

2022-23

INTRODUCTION TO COMPUTING

CSC - 01

Full Marks : 60

Time : Three Hours

The figures in the margin indicate full marks.

Answer *all* the questions in order.

Section - A : (Answer All)

1. What is the purpose of the typedef keyword in C?
 - (a) To define a new data type
 - (b) To declare a variable
 - (c) To define a constant
 - (d) To declare a function
2. What is the difference between a postfix and a prefix increment operator in C?
 - (a) The postfix increment operator increments the operand after it is evaluated, while the prefix increment operator increments the operand before it is evaluated.
 - (b) The postfix increment operator increments the operand before it is evaluated, while the prefix increment operator increments the operand after it is evaluated.

P.T.O.

(2)

- (c) There is no difference between the postfix and prefix increment operator in C.
- (d) The postfix increment operator is not valid in C. 1 [CO3]
3. What is the difference between a call by value and a call by reference in C?
- (a) A call by value passes a copy of the value of an argument to a function, while a call by reference passes the memory address of an argument to a function.
- (b) A call by value passes the memory address of an argument to a function, while a call by reference passes a copy of the value of an argument to a function.
- (c) There is no difference between a call by value and a call by reference in C.
- (d) Both a call by value and a call by reference pass a copy of the memory address of an argument to a function. 1 [CO4]
4. How do you initialize an array in C?
- (a) `int arr[3] = (1,2,3);`
- (b) `int arr(3) = {1,2,3};`
- (c) `int arr[3] = {1,2,3};`
- (d) `int arr(3) = (1,2,3);` 1 [CO7]
5. `#include <stdio.h>`
`int main()`
`{`
`int y = 10000;`

(3)

```
int y = 34;
printf("Hello World! %d\n", y);
return 0;
}
```

- (a) Compile time error
- (b) Hello World! 34
- (c) Hello World! 1000
- (d) Hello World! followed by a junk value

1 [CO1]

6. #include <stdio.h>

```
int main()
{
    int i = 0;
    do
    {
        i++;
        if (i == 2)
            continue;
        printf("In while loop");
    } while (i < 2);
    printf("%d\n", i);
}
```

- (a) In while loop 2
- (b) In while loop in while loop 3
- (c) In while loop 3
- (d) Infinite loop

1 [CO4]

P.T.O.

(4)

7. What are the elements present in the array of the following C code?

```
int array[5] = {5};
```

- (a) 5, 5, 5, 5, 5
 - (b) 5, 0, 0, 0, 0
 - (c) 5, (garbage), (garbage), (garbage), (garbage)
 - (d) (garbage), (garbage), (garbage), (garbage)
- 1 [CO7]

8. #include <stdio.h>

```
int main()
{
    int n = 0, m = 0;
    if (n > 0)
        if (m > 0)
            printf("True");
        else
            printf("False");
    return 0;
}
```

- (a) True
 - (b) False
 - (c) No Output will be printed
 - (d) Run Time Error
- 1 [CO4]

9. What will be the output of following program code?

```
#include <stdio.h>
```

(5)

```
int main(void)
{ char p;
  char buf[10] = {1, 2, 3, 4, 5, 6, 9, 8};
  p = (buf + 1)[5];
  printf("%d", p);
  return 0;
}
```

(a) 5

(b) 6

(c) 9

(d) Error

(e) None of the above

1 [CO7]

10. Choose correct statements about C Language Pass By Value.

(a) Pass By Value copies the variable value in one more memory location

(b) Pass By Value does not use Pointers

(c) Pass By Value protects your source or original variables from changes in outside functions or called functions

(d) All the above

1 [CO6]

Section - B : (Answer All)

Find the output for the following codes.

11. #include <stdio.h>
int main() {

P.T.O.

```
int i=713209;
printf("%d\n",printf("%d",printf("%d",i)));
return 0;
}
```

2 [CO5]

12. #include <stdio.h>

```
void main()
```

```
{
```

```
int i;
```

```
i = 10;
```

```
printf("i : %d\n",i);
```

```
printf("sizeof(i++) is: %d\n",sizeof(i++));
```

```
printf("i : %d\n",i);
```

```
}
```

2 [CO3]

13. #include <stdio.h>

```
int main()
```

```
{
```

```
int i = 6;
```

```
if( ((++i < 7) && (i++/6)) || (++i <= 9));
```

```
printf("%d\n",i);
```

```
return 0;
```

```
}
```

2 [CO4]

14. #include <stdio.h>

```
main()
```

```
{
```

```
int i=5;
```

```
printf("%d%d%d%d%d%d", i++, i--, ++i, -i, i);
```

```
}
```

2 [CO3]

15. #include <stdio.h>

```
int main()
```

(7)

```
{
    int i = 0;
    switch (i)
    {
        case '0': printf("Geeks");
            break
        case '1': printf("Quiz");
            break
        default: printf("GeeksQuiz");
    }
    return 0;
}
```

2 [CO4]

16. #include <stdio.h>
int main()
{
 int a=4,b=5,c=6;
 a=b==c;
 printf("\n a=%d", a);
 return 0;
}

2 [CO1]

17. #include <stdio.h>
int main()
{
 signed char chr;
 chr = 128;
 printf("%d\n", chr);
 return 0;
}

2 [CO3]

P.T.O.

18. #include <stdio.h>

void main()

{

int a[3] = {1, 2, 3};

int *p = a;

printf("%p\t%p", p, a);

}

2 [CO7]

19. #include <stdio.h>

void main()

{

char *s= "hello";

char *p = s;

printf("%c\t%c", p[0], s[1]);

}

2 [CO7]

20. #include <stdio.h>

void main()

{

int k = 8;

int m = 7;

k < m ? k = k + 1 : m = m + 1;

printf("%d", k);

}

2 [CO3]

Section - C : Answer any 3 (three)

21. (a) Convert the following numbers from one number system to another.

(i) 33_{10} to binary

(ii) AF_{16} to decimal

(b) Is the '\0' character mandatory in strings? Why?

3+2=5 [CO1, CO7]

22. Write an algorithm and pseudo code for a loop statement that will show the following output :

1

12

123

1234

12345

23. (a) Explain what is pointer to pointer in C with example.

(b) Differentiate between

(i) Variable Declaration and Variable Definition.

(ii) Function Declaration and Function Definition.

With example.

1+4=5 [CO7, CO6]

24. (a) What is the difference between a pointer to an array and array of pointers? Explain with an example.

(b) What are the differences between iteration and recursion? Explain.

2+3=5 [CO7, CO4]

25. (a) Draw a flow chart to represent a program that reads in a number from the user, and then calculates and displays its factorial.

(b) Discuss the scope and lifetime of variables in C.

3+2=5 [CO2, CO3]

P.T.O.

Section - D : Answer any 3 (three)

26. Write a C program to check if it is a palindrome number or not using a recursive method. 5 [CO4]
 27. Write a C program to reverse a number (Do not use arrays). 5 [CO4]
 28. Write a program in C to sort an array of numbers in descending order using call by reference function call. 5 [CO7]
 29. Write a program in C to extract a substring from a given string. 5 [CO7]
 30. Write a program in C to insert a number in an array. 5 [CO7]
-

Course Outcomes :

- CO1 : Identify how simple real life problems can be modelled as computing problems and in turn be solved by programming.
- CO2 : Formulate simple algorithms for arithmetic and logical problems and present them using pseudo-code and flow-charts.
- CO3 : Choose the right data representation formats, operators and expressions based on the requirements of the problem to be solved.
- CO4 : Understand the usage of various programming constructs (especially, conditional branching, iteration and recursion).

- CO5 : Translate the algorithms to programs (in C language), edit, compile, debug, correct, recompile and execute the programs.
- CO6 : Write modular programs by decompose a problem into several user defined functions.
- CO7 : Use arrays, pointers and structures to formulate algorithms and programs to solve computing problems.

Q. No. CSC - 401

196

ND/B.Tech./Even

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2022-23

COMPUTER ORGANIZATION AND ARCHITECTURE

CSC - 401

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Instructions :

- All parts of a question should be answered together.
- Answer the question no. 1 and any *three* from the rest.

1. (a) What is **Von Neumann bottleneck**.

- (b) A CPU has a 32 KB direct mapped cache with 128-byte block size. Suppose A is a two-dimensional array of size 512×512 with elements that occupy 8-bytes each. Consider the following two C code segments, P1 and P2. P1 and P2 are executed independently with the same initial state, namely, the array A is not in the cache and i, j, x are in registers. Let the number of cache misses experienced by P1 and M1 and that for P2 be M2.

Find the value of $M1/M2$.

P.T.O.

```

P1 :
for (i=0; i<512; i++) {
    for (j=0; j<512; j++) {
        x += A[i][j];
    }
}

```

```

P2 :
for (i=0; i<512; i++) {
    for (j=0; j<512; j++) {
        x += A[j][i];
    }
}

```

- (c) In a k-way set associative cache, the cache is divided into v sets, each of which consists of k lines. The lines of a set are placed in sequence one after another. The lines in set s are sequenced before the lines in set (s+1). The main memory blocks are numbered 0 onwards. The main memory block numbered j must be mapped to the cache lines from _____ to _____.

10 [CO4]

2. What is the function of addressing mode in instruction execution? Explain the role of addressing mode to manage the locality of reference?

Consider a hypothetical processor with an instruction of type **LW R1, 20(R2)**, which during execution reads a 32-bit word from memory and stores it in a 32-bit register R1. The effective address of the memory location is obtained by the addition of a constant 20 and the contents of register R2. What is the addressing mode implemented by this instruction for operand in memory? Explain briefly.

5 [CO2]

3. A two-word instruction is stored in memory at an address designated by the symbol W. The address field of the instruction (stored at W + 1) is designated by the symbol Y. The operand used during the execution of the instruction is

(3)

stored at the effective address symbolized by Z. An index register contains the value X. State how Z is calculated from the other addresses if the addressing mode of the instruction is (i) Direct (ii) relative (iii) indexed. 5 [CO1]

4. Consider a 4-way set associative cache (initially empty) with total 16 cache blocks. The main memory consists of 256 blocks and the request for memory blocks is in the following order : 0, 255, 1, 4, 3, 8, 133, 159, 216, 129, 63, 8, 48, 32, 73, 92, 155. Find the memory block which will NOT be in cache and the total number of hit(s) occurred in the cache using least recently used (LRU) page replacement algorithm? 5 [CO4]

5. Consider two cache organizations :

The First one is 32 KB 2-way set associative with 32-byte block size.

The second one is of the same size but direct mapped. The size of an address is 32 bits in both cases. A 2-to-1 multiplexer has a latency of 0.6 ns while a k-bit comparator has a latency of $k/10$ ns. The hit latency of the set associative organization is h_1 while that of the direct mapped one is h_2 . What is the value of h_2 ? 5 [CO4]

6. Explain the 'principles of locality of references'.

A cache is having 60% hit ratio for read operation. Cache access time is 30ns and main memory access time is 100 ns, 50% operations are read operation. What will be the average access time for read operation? 5 [CO4]

P.T.O.

Course Outcomes :

- CO1 : Analyse the various parts of a modern computer functional units, bus structure, addressing modes and computer arithmetic.
- CO2 : Identify the process involved in executing an instruction and fetching the word from memory.
- CO3 : Design the hardwired and micro programmed control units and implementation of interrupts.
- CO4 : Understand the memory hierarchy and design a memory system.

Even Semester Mid Term Examination, 2022-23

Theory of Computation

CSC 402

Full Marks: 25

Time: 1.5 Hr

Instruction: Answer all the questions.

		Marks	Mapping CO
1.i.	Which of the following statements are true? Justify your answer whenever necessary.	6	
	a. $abcd \in L$ where L is defined as $(d^*c^*b^*a^*)^*$.		
	b. Let L_1 be the regular set described as $((ab)^*(ba)^*) \cap ((ba)^*(ab)^*)$. Is $L = \{\epsilon\}$?		
	c. If L_1 and L_2 are regular languages, then so is their symmetric difference $(L_1 - L_2) \cup (L_2 - L_1)$.		
	d. The language of a DFA in which the only final state is the start state is $\{\epsilon\}$.		
	e. The language $\{x \in \{a, b\}^* \mid x \text{ contains odd number of } b\text{'s}\}$ is regular.		
	f. The set of all palindromes is regular.		
1.ii.	Find the set of all minimum length strings defined by the regular expression $a(b+ab)^* + b(a+ba)^*$.	1	
1.iii.	Let L be the regular set defined by the regular expression $(ab+a)^*abb$. Find the regular expression of the language L^R .	1	
1.iv.	Let R be a regular set and $S \subset R$. Is S always a regular set? Justify your answer.	2	

- 1.v. If R be a regular set and $w \in R$. Let $\min(|w|) = 3$, i.e. the minimum length string in R is 3. What could be the minimum number of states for the FSM recognizing the set R ? 1
- 1.vi. Consider the two grammar: $\boxed{\text{GRAMMAR1 } S \rightarrow SS, S \rightarrow ab|ba}$, and $\boxed{\text{GRAMMAR2 } S \rightarrow abS|baS|ab|ba}$. Whether the two grammar generate the same set of strings? Justify your answer. 2
1. vii. If $L_1 = \{a\}$ and $L_2 = \{b\}$, then represent the set $\{a, b, aa, ab, ba, bb\}$ in terms of L_1, L_2 . 1
- 1.viii. Construct the grammar for all binary strings having equal numbers of 1 and 0. 2
2. Let $\Sigma = \{0, 1\}$ and let $L = \{x \in \Sigma^* \mid x \text{ starts with } 00 \text{ but not with } 00\}$ 6
- Write a regular expression to represent L .
 - Design a NFA (or ϵ -NFA) whose language is L .
 - Design a DFA that accepts L .
3. A string $\beta \in \Sigma^*$ is called a prefix of string $\alpha \in \Sigma^*$ if $\alpha = \beta\gamma$ for some $\gamma \in \Sigma^*$. For example, all the prefixes of $abaa$ are $\{\epsilon, a, ab, aba, abaa\}$. Let $L \subset \Sigma^*$ be a language. By $\text{prefix}(L)$, we denote the set of all prefixes of all strings in L . 3
- Let $N_1 = (Q, \Sigma, \delta, s \in Q, F_1)$ be an NFA, and $N_2 = (Q, \Sigma, \delta, s, F_2)$ be the NFA obtained from N by converting every state of N to a final state. Prove or disprove: We must have $L(N_2) = \text{prefix}(L(N_1))$.

2022-23

DESIGN AND ANALYSIS OF ALGORITHMS

CSC - 403

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Attempt any five questions. Write the answer of all the sub-parts of a question together in order. If you design any algorithm, you must also analyse its time complexity.

1. (a) The asymptotic notation O (big ohh) satisfies the transitive property, i.e. if $f(n) \in O(g(n))$ and $g(n) \in O(h(n))$, then $f(n) \in O(h(n))$. Now we know that $2^n \in O(2^{n-1})$, $2^{n-1} \in O(2^{n-2})$, ..., $2^i \in O(2^{i-1})$. The rule of transitivity says that $2^n \in O(2^{i-1})$. We can go extending this, so that finally $2^n \in O(1)$. Do you agree to what has been proved ? If not, where is the fallacy ?

- (b) If $f(n) \in O(g(n))$, then $2^{f(n)} \in O(2^{g(n)})$. If this statement is true, then prove it, otherwise disprove it.

(3+2)=5 [CO1]

2. (a) Solve the recurrence $T(n) = 2T\left(\left\lfloor \sqrt{n} \right\rfloor\right) + \log n$.

- (b) Arrange the following list of functions and arrange them in ascending order of growth rate, i.e. if $g(n)$ immediately

P.T.O.

(2)

follows $f(n)$, then it should be the case that $f(n)$ is $O(g(n))$:

$$f_1(n) = 10^n, f_2(n) = n^{\frac{1}{2}}, f_3(n) = n^n,$$

$$f_4(n) = \log_2 n \text{ and } f_5(n) = 2^{\sqrt{\log_2 n}}$$

(3+2)=5 [CO1, CO4]

3. (a) Why the partition size in “deterministic median finding algorithm” is not taken as 3 ? Explain your answer using recurrence of the time complexity for this problem.
- (b) Given a doubly linked list, that initially consists of one node which contains the integer 0. You are also given as input an array $A[1..n]$ of n integers that are to be processed in the following way. If the current integer x is odd, then append x to the *list*. If it is even, then first append x and then remove all odd elements before x in the *list*. A sketch of an algorithm for this problem is given below

```
for  $j \leftarrow 1$  to  $n$ 
   $x \leftarrow A[j]$ 
  append  $x$  to the list
  if  $x$  is even then
    while  $\text{pred}(x)$  is odd
      delete  $\text{pred}(x)$ 
    end while
  end if
end for
```

Find out the **amortized time complexity** of the above pseudo-code.

(2+3)=5 [CO1, CO2, CO4]

4. (a) How many exact comparisons will be required to find out the second largest element from an array of n elements using an efficient algorithm ? Explain your answer.
- (b) Consider the following recurrence

$$T(n) = aT\left(\frac{n}{b}\right) + f(n)$$

where $a \geq 1$ and $b > 1$ are constants and $f(n)$ is an asymptotically positive function. If $f(n) = O(n^{\log_b a - \epsilon})$ for some constant $\epsilon > 0$, then prove that $T(n) = \theta(n^{\log_b a})$.

2+3=5 [CO1, CO2, CO3]

5. Discuss the Strassen's Matrix multiplication algorithm to multiply two matrices of order $n \times n$. Show the time complexity analysis of the algorithm. 5 [CO1, CO2, CO4]
6. Derive the lower bound for computing the convex hull of n points lying on a 2-Dimensional plane. 5 [CO1, CO2]

Or

Derive the lower bound for any sorting algorithm which sorts the elements by comparison. You may assume that there are n elements in the given array. Does the time complexity of the radix sort or counting sort contradict with the lower bound of sorting algorithm that you have derived ? Explain your answer.

P.T.O.

(4)

7. Design an efficient algorithm to compute the distance of the closest pair among a given set of n points lying on a plane.
5 [CO1, CO2, CO4].
- 8 (a) Given a sorted sequence (increasing order) of n distinct integers $a[1], a[2], a[3], \dots, a[n]$, design and analyse an efficient algorithm to check if there exists an index i such that $a[i] = i$.
- (b) State only the time complexity to multiply two large n bit binary numbers using Karatsuba's algorithm ?
(4+1=5) [CO1, CO2, CO3, CO4].
-

Course Outcomes :

- CO1 : Students will be able to define many important concepts such as asymptotic analysis, dynamic programming, recurrences etc.
- CO2 : Students will be able to describe the key ideas of different algorithm design paradigms
- CO3 : Can apply different algorithmic ideas efficiently to solve new problems.
- CO4 : Students can analyze and understand the time complexity of the algorithms, and its correctness.
- CO5 : Can evaluate the hardness of an algorithm if required.

Q. No. CSC - 404 **193**

ND/B.Tech./Even

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2022-23

OBJECT ORIENTED PROGRAMMING

CSC - 404

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Answer *all* the questions.

Evaluation will be based on Relative Marking.

1. Predict the output for the given programs :

A. using namespace std;

2 [CO1]

```
int x;
```

```
int main ()
```

```
{
```

```
int x = 10;
```

```
cout << "\n Main block";
```

```
cout << "Value of global x is " << ::x;
```

```
cout << "\nValue of x is " << x;
```

```
{
```

```
    cout<< "\nInner block};
```

P.T.O.

(2)

```
cout<<"\nValue of x is "<<x'
cout << "Value of global x is " << ++(::x);
}
cout<<"\n Re-enter Main block";
cout << "Value of global x is " << ::x;
return 0;
}
```

B. #include <isostream>

2 [CO1]

```
#include <iomanip>
```

```
using namespace std;
```

```
int main ()
```

```
{
```

```
    cout.setf (ios :: floatfield, ios :: scientific);
```

```
    cout<<setprecision(5)<<1234.537<<endl;
```

```
    return 0;
```

```
}
```

C. using namespace std;

2 [CO1]

```
int x = 20;
```

```
int main ()
```

```
{
```

```
    int x = 10;
```

(3)

```
if(x == 10)
{
    int x = 5;
    ::x = x;
}
cout << "x" << x << " : : x" << ::x << endl;
}
```

D. #include <iomanip>

2 [CO1]

#include <ios>

#include <iostream>

using namespace std;

int main ()

{

int num = 50;

cout << "Before setting the width : \n"

<< num << endl;

cout << "Setting the width"

<< "using setw to 10 : \n"

<< setw(10);

cout << num << endl;

return 0;

}

P.T.O.

(4)

2. Discuss how 'cin' and 'cout' work? 2+2 [CO1, CO2]
3. Write a C++ code to read a name in First_name<space> Sur_name format. Then display a pyramid pattern using it's characters. You must use iomanip & cstring header files. Try to write a code with a minimum number of statements.

Ex : Input : Anil Kumar

Anilramuk

nilramu

ilram

Ira

r

4 [CO1, CO3]

4. Consider that you have to develop a database for the Department using Object Oriented Design (OOD). Provide a OOD clearly showing the classes, their relationships (is-a, has-a, etc. if any). also mention the attributes and methods in each class. **Your design should have atleast 10 classes with suitable modeling of their relations.** 4 [CO1, CO2]
5. Write a C++ code that allocates 3-D arrays under following assumptions/cases : (use new & delete operators as required) your allocation should ensure flexibility along with minimum space consumption. 6 [CO1, CO2]
 - (a) the number of planes, rows & cols are unknown
 - (b) only the number of planes are unknown
 - (c) only the number of planes & rows are unknown

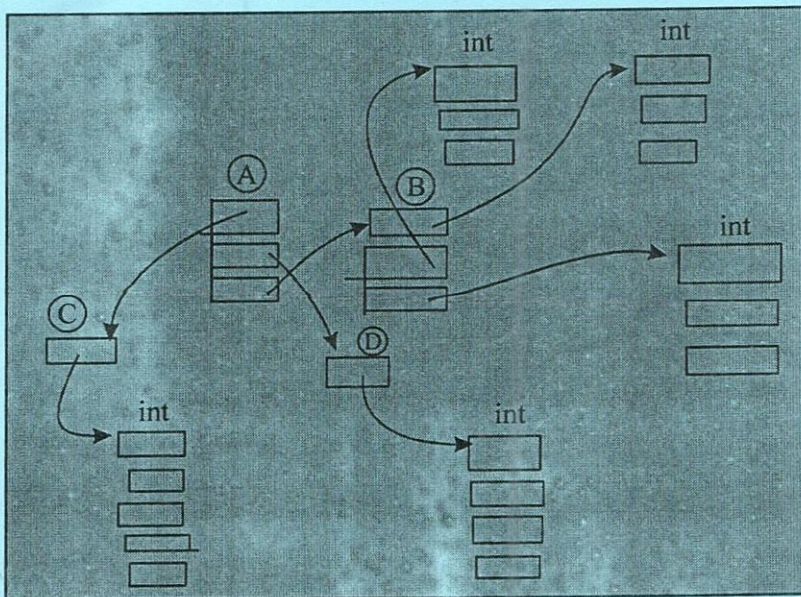
(5)

Write suitable deallocation statements too to avoid garbage. You have to just write the code snippet for allocation and deallocation for each case a, b & c.

6. Write a C++ code where we have to allocate space for a lower triangular matrix. Use dynamic allocation and your code should ensure minimum space usage from the heap.

5 [CO1, CO2]

7. Go through the schematic diagram of allocations. Provide suitable declarations for A, B, C & D. 5 [CO2, CO3]



P.T.O.

Course Outcomes :

- CO1 : Understanding of Object Oriented Design Approach and its real world applications
- CO2 : Analyzing problems in terms of object oriented methodologies.
- CO3 : Implement programs using concepts of classes and objects.
- CO4 : Specify the forms of inheritance and use them in problem solving.
- CO5 : Learn and implement different forms of polymorphism.
- CO6 : Developing skills to write generic codes

Q. No. CSC - 405

0187

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2022-23

SIGNALS AND SYSTEMS

CSC - 405

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Answers *all* the questions.

Write the answers in the order in your answer script.

Graph paper shall be supplied if required.

All symbols used in the question paper have their usual meaning.

1. (a) Define **continuous-time** energy signals and power signals.
- (b) Determine whether the following **discrete-time** signal is an energy signal, power signal, or neither.

$$x(n) = \left(\frac{1}{2}\right)^n u(n)$$

2+3 [CO1]

2. (a) Derive the stability condition of a linear time-invariant (LTI) **continuous-time** system with the impulse response, $h(t)$.
- (b) The impulse response of a **discrete-time** LTI system is given by,

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$$h(n) = \begin{cases} a^n, & \text{for } n \geq 0 \\ b^n, & \text{for } n < 0 \end{cases}$$

Find the range of values of a and b for which the system is stable. 2+3 [CO1]

3. (a) The impulse response of a **continuous-time** LTI system is given by, $h(t) = e^{-at} u(t)$

Determine the step response of the system.

- (b) Define a causal system. 3+2 [CO1]

4. (a) Find the output $y(n)$ of a relaxed **discrete-time** LTI system with impulse response, $h(n) = a^n u(n)$ when the input is unit step signal, $u(n)$

- (b) What do you mean by time-invariant system.

3+2 [CO1]

5. (a) Show that any **discrete-time** signal can be decomposed into an even and an odd component.

- (b) Determine whether or not the following **discrete-time** system is time-invariant:

$$y(n) = \sum_{k=-\infty}^n x(k) \quad \text{2+3 [CO1]}$$

Q. No. CSC - 431

0083

ND/B.Tech./Even

Reg./2022-23

2022-23

DATA STRUCTURE**CSC - 431**

Full Marks : 25

Time : Ninety Minutes

*The figures in the margin indicate full marks.**Answer all the questions.*

1. Define Theta (θ) notation. Prove that $5n^2+17n-5$ is $\theta(n^2)$.
3 [CO1]

2. Write the algorithms to perform insertion and deletion operations in circular queue. 4 [CO2]

3. Write an algorithm to perform 'partition' in quick sort. (Input is given in an array)

Apply your algorithm on the following values and demonstrate the working of the partition algorithm : 15 6 8 19 26 34 7 24 10.

Consider 15 as the pivot element and show the iterations in details. 5 [CO4]

4. Apply the stack-based algorithm to convert the following infix expression into postfix : $K+L-M*N+(O^P)*W/U-T+Q$. Show the contents of the stack during the execution. 5 [CO3]

P.T.O.

(2)

5. Explain the method and write an algorithm to reverse a string using stack. (for example : reverse of STACK is KCATS)

Or,

Explain the method and write an algorithm to check parenthesisbalancing using stack. (Balanced parentheses means that opening brackets and closing brackets maintain proper order logically.) 4 [CO6]

- 6, Derive the time complexity of Binary Search (or 2-way).

Determine whether binary search is more efficient than 3-way (or ternary) search. 4 [CO4]

Course Outcomes :

- CO1 : Understanding the fundamental concepts of data, data types and abstract data types
- CO2 : Implementation of different abstract data types using different data structures
- CO3 : Apply different types of data structures to implement different application problems
- CO4 : Different searching and sorting techniques
- CO5 : Analysis of the suitability/compatibility of different data structures based on the types of applications
- CO6 : Design and development of algorithms for real-life applications.

Q. No. CSC - 432 084

ND/B.Tech./Even

Reg./2022-23

2022-23

DATA STRUCTURES

CSC - 432

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Graph paper shall be supplied, if required.

Section - A

Answer all questions :

1. Answer the following short questions : 10×1
[CO1, CO2, CO3]

(i) Which of the following is a linear data structure ?

(a) Array (b) AVL Trees (c) Binary Trees (d) Graphs

(i) Which of the following is not the type of queue ?

(a) Priority Queue (b) Singular Queue

(c) Circular Queue (d) Ordinary Queue

(iii) When a pop() operation is called on an empty queue, what is the condition called ?

(a) Overflow (b) Syntax error

(c) Underflow (d) Garbage Value

P.T.O.

- (iv) Which of the following data structure allow insertion and deletion from both ends ?
(a) Stack (b) Queue (c) Dequeue (d) String
- (v) Which data structure is mainly used for implementing the recursive algorithm ?
(a) Stack (b) Queue (c) Linked List (d) Graph
- (vi) Which one of the follolwing is the process of inserting an element in the stack ?
(a) Insert (b) Add (c) Push (d) None of these
- (vii) Which of the following is the infix expression ?
(a) $A+B*C$ (b) $+A*BC$ (c) $ABC+*$ (d) None of these
- (viii) If the elements '1', '2', '3' and '4' are inserted in a queue. What would be the order for the removal ?
(a) 1234 (b) 2134 (c) 4321 (d) None of these
- (ix) Which of the following is the time complexity to search an element in the linked list ?
(a) $O(1)$ (b) $O(n)$ (c) $O(\log n)$ (d) $O(n \log n)$
- (x) A mathematical-model with a collection of operations defined on that model is called
(a) Data structure (b) Abstract Data Types
(c) Primitive Data Types (d) Algorithm.

(3)

Section - B

Answer any *three* questions : 5×3

2. Convert the infix expression to postfix using stack : 5 [CO3]

$(P-Q)^R + (S+T) * U/V^P$

3. (a) Write the enqueue operation for a circular queue.
(b) How is the ambiguity resolved while implementing the circular queue ? 4+1
4. Assume a linked list is there with five nodes. Write a program to reverse the middle items of the linked list (2nd node to 4th node) excluding the first and last nodes. 5
5. (a) Why time complexity is not expressed with time as a unit ?
(b) Calculate the complexity of the following code :
- (i) function rand_int(n)
 - (ii) begin
 - (iii) x1<-random(1, n)
 - (iv) x2<-random(1, n)
 - (v) if x1+x2=n then
 - (vi) return 2.x1.x2
 - (vii) else
 - (viii) return x1.x.

P.T.O.

(4)

(ix) end if

(x) end

Course Outcomes :

- CO1 : Understanding the fundamental concepts of data, data types, and abstract data types
- CO2 : Implementation of different abstract data types using different data structures
- CO3 : Apply different types of data structures to implement different application problems

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR
Even Semester Mid-term Examination, 2022-23

Course Code: CSC433

Full Marks: 25

Course Name: Data Structure

Time: 90 Mins

Question Paper No.: NITDGP/CSE433/1

Date of Exam:

Instructions: Answer all the questions.

Materials to be supplied: NIL

Question No.	Body of the Question	Marks	Mapped CO
1	<p>Explain the $O(n)$ with the following example. Find the exact value of $f(n)$, where n is the input of the algorithm.</p> <p>Input: arrays A and B of n integers each, and an integer t.</p> <p>Output: Whether or not A or B contains t.</p> <hr/> <pre> for i := 1 to n do if A[i] = t then return TRUE for i := 1 to n do if B[i] = t then return TRUE return FALSE </pre>	3	CO1
2	Write the algorithms to perform insertion and deletion operations in circular queue.	4	CO2
3	Write an algorithm and Analysis of Time Complexity (find the exact value of $f(n)$) of Bubble Sort when numbers are already sorted.	5	CO4
4	Apply the stack-based algorithm to convert the following infix expression into postfix: $A - B + M * N + (O^P) * W / U - T + Q$. Show the contents of the stack during the execution.	5	CO3
5	Write an algorithm of Stack using Queue. Show the contents of the queue/Queues during the execution.	4	CO6
6	What is Sparse Matrix and write an algorithm of multiplication of Two Sparse Matrix.	4	CO4

Course Outcomes

- CO1: Understanding the fundamental concepts of data, data types and abstract data types
 CO2: Implementation of different abstract data types using different data structures
 CO3: Apply different types of data structures to implement different application problems
 CO4: Different searching and sorting techniques
 CO5: Analysis of the suitability/compatibility of different data structures based on the types of applications
 CO6: Design and development of algorithms for real-life applications

Q. No. CSC 601/ **225**

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

SOFTWARE ENGINEERING

CSC 601

Full Marks : 25

Time : 90 Minutes

The figures in the margin indicate full marks.

Question No.	Body of the Question	Marks	Mapped CO
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Answer any *five* questions.

(Marks $5 \times 5 = 25$)

1. This model of SDLC has 4 quadrants. Name the model. Draw and explain the model giving the tasks carried out by each quadrant. What unique thing does it handle?

1+3+1 CO1, CO4

2. During Software Requirement analysis, the analyst faces three main types of problems in requirements. Name the three problems. Explain the three problems with examples.

Name the activities in Requirement Engineering process.

0.5+3+1.5 CO1, CO2, CO3

3. Write down the Table of Contents for an SRS document.

What are the characteristics of a good SRS document?

3+2 CO5, CO6

4. (i) When can we use RAD model?.What are its limitations? 1 CO1
- (ii) Which model is not suitable for accommodating any change? 1 CO1
- (i) What is an Entity 1 CO2
- (ii) Which model is an evolutionary model of SDLC? 1 CO1
- (iii) What does an ER Diagram express 1 CO2
5. In a University, there are several departments and each department has a head of department who belongs to Faculty. Department have a name, phone extension, specific mailing address and Students that belong to the department. Students can belong to only one Department at a time and Department can have more than one or no Student.

Students and faculty have names and unique identification numbers, with address, age, gender and other information. Student studies different Courses offered by University. Faculty teaches these *Courses*. In each semester one student can take more than one course and Faculty can teach more than one courses. Faculty members can teach in multiple Departments, Each course can be taught by many faculty members or no one.

Faculty members are also working on multiple research projects. These projects are funded by government and university. One project can have more than one faculty member and one faculty member can work on more than one project.

Question:

For the above University Management System draw the ER diagram.

Identify the entities and show the relationships, with reasons, that may exist between the entities 5 CO2

6. A local telephone company uses a software to process requests for field services. A customer complains of a problem. If on diagnosis it is found that the problem is relatively simple, a single repair action occurs. However if it is a complex problem then multiple repair actions may be required.

Show and explain the Relationship, Cardinality and Modality between data objects, customer and the corresponding repair action (1+2+ 2) CO2

COURSE OUTCOMES

- CO1: How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.
- CO2: An ability to work in one or more significant application domains.
- CO3: Work as an individual and as part of a multidisciplinary team to develop and deliver quality software.
- CO4: Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.

(4)

- CO5: Demonstrate an ability to use the techniques and tools necessary for engineering practice.
 - CO6: To manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals Identify and analyses the common threats in each.
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Even Semester Mid-term Examination, 2022-23

**DATA COMMUNICATION AND COMPUTER
NETWORKS**

CSC 602

Full Marks : 25

The figures in the margin indicate full marks.

Question No.	Body of the Question	Marks	Mapped CO
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Answer Q. No. 1 and any *two* from the rest.

- (a) What are two reasons for using layered protocols? What is one possible disadvantage of using layered protocols? (1+1)
 - (b) Encode the following binary string using Manchester coding: 1001101. (1)
 - (c) A noiseless 4-kHz channel is sampled every 1 msec. What is the maximum data rate? How does the maximum data rate change if the channel is noisy, with a signal-to-noise ratio of 30 dB? (2)
- (a) A bit stream 10011101 is transmitted using the standard CRC method described in the text. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose that the third bit from the left is inverted during transmission. Show that this

error is detected at the receiver's end. Give an example of bit errors in the bit string transmitted that will not be detected by the receiver. (6)

(b) Compare and contrast between a circuit-switched network and a packet-switched network. (4)

3. (a) Explain the reason for moving from the Stop-and-Wait ARQ Protocol to the Go-Back-N ARQ Protocol. Specify what possible actions a sender station takes when (i) a data frame is lost, (ii) a negative acknowledgment is lost in Go-back-n AR. (2+3)

(b) Define framing and the reason for its need. (2)

(c) What are the maximum allowable window sizes in a Go-back-n ARQ and Selective reject ARQ. Why are they different? (3)

4. (a) Explain why collision is an issue in a random access protocol but not in controlled access or channelizing protocols. Can you explain why the vulnerable time in ALOHA depends on frame transmission time (T_{fr}), but in CSMA depends on propagation delay (T_p)? (2+2)

(b) We have a pure ALOHA network with 100 stations. If $T_{fr} = 1 \mu s$, what is the number of frames/s each station can send to achieve the maximum efficiency. (4)

(c) Write the functionalities of the token passing method. (2)

Even Semester Mid-term Examination, 2022-23

DATABASE MANAGEMENT SYSTEM

CSC 631

Full Marks : 25

Time : 90 Minutes

*The figures in the margin indicate full marks.*Answer *all* the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	(i) In 1: N relationship, foreign key is placed in (1*10=10)	1*7= 7	
	(a) In the parent table		
	(b) In the child table		
	(c) Either parent table or child table		
	(d) Either table without specifying parent and child tables		
	(ii) Following which option in relational algebra is correct		
	(a) $r \cap s = r - (r \times s)$		
	(b) $r \cap s = r - (r - s)$		
	(c) $r \cap s = r - (r \cup s)$		
	(d) None of them		

(iii) Which of these statements below is/ are correct?

- (a) SQL permits attribute names to be repeated in the same relation
- (b) SQL query automatically eliminates duplicates
- (c) SQL query will work if there are no indexes on the relations
- (d) None of the above-mentioned

(iv) Let E1 and E2 be two strong entities in an ER diagram with simple valued attributes. R1 and R2 are the two relationships between them, whereas R1 is many to many relationship and R2 is one to many relationship. The minimum number of tables required to represent E1, E2, R1 and R2 in relational model are

- (a) 2
- (b) 4
- (c) 3
- (d) 5

(v) Consider the following three relations in a relational database.

Employee (eid, eName) , Brand(bid, bName), Own(eid , bid) where eid, and bid are primary key in Employee relation and Brand relation respectively.

Which of the following relational algebra expressions return the set of elds who own all the brands?

- (a) $\pi_{eid}(\pi_{eid,bid}(Own) / \pi_{bid}(Brand))$

(b) $\pi_{eid}(\pi_{eid,bid}(Own) / \pi_{bid}(Own))$

(c) $\pi_{eid}((\pi_{eid}(Own) \times \pi_{bid}(Own) / \pi_{bid}(Brand)))$

(d) All the above

(vi) If D_1, D_2, \dots, D_n are the domains in a relational model, then the relation is a subset of

(a) $D_1 + D_2 + \dots + D_n$

(b) $D_1 \times D_2 \times \dots \times D_n$

(c) $D_1 \cap D_2 \cap \dots \cap D_n$

(d) $D_1 \cup D_2 \cup \dots \cup D_n$

(vii) Which of the following indicates the maximum number of entities that can be involved in a relationship?

(a) Minimum cardinality

(b) Maximum cardinality

(c) ERD

(d) Greater Entity Count (GEC)

2. Suppose you are given the following requirements for a simple database for the **National Hockey League (NHL)**:

- the NHL has many teams, each team has a name, a city, a coach, a captain, and a set of players,

- each player belongs to only one team,
- each player has a name, a position (such as left wing or goalie), a skill level and a set of injury records.
- a team captain is also a player.
- a game is played between two teams (referred to as `host_team` and `guest_team`) and has a date and a score

Construct a clean and concise **ER diagram** for the NHL. List your assumptions and clearly indicate the cardinality mappings in your ER diagram. 5

3. Explain with two examples why the set $\{\sigma, \Pi, U, -, X\}$ is called the complete set of relational algebra. 3
4. What is data independence? Explain two types of data independence. 3
5. Explain the term "foreign key" with the help of an example and highlight its importance in the design of databases. 3
6. Consider the following tables in the University database system 4

Department (dept_name, building, budget)

Instructor (ID, name, position, dept_name, salary)

Section (course_id, sec_id, semester, year, building, room_no, time_slot_id)

Course (course_id, course_name, credit, dept_name)

Taught (ID, course_id)

Write relational algebra expressions for the following queries:

(5)

(i) Find the names of all instructors whose department is in the Main building.

(ii) Find the set of all courses taught in the Odd semester of 2020, and in the Even semester of 2021.

(iii) Find the name of all courses taught by Prof. Layek

(iv) Find the details about the courses offered by the CSE department

COURSE OUTCOMES

CO1:

CO2:

CO3:
