NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR (COMPUTER SCIENCE & INFORMATION TECHNOLOGY
(SPECIALIZATION IN ARTIFICIAL INTELLIGENCE)
SPRING SEMESTER EXAMINATIONS 2023
(FOR BACKLOG STUDENTS)

Time: 3 Hours **Dated:04-08-2023**
Max.Marks:60

Discrete Structures- CT-162

Question 1 **[CLO 1 – 16 marks]**

a. Translate "There is an employee in the my office who does not understand English" into logical expressions using predicates, quantifiers, and logical connectives (02 mark)

b. Let U = {x | x is a positive integer less than 10}, A = {x | x is an odd positive integer less than 7} & B = {x | x is an even positive integer less than 10}. Find: (i) A' (ii) A∩B and (iii) Power Set of A. (03 marks)

c. Let f be the function from {a,b,c,d} to {1,2,3,4} with f(a)= 4, f(b)=2, f(c)=1 and f(d)= 3. Determine whether f is a bijection? (02 marks)

d. What is the converse, contrapositive and Inverse of the statement "If Its sunny, then we will go to play" (03 Mark)

e. Translate "$\forall x(M(x) \rightarrow I(x))$" into English, where $M(x)$ is "x is a Mathematician" and $I(x)$ is "x is Intelligent" and the domain consists of all people (02 marks)

f. Proof De-Morgan's Law in the context of Boolean Algebra using truth table (04 marks)

Question 2 **[CLO 2 – 20 marks]**

a. Find f(1), f(2), f(3), and f(4) if f(n) is defined recursively by f(0) = 1 and for n = 0, 1, 2, ...
f(n + 1) = f(n) + 2. (02 marks)

b. What is the probability that a positive integer not exceeding 100 selected at random is divisible by 5 or 7? (02 marks)

c. What is the probability that Abby, Barry, and Sylvia win the first, second, and third prizes, respectively, in a drawing if 200 people enter a contest and (02 marks)
   a) no one can win more than one prize.
   b) winning more than one prize is allowed.

d. If a Football player takes 6 independent penalties with a probability of 0.8 of getting a goal on each shot, compute the probability that he scores exactly 4 goals (02 marks)

e. Compute the probability that a randomly selected integer chosen from the first 75 positive integers is odd (02 mark)

f. Compute the probability that a five-card poker hand contains the four of diamonds and one of spades (02 mark)

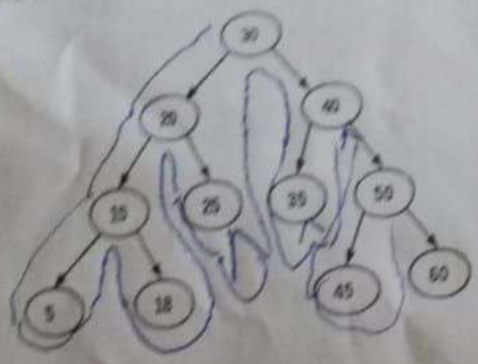
g. Compute the Variance of the number of times a 4 appears when a fair die is rolled 10 times (02 mark)

h. Describe the pseudo code of Bubble sort algorithm (06 marks)

[CLO 3 – 24 marks]

Question 3

a. Find the result of Inorder, Preorder & Postorder traversal of the below tree (09 marks)



b. There are 18 mathematics majors and 325 computer science majors at a college (03 marks)

a. In how many ways can two representatives be picked so that one is a mathematics major and the other is a computer science major?

b. In how many ways can one representative be picked who is either a mathematics major or a computer science major?

c. Apply pigeonhole principle to solve the following (03 Marks)

a. A bag contains 10 red marbles, 10 white marbles, and 10 blue marbles. What is the minimum no. of marbles you have to choose randomly from the bag to ensure that we get 4 marbles of same color?

b. A drawer contains 12 red and 12 blue socks, all unmatched. A person takes socks out at random in the dark. How many socks must he take out to be sure that he has at least two blue socks?

d. Find the probability of each outcome when a biased die is rolled, if rolling a 2 or rolling a 4 is three times as likely as rolling each of the other four numbers on the die and it is equally likely to roll a 2 or a 4. (03 mark)

e. Draw undirected graphs represented by given adjacency matrices (06 marks)

a)

	1	2	3
a	1	3	2
b	3	0	4
c	2	4	0

b)

$$\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

c)

$$\begin{bmatrix} 0 & 1 & 3 & 0 & 4 \\ 1 & 2 & 1 & 3 & 0 \\ 3 & 1 & 1 & 0 & 1 \\ 0 & 3 & 0 & 0 & 2 \\ 4 & 0 & 1 & 2 & 3 \end{bmatrix}$$

Mr. Muhammad Mubashir SEAT NO. CTAI-20001

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
FIRST YEAR (CS & IT SPECIALIZATION IN "ARTIFICIAL INTELLIGENCE")
SPRING SEMESTER EXAMINATIONS 2023
Batch 2022

Time : 3 Hours

Dated : 07-AUG-23
Max Marks : 60

Discrete Structures - CT-162

Question 1 **[CLO 1 – 08 marks]**

a. Compute the cardinality of the set: {a,{a},{a,{a,a}}} (01 mark)
b. Let A={a,b,c}, B={x,y} and C={0,1}. Find C x B x A (01 mark)
c. Suppose that U= {1,2,3,4,5,6,7,8,9,10}, A= {3,4,5} and B= {1,3,6,10}. Find: A' and A∩B. (02 marks)
d. Let f be the function from {a,b,c,d} to {1,2,3,4} with f(a)= 4, f(b)=2, f(c)=1 and f(d)= 3. Determine whether f is a bijection? (02 marks)
e. Let p and q be the propositions:
   p: You drive over 65 miles per hour
   q: You get a speeding ticket
   Write following propositions using p and q and logical connectives (02 marks)
   i. You do not drive over 65 miles per hour.
   ii. You drive over 65 miles per hour, but you do not get a speeding ticket.
   iii. You will get a speeding ticket if you drive over 65 miles per hour
   iv. If you do not drive over 65 miles per hour, then you will not get a speeding ticket.

Question 2 **[CLO 1 – 08 marks]**

a. Use rules of inference to show that the hypotheses "If it does not rain, then the sailing race will be held" "If the sailing race is held, then the trophy will be awarded," and "The trophy was not awarded" imply the conclusion "It rained." (04 marks)
b. Proof De-Morgan's Law in the context of Boolean Algebra using truth table (04 marks)

Question 3 **[CLO 2 – 08 marks]**

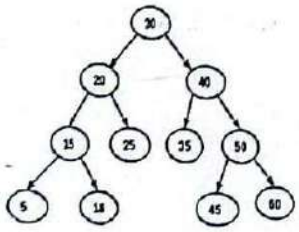
a. Find f(2) and f(3) if f is defined recursively by f(0) = −1, f(1) = 2, for n = 1, 2, … (02 marks)
   i. $f(n+1) = f(n) + 3f(n-1)$
   ii. $f(n+1) = f(n)^2 f(n-1)$
b. Use mathematical induction to show that $1 + 2 + 2^2 + \cdots + 2^n = 2^{n+1} - 1$ for all nonnegative integers n (04 marks)
c. If a basketball player takes 8 independent free throws with a probability of 0.7 of getting a basket on each shot, compute the probability that he gets exactly 6 baskets (02 marks)

Question 4 **[CLO 2 – 08 marks]**

a. Compute the probability that a randomly selected integer chosen from the first 100 positive integers is odd (01 mark)
b. Compute the probability that a five-card poker hand contains the two of diamonds and three of spades (01 mark)
c. Compute the Variance of the number of times a 6 appears when a fair die is rolled 6 times (01 mark)
d. Let E and F are events of a experiment such that P(E) = 3/10 P(F) = ½ and P(F|E) = ⅖. Find the value of (i) P(E ∩ F) (ii) P(E|F) (iii) P(E U F) (03 marks)
e. Describe the pseudo code of Binary Search algorithm (02 marks)

Question 5 **[CLO 3 – 14 marks]**

a. Find the result of Inorder, Preorder & Postorder traversal of the below tree (06 marks)



b. Construct circuits from inverters, AND gates, and OR gates to produce these outputs. (04 marks)
   a) x + y b) (x + y)x
   c) xyz + x y z d) (x + z)(y + z)
c. Solve the average time complexity of linear search algorithm (04 marks)

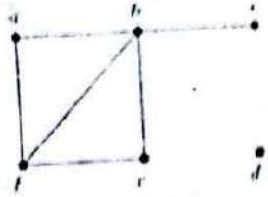
Question 6 **[CLO 3 – 14 marks]**

a. There are 18 mathematics majors and 325 computer science majors at a college (02 marks)
   i. In how many ways can two representatives be picked so that one is a mathematics major and the other is a computer science major?
   ii. In how many ways can one representative be picked who is either a mathematics major or a computer science major?
b. A bowl contains 10 red balls and 10 blue balls. A woman selects balls at random without looking at them (02 marks)
   i. How many balls must she select to be sure of having at least three balls of the same color?
   ii. How many balls must she select to be sure of having at least three blue balls?
c. How many bit strings of length 10 contain (03 marks)
   i. Exactly four 1's
   ii. At most four 1's
   iii. At least four 1's

d. How many possibilities are there for the win, place, and show (first, second, and third) positions in a horse race with 12 horses if all orders of finish are possible? (01 mark)

e. Find the sum of the degrees of the vertices of each graph and verify that it equals twice the number of edges in the graph (03 marks)

1.



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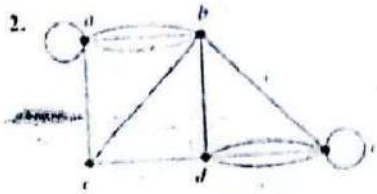

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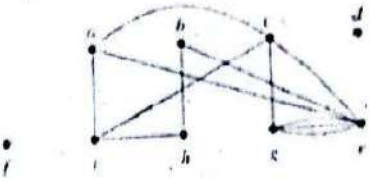


f. Draw undirected graphs represented by given adjacency matrices (03 marks)

a)
$$\begin{bmatrix} 1 & 3 & 2 \\ 3 & 0 & 4 \\ 2 & 4 & 0 \end{bmatrix}$$

b)
$$\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

c)
$$\begin{bmatrix} 0 & 1 & 3 & 0 & 4 \\ 1 & 2 & 1 & 3 & 0 \\ 3 & 1 & 1 & 0 & 1 \\ 0 & 3 & 0 & 0 & 2 \\ 4 & 0 & 1 & 2 & 3 \end{bmatrix}$$

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR SPRING SEMESTER (BACHELOR OF SCIENCE IN COMPUTER SCIENCE & INFORMATION TECHNOLOGY)
EXAMINATIONS 2018
BATCH 2017

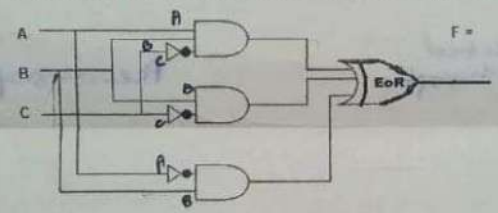
Time: 3 Hours **Dated:03-09-2018**
Max.Marks:60

Discrete Structures - CT-162

Instructions: attempt any Five questions. All questions carry equal marks.

Question No. 1 (a). A farmer has corn stored in an open crib in a barn. He also has a goat, and an absent minded hired hand who often leaves the barn door open, and there is a wolf lurking in the woods near the barn. The farmer wants to device an alarm system that will activate if the goat is in danger of being eaten by the wolf and/or the corn is in danger of being eaten by the goat. Draw truth table and the circuit.

(b) Find the Boolean expression F and truth table for logic circuit. Also find value of F (1,0, 1).



Question No.2. (a) Setup a network of 50 computers, each of them is connected with 20 other computers. The distance between each computer is 15 meters, if the cost of wire is Rs. 5 per meter, how much wire, and what will be the total cost will be required to setup the network.

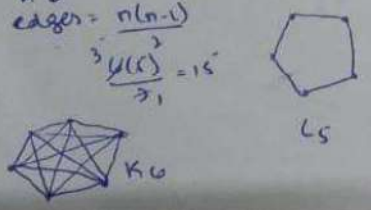
(b). Perform the operation in binary number systems and verify results in decimal system

Using 2' & Complement

(i) 53+21 (ii) 37 - 15

Question No 3.(a) Define degree, in-degree and out-degree of vertex in a graph. Find the in-degree and out-degree of each vertex in the graph A and Graph B shown in Question **No 4 (b).**

(b) Define Complete Graphs, Cycle and Wheel. Draw figures for K_6, C_5 and W_7.



P.T.O

SEAT NO. CT-21090

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR(BACHELOR OF SCIENCE IN COMPUTER SCIENCE)
SPRING SEMESTER EXAMINATIONS 2022
BATCH 2021

Time: 3 Hours **Dated:18-08-2022**
Max.Marks:60

Discrete Structures - CT-162

Instructions:

- **Attempt all parts of a question together.**
- Show complete working.
- Solutions must be clear and legible.

Question Number: 1 (10 Marks)

a. Give an example of a function from N to N which is both one-to-one and onto. Explain. [3]

b. Estimate *gcd*(4807,2091) using Euclidean algorithm. [4]

c. Undergraduate students at a university belong to one of four groups depending on the year in which they are expected to graduate. Each student must choose one of 21 different programs. Using Pigeonhole Principle, conclude how many students are needed to assure that there are two students expected to graduate in the same year with the same program? [3]

Question Number: 2 (10 Marks)

a. Explain if these system specifications are consistent. "The system is in multiuser state if and only if it is operating normally. If the system is operating normally, the kernel is functioning. The kernel is not functioning, or the system is in interrupt mode. If the system is not in multiuser state, then it is in interrupt mode. The system is not in interrupt mode." [4]

b. Express the following quantified predicates in English. Let $C(x)$ be "x is a circle," $T(x)$ be "x is a triangle", $A(x, y)$ be "x is above y," and $S(x, y)$ be "x has the same color as y." The domain of both x and y is geometric shapes.

i. $\forall x(C(x) \rightarrow \exists y(T(y) \wedge S(x, y)))$ [1.5]
ii. $\exists x(T(x) \wedge (\forall y(C(y) \rightarrow A(x, y))))$ [1.5]
iii. $\forall x(T(x) \wedge (\forall y(C(y) \wedge A(y, x)) \rightarrow S(y, x)))$ [1.5]
iv. $\exists x(C(x) \wedge \exists y(T(y) \wedge S(x, y)))$ [1.5]

Question Number: 3 (10 Marks)

a. Show that $n^2 + 1 \geq 2^n$ when n is a positive integer with $1 \leq n \leq 4$. [2]

b. Apply mathematical induction to prove that for every positive integer n,
$1^2 - 2^2 + 3^2 - \cdots + (-1)^{n-1}n^2 = (-1)^{n-1}n(n+1)/2$ [4]

c. Prove that the given recursive algorithm to find the n^{th} term of the sequence defined by $a_0 = 1$, $a_1 = 2$, $a_2 = 3$, and $a_n = a_{n-1} + a_{n-2} + a_{n-3}$, for $n = 3, 4, 5, \ldots$, is correct. [4]

```
procedure a (n: nonnegative integer)
if n = 0 then return 1
else if n = 1 then return 2
else if n = 2 then return 3
else return a(n − 1) + a(n − 2) + a(n − 3)
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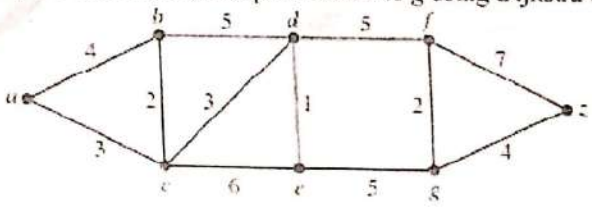
P.T.O

Question Number: 4 **(10 Marks)**

a. Examine the algorithm in Question 3(c) to devise its iterative algorithm. Compute the time complexity of the iterative algorithm. [6]

b. Inspect the given graph to find the shortest path from b to g using Dijkstra's algorithm. [4]

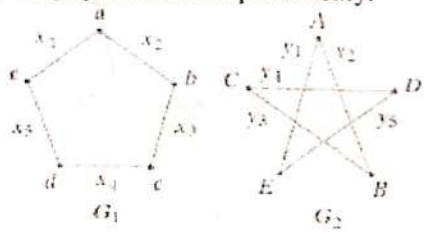


Question Number: 5 **(10 Marks)**

a. Diagram a DFA that recognizes the set of bit strings consisting of a 0 followed by an odd number of 1s. [4]

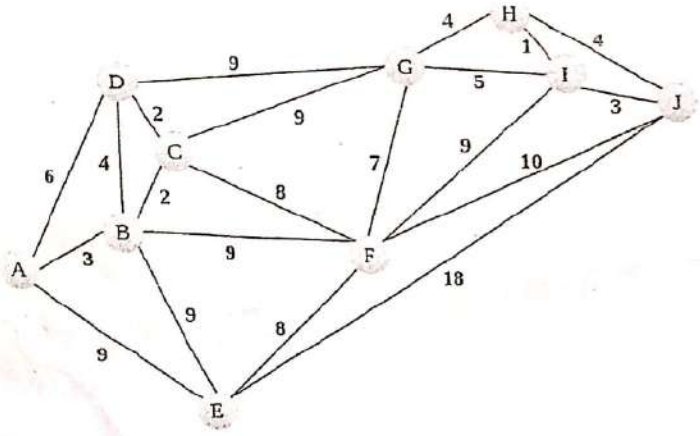
b. Analyze the grammar $G = (V, T, S, P)$ to determine whether the word $cbab$ belongs to the language generated by G, where $V = \{a, b, c, A, B, C, S\}$, $T = \{a, b, c\}$, S is the starting symbol, and $P = \{S \to AB, A \to Ca, B \to Ba, B \to Cb, B \to b, C \to cb, C \to b\}$. [3]

c. Determine whether the given graphs are isomorphic. Justify. [3]



Question Number: 6 **(10 Marks)**

Analyze the following graph to construct a minimum spanning tree using Prim's algorithm. [10]



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CT-005

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY
FSCS, Midterm Examinations Spring 2022

Time: 90 minutes **Discrete Structures (CT-162) - A** **Max Marks: 20**

Note: Attempt all parts of a question together.

Q-1) Express **(4)**

a. Whether the divides relation on S is reflexive, symmetric, or transitive, where S is a set of first four perfect squares. [2]

b. gcd(1326,252) using Euclidean Algorithm. [2]

Q-2) Indicate **(4)**

a. How many offices are in the building if it contains 27 floors and has 37 offices on each floor? [1]

b. An examination consists of 15 questions out of which the student must answer 8. How many different ways can a student choose questions to answer? [1]

c. What is the minimum number of students required if there are 12 computers and at least four students will share the same computer? [2]

Q-3) Produce the following translations. **(4)**

a. Propositions p "The project is finished," c "Client is happy," b "Bills are paid," and l "Lights go out," into English statements.

i. $p \rightarrow (c \wedge b \wedge \neg l)$ [1]

ii. $p \wedge (\neg c \oplus b)$ [1]

b. System specifications into quantified predicates using predicates, quantifiers, and logical connectives.

i. There is a node which is functional at every failure on site. [1]

ii. Every program must terminate gracefully in case of some errors. [1]

Q-4) Construct **(4)**

a. A solution for the puzzle:
A girl meets a lion and bear in the forest. The lion lies every Monday, Tuesday and Wednesday and the other days he speaks the truth. The bear lies on Thursdays, Fridays and Saturdays, and the other days of the week he speaks the truth. "Yesterday I was lying," the lion told the girl. "So was I," said the bear. What day is it? [2]

b. A logic circuit for the expression $(b \vee \neg c) \wedge \neg (a \vee c)$. [2]

Q-5) Show that: **(4)**

a. "If I study, I will pass the examination". "I did not pass the examination". "If I do not study, I will lose the scholarship" lead to the conclusion "I lost the scholarship" using rules of inference. [1]

b. If n is an even integer, then $n^2 - 6n + 5$ is odd using a direct proof. [1]

c. For all integers n, if $n + 2$ is even, then n is even using a proof by contraposition. [1]

d. If $n^3 + 13$ is an odd integer, then n is even using a proof by contradiction. [1]

SEAT NO. CT-020

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR(BACHELOR OF SCIENCE IN
COMPUTER SCIENCE & INFORMATION TECHNOLOGY)
SPRING SEMESTER EXAMINATIONS 2021
BATCH 2020

Time: 3 Hours

Dated:27-08-2021
Max.Marks:60

Discrete Structures - CT-162

Q1. Define the following.

a) Pigeon Hole with Examples

b) Functions and Its types

c) How many positive integers not exceeding 100 are divisible by 2 or 5.

d) If two dices are rolled then what is the probability that the sum of both is 6.

e) Prove by mathematical induction for Geometric series.

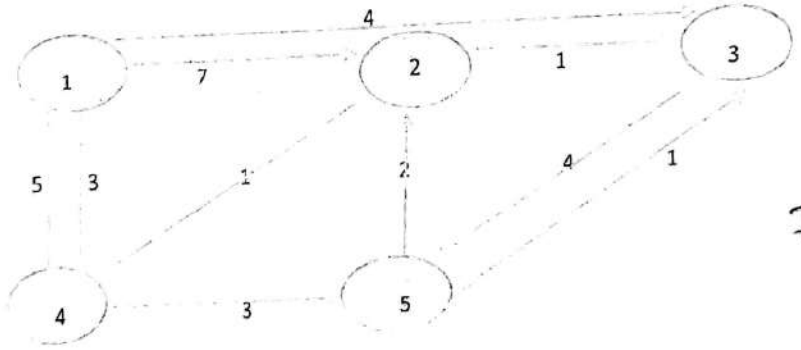
Q2. (a) Sort the following using the Quick sort and write the algorithm of the quick sort.

5, 17, 10, 20, 50, 45, 55,33,,32

(b) Write the algorithm of the Heap sort and sort the following series.

16, 14, 20, 2, 19, 55, 40,52,45

Q3. Find the shortest Path first using a Dijkestra Algorithm.



Q4) Define complete binary tree, full binary tree and complete binary tree and not a complete binary tree.

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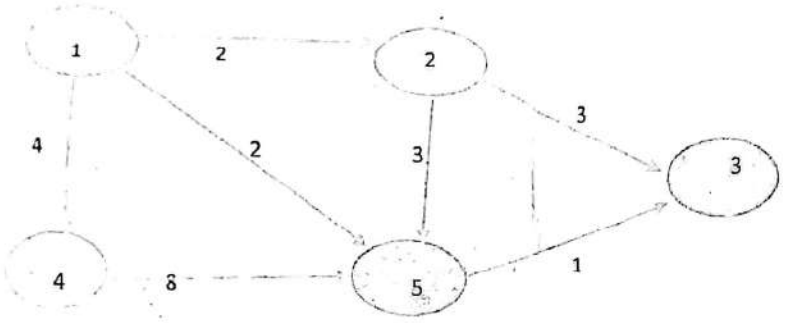
Q4. Applying Bellman Ford algorithm.



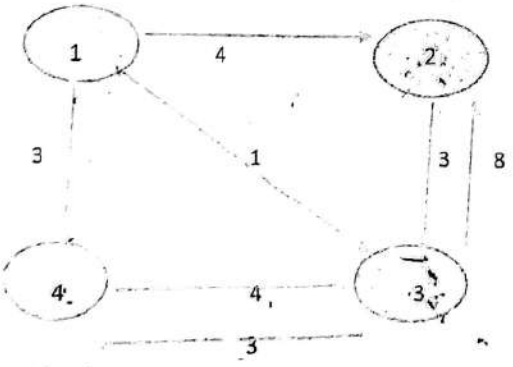
2-2
3-3
4-4
5-2

Q5. Using Huffman coding to code the following sentence.

PQRSTWEPPQRSRSTTPWE?

148
84

Q6. Find the shortest path using the Floyd warshall Method.



$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} 0 & 4 & 13 & \\ \infty & 0 & 31 & \\ \infty & 8 & 0 & 0 \\ \infty & 12 & 4 & 0 \end{bmatrix} \end{array}$$

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

FIRST YEAR (SOFTWARE ENGINEERING)

FALL SEMESTER EXAMINATION 2020

BATCH 2020-2021

Time: 3.5 Hours (Attempting & Uploading) Dated: 08-02-2021 Max.Marks:60

Discrete Structures – (CT-162)

Instructions: Attempt all Questions
Use diagrammatic representation and assumptions where necessary Borrowing of Calculator is strictly not allowed.

QUESTION#1: (C2)

a) **Translate** in two ways each of these statements into logical expressions using predicates, (3) quantifiers, and logical connectives. First, let the domain consist of the students in your class and second, let it consist of all people.

i) There is a person in your class who cannot swim.

ii) Everyone in your class is friendly.

iii) Some student in your class does not want to be rich.

b) Given the hypothesis: (5) "Linda, a student in this class, owns a red convertible".
"Everyone who owns a red convertible has gotten atleast one speeding ticket".
"Therefore, someone in this class has gotten a speeding ticket."
Clarify your answer with the proper premises, logical expressions and rules. (Assume universe of discourse is all people).

c) **Express** each of these system specifications using predicates, quantifiers, and logical (2) connectives.

i) Whenever there is an active alert, all queued messages are transmitted.

ii) The firewall is in a diagnostic state only if the proxy server is in a diagnostic state.

QUESTION#2: (C3)

a) **Apply** Binary Search Algorithm to find the item 56. (Use insertion sorting) (5)
10,56,15,45,78,44,89,24,6,100

b) Encrypt the message "EXPERIENCE IS A GREAT TEACHER "and then decrypt the (5) obtained cipher text back to plain text by **applying** the function given below: f(p)=(11p+8)mod 26

QUESTION#3: (C3)

a) **Compute** the sequence of pseudorandom numbers using the linear congruential generator (3) $x_{n+1} = (4x_n + 1)$ **mod** 7 with seed $x_0 = 3$.

b) **Compute** the coefficient of $\mathbf{x^{101}}$ in the expansion of $\mathbf{(2-x)^{200}}$. (3) c) **Use** Euclidean algorithm

to find the gcd(9888,6060) (2)
d) **Determine** whether the integers in each of these sets are pairwise relatively prime. (2) i) 21, 34, 55 ii) 14, 17, 85
iii) 25, 41, 49, 64 iv) 17, 18, 19, 23

QUESTION#4: (C2)

a) A bowl contains ten red balls and ten blue balls. A women selects balls at random without looking at them. **Compute** how many balls must she select to be sure of having at least three balls of same color. (3)
b) Determine whether each of these integers is congruent to 3 modulo 7. (4) **i)** 37 **ii)** 66 **iii)** −17 **iv)** −67c)
c) **Express** the statements into logical expression:(Assume universe of discourse by yourself) (3)
i) There is a student in this class who owns a computer.
ii) Every student in this class has been in every building on campus.
iii) The sum of two positive integers is positive.
iv) Every real number except zero has a multiplicative inverse.

QUESTION#5: (C3)

a) Let f be the function from {a,b,c,d} to {1,2,3,4} with f(a)= 4, f(b)=2, f(c)=1 and f(d)= 3. (2) **Determine** whether f is a bijection??
b) **Draw** the truth table of NAND and NOR and also write their symbol. (3) c) **Compute:** (5) i. Prime factorization of 729
ii. gcd(1000,625) and lcm(1000,625). Verify that the product of gcd and lcm of given integers is equal to the product of integers.
iii. -97mod11
iv. which positive integers less than 12 are relative prime to 12?
v. two integers that are congruent to 4 modulo 12.

QUESTION#6: (C2)

a) **Compute** the following double summation. (4) i. ii.

$$\sum_{i=0}^{2}\sum_{j=0}^{3} i^2 j^3 \qquad \sum_{i=0}^{3}\sum_{j=0}^{2} (3i+2j)$$

b) Elaborate the algorithm of linear search. (3) **c) Discuss** the properties of algorithm. (3)