National University

of Computer & Emerging Sciences FAST Peshawar Campus

Name: _____ Roll No: _____

Program: BS (CS)
Semester: Fall – 2022
Time Allowed: 1:00 hour
Course: Discrete Structures

Examination: Sessional-II
Total Marks: 21 Weightage: 20%
Date: Oct 2022
Instructor: Nouman Azam

NOTE: Attempt all questions.

1. Consider the relation R = {(a,b)| a – b is $\in Z^+$} defined on set of real numbers. What is the equivalence class of ½ **(3 marks) (CLO 3)**

2. Construct matrices corresponding to all possible relations defined on the set A = {1,2} which are **(3*2 = 6 marks) (CLO 3)**
   a. Reflexive
   b. Symmetric

3. Construct graphs corresponding to all possible relations defined on the set A = {1,2} which are **(3*2 = 6 marks) (CLO 4)**
   a. Reflexive
   b. Symmetric

4. List the ordered pairs in the equivalence relation produced by the partition{{a,d,e}, {b,c,f}} of the set {a,b,c,d,e,f}. **(3 marks) (CLO 3)**

5. Find the relation R = {(a,b)| a ∩ b = b ∩ a) defined on the set A = {{a}, {b}, {a,b}, {b,c}} **(3 marks) (CLO 3)**

Question 6 and 7 are Optional: (Do not attempt if you think that your marks will be sufficient from the above questions)
If your marks are less than full marks, then I will add the marks from these two questions to your final marks of the sessional exam.

6. The inverse relation is given by R^{-1} = {(b,a)| (a,b) ∈ R}. Compute the inverse of the relation R = {(a,b)| a ∩ b = ∅} which is defined on the power set of set A = {a,b,c}. **(3 marks) (CLO 3)**

7. Find out three incomparable elements in the posets of (P({a, b, c}), ⊆) where P(.) represents the power set. **(3 marks) (CLO 3)**

Good luck

Grand Quiz
Section A
Discrete Structures

University
Peshawar Campus

Quiz 7

1. Construct spanning tree of W_5 graphs using depth first search.

2. Draw a circular graph for the graph represented by the following sets
   a. Set of vertices = $V = \{a_1, a_2, a_3, a_4\}$
   b. Set of edges = $E = \{(a_1, a_2), (a_3, a_4), (a_1, a_3), (a_2, a_4)\}$

Quiz 8

1. Consider the following partial order $(\{2, 3, 6, 12, 24, 36, 48, 60, 72\}, |)$. Construct the corresponding Hasse diagram of the relation.

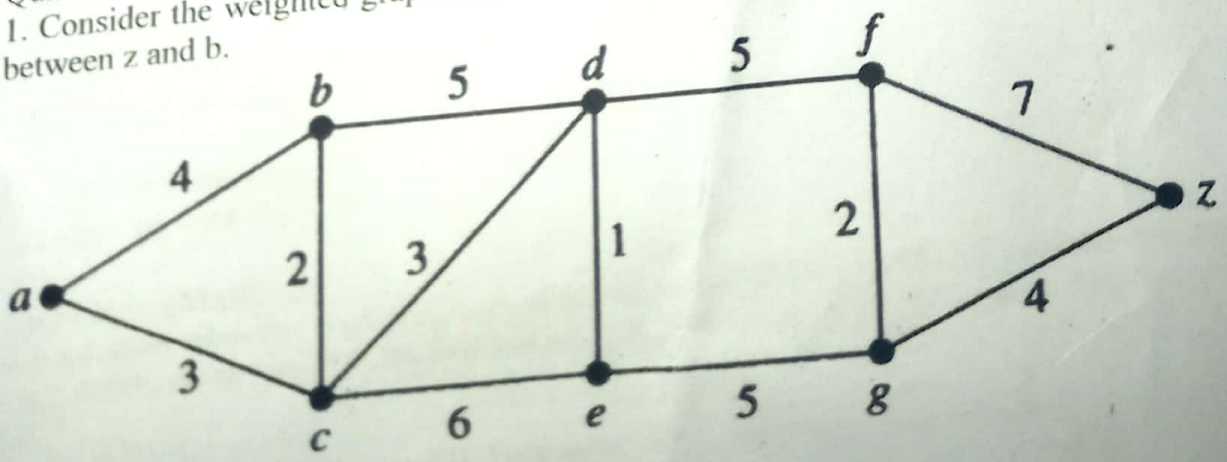
2. What is the minimum value of N for which K_N is bipartite graph.

Quiz 9

1. Consider Hasse diagram with only four element. Construct all possible types of Hasse diagrams that can constructed.

Quiz 10

1. Consider the weighted graph shown below. Use the Dijistra algorithm to find the minim path between z and b.



National University

of Computer & Emerging Sciences FAST Peshawar Campus

Name: _____ Roll No:

Program: BS (SE, CS)
Semester: Spring – 2022
Time Allowed: 1 hour
Course: Discrete Structures

Examination: Sessional 1
Total Marks: 20 Weight: 20
Date: Mar 2022
Instructor: Dr. Nouman Azam

NOTE: Attempt all questions.

Question 1: **(Marks 5)**
Use principle or resolution to show that the argument below is with the following primses is a valid or invalid argument.

P1: $(p \wedge t) \rightarrow (r \vee s)$
P2: $q \rightarrow (u \wedge t)$
P3: $u \rightarrow p$
P4: $\neg s$
C: $q \rightarrow r$

Hint: This will be solved using Demorgan's
Hint: This will be solved using distributive law

Question 2: **(Marks 4)**
Rewrite an expression corresponding to the expressions given below such that no negation comes before any of the quantifiers

3.1. $\neg\forall x \neg\forall y \neg\exists z\ P(x,y,z)$
3.2. $\neg\exists x \neg\forall y \neg\forall z\ P(x,y,z)$

Question 3: **(Marks 5)**
This question relates to the inhabitants of the island of knights and knaves created by Smullyan. The knights only speak the truth the implication " If 2+3 = 5 then 5!= 5" Is true. The knaves only speak lies.

You encounter two people A and B. Determine if possible what A and B are if
A says "The two of us are both knights" and
B says "A is a knave"

Note Strictly assume the following propositions in your answer
P = A is a knight
Q = B is a knight
$\neg$P = A is a knave
$\neg$Q = B is a knave

Question 4: **(3 marks)**
Assume that the statement $(p \wedge q) \rightarrow q$ is in converse form. Contrust the following forms

a) Implication
b) Contrapositive
c) Inverse

Question 5: **(3 Marks)**

Are these system specifications consistent? "if the system software is being upgraded, users cannot access the file system. If users can access the file system, they can save new files. If users cannot save new files, then the software system is not being upgraded"

p

q

if p, q.

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Name: _____ Roll No:

Program: BS (CS)
Semester: Fall – 2022
Time Allowed: 1 hour
Course: Discrete Structures

Examination: Sessional 1
Total Marks: 31 Weight: 20
Date: Sep 2022
Instructor: Dr. Nouman Azam

NOTE: Attempt all questions.

Q1: Use the principle of resolution to show that the hypothesis "Chohan works hard", "If Chohan works hard then he is a dull boy", "if Chohan is a dull boy, he will not get a job" imply the conclusion "Chohan will not get the job". **(Marks 3)**
Note: Assume the following propositions for solving out this question
p = Chohan works hard
q = Chohan is a dull boy
r = Chohan will get a job

Q2: Find the negation fo the following statements. **(6 marks)**

a. $\forall x \forall y\ (P(x,y) \rightarrow \sim Q(x,y))$

b. $\exists x \forall y\ (P(x,y)\ V \sim Q(x,y))$

Note: When you are done with simplification of the quantifiers then also use the equivalences of $P \rightarrow Q = \sim P\ V\ Q$ and DE Morgan law to simplify further your answer. I will deduct marks if you ignore this.

Q3: Write a logical expression corresponding to the following using only the predicates, logical conjunctions, disjunction and nothing else. Assume the domain of x,y = {1,2} **(Marks 6)**

$\neg \forall x \forall y\ P(x,y) =$

$\exists x \neg \forall y\ P(x,y) =$

Q4: The following question relates to the inhabitants of the island of knights and knaves created by Smullyan. **The knights always speak lies and the knaves always speak the truth**. You encounter two people A and B. Determine if possible what A and B are if they address you in the way given below. If you cannot determine what these two people are, can you draw any conclusions? **(Marks 10)**

A says "The two of us are both knights" and
B says "A is a knave"

Assume the following propositions. Marks will be deducted if you do not assume the proposition given below.

P = B is a knight
Q = A is a knight

~P = B is a knave
~Q = A is a knave

Q5: Assume that the statement "if it is sunny day then I will not go to beach" is in contrapositive form. Make the following forms of this statement using English sentences **(6 marks)**

a. Converse:
b. Contrapositive:
c. Inverse:

Name: _____ Roll No: _____

Program: BS (CS, SE)
Semester: Fall – 2022
Time Allowed: 3 Hours
Course: Discrete Structures

Examination: Final
Weight 45% Total Marks: 67
Date: June, 2022
Instructor: Dr. Nouman Azam

NOTE: Attempt all questions on a sheet of paper.
Try attempting all questions in the order they are given in the paper.

Graphs

1. Degree sequence: **The degree sequence of a graph is the sequence of the degrees of the vertices of the graph in a decreasing order**. For instance the degree sequence of W_5 is 5,3,3,3,3,3. What is the degree sequence of (**Points 1*8 = 8**)
   a. What is the degree sequence of Q_n
   b. What is the degree sequence of $K_{m,n}$ $(m>n)$
   c. What is the degree sequence of C_n
   d. What is the degree sequence of K_n
   e. Compute the edge in a graph with degree sequence 4, 3 ,3 ,2, 2
   f. Compute the edge in a graph with degree sequence 5, 2, 2, 2, 2, 1
   g. Draw the graph in part e
   h. Draw the graph in part f

2. The **complementary graph** G of a simple graph G has the same vertices as G. Two vertices are adjacent in G if and only if they are not adjacent in G. (**Points 2*2 = 4**)
   a. Draw the complementary graph corresponding to K_5.
   b. Draw the complementary graph corresponding to W_5.

3. Draw a circular graph corresponding to the adjacency matrix below (**Points 2*2 = 4**)
   a.

	a	b	c	d
a	0	1	1	1
b	1	0	0	1
c	1	0	0	1
d	1	1	1	0

   b. Compute the degrees of the individual vertices in the graph above in part (a)

4. Construct the following (**Points 2*4 = 8**)
   a. Adjacency matrix representing K_6
   b. Adjacency matrix representing Q_3
   c. Incidence matrix representing C_4
   d. Incidence matrix representing $K_{3,3}$

5. Answer the following questions with justification (**Points 2* 4 = 8**)
   a. Can a graph with cut edge have a euler circuit.
   b. A graph has a euler circuit of length 10. What must be the degree of the graph ?
   c. A graph has a hamilton circuit of length 5. How many vertices are there in the graph ?
   d. A graph has a Hamilton circuit and Euler circuit of length 5. How many edges and vertices must be there in the graph.

6. How many connected components are there in the graph with 1000 vertices (**Points 2*4 = 8**)
   a. Having one edge which is not a loop.
   b. Having two edges which are not loops and are between two distinct pair of vertices.
   c. Having 3 edges, assuming that the graph is a simple graph with no circuits. Moreover, the maximum length of any path in the graph is 1.
   d. Having 1 simple circuit of length 10 and no other edges. Moreover, assume that the graph is a simple graph

7. An **edge coloring** of a graph is an assignment of colors to edges so that edges incident with a common vertex are assigned different colors. Use edge coloring to color the following graphs (**Points 2* 2 = 4**)
   a. K_6
   b. C_6

   Note: I am talking about edges and not vertices. If you colored, the vertices you receive zero.

Trees

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8. Consider the following sets A = {a1,a2} and B = {a1,a2,a3} and C = {a1,a2,a3,a4} and the universal set U = {a1,a2,a3, ... a10} (**Points 2**)

   Compute the following expression which is in prefix form P(.) ∩ ∩ U A B C U A B
   (Please note that U in this expression is the union operation and P(.) is the power set operation of a certain set)

9. Consider the expression $(\neg(p \wedge q)) \leftrightarrow (\neg p \vee \neg q)$. (**Points 2*4 = 8**)
   a. Find the ordered rooted tree representing the above proposition.
   b. From the tree in part a, compute prefix form of the expression.
   c. From the tree in part a, compute postfix forms of the expression.
   d. From the tree in part a, compute the infix forms of the expression.

Shortest Paths and Spanning Trees

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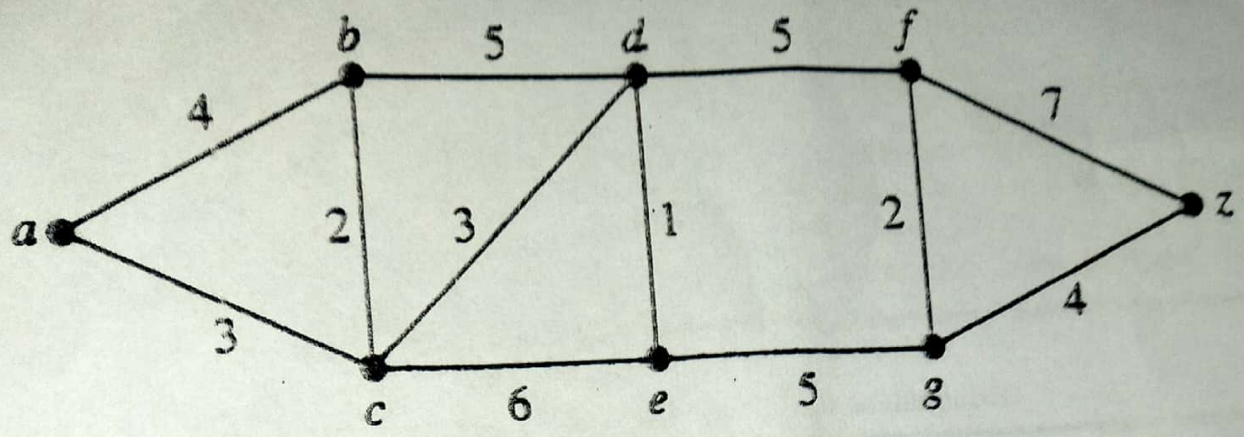
10. Consider the weighted graph shown below. Use the Dijistra algorithm to find the minim path between vertex 'z' to vertex 'b'. (**Points 5**)



Hint: I need

1. A table which shows the application of the dijistra algorithm.
2. The minimum path from 'z' to vertex 'b'

11. Consider the graph $K_{3,3}$, construct its spanning trees using (**Points 2*2 = 4**)
    a. Depth first search algorithm.
    b. Breadth first search algorithm.

12. Use backtracking to solve the following problems (**Points 2*2 = 4**)
    a. 5-Queens with an initial condition shown below

1				
	1			

b. · Find the subset, if it exits of the set {27, 24, 19, 14, 10, 8} with a sum of 34.

Good Luck

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Name: _____ Roll No: _____

Program: BS (SE)
Semester: Spring – 2023
Time Allowed: 3:00 hour
Course: Discrete Structures

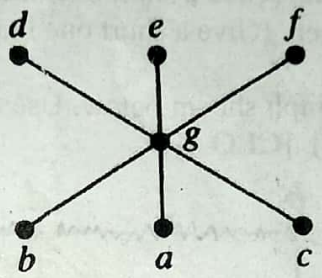
Examination: Final
Weightage 45% Total Marks: 49
Date: June, 2023
Instructor: Dr. Nouman Azam

34 = B2.
36 = 34

NOTE: Attempt all questions.

Partial Order

1. In the Hasse Diagram given below, **(Points 5 *2 =10) [CLO 2]**



   a. Construct the original relation R from the Hasse diagram.
   b. Write the minimal and maximal elements.
   c. Write the least and greatest elements.
   d. Write the lower and upper bound of the set {d,e}.
   e. Write the greatest lower bound and least upper bound of the set {a, g}.

Graphs

2. The **complementary graph** G of a simple graph G has the same vertices as G. Two vertices are adjacent in G if and only if they are not adjacent in G. **(Points 2 *2 = 4) [CLO 2]**
   a. Draw the complementary graph corresponding to K_5.
   b. Draw the complementary graph corresponding to W_5.

3. Adjacency matrix **(Points 2 *2 = 4) [CLO 3]**
   a. Draw the adjacency matrix for the graph represented by the set of vertices = V = { a_1,a_2,a_3,a_4} and set of Edge = E = {(a_1,a_2), (a_3,a_4), (a_1,a_3), (a_2,a_4)}
   b. Consider the adjacency matrix given. The vertices in the graphs are {a,b,c}. What is the total degree of the graph?, Is the graph a simple graph?

$$\begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

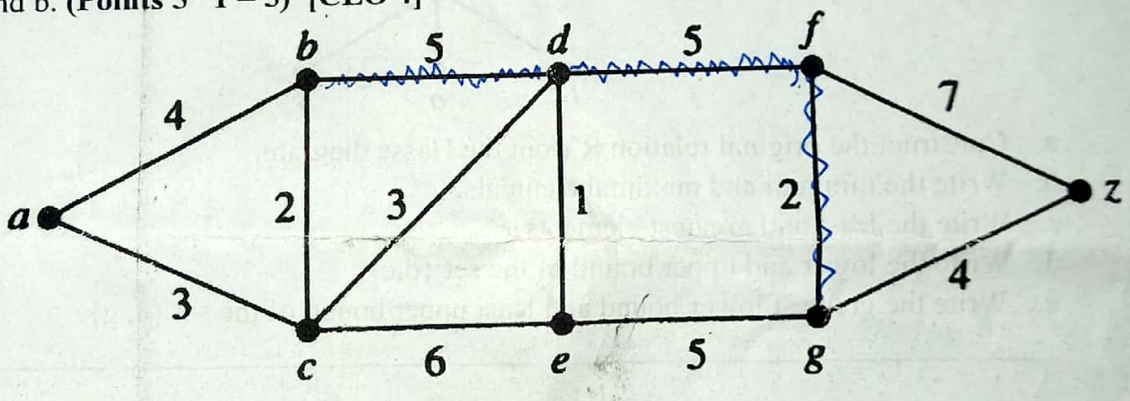
4. A simple graph is called **regular** if every vertex of this graph has the same degree. Which of the following graphs are regular? **(Points 2 *2 = 4) [CLO 3]**
   a. C_n, K_n, W_n (Give a short one liner explanation for each case)
   b. What is the total degree of a regular graph with 10 vertices each having a degree of 10?

5. For what values of **n** the graphs below have a Euler circuit. If the circuit does not exist for any value then mention it. **(Points 4 *2 = 8) [CLO 3]**
   a. K_n (Give a short one liner explanation)
   b. W_n (Give a short one liner explanation)
   c. C_n (Give a short one liner explanation)
   d. Q_n (Give a short one liner explanation)

6. How many cut edges and cut vertices are there in the following graphs. If it does not exist then explain. **(Points 2 *2 = 4) [CLO 4]**
   a. K_6 (Give a short one liner explanation)
   b. $K_{3,3}$ (Give a short one liner explanation)

7. What is the chromatic number of a graph with **(Points 2 *2 = 4) [CLO 4]**
   a. K_N where N is odd. (Give a short one liner explanation)
   b. C_N where N is even. (Give a short one liner explanation)

8. Consider the weighted graph shown below. Use the Dijistra algorithm to find the minim path between g and b. **(Points 5 *1 = 5) [CLO 4]**



Hint: I need
   1. A table which shows the application of the dijistra algorithm.
   2. The minimum path
   3. The minimum distance

Tree

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9. Backtracking and spanning trees **(Points 2 *3 = 6) [CLO 4]**
   a. Solve out the 5 Queens problem using backtracking strategy.
   b. Construct spanning trees of these graphs K_5 and C_6 using depth first search.
   c. Construct spanning trees of these graphs K_5 and C_6 using breadth first search.

Good Luck