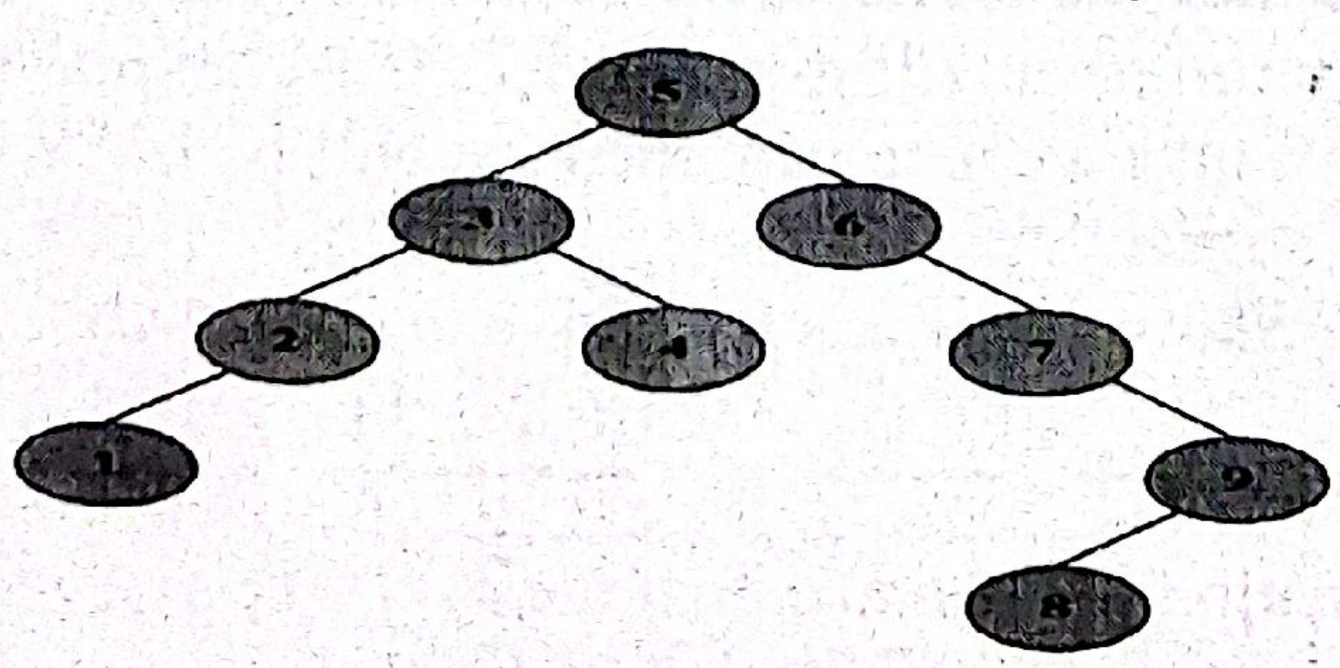
b. State hand-shacking theorem. Prove hand-shaking theorem for the graph in fig. 7(a). 3

c. Write short notes on bipartite graph. Check the graphs C_6 and K_3 are bipartite or not. 3

d. Draw a complete graph and an isomorphic graph. 2

8. a. Define Euler-path, Euler circuit, Hamiltorian-path and Hamiltorian-circuit with example. 3

b. What do you mean by tree traversal? How many ways a tree can be traversed? Traverse the following tree. 4



c. Evaluate the postfix expression $7\ 2\ 3 * -4 \uparrow 9/+$ and draw a binary tree after converting it into infix form. $4\frac{2}{3}$

Pabna University of Science and Technology
Department of Computer Science and Engineering
B.Sc. Engineering Special Examination-2018
Course Title: Discrete Mathematics
Course No: CSE 1203
Time: 3:00 hours (For PART-A and PART-B)

PART-A

Full Mark: 35

N.B:
i. Answer any **Three** questions.
ii. Separate answer script must be used for answering the questions of PART-A.
iii. Figures in the right margin indicate marks.

1. a. Define proposition. What do you understand by compound proposition? Explain how compound propositions are formed using logical operators? $4\frac{2}{3}$

   b. What do you understand by Conditional Statements? Explain how $p \to q$ can be expressed in the following ways: 4
      i. "p only if q"
      ii. "q unless $\neg q$"

   c. The two statements "If you watch television for long time, your mind will decay" and "If your mind does not decay, you do not watch television for long time" are logically equivalent. Explain. 3

2. a. Define the terms- Converse, Contrapositive and Inverse. State the converse, contrapositive and inverse of each of these following conditional statements. 5
      i. It rains if it is a weekend day.
      ii. I go to the beach whenever it is a sunny summer day.

   b. Write down the Commutative law and Absorption law of logical equivalence. 3

   c. Given $(\neg p \lor q) \to (r \lor \neg q)$. Rewrite it as a statement using only $\neg$ and $\land$. $3\frac{2}{3}$

3. a. Define Quantifiers. Consider the statement, "For all computer programs P, if P is correctly compiled then P gives desired output." What is the negation of this statement? $4\frac{2}{3}$

   b. Consider the following hypotheses 4
      i. $\neg S \land C$
      ii. $W \to S$
      iii. $\neg W \to T$
      iv. $T \to H$

      Show that the above hypotheses lead to the conclusion H.

   c. Express the statement "Everyone has exactly one best friend" as a logical expression involving predicates, logical connectives and quantifiers with domain consisting of all people. 3

4. a. Write down the Disjunctive Syllogism and Hypothetical Syllogism rules of Inference. 2

   b. Prove that there is no solution in integers x and y to the equation $2x^2 + 5y^2 = 14$ 4

   c. Describe Exhaustive Proof. Prove that the only consecutive positive integers not exceeding 100 that are perfect powers are 8 and 9 $5\frac{2}{3}$

PART-B	Full Mark: 35

N.B:

i. Answer any **Three** questions.
ii. Separate answer script must be used for answering the questions of PART-B.
iii. Figures in the right margin indicate marks.

1. a. Translate the statement $\exists x \forall y \forall z \left(\left(F(x,y) \wedge F(x,z) \wedge (y \neq z) \right) \rightarrow \neg F(y,z) \right)$ into English, where $F(x,y)$ means x and y are friends and the domain for x, y and z consists of all students in your class. $4\frac{2}{3}$

b. Show that "If n is an integer and n^2+5 is odd, then n is even". 3

c. Prove the De Morgan's law: $\overline{A \cup B} = \bar{A} \cap \bar{B}$. 4

2. a. Define Set, Subset and Power Set. What is the power set of the set $\{\emptyset\}$. $4\frac{2}{3}$

b. Define One-to-One Correspondence. Let a function $f: R^+ \rightarrow R^+$ with $f(x) = x^2$. Is f invertible? If yes find the inverse function. 4

c. Prove that $\lfloor 2x \rfloor = 2\lfloor x \rfloor$ whenever x is a real number. 3

3. a. Define Relation. Consider these following relations on the set of integers: 4

$R_1 = \{(a,b) \mid a \leq b\}$
$R_2 = \{(a,b) \mid a > b\}$
$R_3 = \{(a,b) \mid a + b \leq 3\}$
$R_4 = \{(a,b) \mid a = b + 1\}$
$R_5 = \{(a,b) \mid a = b \ or \ a = -b\}$

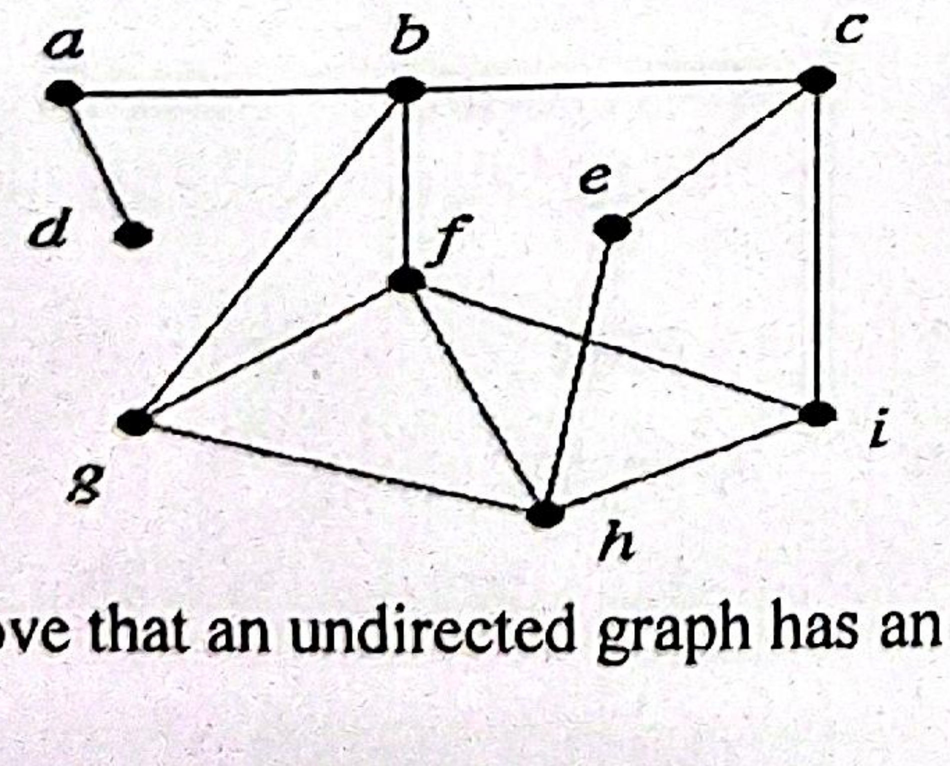
Which of these relations contain each of the pairs (1,1), (1,2), (2,-2), (3,3), (2,1).

b Let R = {(1,1),(2,1),(2,3),(3,3),(3,4),(4,2)}. Find R^4. $4\frac{2}{3}$

c. What is the composite of the relations R and S, where R is the relation from {1, 2, 3} to {1, 2, 3, 4} with R = {(1, 1), (1, 4), (2, 3), (3, 1), (3, 4)} and S is the relation from {1, 2, 3, 4} to {0, 1, 2} with S = {(1, 0), (2, 0), (3, 1), (3, 2), (4, 1)}? 3

4. a. Define simple graph and multigraph with examples. 4

b. What do you understand by Bipartite graph? Is the following graph Bipartite? 3



c. Prove that an undirected graph has an even number of vertices of odd degree. $4\frac{2}{3}$

Pabna University of Science and Technology

Department of Computer Science and Engineering

B. Sc. Engineering 1st Year 2nd Semester Examination 2023

Course Title: Discrete Mathematics

Course Code: CSE 1203

Time: 3:00 hours (PART-A & PART -B) Full Marks: 70

PART-A **Marks 35**

N.B: (i) Answer any three questions from PART A (Q1 to Q4).
(ii) Figures in the right margin indicate marks.

1. a) What is Discrete Mathematics? Explain the goals of discrete mathematics course. 4

b) Construct a truth table for the following compound propositions, $(p \vee q) \rightarrow (p \wedge q)$, where p and q represent arbitrary propositions. Determine whether this compound proposition is tautology, contradiction, or contingency. Justify your answer. $3\frac{2}{3}$

c) Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives. Let the domain consist of all people. 4

- (i) Someone in your class can speak Japanese.
- (ii) Everyone in your class is friendly.
- (iii) There is a person in your class who was not born in Pabna.
- (iv) No student in your class has taken a course in logic programming.

2. a) Define the following terms with example, 3

- (i) Existential quantifier
- (ii) Universal quantifier

b) Show that $\neg\forall x(P(x) \rightarrow Q(x))$ and $\exists x(P(x) \wedge \neg Q(x))$ are logically equivalent. 3

c) Express the statement "Every student in this class has studied discrete mathematics" using predicates and quantifiers. $2\frac{2}{3}$

d) Translate the following statement into English, where C(x) is "x has a computer," $F(x, y)$ is "x and y are friends," and the domain for both x and y consists of all students in your school. 3

$$\forall x(C(x) \vee \exists y(C(y) \wedge F(x,y)))$$

3. a) What do you mean by rules of inference? What rules of inference are used in the following famous argument? "All men are mortal. Socrates is a man. Therefore, Socrates is mortal." $3\frac{2}{3}$

b) Show that hypothesis H1, H2, and H3 lead to conclusion C. Where, 4

H1: "If you send me an e-mail message, then I will finish writing the program."
H2: "If you do not send me e-mail message, then I will go to sleep early."
H3: "If I go to sleep early, then I will wake up feeling refreshed."
C: "If I will not wake up feeling refreshed, then I finish writing the program."

c) Let, $Q(m,n)$ denote "$m + n = 0$." What are the truth values of the quantifications $\exists n \, \forall m \, Q(m,n)$ and $\forall m \, \exists n \, Q(m,n)$, where the domain of all variables, $m, n \in \mathbb{R}$. Justify your answer with proper examples. 4

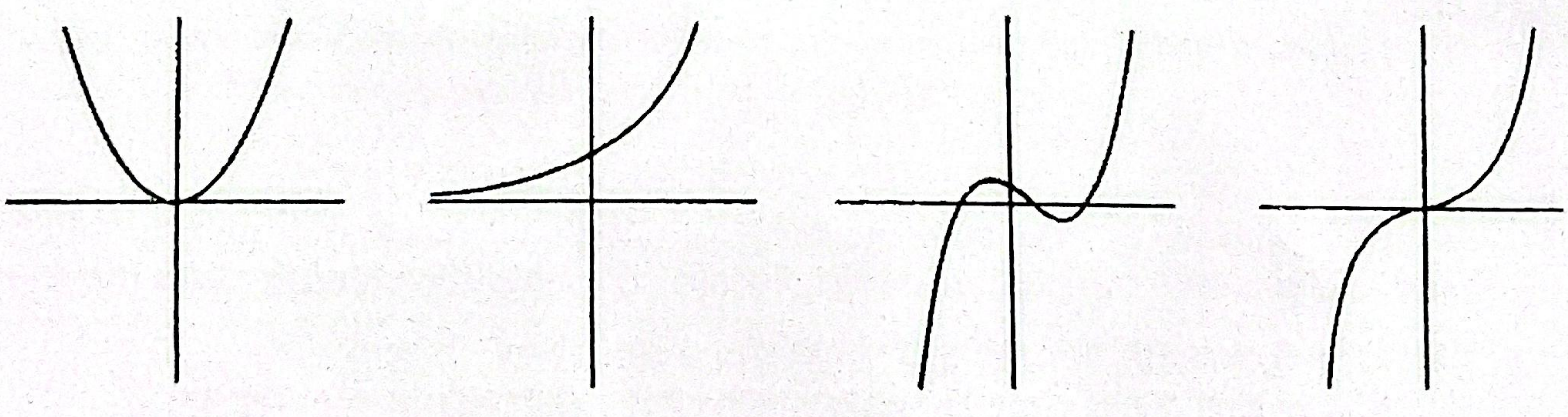
4\. a) Define the complement of a set and the power set. Find the power set of the following sets, 4
A = {cse, pust, eee}; B = {} and C = {{}}

b) Let f and g be two functions from Z to Z, where $f(x) = 2x^2$ and $g(x) = 3x$. Find the value of 4
(i) $(f \, O \, g)(x)$
(ii) $(g \, O \, f)(x)$
(iii) $(f \, O \, g)(-4)$
(iv) $(g \, O \, f)(5)$
Do these functions [*i)* $(f \, O \, g)(x)$ *and ii)* $(g \, O \, f)(x)$] are Bijective? Justify your answer.

c) Answer the following questions, $3\frac{2}{3}$
(i) Norway-based Telecom Brand Grameenphone (GP) is a well-known telecom operator in Bangladesh which has started using the new number slot "+88013 XX XXX XXX" to create connections for their new subscribers. Here, "X" can be any decimal digit from 0 to 9. How many new connections can GP provide with this new number slot?
(ii) By applying the pigeonhole counting theorem, demonstrate that among any group of five (not necessarily consecutive) integers, there are two with the same remainder when divided by 4.
(iii) Consider, the CSE department of PUST has arranged a programming contest. The number of participants is 20. How many ways are there to select a first-prize winner, a second-prize winner, and a third-prize winner from 20 different participants who have joined the programming contest?

PART-B	Marks 35
N.B: (i) Answer any three questions from PART B (Q5 to Q8).	
(ii) Figures in the right margin indicate marks.	

5\. a) Define one-to-one, onto and invertible functions with proper mathematical notations. $6\frac{2}{3}$
Consider the following four functions ($f_1(x), f_2(x), f_3(x)$ and $f_4(x)$) from $\mathbb{R}$ into $\mathbb{R}$:



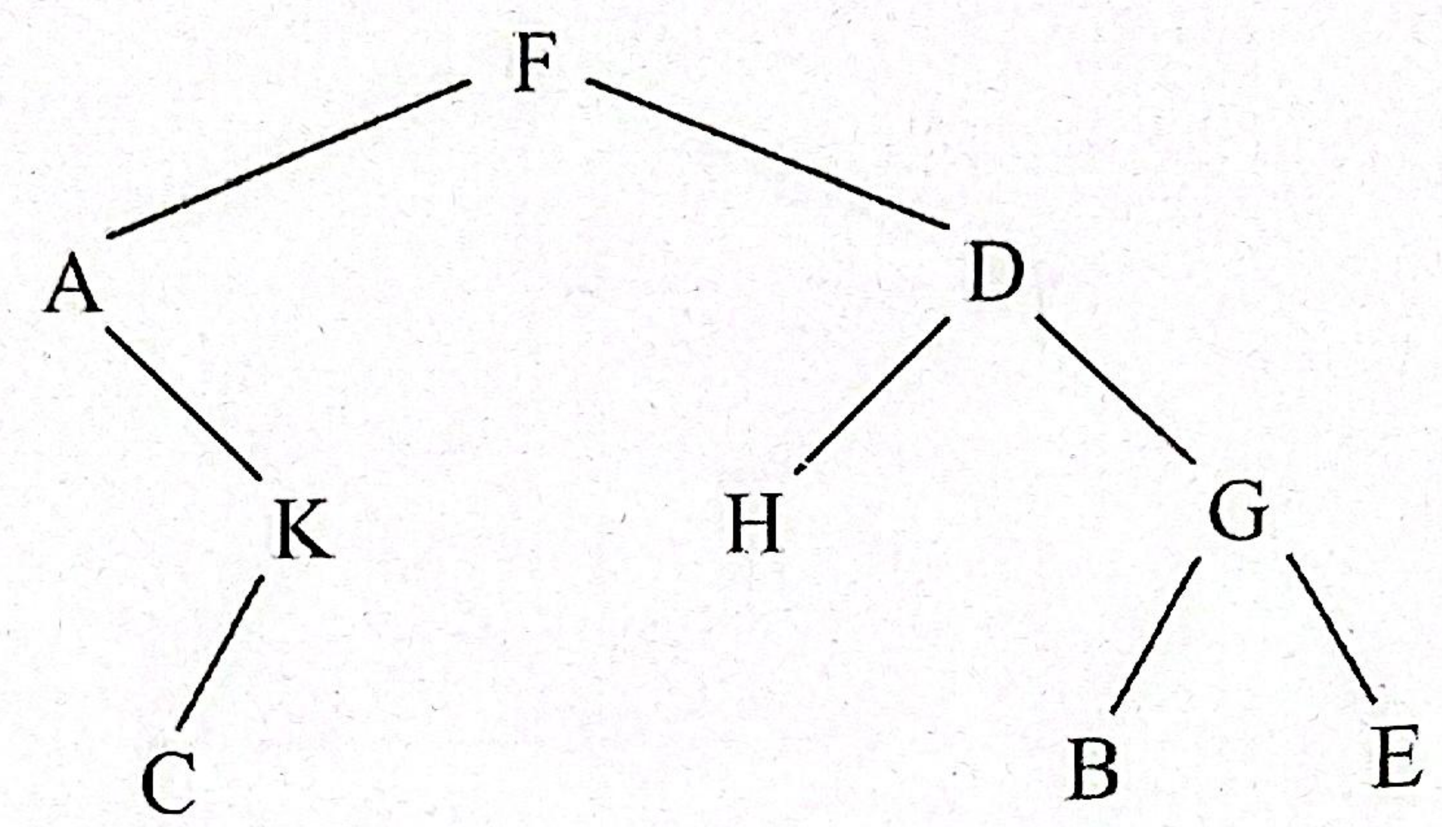
$f_1(x) = x^2$ $f_2(x) = 2^x$ $f_3(x) = x^3 - 2x^2 - 5x + 6$ $f_4(x) = x^3$

Now determine whether or not the above four functions are one-to-one, onto, invertible. If it is invertible, then find the inverse function $f^{-1}(x)$.

b) Consider the following five relations on the set $S = \{x, y, z\}$: 5
$R_1 = \{(x, x), (x, y), (x, z), (z, z)\}$
$R_2 = \{(x, x), (x, y), (y, x), (y, y), (z, z)\}$
$R_3 = \{(x, x), (x, y), (y, y), (y, z)\}$
$R_4 = \emptyset$
$R_5 = S \times S$
Determine whether or not each of the above relations on S is:
a) reflexive; (*b*) symmetric; (*c*) transitive; (*d*) antisymmetric.

6. a) State the sum rule principle and product rule principle. $2\frac{2}{3}$

b) Consider the binary tree T in the following figure, 5

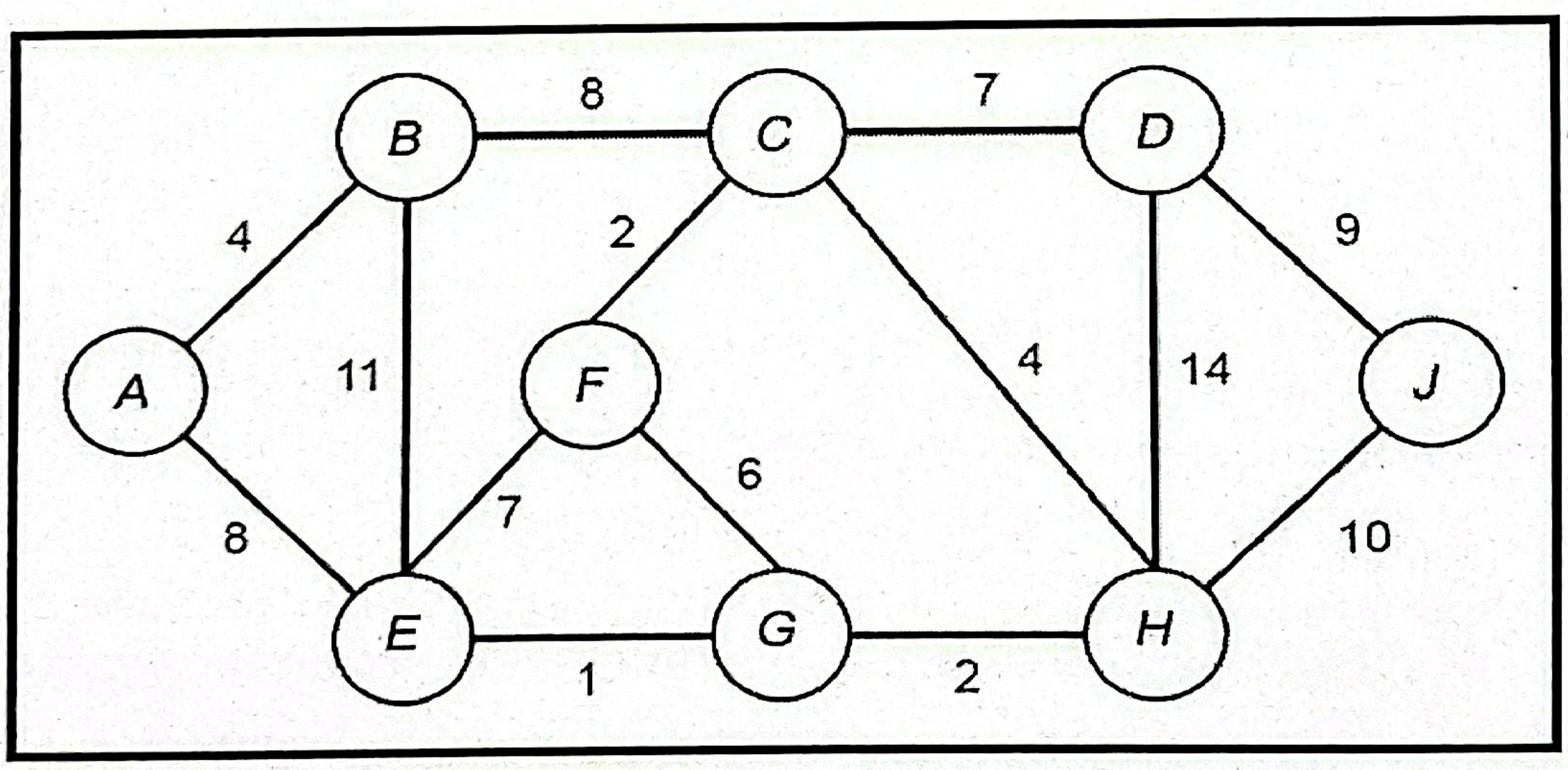


Now answer the following questions with proper justification,

(i) Find the depth d of T.
(ii) Traverse T using the preorder algorithm.
(iii) Traverse T using the inorder algorithm.
(iv) Traverse T using the postorder algorithm.
(v) Find the terminal nodes of T, and the order they are traversed in (ii), (iii), and (iv)

c) Find the number of mathematics students at a college taking at least one of the languages French, German, and Russian, given the following data: 4
65 study French, 20 study French and German, 45 study German, 25 study French and Russian, 8 study all three languages. 42 study Russian, 15 study German and Russian,

7. a) Find all the spanning tree of graph G and find which is the minimal spanning tree of G shown in fig: 6

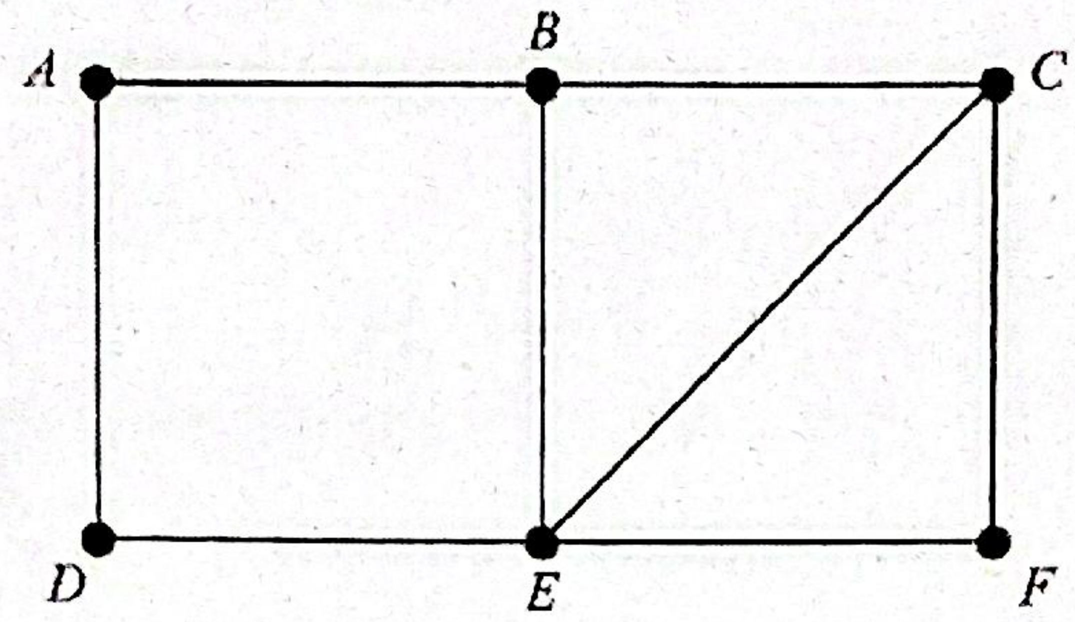


b) Define Directed Graph. A drawing of the directed graph with vertices a, b, c, d, and e, and edges (a, a), (a, b), (b, c), (b, d), (a, d), (a, e), (e, d), (e, e), (e, a), (d, d), (c, e), (c, a) and (b, e). $3\frac{2}{3}$

c) How many 5-digit numbers can be formed by using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 if every number is to start with '40' with no digit repeated? 2

8. a) Define bipartite graph with example. Is C_6 bipartite? Justify your answer. $3\frac{2}{3}$

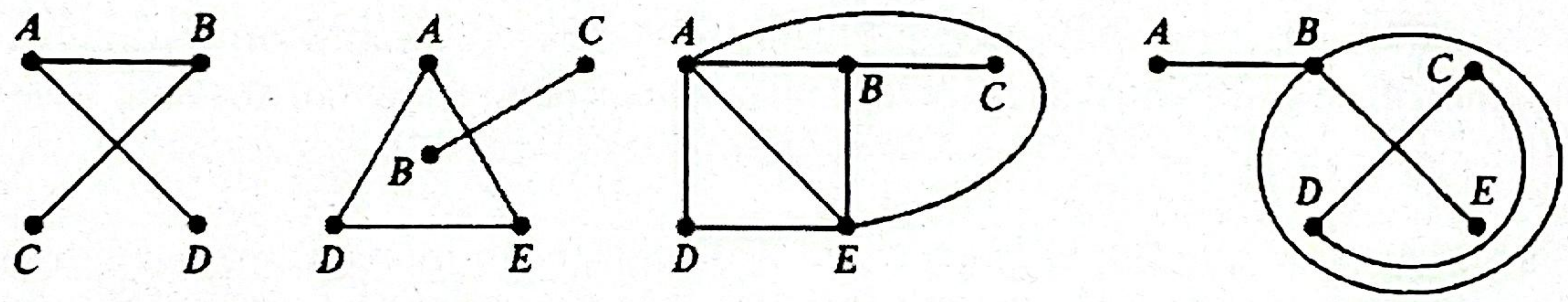
b) Consider the graph G in the following figure, 4



Now answer the following questions with definition and proper justifications:

(i) Define simple path and find all simple paths from A to F
(ii) Define trail and find all trails from A to F
(iii) Find $d(A, F)$; the distance from A to F
(iv) Find $diam(G)$, the diameter of G.

c) Consider the following multigraphs, 4



(1) (2) (3) (4)

Now answer the following questions with proper justifications:

(i) Which of them are connected? If a graph is not connected, find its connected components.
(ii) Which are cycle-free (without cycles)?
(iii) Which are loop-free (without loops)?
(iv) Which are (simple) graphs?

Pabna University of Science and Technology
Department of Computer Science and Engineering
B.Sc. Engineering Examination 1st Year 2nd Semester-2020
Course Title: Discrete Mathematics
Course No: CSE-1203
Time: 3:00 hours (For PART-A and PART-B)

PART-A

N.B:
i. Answer any **Three** questions.
ii. Figures in the right margin indicate marks.

1. a. What is Discrete Mathematics? Explain the goals of discrete mathematics course. $4\frac{2}{3}$

   b. Define Proposition, Tautology, Contradiction and Contingency. Show that $q \vee (p \wedge \neg q) \vee (\neg p \wedge \neg q)$ is a Tautology. 4

   c. What do you understand by compound proposition? Explain how compound propositions are formed using logical operators? 3

2. a. What do you understand by Conditional Statements? $4\frac{2}{3}$
   Let p, q, and r be the propositions.
   p: You have the flu. q: You miss the final examination. r: You pass the course.
   Express each of these propositions as an English sentence.
   (i) $\neg q \leftrightarrow r$ (ii) $p \vee q \vee r$ (iii) $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$

   b. Show that $(p \rightarrow r) \vee (q \rightarrow r)$ and $(p \wedge q) \rightarrow r$ are logically equivalent 4

   c. Given $(\neg p \vee q) \rightarrow (r \vee \neg q)$. Rewrite it as a statement using only $\neg$ and $\wedge$. 3

3 a. What is Quantification? Write the following statement in symbolic form using quantifiers: $4\frac{2}{3}$
   All students have taken a course in mathematics.
   Some students are intelligent, but not hardworking.
   There is no one in this class who knows French and Russian.

   b. Translate the statement $\exists x \forall y \forall z \left((F(x,y) \wedge F(x,z) \wedge (y \neq z)) \rightarrow \neg F(y,z) \right)$ into English, where $F(x,y)$ means x and y are friends and the domain for x, y and z consists of all students in your class. 4

   c. What do you mean by recursion? Explain with proper example 3

4. a. Write down the Disjunctive Syllogism and Hypothetical Syllogism rules of Inference. 2

   b. Prove that there is no solution in integers x and y to the equation $2x^2 + 5y^2 = 14$ 4

   c. What is "Direct Proof"? Give a direct proof of the theorem "If m and n are both perfect squares, then nm is also a perfect square". $5\frac{2}{3}$

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Course Title: Discrete Mathematics
Course No: CSE-1203
Time: 3:00 hours (For PART-A and PART-B)

PART-B

N.B:
i. Answer any Three questions.
ii. Figures in the right margin indicate marks.

5. a. Define Set, Subset and Power Set with example. What is the power set of the set $\{\emptyset\}$. $4\frac{2}{3}$

b. Let A, B and C are sets. Show that $\overline{A \cup (B \cap C)} = (\bar{C} \cup \bar{B}) \cap \bar{A}$ 4

c. Define "Onto" function. Determine whether the function $f(n) = n^2 + 1$ from the set of integers to the set of integers is Onto. 3

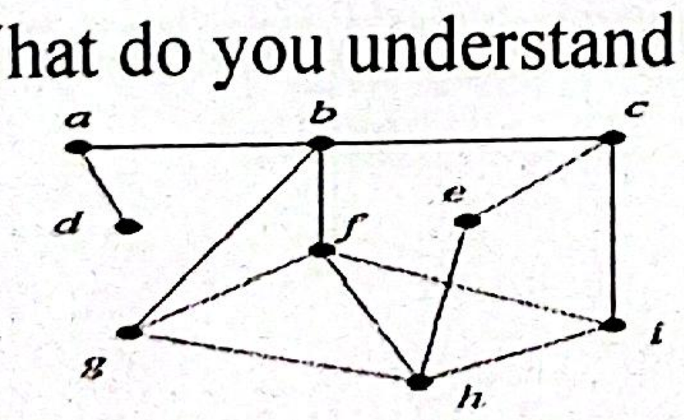
6. a. What are Relations? Determine how many relations are possible on the set A= $\{1,3,5\}$. 4

b Write down the properties of Relations. Let A = {1, 2, 3, 4}, give an example of a relation for each of the followings: $4\frac{2}{3}$
(i) neither symmetric nor antisymmetric.
(ii) anti-symmetric and reflexive but not transitive.
(iii) transitive and reflexive but not anti-symmetric.

c. Let R = {(1,1),(2,1),(2,3),(3,3),(3,4),(4,2)}. Find R4. 3

7. a. Define simple graph and multigraph with examples. 4

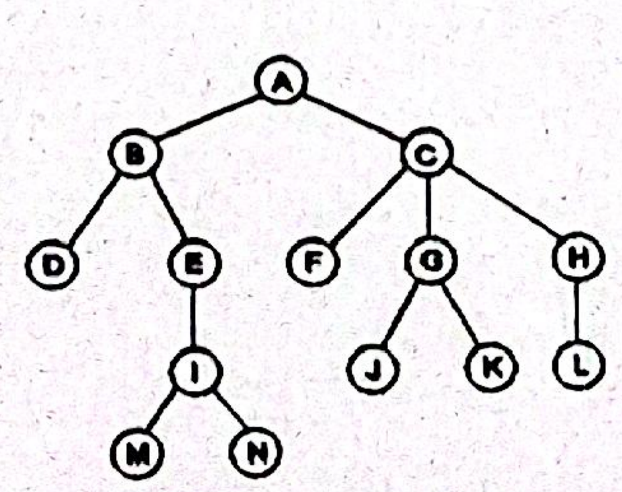
b. What do you understand by Bipartite graph? Is the following graph Bipartite? 3



c. Prove that an undirected graph has an even number of vertices of odd degree. $4\frac{2}{3}$

8. a. Define the following terms with proper figures. 3
i. Full Binary Tree
ii. Complete Binary Tree
iii. Binary Search Tree

b. What do you mean by tree traversal? How many ways a tree can be traversed? Traverse the following tree. $4\frac{2}{3}$



c. Convert the expression $3\ 2 * 2 \uparrow 5\ 3 -\ 8\ 4 / * -$ in to infix form and draw a binary tree for the resultant expression 4

Pabna University of Science and Technology

Department of Computer Science and Engineering

B. Sc. Engineering Special Examination-2017

Course Title: Discrete mathematics

Course No: CSE-1203

Time: 3:00 hours (For PART-A and PART-B)

PART-A Full Mark:35

N.B:

i. Answer any **Three** questions.
ii. Separate answer script must be used for answering the questions of PART-A.
iii. Figures in the right margin indicate marks.

1. a. Define proposition. What do you understand by compound proposition? Explain how compound propositions are formed using logical operators? $4\frac{2}{3}$

   b. What do you understand by Conditional Statements? Explain how $p \to q$ can be expressed in the following ways: 4
      i. "p only if q"
      ii. "q unless $\neg q$"

   c. There are two restaurants next to each other. One has a sign says "Good food is not cheap" and other has a sign that says "Cheap food is not good". Are the signs saying the same thing? 3

2. a. Construct a truth table for the compound proposition $(p \to q) \leftrightarrow (\neg q \to \neg p)$. 5

   b. Write down the Commutative law and Absorption law of logical equivalence. 3

   c. Given $(\neg p \vee q) \to (r \vee \neg q)$. Rewrite it as a statement using only $\neg$ and $\wedge$. $3\frac{2}{3}$

3. a. Define Quantifiers. Consider the statement, "For all computer programs P, if P is correctly compiled then P gives desired output." What is the negation of this statement? $4\frac{2}{3}$

   b. Consider the following hypotheses 4
      i. $\neg S \wedge C$
      ii. $W \to S$
      iii. $\neg W \to T$
      iv. $T \to H$

      Show that the above hypotheses lead to the conclusion H.

   c. Consider the statement, "For all real numbers x and y, if $x^2 = y^2$ then $x = y$." Is the proposed negation "If $x \neq y$ then $x^2 \neq y^2$" the correct negation? If not, what is the correct negation? Which is true, the original statement or its negation? 3

4. a. Write down the Disjunctive Syllogism and Hypothetical Syllogism rules of Inference. 2

   b. Prove that there is no solution in integers x and y to the equation $2x^2 + 5y^2 = 14$ 4

   c. What is "Direct Proof"? Give a direct proof of the theorem "If m and n are both perfect squares, then nm is also a perfect square". $5\frac{2}{3}$

	PART-B	Full Mark: 35

N.B:
- i. Answer any **Three** questions.
- ii. Separate answer script must be used for answering the questions of PART-B.
- iii. Figures in the right margin indicate marks.

1. a. Translate the statement $\exists x \forall y \forall z \left((F(x,y) \wedge F(x,z) \wedge (y \neq z)) \rightarrow \neg F(y,z) \right)$ into English, where $F(x,y)$ means x and y are friends and the domain for x, y and z consists of all students in your class. $4\frac{2}{3}$

   b. Show that "If n is an integer and n^2+5 is odd, then n is even". 3

   c. Prove the De Morgan's law: $\overline{A \cup B} = \bar{A} \cap \bar{B}$. 4

2. a. What can you say about the sets A and B for each of the followings? $4\frac{2}{3}$
   - i. $A \cap B = A$
   - ii. $A \cup B = B$
   - iii. $A - B = A$

   b. Define One-to-One Correspondence. Let a function $f: R^+ \rightarrow R^+$ with $f(x) = x^2$. Is f invertible? If yes find the inverse function. 4

   c. Prove that $\lfloor 2x \rfloor = 2\lfloor x \rfloor$ whenever x is a real number. 3

3. a. Define Relation. Consider these following relations on the set of integers: 4

   $R_1 = \{(a,b) \mid a \leq b\}$
   $R_2 = \{(a,b) \mid a > b\}$
   $R_3 = \{(a,b) \mid a + b \leq 3\}$
   $R_4 = \{(a,b) \mid a = b + 1\}$
   $R_5 = \{(a,b) \mid a = b \ or \ a = -b\}$

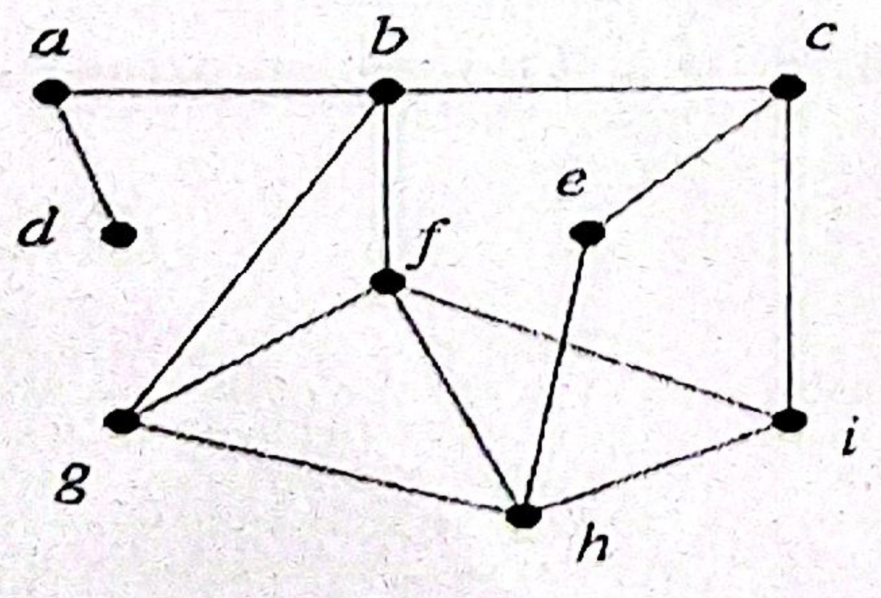
   Which of these relations contain each of the pairs (1,1), (1,2), (2,-2), (3,3), (2,1).

   b Let R = {(1,1),(2,1),(2,3),(3,3),(3,4),(4,2)}. Find R^4. $4\frac{2}{3}$

   c. Let R be the relation {(1,2), (1,3), (2,3), (2,4), (3,1)} and S be the relation {(2,1), (3,1), (3,2), (4,2)}. Find $S \circ R$. 3

4. a. Define simple graph and multigraph with examples. 4

   b. What do you understand by Bipartite graph? Is the following graph Bipartite? 3



   c. Prove that an undirected graph has an even number of vertices of odd degree. $4\frac{2}{3}$