



# Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Gopalganj-8100

1<sup>st</sup> Year 1<sup>st</sup> Semester B.Sc. Engg. Examination – 2013

## Department of Computer Science and Engineering

Course No: CSE120

Course Title: Discrete Mathematics

Full Marks: 70

Time: 3 Hours

N.B.: i) Answer SIX questions, taking any THREE from each section.

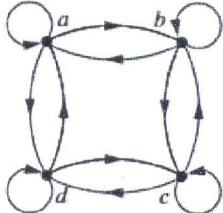
ii) All questions are of equal values.

iii) Used separate answer script for each section.

### Section -A

1. a) What are the negations of the statements  $\forall x(x^2 > x)$  and  $\exists x(x^2 = 2)$ ? 2  
b) Show that  $(\neg p \vee (\neg p \wedge q))$  and  $\neg p \wedge \neg q$  are logically equivalent by developing a series of 3  
logical equivalences.  
c) Express the statement “Everyone has exactly one best friend” as a logical expression involving 2  
predicates, quantifiers with a domain consisting of all people, and logical connectives. 1  $\frac{2}{3}$   
d) What are the rules of inference for quantified statements? Show that the premises “A student in 5  
this class has not read the book,” and “Everyone in this class passed the first exam.” Imply the  
conclusion “Someone who passed the first exam has not read the book.”

2. a) Determine whether the relation with the directed graph shown is an equivalence relation. 4



- b) If  $R \subseteq A \times B$  and  $S \subseteq B \times C$  be two relations then show that  $(S \circ R)^{-1} = R^{-1} \circ S^{-1}$ . 3  
c) Consider the following relations on  $\{a, b, c, d\}$  2  
 $4 \frac{2}{3}$

$$R1 = \{(a, a), (a, b), (b, a), (b, b), (c, d), (d, a), (d, d)\}.$$

$$R2 = \{(a, a), (a, b), (b, a)\}.$$

$$R3 = \{(a, a), (a, b), (a, d), (b, a), (b, b), (c, c), (d, a), (d, d)\}.$$

$$R4 = \{(b, a), (c, a), (c, b), (d, a), (d, b), (d, c)\}$$

Which of these relations are reflexive, symmetric, antisymmetric and transitive? Justify your answer.

3. a) Define Cartesian product. Let A represent the set of all student at a university and B represent the 4  
set of all courses offered at the university. What is the Cartesian product of  $A \times B$  ?

- b) Define the following terms: 2  
 $3 \frac{2}{3}$

Ordered pairs, n-tuples and inverse function with example.

- c) What are the differences between One to One and Onto function? Determine whether the function 4  
 $f(x) = x^2$  from the set of integers to the set of integers is One to One.

4. a) What are the general properties of algebraic system? 3

- b) Let  $V = \{S, A, B, a, b\}$   $T = \{a, b\}$ . Find the language generated by the grammar 3  
 $G = (V, T, S, P)$ , when the set P is the set of productions and S is starting symbol.  
 $P = \{S \rightarrow AB, A \rightarrow aAb, B \rightarrow bBa, A \rightarrow aa, B \rightarrow b\}$  and  $S \rightarrow aA$

- c) Define phrase structure grammar with example. 2

- d) What do you understand by formal language definition and grammar? Give example. 2  
 $3 \frac{2}{3}$

## Section – B

1. a) Suppose the following sequences list the nodes of a binary tree T in pre-order and post order respectively

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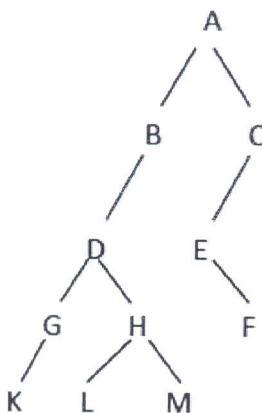
Preorder: \*, +, a, -, b, c, /, -, d, e, -, +, f, g, h

Postorder: a, b, c, -, +, d, e, -, f, g, +, h, -, /, \*

Draw the diagram of the tree T.

- b) Consider the binary tree T in fig:

6



Write preorder algorithm and Simulate the preorder traversal algorithm with tree T and show the contents of STACK at each step.

- c) Define the following terms: terminal nodes and siblings.

2

2. a) What do you mean by universal and existential quantification? Give example each of them.

3

- b) Translate the following statement into English

2

$\exists x \forall y \forall z ((F(x, y) \wedge (F(x, z) \wedge (y \neq z)) \rightarrow \neg F(y, z))$  Where F(a, b) means a and b are friends and the domain for x, y, z consists of all students in CSE department.

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- c) Let P(x) be the statement “X can speak Bengali” and let Q(x) be the statement “X knows the computer language C++”. Express each of the following sentences in term of P(x), Q(x), quantifiers and logical connectives. The domain for quantifiers consists of all students in CSE department.

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- i) There is a student in CSE department who can speak Bengali and knows C++.  
 ii) There is a student in CSE department who can speak Bengali but doesn't know C++.

3. a) What is chromatic number? What is the chromatic number of  $W_n$  graph?

2

- b) Find an adjacency matrix for each of these graphs

3

- a)  $K_n$  b)  $W_n$  iii)  $C_n$

- c) What is graph coloring? What do you mean by four colour theorem?

2

- d) Prove that i)  $\emptyset \subseteq S$  and ii)  $S \subseteq S$  for every set S.

3

4. a) The six weights 4, 15, 24, 8, 19 and 16 are given. Find a 2- tree with the given weights and a minimum path length p.

3

- b) Write the HANDSHAKING THEOREM. How many edges are there in a graph with 18 vertices each of degree 8?

2

- c) Define the following terms with example: Semigroup, monoid and group of algebra.

3

- d) What is the signature of algebra? Show that  $(I, +, 0)$  and  $(\Sigma^*, ., \lambda)$  are of the same species and  $(R, ., 1)$  and  $(I, -, 0)$  have same signature but different properties.

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