Shahjalal University of Science and Technology

Institute of Information and Communication Technology

Program: BSc (Engg.) in Software Engineering

1st Year 1st Semester Examination, 2019

Course: **SWE123** (Discrete Mathematics)

Full Marks: 100 **Time: 3 Hours**

Part A
[Answer all the questions]

Q.1. Answer any FIVE. **5x2=10**

a) Show an adjacency matrix for the graph shown in Figure 2.
b) Show an incident matrix for the graph shown in Figure 3.
c) Write the truth table for $\neg(\neg p \wedge q) \vee q \Leftrightarrow q$.
d) What do you understand by Bipartite Graph?
e) Define Contrapositive.
f) Make an AND gate using only NOR gates.

Q.2. Answer any FOUR. **4x5=20**

a) The letters and their frequency distribution are as follows: A(18%), B(5%), D(6%), E(30%), G(8%), H(7%), L(4%), N(10%) and S(12%). Now generate prefix codes for these letters using a binary tree by Huffman coding.

b) Write the Pre Order, Post Order and In Order traversal on Figure 1.

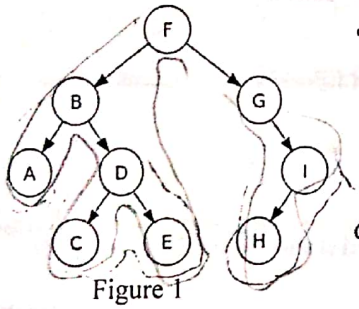


Figure 1

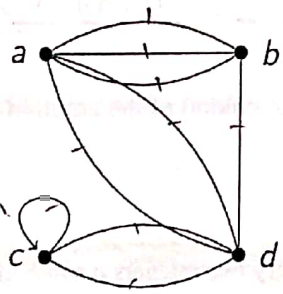


Figure 2

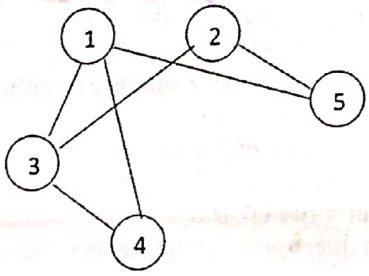
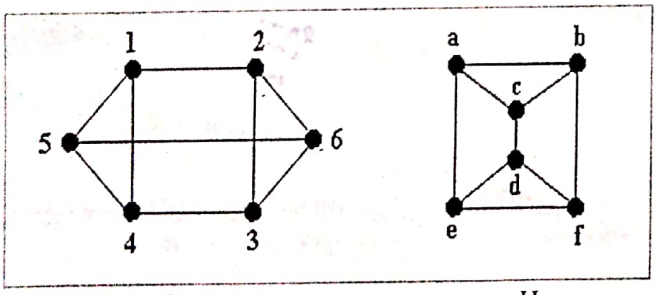


Figure 3



G H

Figure 4

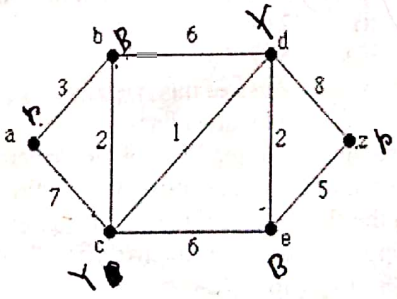


Figure 5

c) Determine whether the graphs shown in figure 4 (The graphs G and H) are isomorphic.
d) Using Dijkstra's algorithm to find a shortest path from a to z on figure 5.
e) What is the value of the prefix expression + - * 2 3 5 / ↑ 2 3 4?

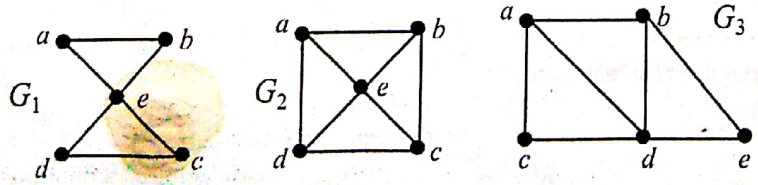


Figure 6.

Q.3. Answer any TWO. **2x10=20**

a) i) Which of the directed graphs in figure 6 have a Euler circuit? Of those that do not, which have an Euler path? **6**

ii) Find the bitwise AND, and bitwise XOR of following pair of bit strings. **4**

1. 1011110, 0100001
2. 11110000, 10101010

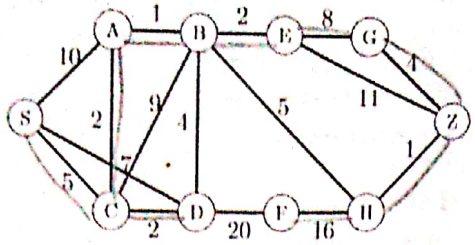


Figure 7

b) i) Use Prim's algorithm to find a minimum spanning tree in the graph shown in figure 7. 5

ii) Design a logic circuit that has three inputs, A, B, C, and whose output will be HIGH only when a majority of the inputs are LOW. 5

c) i) Consider the following K map and simplify the logic equation. 5

	$\overline{C}\,\overline{D}$	$\overline{C}D$	CD	$C\overline{D}$
$\overline{A}\,\overline{B}$	0	1	1	0
$\overline{A}B$	0	0	0	0
AB	0	0	0	1
$A\overline{B}$	0	0	0	1

ii) Define Binary Search Tree (BST). Form a BST for the words *mathematics, physics, geography, zoology, meteorology, psychology,* and *chemistry.* 5

Part B

[Answer any five]

Q.4. Answer any FIVE. **5x2=10**

a) What is the GCD of $2^2 \times 3 \times 5 \times 7^9 \times 11 \times 13$ and $2^{11} \times 3^9 \times 11 \times 17^{71}$?

b) What do you mean by a Planer Graph.

c) Show that $(2x^2+6)/(x-100)$ is $O(x)$.

d) What is the chromatic number (number of colors) of the graph in figure 5?

e) Explain Induction Principles.

f) Find an inverse of 3 modulo 7.

Q.5. Answer any FOUR. **4x5=20**

a) Give a direct proof of the theorem "for every two integers *a* and *b*, if *a* and *b* are odd, then *ab* is odd".

b) Which of these sentences are propositions? What are the truth values of those that are propositions?

i) Dhaka is the capital of Bangladesh.
ii) 2+3=5
iii) 5+7=10
iv) Answer this question.
v) You are a liar.

c) State and proof the Pigeonhole Principle.

d) How many students must be in a class to guarantee that at least two students receive the same grade on the final exam, if the exam is graded on a scale from 0 to 100 points?

e) Suppose 5 numbers are given as follows:
348, 143, 361, 423, 538
Now sort the number using BUBBLE SORT algorithm.

Q.6. Answer any TWO. **2x10=20**

a) Express each of these sentences using logical operators, predicates, and quantifiers. **10**

i) Every bird can fly.
ii) There is no dog that can talk.
iii) Someone in your class can speak Hindi.
iv) Everyone is studying discrete mathematics.
v) All lions are fierce.

b) i) Determine whether 17 is congruent to 5 modulo 6 and whether 24 and 14 are congruent modulo 6. 5

ii) What sequence of pseudorandom numbers is generated using the linear congruential generator $x_{n+1} = (3x_n + 1) \bmod 7$ with seed $x_0=3$?. 5

c) i) Use mathematical induction to prove that n^3-n is divisible by 3 whenever n is a positive integer. 6

ii) (a) Make a Binary tree using the letters in the given sequence: U, W, J, Z, K, S, F, V, H, R, N, A, X, P, C, D. 2

(b) What happens if you supply the letters in sorted order? 2