National Institute of Technology, Delhi

End Semester Examination (Spring, 2023)

Branch	**: CSE**	**Semester**	**: IV**
Title of the Course	**: DIGITAL ELECTRONICS & LOGIC DESIGN**	**Course Code**	**: ECB 257**
Time	**: 3 Hours**	**Maximum Marks**	**: 50**

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Understand the basic logic gates and the fundamental conepts and techniques uesed in digital electronics	**Understanding** (Level II)
CO2	To understand and examine the structure of various number systems and their application in digital design.	**Analyzing** (Level IV)
CO3	The ability to understand analyze and design the combinational and sequential circuits.	**Creating** (Level VI)
CO4	ability to identify basic requirements for the design application and propose a cost-effective solution. Identify and prevent various timing problems in digital design.	**Evaluating** (Level V)

Course Outcomes (CO's)	CO1	CO2	CO3	CO4
Questions No.	Q5	Q2	Q1,3,4	Q1,3,5

- **All questions are compulsory.**
- All questions should be answered in the same sequence as mentioned in the paper: You have to answer Q1 first, then Q2, so on, and finally Q 5. **ELSE QUESTIONS SHALL NOT BE EVALUATED.**

Q1. A digital system governing the door of a lift in a 3-floor building is as follows. This system (Fig. 1) has four inputs. Input M=1 indicates that lift is moving, and M= 0 indicates that lift is stationary. Inputs F1, F2, and F3 indicate the floor. These inputs are normally 0 and become 1 if the lift is aligned at that floor level. For example, if the lift is aligned at the level of 1st floor, F1 = 1, F2 = 0, and F3 = 0. The system output is the OPEN signal. It is 0 when the door of the lift cannot **[10]**

be opened and becomes 1 if the lift door can be opened. Design the logic circuit for this digital system.

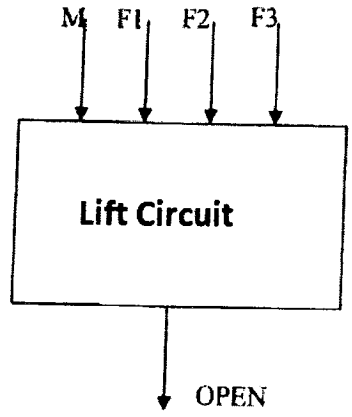


Fig. 1

Q2.

1. An unknown number system with base B is given as $(\sqrt{41})_B=(5)_{10}$. Calculate the value of B. **[5+5]**

2. If $(10W1Z)_2 \times (15)_{10} = (Y01011001)_2$, then find the value of W, Y, and Z.

Q3.

1. Express the function **[5+5]**

$$F=A\odot B\odot C\odot D$$

as the sum of minterms, where $\odot$ denotes the equivalence operation.

2. Implement the given logic using 3 × 8 multiplex

$$F = \sum(0, 1, 2, 3, 4, 10, 11, 14, 15).$$

Q4.

1. Convert JK flip flop into AB flip flop, where the truth table of AB flip flop is given as **[10]**

A	B	Q_{n+1}
0	0	1
0	1	Q_n
1	0	Q_n'
1	1	0

Note: Q_n' denotes complement of Q_n

Q5.

1. Explain race around condition? Suggest at least two methods to overcome race around conditions. **[6+4]**
2. What is meant by a universal gate? Give at least two examples of universal gates along with their truth table and logic circuit diagram.

Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech 2nd year End Semester), 2023

Branch : CSE | Semester: 4th

Title of the Course: Communication System | Course Code: ECB-256

Time: 3 Hours | Maximum Marks: 50

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Introduction of various amplitude modulation and demodulation schemes and analyzing their spectrum using Fourier transform.	Understanding (Level II)
CO2	Analyze the various generation and detection methods of narrow and wideband frequency modulation.	Analyzing (Level IV)
CO3	Understand the concepts of pulse modulation, sampling process, delta modulation and ADCM	Analyzing (Level IV)
C04	Understand the concepts of source coding and data compression techniques, Line coding schemes and analysis of ISI Mitigation Techniques	Evaluating (Level V)

Course Outcomes(CO's)	CO1	CO2	CO3	CO4
Questions No.	Q.1, Q.3	Q.2	Q.4, Q.5, Q.6	Q.7, Q.8

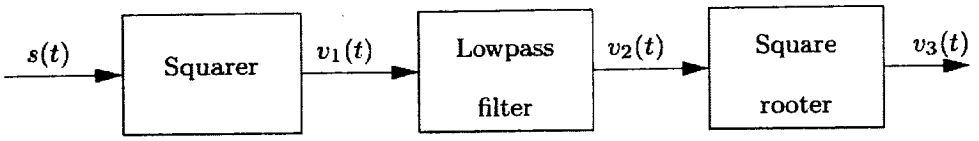
Note: Attempt all questions

Section-1

Q.1 Explain the generation of double sideband suppressed carrier modulated signal (DSB-SC) using a balance modulator, What are its limitation? How can they overcome ? [6]

Q.2 Describe method for threshold improvement in FM discriminator. [6]

Q.3 The AM signal $s(t) = A_c[1 + k_a m(t)]\cos(2\pi f_c t)$ is applied to the system shown in figure below. Assuming that $|kam(t)| < 1$ for all t and $m(t)$ is band limited to $[-W, W]$, and the carrier frequency $f_c > 2W$. Show that $m(t)$ can be obtained from the square rooter output, $V_3(t)$. Find the expression for $V_1(t)$, $V_2(t)$ and $V_3(t)$. Assume the given low pass filter is ideal. [6]



OR

Q.4 In a binary PCM system, the output signal-to-quantizing-noise ratio is to be held to a minimum of 40 dB. Determine the number of required levels, and find the corresponding output signal-to quantizing-noise ratio. [6]

Section-2

Q.5 Explain the Sampling theorem and prove it using the properties of Fourier transform. [8]

Q.6 Describe the delta modulation system. What are its drawback ? How can they overcome ? [8]

Q.7 Consider a (5, 1) linear block code defined by the generator matrix **G** = [1 1 1 1]. [8]

(a) Find the parity-check matrix **H** of the code in systematic form.

(b) Find the encoding table for the linear block code.

(c) What is the minimum distance d_{min} of the code? How many errors can the code detect? How many errors can the code correct?

(d) Find the decoding table for the linear block code (consider single bit errors only).

Q.8 A source emits seven symbols x1, x2, x3,.....x7 with respective probabilities 0.35, 0.3,0.2, 0.1, 0.04, 0.005, and 0.005. Give Huffman coding for these symbols and find the average length of the codewards. [8]

Roll No.:.....

National Institute of Technology Delhi

Name of the Examination: End Sem Examination (May 2023)

Branch: (B.Tech. CSE)
Title of the Course: Theory of Computation

Time: 3 Hours
Note:1. Attempt all questions. **2.** Read all questions carefully **3.** Missing parameters or values may be assumed.

Semester: IV
Course Code: CSL 251
Maximum Marks: 50

Q.No.	1	2	3	4	5	6
C.O.	CO1	CO4	CO4	CO3	CO5	CO2

1. (a) Consider the grammer, (3)
$S \rightarrow aS|aSbS|\epsilon$
This grammer is ambiguous. Show in particular that the string aab has two
   i. Parse trees
   ii. Leftmost derivation

   (b) Suppose the PDA, $P = (\{q,p\},\{0,1\},\{Z_0,X\},\delta,q,Z_0.\{p\})$ has the following transition function (5)

$\delta(q,0,Z_0) = \{(q,XZ_0)\}$
$\delta(q,0,X) = \{(q,XX)\}$
$\delta(q,1,X) = \{(q,X)\}$
$\delta(q,\in,X) = \{p,\in\}$
$\delta(p,\in,X) = \{p,\in\}$
$\delta(p,1,X) = \{(p,XX)\}$
$\delta(p,1,Z_0) = \{p,\in\}$
Starting from the initial ID, (q,w,Z_0), show all the reachable $ID's$ when the input w is,
   i. 0011
   ii. 010

2. (a) Design a PDA to accept each of the following languages.You may accept either by final state or by empty stack, whichever is more convenient. (5)
   i. $\{0^n1^n : n \geq 1\}$.
   ii. The set of all strings of 0's and 1's such that no prefix has more 1's than 0's.
   iii. The set of all strings of 0's and 1's with an equal number of 0's and 1's.

(b) Let P be PDA with empty stack language $L = N(P)$, and suppose that ϵ is not in L. Describe, how would you modify P so that it accepts $L \cup \{\epsilon\}$ by empty stack. (3)

3. (a) Convert grammar, $S \rightarrow 0S1|A$
$A \rightarrow 1A0|S|\epsilon$
to a PDA that accepts the same language by empty stack. (4)

(b) Construct a CNF in GNF equivalent to the CFG where S is the start symbol, (4)
$S \rightarrow AA|a$
$A \rightarrow SS|b$

4. (a) Explain the Pumping Lemma for the context free languages. Let $L = \{a^i b^j c^k | i < j < k\}$ Check through CFL pumping lemma that it is not context free language. (5)

(b) Design Turing Machines for the language: $\{a^n b^n c^n | n > 1\}$. (5)

5. (a) Show the ID's of the Turing machine of Fig. 1 if the input tape contains 000111. (4)

State	Symbol 0	1	X	Y	B
q_0	(q_1, X, R)	–	–	(q_3, Y, R)	–
q_1	$(q_1, 0, R)$	(q_2, Y, L)	–	(q_1, Y, R)	–
q_2	$(q_2, 0, L)$	–	(q_0, X, R)	(q_2, Y, L)	–
q_3	–	–	–	(q_3, Y, R)	(q_4, B, R)
q_4	–	–	–	–	–

Figure 1: A Turing machine to accept $\{0^n 1^n | n \geq 1\}$

(b) Write one of the possible codes for the Turing machine of Fig. 1. (4)

6. (a) Explain the following: (8)
   i. Diagonalization Language
   ii. Classes P and NP of problems

National Institute of Technology, Delhi
Name of the Examination: B. Tech Second Year (AY 2022-2023)
End Semester Examination (Spring Semester)

Branch: **CSE** Semester : IV
Title of the Course : Object Oriented Programming
Course Code : CSB273
Time: 3 Hours **Maximum Marks:50**

Course Matrix (CO Mapping)

	QUE1	QUE2	QUE3			QUE4		QUE5
	1-10	1-5	1)	2)	3)	1)	2)	
Marks	1 Mark each	1 Mark each	5	5	5	5	5	10
CO	CO1	CO1	CO2	CO2	CO2	CO3	CO3	CO3

1=Addressed to small extent
2= Addressed significantly
3= Addressed strongly (major part of course)

Que1: Choose One correct answer. (1 Mark each)

1. Which of the following statements are true about Catch handler?
   1) It must be placed immediately after try block T.
   2) It can have multiple parameters.
   3) There must be only one catch handler for every try block.
   4) There can be multiple catch handler for a try block T.
   5) Generic catch handler can be placed anywhere after try block.
      A. Only 1, 4, 5
      B. Only 1, 2, 3
      C. Only 1, 4
      D. Only 1, 2

2. An exception can be of only built-In type.
   A) True B) False

3. Functions called from within a try block may also throw exception.
   A) True B) False

4. Generic catch handler is represented by _____ .
   A) catch(..,)
   B) catch(---)
   C) catch(...)
   D) catch(void x)

5. The code of statements which may cause abnormal termination of the program should be written under_____ block.
   A) Try
   B) Catch
   C) Throw
   D) Finally

6. Scope resolution operator is used_____ .
   A) to resolve the scope of global variables only
   B) to resolve the scope of functions of the classes only
   C) to resolve scope of global variables as well as functions of the classes
   D) None of these

7. Which of the following is the perfect set of operators that can't be overloaded in CPP ?
   A) +=, ?, :: , >>
   B) >>, <<, ?, *, sizeof()
   C) :: , . , .* , ?:
   D) :: , ->, * , new, delete

8. In case of inheritance where both base and derived class are having constructor and destructor, then which if the following are true ?

   1. Constructors are executed in their order of derivation
   2. Constructors are executed in reverse order of derivation
   3. Destructors are executed in their order of derivation
   4. Destructors are executed in reverse order of derivation

   A) Only 2 ,4
   B) Only 1 , 3
   C) Only 1 , 4
   D) Only 2, 3

9. Which of the followings are true about constructors?

   1. A class can have more than one constructor.
   2. They can be inherited.
   3. Their address can be referred.
   4. Constructors cannot be declared in protected section of the class.
   5. Constructors cannot return values.

   A) Only 1,2,4
   B) 1,2,4,5
   C) 1,3,5
   D) 1,4,5

10. Which of the followings are true about Virtual functions?
   A) They must be non-static member function of the class
   B) They cannot be friends
   C) Constructor Functions cannot be virtual
   D) All of these

Que2 : Find the output of following program code. (1 Mark each)

1.
```
#include<iostream.h>
void Execute(int &x, int y = 200)
{
 int TEMP = x + y;
 x+= TEMP;
 if(y!=200)
 cout<<TEMP<<x<<y"--";
}
int main()
{
 int A=50, B=20;
 cout<<A<<B<<"--";
Execute(A,B);
 cout<<A<<B<<"--";
 return 0;
}
```

2.

```
int main()
{
int i=0,x=0;
for(i=1;i<10;i*=2)
{
   x++;
   cout<<x;
}
cout<<x;
return 0;
}
```

3.

```
int main()
{
int x = 5;

if(x++ == 5)
cout<<"Five"<<endl;
else
if(++x == 6)
cout<<"Six"<<endl;

return 0;
}
```

4.
```
#include<iostream>
using namespace std;
main()
 {
  char s[] = "Fine";
  *s = 'N';
  cout<<s<<endl;
}
```

5.
```
  public class Test {
   public void print(Integer i) {
      System.out.println("Integer");
   }

   public void print(int i) {
      System.out.println("int");
   }

   public void print(long i) {
      System.out.println("long");
   }

   public static void main(String args[]) {
      Test test = new Test();
      test.print(10);
   }
}
```

Que 3: Write a C++ program for the following. (5 Marks each)

1. Write a program to implement Sieve of Eratosthenes algorithm to find prime numbers up to any given number.

   NOTE: It works on a very simple logic of iteratively marking every composite (non-prime) starting from 2. It is done by marking multiple of 2 and then chooses the next greatest numbers which is not marked and mark its multiple and so on.

   Algorithm:
   Step 1: let i=2, the smallest prime number
   Step 2: mark all multiple of 'i' i.e. 2i,3i,4i,... as non-prime
   Step 3: find the next greatest number which is not marked and update value of 'i' to the number chosen
   Step 4: repeat step 3
   Step 5: all the numbers that are not marked are prime numbers.

2. Find the GCD (Greatest Common Divisor) of two numbers using EUCLID'S ALGORITHM

   Euclidean Algorithm for GCD: This algorithm stands on two basic facts :
   i. If we try to decrease the bigger number by subtracting that number by the small then the GCD remains unaffected.
   ii. The base case in our algorithm is when we divide the smaller number and remainder comes out to be zero then algorithm stops.

3. Write C++ Program to Swap Numbers in Cyclic Order Using Call by Reference
   Example : Value before swapping: a=1; b=2; c=3
   Value after swapping numbers in cycle: a=3; b=1; c=2

Que4: Write the source code in C++ for following projects (5 Marks each)

1. Student Report Management System
   This is a simple console app. Through this project, illustrate input/output streams and the file management system of C++. The program should collect student details like name, roll number, marks in each subject, and calculates their grade.

   Note that we focus only on the correct inputs in this project, and you can enhance it to handle wrong inputs.

2. Login and Registration System
   - First give two options for user to register or login?
   - If user wants to register then ask to enter the username and password and store this into a file.
   - If user wants to login, ask the user to enter the username and password. Then check the entered username and password, and print a message that "Invalid username and password" if mismatched ,or "successfully login" if matched.

Que 5: Implement the following using Object Oriented Programming concept. (10 Marks)

"A to Z Fruit Shop" is a growing fruit shop in **DELHI** city. Since they are offering quality and fresh fruits to customers in best price, their customer strength is increasing tremendously. In this regard they need billing software to provide a fast and accurate service. Billing software also supports high to maintain sales data.

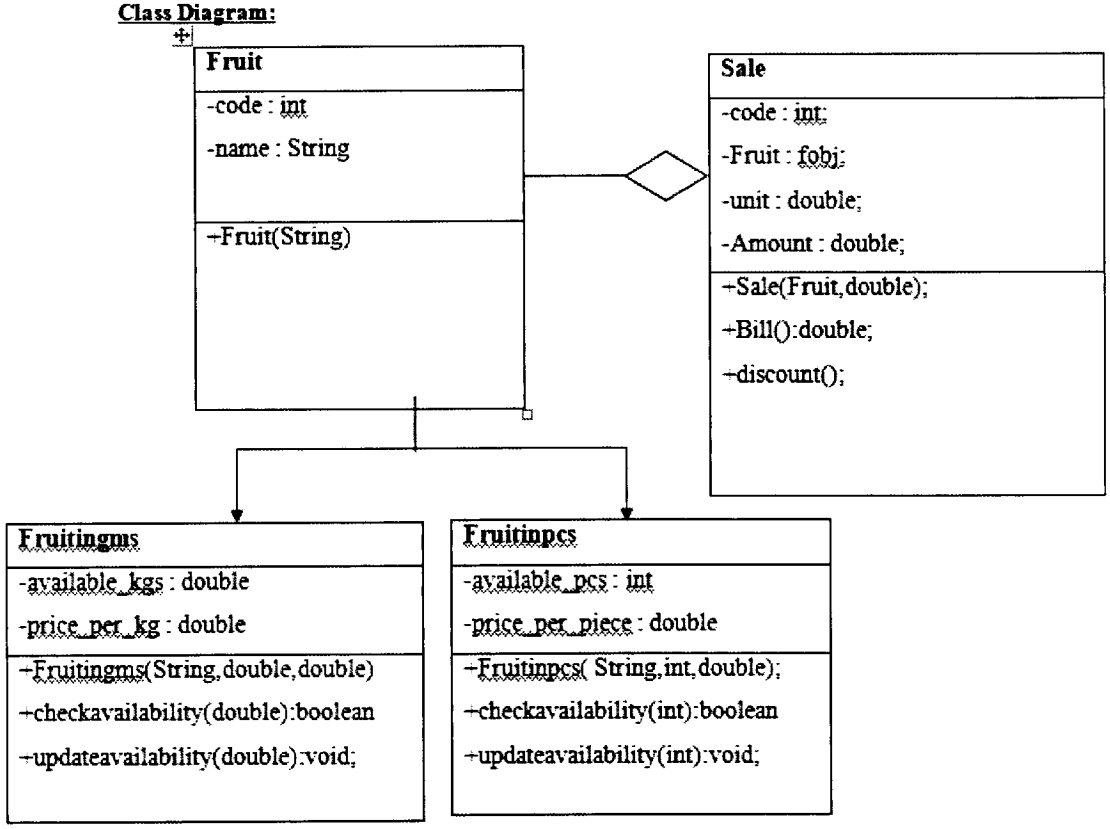
Business Rules:

1. Every item stock should be verified for availability before billing.
2. 5% discount should be provided for purchase more than Rs. 500/-
3. All fruits except banana are selling for price-per-kilo gram.
4. Selling Banana for price-per-piece.

Rules:

1. Don't add additional instance variable in the given class.
2. Do Type conversions wherever it is necessary.

Class Diagram:



Fruitingms Class

- Write constructor method fruitingms() for this class.
- Write Check _availability() method which takes "need" in kilograms as input and returns false if available_kgs is less than "need" else return true.
- Write update_availability () method which takes "need" in kilograms as input and reduce this "need" from available_kgs.

Fruitinpcs Class

- Write constructor method fruitinpcs() for this class.
- Write Check _availability() method which takes "need" in pieces as input and returns false if available_pcs is less than "need" else return true.
- Write update_availability () method which takes "need" in pieces as input and reduce this "need" from available_pcs.

Sale Class

- Constructor for this class
- Bill() method
- Validate availability of fruit before billing
- Calculate amount by product of unit and price
- Provide discount by calling discount() if amount is greater than 500
- Update availability of fruit after billing
- Discount method calculates discount of 5%.

Roll No.:.....

National Institute of Technology, Delhi

End Semester Examination (Spring, 2023)

Branch	**: B. Tech**	**Semester**	**: 4th**
Title of the Course	**: Software Engineering**	**Course Code**	**: CSB 253**
Time	**: 3 Hours**	**Maximum Marks**	**: 50**

Question Paper mapping with CO

Q.No.	1	2	3	4	5 a	6	7	8
Marks	(4+2 =6)	(3+2 =5)	(5+3 =8)	(3+2 =5)	(3+3 =6)	5	(3+2 =5)	(4+2 +4= 10)
CO	CO1	CO2	CO2	CO3	CO3	CO3	CO4	CO4

Q1. a) Distinguish between software verification and software validation. Can one be used in place of the other? Justify your answer. In which phase(s) of the iterative waterfall SDLC are the verification and validation activities performed? **[CO1]** **[4+2]**

b) Explain the following terms

1) Sprints

2) Scrum model

Q2. a) What do you mean by the term phase containment of errors? Why is phase containment of errors is considered to be important? How can phase containment of errors be achieved in a software development project? **[CO2]** **[3+2]**

b) Differentiate between decision table and decision tree with the help of example.

Q3. (a) Enumerate the different types of cohesion that a module in a design might exhibit. Give examples of each. **[CO2]** **[5+3]**

(b) What do you understand by the problems of overspecification, forward reference, and noise in an SRS document?

Q4. (a) Let us consider the following C program: **[CO3]** **[3+2]**

```
main ()
{
 int a, b, c, avg;

 scan ("%d  %d  %d", &a, &b, &c);
 avg = (a+b+c)/3;
 printf ("avg = %d", avg);
}
```

Calculate the Estimated Length, Volume, Effort, Errors and Time using Halstead's.

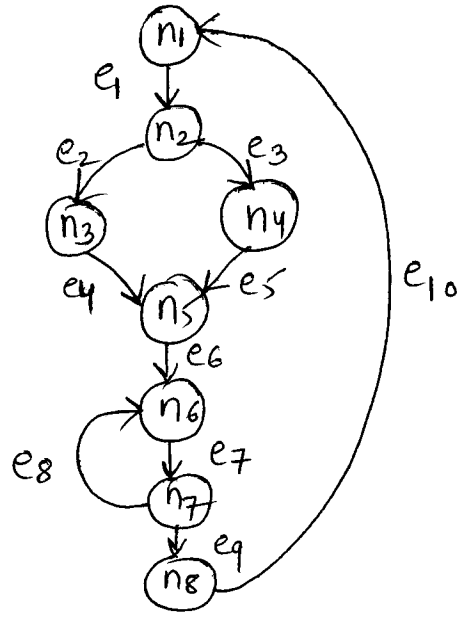
(b) Discuss the advantages and disadvantages of Halstead's software science.

Q5. (a) A software company needs to develop a project that is estimated as 1000 function points and is planning to use JAVA as the programming language whose approximate lines of code per function point is accepted as 50. Considering a = 1.4 as multiplicative factor, b = 1.0 as exponention factor for the basic COCOMO effort equation and c = 3.0 as **[CO3]** **[3]**

multiplicative factor and d = 0.33 as exponention factor for the basic COCOMO duration equation, approximately how long does the project take to complete?

(b) A software project was estimated at 864 Function Points. A six-person team will be assigned to project consisting of a requirement gathering person, two programmers and two testers. The salary of the designer is Rs. 70,000 per month, requirement gatherer is Rs. 50,000 per month, programmer is Rs. 60,000 per month. Average productivity for the team is 12 FP per month. Estimate the cost of the project? [3]

Q6. Find the cyclomatic complexity of the following flow graph of software code. **[CO3]** **[5]**



Q7
a) Prove that branch coverage-based testing technique is a stronger testing technique compared to a statement coverage-based testing technique. **[CO4]** **[3+2]**
b) Briefly highlight the difference between code inspection and code walkthrough. Compare the relative merits and demerits of code inspection and code walkthrough.

Q8.
a) Discuss the various maintainence models in detail. **[CO4]** **[4+2+4]**
b) Differentiate between white box and black box testing.
c) Discuss the following terms
1) Regression Testing
2) Path Testing
3) Data flow and Mutation testing
4) Cause Effect Graphing

Course Matrix (CO-PO-PSO Mapping)

COs	POs													
	PO 1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	2	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	3	-	-	-	-	-	-	-	-	3	3
CO4	2	2	3	3	-	-	-	-	-	-	-	-	2	3

1=Addressed to small extent
2= Addressed significantly
3= Addressed strongly (major part of course)

National Institute of Technology, Delhi
Name of the Examination: Design and Analysis of Algorithms
End Semester Examination (Autumn Semester 2023)

Branch: CSE **Semester: IVth**
Title of the Course: Design and Analysis of Algorithms **Course Code: CSB-252**
Time: 3 hrs **Maximum Marks: 50**

Question Paper mapping with CO

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Marks	3	3	3	3	3	4	4	4	4	4	4	6	6
CO	CO1	CO2	CO2	CO3	CO4	CO1	CO2	CO3	CO3	CO4	CO4	CO3	CO4

Section I: Each question carries 3 marks

Ques 1. In which cases is the time complexity of the radix sort algorithm better than the time complexity of comparison-based sorting algorithms?

Ques 2. Consider an array A = [50, 20, 70, 10, 30, 40, 60]. Perform two iterations of Bubble sort on this array and show the intermediate states of the array after each iteration.

Ques 3. Consider a Binomial Heap with 15 elements. What is the maximum number of trees it can have, and what is the degree of the largest tree?

Ques 4. Given a B-Tree of order m = 5, what is the maximum number of keys and children a single node can have?

Ques 5. How many nodes must be traversed to extract the minimum element from a Fibonacci Heap with n = 10 elements, considering the worst-case scenario?

Ques 6. A Priority Queue is implemented using a Binary Min-Heap with 10 elements. If the smallest element is removed, how many comparisons are needed to restore the Min-Heap property?

Section II: Each question carries 4 marks

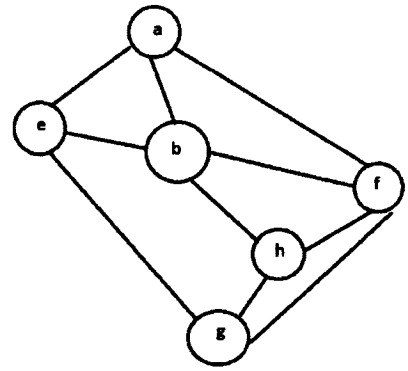
(Note: It is necessary to list every step with justification)

Ques.7 In Rabin-Karp string matching algorithm with working modulo q=11, how many spurious hits does the Rabin-Karp matcher in the text T=3141592653589793, when looking for the pattern P=26.

Ques.8 Consider a B-Tree of order 5 (each node can have a maximum of 5 children). The tree currently contains 123 keys. What is the minimum and maximum number of levels in the tree, and what is the minimum and maximum number of nodes in the tree?

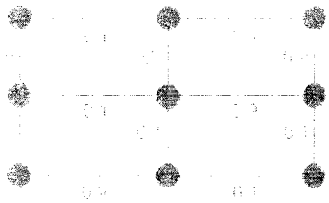
Ques.9 Among the following sequences:

(I) a b e g h f
(II) a b f e h g
(III) a b f h g e
(IV) a f g h b e



Which are the depth-first traversals of the above graph?
(A) I, II, and IV only
(B) I and IV only
(C) II, III, and IV only
(D) I, III, and IV only

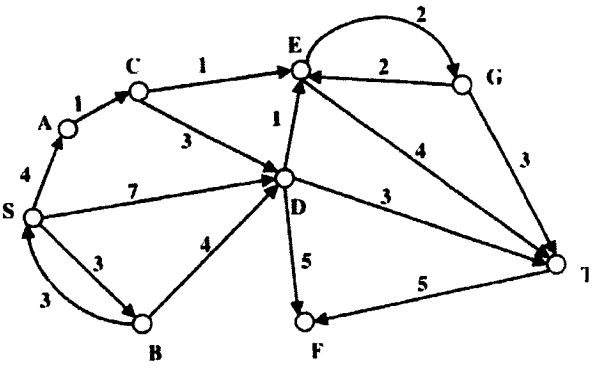
Ques.10 Consider the following undirected graph with edge weights as shown:



Find the number of minimum-weight spanning trees of the graph?

Ques.11 Consider the directed graph shown in the figure below. There are multiple shortest paths between vertices (S) and (T). Which one will be reported by Dijkstra's shortest path algorithm? Assume that, in any iteration, the shortest path to a vertex (v) is updated only when a strictly shorter path to (v) is discovered.

A. SDT
B. SBDT
C. SACDT
D. SACET

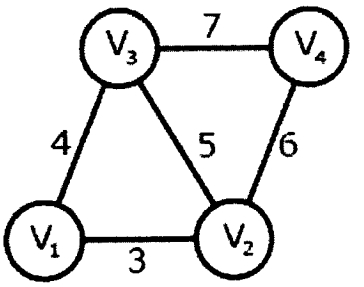


Section III: Each question carries 6 marks

(Note: It is necessary to list every step with justification)

Ques.12

A) An undirected graph G(V, E) contains n (n > 2) nodes named v1 , v2 ,....vn. Two nodes vi , vj are connected if and only if 0 < |i – j| <= 2. Each edge (vi, vj) is assigned a weight i + j. A sample graph with n = 4 is shown below.



Identify the cost of minimum spanning tree (MST) of such a graph with n nodes?

B) Determine the length of the path from v5 to v6 in the MST of previous question with n = 10 is?

Ques.13

A) Consider the following recursive function that takes two arguments

```
unsigned int foo(unsigned int n, unsigned int r) {
 if (n  > 0) return (n%r +  foo (n/r, r ));
 else return 0; }
```

Write the return value of the function foo when it is called as foo(345, 10) ?

B) Consider the same recursive function that takes two arguments

```
unsigned int foo(unsigned int n, unsigned int r) {
 if (n > 0) return (n%r + foo (n/r, r ));
 else return 0; }
```

Write the return value of the function foo when it is called as foo(513, 2) ?

Course Matrix (CO-PO-PSO Mapping)

COs	POs													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3												3	
CO2	3	3												2
CO3	3		3	3										3
CO4	3	2	3										3	

1=Addressed to small extent

2= Addressed significantly

3= Addressed strongly (major part of course)