NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester Mid-term Examination, 2021-22

Course Code: CSC01 Full Marks: 25

Course Name: INTRODUCTION TO COMPUTING Time: 90 Minutes

Question Paper No.: NITDGP/CSC01/ Date of Exam: 31/05/2022

Instructions: Answer all the questions in order

Qs No.	Answer all questions	Marks	CO
	SECTION: A (Answer any 5)		
1	Determine the 1's complement and 2's complement of the binary number: 11010010.0101	2	CO3
2	Convert: $(1024)_{10} = (?)_2$ and $(1101101100)_2 = (?)_{10}$	2	CO3
3	Write three essential statements (/components) to implement loop.	2	CO4

4	Consider the C program that reads marks obtained in Mid-Term Assessment of Introduction to Computing and prints the percentage of marks obtained. Will this program be able to produce correct output for all possible values of marks obtained? If not, modify the program so that it prints the correct percentage of marks obtained.
	`int main()`
	`{`
	`int marks;`
	`int TOTAL = 30;`
	`float percentage;`
	`printf("Enter the marks obtained\n");`
	`scanf("%d",&marks);`
	`percentage = (marks/TOTAL)*100;`
	`printf("Percentage of marks obtained: %f\n", percentage);`
	`return 0;`
	`}`
		2	CO3, CO5

5	Explain the usage of *'break'* and *'continue'* with suitable examples.	2	CO4
6	Draw a flowchart for computing the summation of first 10 natural numbers.	2	CO1, CO2
	SECTION: B (Answer any 2)		

7	Write a C program to print the following using for-loop:
	`*`
	`+ *`
	`+ * +`
	`+ * + *`
	`+ * + * +`
	`+ * + * + *`
	`+ * + * + * +`
		5	CO2, CO5

8	Write a C program to compute the GCD of two given numbers. Do not use recursion.	5	CO1, CO2, CO5
9	Explain the similarities and differences between if-else-if ladder and switch case with suitable examples.	5	CO4

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.

	SECTION: C		

10	What will be the output of the following program?
	`#include <stdio.h>`
	`main()`
	`{`
	`int a=20,b=10;`
	`{`
	`int a = 0;`
	`int c = a + b;`
	`printf("a = %d b = %d c = %d\n",a,b,c);`
	`}`
	`b = a;`
	`printf("a = %d b = %d\n",a,b);`
	`}`
		1	CO3, CO5

11	What will be the output of the following program?
	`#include <stdio.h>`
	`int main()`
	`{`
	`int i;`
	`if (printf("0"))`
	`i = 3;`
	`else`
	`i = 5;`
	`printf("%d", i);`
	`return 0;`
	`}`
		1	CO3, CO5

12	Which of the following variable declaration is invalid? (a) 2A (b) A2 (c) AA2 (d) A2A	1	CO5

13	What will be the output of the following program?
	`void main()`
	`{`
	`int a=15, b=8, c=16, x, y;`
	`x= a*15+b*10%c;`
	`y=b+5-b+9/3;`
	`printf("x=%d y=%d", x, y);`
	`}`
		1	CO3, CO5

14	What will be the output of the following program?
	`#include<stdio.h>`
	`void main()`
	`{`
	`double k = 0;`
	`for(k=0.0; k<3.0; k++);`
	`printf("%f", k);`
	`}`
		1	CO3, CO5

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC 401 Full Marks: 30

Course Name: Computer Organization and Architecture Time: 90 Minutes

Question Paper No.: NITDGP/CSC401/215 Date of Exam: 25/04/2022

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	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 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
2	Find the expression of throughput for a pipelined processor with 'k' segment pipeline with clock cycle time as 'Tp'. Let there be 'n' tasks to be completed in the pipelined processor.	2	CO5
3	Consider a pipelined processor with the following four stages: The IF, ID and WB stages take one clock cycle each to complete the operation. The number of clock cycles for the EX stage depends on the instruction. The ADD and SUB instructions need 1 clock cycle and the MUL instruction needs 3 clock cycles in the EX stage. Operand forwarding is used in the pipelined processor. What is the number of clock cycles taken to complete the following sequence of instructions? ADD R2, R1, R0 R2 ← R1 + R0 MUL R4, R3, R2 R4 ← R3 * R2 SUB R6, R5, R4 R6 ← R5 - R4	5	CO5
4	A processor has 40 distinct instructions and 24 general purpose registers. A 32-bit instruction word has an opcode, two register operands and an immediate operand. Find the number of bits available for the immediate operand field?	2	CO1
5	Consider a 4-way set associative cache consisting of 128 lines with a line size of 64 words. The CPU generates a 20-bit address of a word in main memory. Find the number of bits in the TAG, LINE and WORD fields.	3	CO4
6	Consider a 4-stage pipeline processor. The number of cycles needed by the four instructions I1, I2, I3, I4 in stages S1, S2, S3, S4 is shown below. What is the number of cycles needed to execute the following loop? For (i=1 to 2) {I1; I2; I3; I4;}. Consider no hazards are there.	5	CO5
7	What is the difference between a hardwired implementation and a microprogrammed implementation of a control unit?	3	CO3
8	What is the distinction between spatial locality and temporal locality? Consider a direct mapped cache with 8 cache blocks (0 – 7). If the memory blocks required are in order (2, 5, 15, 1, 8, 4, 0, 16, 19, 2, 13, 25, 18, 30, 24, 0, 67, 35, 5, 25). What is the hit ratio?	5	CO4

	S1	S2	S3	S4
I1	2	1	1	1
I2	1	3	2	2
I3	1	1	1	3
I4	1	2	2	2

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.
- CO5: Understand Pipelined execution and instruction scheduling.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC402 Full Marks: 30

Course Name: Theory of Computation Time: 90 Minutes

Question Paper No.: Date of Exam: 26/04/2022

Instructions: Answer all the questions.

Q. No.	Body of the Question	Marks	Mapped CO
1	Construct a PDA for the grammar given below: G: S → aAA A → aS| a	5	CO3
2	Convert the PDA constructed above to a PDA accepting by final state.	5	CO3
3	What is a non-deterministic TM? Can it be converted into an equivalent deterministic TM? If yes, explain in brief how it can be done.	5	CO4
4	Design a Turing Machine M to "Decide" the language L = $\{0^n1^n2^n \mid n \geq 0\}$ Using a TM, M' that decides L = $\{0^n1^n \mid n \geq 0\}$, as a subroutine TM.	5	CO4
5	Explain the significance of recursive and recursively enumerable sets w.r.t. the halting problem of TM, with examples.	5	CO5
6	We know that CFLs are not closed under complement. let L = {ww | w ∈ {a, b}*}. L is not a CFL. Prove that ~L is however a CFL, by constructing a NPDA, M such that L(M)=~L. {~L denotes complement of L}	5	CO3

Course Outcomes
CO1: Explain the concept of regular languages through regular expressions and finite automata.
CO2: Describe context-free languages and context free grammars.
CO3: Design grammars and automata for various languages.
CO4: Examine the power of Turing machines and design TM for simple problems.
CO5: Analyze the concept of undecidability in the context of Turing machine design.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC 403 Full Marks: 30

Course Name: Design and Analysis of Algorithms Time: 90 Minutes

Question Paper No.: NITDGP/CSC 403/3 Date of Exam: 27/04/2022

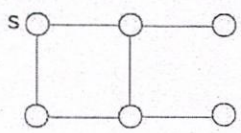
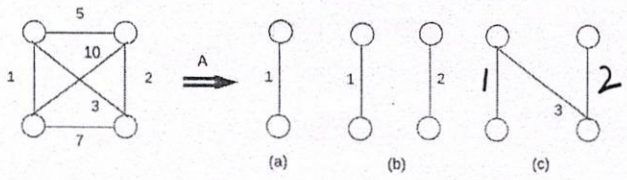
Instructions: Answer any 15 questions.

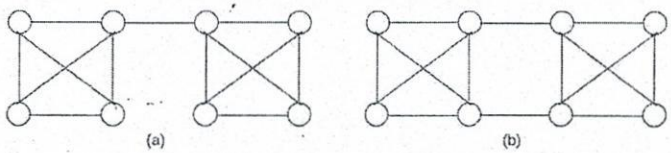
Materials to be supplied: NIL.

Question No.	Body of the Question	Marks	Mapped CO

1.	Consider the following loop:
	j = 0
	p=k
	for (i = 1 to n)
	while (i < k and k≠0)
	j = j + 1
	k = k-1
	k=p
	Here, k is a constant. In this code segment is amortized analysis necessary? Justify.
		2	CO1, CO4

2.	Why, in amortized analysis, it is essential to show $\emptyset(D_i) \geq 0$? i.e potential of the data structure having non-negative cost.	2	CO1, CO4
3.	Consider the expression: $\sum_{i=1}^{n} \widehat{c_i} = \sum_{i=1}^{n} (c_i + \emptyset(D_i) - \emptyset(D_{i-1})$ Where $\widehat{c_i}$ is the amortized cost and c_i is the actual cost in potential method. Simplify this equation.	2	CO1, CO4
4.	Give a real-life example where amortized analysis could be applied. Describe briefly.	2	CO3
5.	Say, we have some sensors to collect data about an assembly of n persons. After collecting the data we want to retrieve the information about the closest proximity of any two persons during the entire period when the data were collected. You should take into consideration that the data are collected for every 1 s and k samples are collected where k is constant (data of every 1 s is called a sample). You should assume that during 1 s, all the positions of the persons are not	2	CO2,CO3,CO4

Question No.	Body of the Question	Marks	Mapped CO
	changing but it can change in the next 1 s and so on. Design an O($n\ lg\ n$) divide and conquer solution for this problem by applying closest pair finding algorithm.. Describe a brief idea.		
6.	Can you recognize this recurrence? $T(n) = 7\ T(n/2) + \Theta(n^2)$ How does this recurrence come up? Give a brief idea.	2	CO1
7.	In your school days, you have learnt to multiply two n-digit numbers. Can you say what is the time complexity of that (one line you should write for this)? Now, is it possible to reduce the time complexity of multiplying two numbers? Give a brief description of that. Write the recurrence formula.	0.5 + 1.5	CO1, CO2, CO4
8.	Can we define the median only as $i = \lfloor \frac{n+1}{2} \rfloor$? If not, why? What way can you modify the definition? Define the median finding problem as the k^{th} smallest element finding problem.	2	CO1,CO2
9.	Give a real-life application where we need to compute Convex Hull. Describe briefly an algorithm of finding Convex Hull, CH(Q), where Q is a set of points in two dimensions.	2	CO2,CO4
10.	Give a real-life example where depth first search (DFS) can be utilized. Describe briefly, how you can map that problem into a DFS problem.	2	CO2,CO3
11.	Consider the following graph:  Apply BFS and find the shortest path to every other vertex of the graph in terms of number of hops. Source is the vertex s.	2	CO1,CO2
12.	Consider the following graph (weighted) and its solution after applying algorithm A.  	2	CO1,CO2

Question No.	Body of the Question	Marks	Mapped CO
	Identify the algorithm A. What is the time complexity of the algorithm A (briefly describe)?		
13.	Is the Dijkstra's shortest path algorithm a greedy one? Justify. Give a real-life example where Dijkstra's algorithm could be applied. Justify.	2	CO1,CO3
14.	Write the pseudocode of any one of these graph problems: BFS, DFS. Give comments on some important lines of the pseudocode.	2	CO1,CO2
15.	Give a brief sketch of the analysis of Randomized quicksort.	2	CO4,CO5
16.	Consider the following two graphs:  (a) (b) Which graph is more vulnerable? How can you compute this vulnerability using randomized min-cut algorithm? Describe.	2	CO4,CO5
17.	Consider the following two problems and write the recurrences that emerge out of the problems: i) Merge Sort ii) Binary Search Clearly specify the subproblem sizes, number of subproblems to be solved, time required for divide and combine operations.	2	CO2,CO4,CO5

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

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC404 Full Marks: 30

Course Name: Object Oriented Programming Time: 90 Minutes

Question Paper No.: NITDGP/ 132 Date of Exam:

Instructions: Answer all the questions.

SECTION A. 2X10 = [20]

Question No.	Body of the Question	Marks	Mapped CO
1	What are the basic advantages of using Object Oriented Programming over Procedure Oriented Programming?	2	CO1
2	Explain why inline function are preferred over macros?	2	CO1
3	What is the difference between Deep and Shallow copy?	2	CO2
4	Write a **class Circle** which represents a circle by a radius r. Add suitable constructor, destructor and a method to calculate area of the circle.	2	CO2
5	Mention the uses of constructor initializer list with an example.	2	CO2
6	Define a node (to be used for doubly linked lists) class constructor with suitable default arguments.	2	CO2
7	Write a function declaration for an operator overloading function to overload a binary '-' (minus) operator using a member function.	2	CO4
8	Explain with sample code how unary pre-increment and pre-decrement operator overloading is differentiated by compiler.	2	CO4
9	Write a function declaration for an operator overloading function to overload a binary '*' (minus) operator using friend function.	2	CO4
10	"We should prefer passing/returning reference of an object instead of its value" – Justify the statement.	2	CO2

SECTION B. Multiple Choice Questions: 1X10 = [10]

1. Which is a proper function declaration?

   (a) float amount(float a, float b=10.5, float c);
   (b) float amount(float a, float b=10.5, float c=19.5);
   (c) float amount(float a=12.5, float b=10.5, float c);
   (d) none of the above.

2. What happens when an object is passed by reference?
   (a) Destructor is called at end of function
   (b) Destructor is called when called explicitly
   (c) Destructor is not called
   (d) Destructor is called when function is out of scope

3. Polymorphism can be exhibited in form of the following (you may choose multiple options):
   a) Operator overloading
   b) Function overloading
   c) Inline functions
   d) Dynamic binding
   e) Templates
   f) Static declaration
   g) Encapsulation

Course Outcomes
CO1: Apply Object oriented approach to design software.
CO2: Implement programs using classes and objects.
CO3: Specify the forms of inheritance and use them in programs.
CO4: Analyze polymorphic behavior of objects.

4. Consider the equation Z=3*X to overload the * operator which function is used. Z and X are objects of the same class.
   (a) Friend
   (b) virtual
   (c) Member
   (d) None of the above.

5. Which of the following is true about this pointer?
   (a) *this* pointer can be used in non-member function
   (b) It is passed as a hidden argument to all function calls
   (c) It is passed as a hidden argument to all non-static function calls
   (d) It is passed as a hidden argument to all static functions

6. What is the best possible prototype for overloading the << operator (with cascading) for a Class X?
   (a) void operator<<(ostream a, const X & b);
   (b) X & operator<<(ostream & a, const X & b);
   (c) X * operator<<(ostream a, const X & b);
   (d) X operator<<(ostream a, X & b);
   (e) X & operator<<(const ostream a, const X & b);
   (f) X & operator<<(ostream a, const X b);

7. A best equivalence to call_by_value **void func(XYZ a)** can be (select multiple options is available):
   a) void func(XYZ &a)
   b) void func(const XYZ &a)
   c) void func(XYZ const &a)
   d) void func(const XYZ *a)
   e) void func(XYZ & const a)

8. When an object needs to be returned from a function. The following may be true (select multiple options is available) :
   a) The function returns return(*this)
   b) The function returns a local object
   c) The function returns a global object
   d) The function returns a local static object
   e) The function returns return(this)

9. Which of the following statement is correct?
   a) Implicit this pointer, is not passed in friend function
   b) Including this pointer, two arguments are passed in a binary operator function implemented using friend function
   c) Including this pointer, two arguments are passed in an unary operator function implemented using friend function
   d) Excluding this pointer pre-increment operator requires two arguments
   e) Excluding this pointer post-increment operator requires two arguments

10. Which can be used to access class members?

```
class Item{  int a,b;
        public:          getdata(); };
  int main() {
        Item x;
        Item *ptr=&x;
        .....}
```

   (a) *ptr.getdata();
   (b) (*ptr).getdata();
   (c) *ptr->getdata();
   (d) None of the above.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

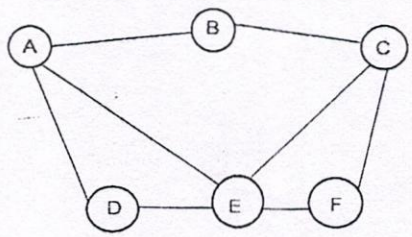
Even Semester End-term Examination, 2021-22

Course Code: CSC431 Full Marks: 30

Course Name: Programming and Data Structure Time: 90 Minutes

Question Paper No.: NITDGP/CS431/1 Date of Exam: 28/04/2022

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	Huffman coding is a lossy data compression scheme. True or False	1	CO1
2	Huffman coding assigns fixed size codes. True or False	1	CO1
3	Huffman coding assigns smaller size code to higher frequent symbols. True or False	1	CO2
4	Uniform frequencies for all symbols makes Huffman code more effective. True or False	1	CO3
5	Define vertex, edge, and path in a graph.	1+1+1	CO1
6	Differentiate DFS and BFS.	2	CO3
7	Differentiate linear and tree indexing.	1	CO3
8	Differentiate separate chaining and open addressing.	2	CO1
9	Draw the expression tree for the following arithmetic expression. A=(P+r/n)^ t	2	CO2
10	Construct Symbols table and draw a Huffman tree for the symbols "Hello World".	2+2	CO3
11	Insert the following sequence of keys in the hash table using open hashing. Hash function A%6. 10, 25, 30, 45, 56, 67. Find the adjacency matrix and adjacency list for the following graph. 	4	CO3

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.

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

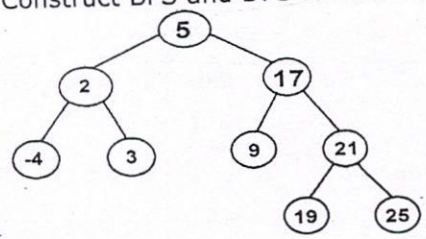
Even Semester End-term Examination, 2021-22

Course Code: CSC431 Full Marks: 30

Course Name: Programming and Data Structure Time: 90 Minutes

Question Paper No.: NITDGP/CS431/1 Date of Exam: 28/04/2022

Instructions: Answer all the questions.

12	Generate linear probing table for the following list of elements. 1, 2, 42, 4, 12, 14, 17, 13, 37	2	CO3
13	Construct BFS and DFS for the following tree. 	2+2	CO3
14	Explain linear indexing with an example.	2	CO1

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.

*** * * Best wishes * * ***

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC 432 Full Marks: 30

Course Name: Data Structure Time: 90 Minutes

Question Paper No.: NITDGP/CSC432/1 Date of Exam: 28/04/2022

Instructions: Answer all the questions.
Materials to be supplied: NA

Question No.	Body of the Question	Marks	Mapped CO
1	Given a list, write a function to swap first and last element of the list Example: **Input :** [12, 35, 9, 56, 24] **Output :** [24, 35, 9, 56, 12]	3	CO1
2	Write a recursive function to check weather an input string is a palindrome or not?	3	CO1
3	Write a pseudo code/function to concatenate two input lists of English words and print them in alphabetical order.	3	CO2
4	Given is a nested tuple. Write a program to modify the first item (22) of a list inside a following tuple to 222. Given: tuple1 = (11, [22, 33], 44, 55) Expected output: tuple1 = (11, [222, 33], 44, 55)	3	CO2
5	Write a pseudo code/flowchart to find the position of a target value within a list using sequential search.	3	CO5
6	Compare and contrast the linearSearch and binarySearch algorithms by searching for numbers 45 and 54 in the following list: (3, 8, 12, 34, 54, 84, 91, 110).	3	CO5
7	a) Write the pseudo code/flowchart/Algorithm for Binary Search. b) What is the basic assumption about the input data to apply Binary search? c) Take an input list and then apply the above code/flowchart/Algorithm for Binary Search to search a particular item from the list. Show each steps of iteration separately. d) Calculate the time complexity of the (a).	5+1+3+3= 12	CO5

Course Outcomes
CO1. Describe linear data structures using array and linked list
CO2. Apply data structures like stacks, queues in linear data structure.
CO3. Discuss non-linear data structures tree and its application.
CO4. Apply various algorithms in graph.
CO5. Solve searching, sorting and hashing techniques in data structures
CO6. Interpret sorting algorithms for a given problem.

Anirban Dutta 07/04/2022.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC433 Full Marks: 30

Course Name: Data Structures Time: 90 Minutes

Question Paper No.: NITDGP/CSE433/1 **Department:** MME Date of Exam:

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	How many solutions are available for a graph having negative weight cycle? a) One solution b) Two solutions c) No solution d) Infinite solutions	1	CO1, CO4,CO3
2	Consider a Singly linked list of the form where F is a pointer to the first element in the linked list and L is the pointer to the last element in the list. The time of which of the following operations depends on the length of the list? i. Delete the Last element of the list ii. Delete the first element of the list iii. Add an element after the last element of the list iv. Interchange the first two elements of the list	2	CO1, CO4,CO3
3	A queue is implemented using an array such that ENQUEUE and DEQUEUE operations are performed efficiently. Which one of the following statements is CORRECT (n refers to the number of items in the queue)? i. Both operations can be performed in O(1) time ii. At most one operation can be performed in O(1) time but the worst case time for the other operation will be $\Omega(n)$ iii. The worst-case time complexity for both operations will be $\Omega(n)$ iv. Worst case time complexity for both operations will be Ω (log n)	2	CO1, CO4,CO3
4	Breadth First Search (BFS) is started on a binary tree beginning from the root vertex. There is a vertex t at a distance four from the root. If t is the n-th vertex in this BFS traversal, then the maximum possible value of n is _____ (a) 15 (b) 16 (c) 31 (d) 32	2	CO3,CO5
5	What does the following function do for a given Linked List with the first node as its head? *void foo(struct node* head)* *{* *if(head != NULL)* *return;* *foo(head->next);* *printf("%d ", head->data);* *}* A.) Prints all nodes of linked lists B.) Prints all nodes of linked list in reverse order C.) Throws an error	2	CO1, CO4,CO3

Course Outcomes
CO1:
CO2:
CO3:

	D.) Nothing will be printed		
6	Suppose we have an empty stack having operations like push, pop and queue having operations like enqueue, dequeue. What will be the value of stack and queue after the following number of operations : *Push(5)* *Push(3)* *Enqueue(1)* *Enqueue(Pop())* *Push(Dequeue())* *Pop()* *Push(8)* *Push(9)* *Dequeue()* *Push(4)* *Pop()* *Enqueue(Pop())* *Enqueue(6)* *Pop()* A.) Stack - 5 8, Queue - 9 B.) Stack - 5 8, Queue - 9 6 C.) Stack - 5, Queue - 9 6 D.) Stack - 5 8 9, Queue - Empty	2	CO1, CO4,CO3
7.	Which of the following data structures is not an efficient way to check whether an arithmetic expression has balanced parentheses? *i.) Stack* *ii.) Queue* *iii.) Tree* *iv.) List* Which of the following is correct? A.) i Only B.) ii Only C.) i, ii, and iii D.) ii, iii, and iv	2	CO1,CO4 , CO5
8	Given the following sequence of letters and asterisks: EAS*Y*QUE***ST***IO*N*** Consider the queue data structure, supporting two operations insert and remove, as discussed in class. Suppose that for the above sequence, each letter (such as E) corresponds to an insert of that letter into the queue and each asterisk (*) corresponds a remove/dequeue operation on the queue. Show the sequence of values returned by the remove/dequeue operations	3	CO1, CO4,CO5
9	Explain the O**(n)** with the following example. Find the exact value of f(n) if you implement using (a) link list (b) array, where n is the input of the algorithm	4	CO4

	Input: arrays A and B of n integers each, and an integer t.
	Output: Whether or not A or B contains t.
	--- 	
	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		

10	Explain the O(**n**) with the following example. Find the exact value of f(n) if you implement using (a) link list (b) array, where n is the input of the algorithm.
	Dijkstra(G,w,s)
	{ % Initialize
	for (each $u \in V$)
	{
	$d[u] = \infty$;
	$color[u]$ =white;
	}
	$d[s] = 0$;
	$pred[s] = NIL$;
	Q = (queue with all vertices);
	while (Non-Empty(Q)) % Process all vertices
	{
	u = Extract-Min(Q); % Find new vertex
	for (each $v \in Adj[u]$)
	if ($d[u] + w(u,v) < d[v]$) % If estimate improves
	{
	$d[v] = d[u] + w(u,v)$; relax
	$pred[v] = u$;
	}
	$color[u]$ =black;
	}
	}
		4	CO4

11	If we assign the **Front=0 and Rear =0** then what problem we will face in circular linked list (Using Array)? Justify your answer with example and picture.	3	CO1, CO4,CO5
12	Tell us one example where edge weight may be negative. How Bellman-Ford Algorithm find the Negative edge cycle?	3	CO1,CO4

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC 601 Full Marks: 30

Course Name: Software Engineering Time: 90 Minutes

Question Paper No.: NITDGP/CSC 601/CSCSE2122 Date of Exam: 18/04/2022

Instructions: Answer any 5 (Five) questions from each group. Answer the questions of one group in continuation at one place.

GROUP A: Answer any 5 (Five) questions		(5X2 = 10 Marks)	
Question No.	Body of the Question	Marks	Mapped CO
1	Briefly explain the Well-formedness rules in Unified Modelling Language (UML)	2	CO1
2	What is association class in UML Class diagram? Explain with example.	2	CO4
3	Define the term "Dependency" relationship in UML with its notation. Give example.	2	CO5
4	Briefly explain different presentation options of "Objects" in UML.	2	CO6
5	What is component? Give example using UML Notation.	2	CO1
6	What is the purpose of Deployment Diagram in UML structural modelling? Give example.	2	CO3
GROUP B: Answer any 5 (Five) questions		**(5X2 = 10 Marks)**	
7	In which type of testing (top-down or bottom up) is stubs used? How is it different from drivers?	2	CO3
8	(a): A system is tested beyond normal operational capacity, often to a break point, then what type of testing is the system subjected to? (b) Name one more testing technique belonging to the same category of non-functional performance testing.	1 1	CO6 CO6
9	What is regression testing? When do you perform regression testing?	2	CO3

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. • 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.

10	These types of programming errors have been detected during data flow testing. Are these errors? If errors, specify the error, if acceptable, write the same. Ku, ud, ku, du	2	CO6
11	In which category (White-box testing or black-box testing) do the following testing techniques fall? (a) Equivalence class testing (b) Unit Testing (c) Path testing (d) Data flow testing	2	CO6
12	In data flow testing which path is prone to error and must be tested? Define the path	2	CO3
GROUP C: Answer any 5 (Five) questions		**(5X2 = 10 Marks)**	
13	What is Decision Tree? Explain With a simple example	2	CO1
14	What is sliding window planning?	2	CO6
15	The size of an organic type software product has been estimated to be 32000 lines of source code. The average salary of a software developer is Rs. 15,000 per month. Determine the effort required to develop the software product, the nominal development time, and the cost to develop the product.	3	CO5
16	What are the metrics for project size estimation? Briefly explain them.	2	CO4
17	Explain the requirement of Decision Table with a suitable example.	2	CO1
18	What is complete COCOMO? How is it different from basic and intermediate COCOMO?	1+1	CO5

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CSC 631 | Full Marks: 30

Course Name: DATABASE MANAGEMENT SYSTEM | Time: 90 Minutes

Question Paper No.: NITDGP/CSC631 | 71 | Date of Exam: 19/04/2022

Instructions: ***Question 1 is compulsory and answer any five questions from the rest***

<table>
<tr><th>Question No.</th><th>Body of the Question</th><th>Marks</th><th>Mapped CO</th></tr>
<tr><td>1</td><td>
a. Consider the following functional dependencies F = {AB→ CD , AF → D , DE → F , C → G, F→ E , G → A}. Find {AB}⁺ and {BG}⁺.
b. Consider a B+ tree in which the maximum number of search keys is 4. What is the minimum number of children and key values in any non-leaf non-root node?
c. An entity set that does not have sufficient attributes to form a key is termed as.....
d. Relations produced from ER Model will always be in ..... NF (normal form).
e. Consider the following relations:

<table>
<tr><th colspan="2">Student</th></tr>
<tr><th>Roll</th><th>Name</th></tr>
<tr><td>1</td><td>Raj</td></tr>
<tr><td>2</td><td>Rohit</td></tr>
<tr><td>3</td><td>Raj</td></tr>
</table>
<table>
<tr><th colspan="3">Performance</th></tr>
<tr><th>Roll</th><th>CID</th><th>Marks</th></tr>
<tr><td>1</td><td>Math</td><td>80</td></tr>
<tr><td>1</td><td>English</td><td>70</td></tr>
<tr><td>2</td><td>Math</td><td>75</td></tr>
<tr><td>3</td><td>English</td><td>80</td></tr>
<tr><td>2</td><td>Bio</td><td>65</td></tr>
<tr><td>3</td><td>Math</td><td>80</td></tr>
</table>

SQL query is as follows:
SELECT S. Name, sum (P. Marks) FROM Student S, Performance P
WHERE S.Roll = P.Roll GROUP BY S.Name

How many rows will be returned by the above SQL query?
</td><td>1*5=5</td><td>CO1, CO2, CO3</td></tr>
<tr><td>2.</td><td>
(i) Define Boyce- Codd's normal form. How does it differ from 3 NF?
(ii) Consider the relation R (A, B, C, D) and the set of functional dependencies that hold on it as {{AB → CD}, {D → B}}. (a) Is R in 3 NF? (b) Is the relation in BCNF? (c) If not, decompose it into a set of BCNF decomposition.
</td><td>2+3=5</td><td>CO1, CO2</td></tr>
<tr><td>3.</td><td>
(i) Consider a relation R = { A, B, C, D, E, F, G, H, I, J} and the set of functional dependencies

F= {{ AB → C }, {A → DE} , { B → F}, {F → GH} , {D → I J} }.

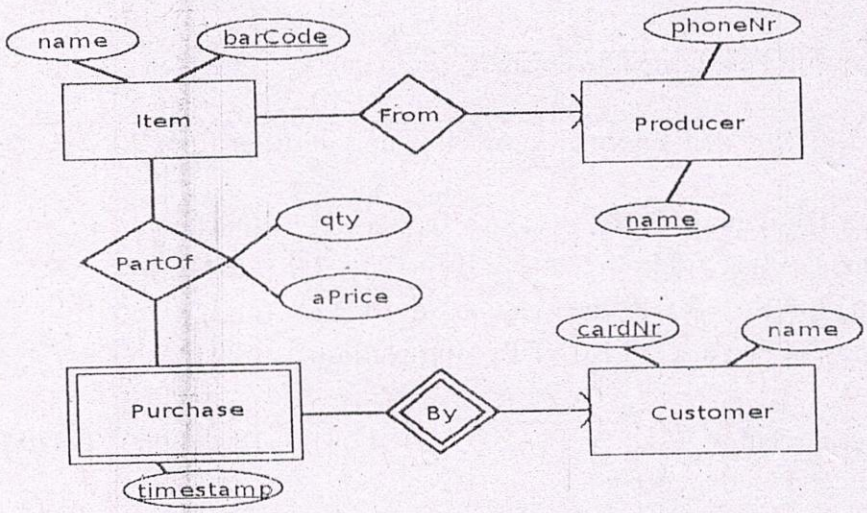
What is the key for R? Decompose R into 2 NF if it is not in 2 NF.
</td><td>3 +2=5</td><td>CO1, CO2</td></tr>
</table>

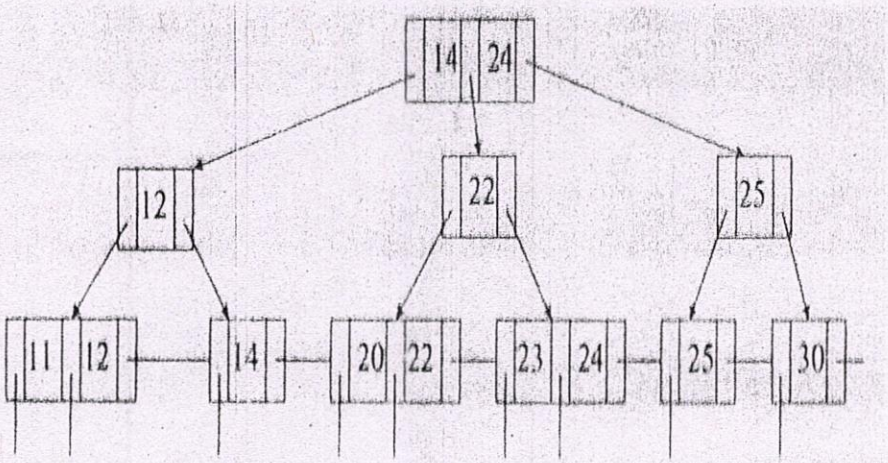
(ii) Consider the following relation :

A	B	C	TUPLE #
10	b1	c1	#1
10	b2	c2	#2
11	b4	c1	#3
12	b3	c4	#4
13	b1	c1	#5
14	b3	c4	#6

Given the above state, which of the following dependencies may hold in the above relation? If the dependency cannot hold, explain why *by specifying the tuples that cause the violation.*

(a) $A \rightarrow B$, (b) $B \rightarrow C$, (c) $C \rightarrow B$, (d) $B \rightarrow A$

4.	(i) Explain the distinctions among the terms primary key, super key, and candidate key. Let the Relation R (A, B, C, D) with FD set {A->BC, B->A, A->C, A->D, D->A}. How many **candidate keys** will be there in R? And also identify them. (ii) Use Armstrong's axioms to prove the soundness of the **union rule** and **pseudo transitivity rule.**	2+3=5	CO1, CO2
5.	The below ER diagram is used by a store to keep track of its sales. Translate the ER diagram into a set of relations. Marks keys and references in your answer. 	5	CO2
6.	Consider a disk with block size B= 512 bytes. A block pointer is P = 6 bytes long and a record pointer is P_r = 7 bytes long. A file has r =	5	C01,C 03

	30,000 EMPLOYEE records of fixed length. Each record has the following fields: NAME (30 bytes), SSN (9 bytes), DEPARTMENT CODE (9 bytes), ADDRESS (40 bytes), PHONE (9 bytes), BIRTHDATE (8 bytes), SEX (1 byte), JOB CODE (4 bytes), SALARY (4 bytes). An additional byte is used as a deletion marker. (a) Calculate record size in bytes. (b) Calculate the blocking factor (bfr) and the number of file blocks for storing the records of the file (c) Suppose the file is ordered by the key field SSN and we want to construct the primary index on SSN. Calculate the index blocking factor and the number of index entries in the index file.		
7.	What is the order p of a B+ tree? Consider the following B+ tree with order 3. When we insert element 15, what will be the number of internal nodes and leaf nodes in the resulting tree? Show the steps to justify your answer. 	5	CO1,CO3

Course Objectives:

CO1: Understand the basic concepts and appreciate the applications of database systems
CO2. Comprehend the fundamentals of design principles for the logical design of relational databases
CO3: Apply the query writing skill

Data Communication and Computer Networks
Paper Code: CSC 602
B.Tech/CSE/6th Semester/2021 - 22
Full Marks: 30
Group - A

Choose the correct alternatives of the following: **(1×6)**

1. For which one of the following reasons does Internet Protocol (IP) use the time to- live (TTL) field in the IP datagram header

(a) Ensure packets reach destination within that time, (b) Discard packets that reach later than that time, **(c)** Prevent packets from looping indefinitely, (d) Limit the time for which a packet gets queued in intermediate routers.

2. Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links.

[S1] The computational overhead in link state protocols is higher than in distance vector protocols.
[S2] A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol.
[S3] After a topology change, a link state protocol will converge faster than a distance vector protocol.

Which one of the following is correct about S1, S2, and S3?

(a) S1, S2, and S3 are all true, (b) S1, S2, and S3 are all false, (c) S1 and S2 are true, but S3 is false, **(d)** S1 and S3 are true, but S2 is false.

3. In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are

(a) Last fragment, 2400 and 2789, (b) First fragment, 2400 and 2759, **(c)** Last fragment, 2400 and 2759, (d) Middle fragment, 300 and 689.

4. Consider a source computer(S) transmitting a file of size 10^6 bits to a destination computer(D)over a network of two routers (R_1 and R_2) and three links(L_1, L_2, and L_3). L_1 connects S to R_1; L_2 connects R_1 to R_2; and L_3 connects R_2 to D. Let each link be of length 100 km. Assume signals travel over each link at a speed of 10^8 meters per second. Assume that the link bandwidth on each link is 1Mbps. Let the file be broken down into 1000 packets each of size 1000 bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D?

(a) 1005 ms, (b) 1010 ms, (c) 3000 ms, (d) 3003 ms

5. In the slow start phase of the TCP congestion control algorithm, the size of the congestion window

(a) does not increase, (b) increases linearly, (c) increases quadratically, **(d)** increases exponentially.

6. The transport layer protocols used for real time multimedia, file transfer, DNS and email, respectively are:

(a) TCP, UDP, UDP and TCP, (b) UDP, TCP, TCP and UDP, (c) UDP, TCP, UDP and TCP, (d) TCP, UDP, TCP and UDP.

Group – B

Answer any ***twelve (12)*** questions of the following. (12×2)

7. A network on the Internet has a subnet mask of *255.255.240.0*. What is the maximum number of hosts it can handle?

8. You have just explained the ARP protocol to a friend. When you are all done, he says: *''I've got it. ARP provides a service to the network layer, so it is part of the data link layer.''* What do you say to him?

9. A token bucket scheme is used for traffic shaping. A new token is put into the bucket every 5 µsec. Each token is good for one short packet, which contains 48 bytes of data. What is the maximum sustainable data rate?

10. Imagine that a two-way handshake rather than a three-way handshake were used to set up connections. In other words, the third message was not required. Are deadlocks now possible?

11. In a connection, the value of cwnd is 4000, and the value of rwnd is 5000. The host has sent 3000 bytes, which have not been acknowledged. How many more bytes can be sent?

12. We can create UDP as a reliable protocol, and it is helpful in a challenged environment (Where Internet connection is intermittent)"-Justify your answer with an example.

13. Write down a case where TCP/IP protocol faces a problem without pseudo header.

14. Why IPv6 is preferred than IPv4?

15. Write the keys for understanding the distance vector routing.

16. Define Masking.

17. What is meant by quality of service in a network?

18. How does TCP work? Is UDP better than TCP?

19. Distinguish between static and dynamic routing.

20. Discuss about loop instability problem of distance vector routing.

21. Consider an instance of TCP's Additive Increase Multiplicative Decrease (AIMD) algorithm where the window size at the start of the slow start phase is 2 MSS and the threshold at the start of the first transmission is 16 MSS. Assume that a timeout occurs during the fifth transmission. Find the congestion window size at the end of the ninth transmission.