06378

DIPLOMA IN CIVIL ENGINEERING

Term-End Examination

June, 2013

BCS-042 : ANALYSIS AND DESIGN OF ALGORITHM

Time : 2 hours *Maximum Marks : 50*

Note : *Question number **1** is **compulsory.** Answer **any three** from the rest **(Section -B)***

SECTION-A

1. (a) Put the following classes of algorithms in increasing order of growth : 2

   (i) $0(n)$

   (ii) $0(2^n)$

   (iii) $0\left(\log_2^N\right)$

   (iv) $0(\sqrt{n})$

   (b) Write the names of the following symbols : 3

   (i) θ

   (ii) Ω

   (iii) $\forall$

   (c) Write the values of the followings : 3

   (i) $[4.4]$

   (ii) $[-4.4]$

   (iii) $\log_2(4+16)$

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(d) Write an algorithm for the linear search and analyse its time complexity in best case and worst case consider the following list : 8
15, 10, 20, 5, 3, 12, 2
Apply your Algorithm and show the steps to find an element 12 (i.e key=12) in the list given

(e) Define θ(Theta) Notation. By using Basic definition of θ, show that $3x+5=\theta(x)$ 4

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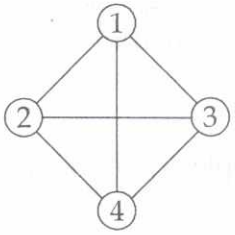
SECTION-B

2. (a) Write a adjacency list and adjacency matrix representation of the following graph : 5



(b) Find the time complexity of the following : 5

```
for (i=1 ; i≤n ; i++)
    i=i*2 ;
```

3. (a) Explain the following terms : 5
   (i) Space complexity
   (ii) Time complexity
   (iii) Recurrence
   (iv) Lower bound
   (v) Combinational problem

   (b) Write a Recurrence Relation for the following Recursive factorial function : 5

```
int FACT (int n)
{
    if(n==1)
        return 1
    else
        return n*FACT(n-1)
}
```

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4. What is an optimization problem ? What are the data structure and functions required to solve optimization problem using Greedy techniques. 10

5. Write a Pseudo code for merge sort algorithm. Apply the merge sort algorithm to sort the following : 10
15, 4, 3, 10, 8, 7, 13, 6
Also write the time complexity of merge sort in worst case.

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No. of Printed Pages : 3

BCS-042

00624

BACHELOR OF COMPUTER APPLICATIONS (Revised)

Term-End Examination

December, 2013

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question number **1** is **compulsory.** Answer **any three** from the rest.*

SECTION - A

1. (a) Put the following classes of algorithms in increasing order of growth. **2**

(i) $O(n \log^n)$

(ii) $O(\log^n)$

(iii) $O(n^2)$

(iv) $O(\sqrt{n})$

(b) Define three most common asymptotic notations and its meanings. **3**

(c) Write the values of the followings **3**

(i) [3.3]

(ii) $log_3 \frac{27}{9}$

(iii) [-3.3]

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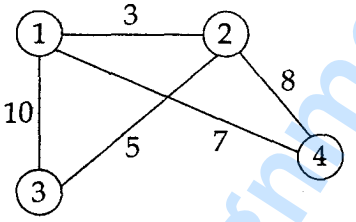
(d) Write binary search algorithm and analyze its time complexity is best and worst case. Apply Binary search algorithm to find the number of comparisions made by the algorithm to search a key value (Say Key =32), in the following list : 5, 10, 15, 20, 25, 30, 32, 35. 8

(e) Define O (Big-'oh') Notation. By using basic definition show that $(3x^2+4x+1)=O(x^2)$ 4

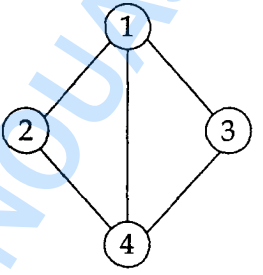
SECTION - B

2. Write a Pseudo - code for prim's Algorithm to find Minimum cost spanning tree. Apply prim's Algorithm and find minimum spanning tree for the following graph (Starting vertex is 1). 10



Also write its Running time of the algorithm used.

3. Write pseudo - code for DFS. Find DFS for the following graph. 10



What is the running time of the algorithm.

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4. (a) Write a Recurrence Relation for the following Recursive function : 5

```
Fib (int n)
{
        if(n==0) return 0
        if(n==1) return 1
        else
        return (Fib(n-1)+Fib(n-2))
}
```

(b) Find the time complexity of the following loop : 5

```
for (i=1; i≤n ; i++)
        i =i * 3
```

5. (a) What is Greedy technique ? What type of problems can be solved by using greedy techniques ? 5

(b) Apply the Quicksort algorithm to sort the given elements. 5, 8, 2, 7, 9, 15, 4 units its time complexity in worst case. 5

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No. of Printed Pages : **3**

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (Revised)

Term-End Examination

June, 2014

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

03619

Time : 2 hours *Maximum Marks : 50*

Note : *(i) Question number **1** is **compulsory.***

*(ii) Answer **any three** from the rest.*

(iii) Pseudo code should be nearer to C-Programming language notation

SECTION - A

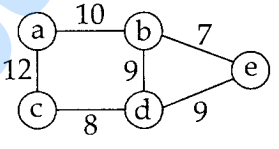
1. (a) Given the following list of 8 integers, sort them using insertion sort. Determine the number of comparisons used by the sorting algorithm as well as the total number of assignment operations. **8**

25	15	7	10	8	12	6	13

Show the process of sorting.

(b) Define Θ (big theta) notation. By using a basic definition show that $5n^2 + 9n - 8 = \Theta(n^2)$. **4**

(c) Draw all the spanning trees of the following weighted connected graph. **3**



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(d) What is recurrence relation ? What is an initial condition ? Define recurrence relation and initial conditions for the followings : 5

(i) Fibonacci sequence

(ii) Factorial function

SECTION - B

2. Define a fractional knapsack problem. Find the optimal solution to the following instance of a knapsack problem. Show step by step running of the algorithm. **10**

Number of object ; $n = 5$

Capacity of knapsack ; $M = 10$

$(P_1, P_2, P_3, P_4, P_5) = (12, 32, 40, 30, 50)$

Where P_i is profit

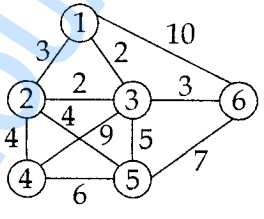
and

$(W_1, W_2, W_3, W_4, W_5) = (4, 8, 2, 6, 1)$

Where W_i - is weight

Each object has a profit P_i and weight W_i. The problem is to fill a knapsack (up to its maximum capacity M) which maximises the total profit earned.

3. Write kruskal's algorithm and apply it to find a MST of the following graph also discuss complexity of the algorithm. **10**



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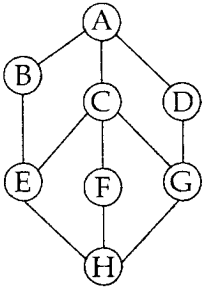
4. (a) Define the following terms : 8
   (i) Mathematical Induction
   (ii) Dynamic programming technique
   (iii) Optimization problem
   (iv) Single source shortest path problem

   (b) What is a complete graph. Draw a complete graph with four vertics. 2

5. (a) For the given graph, write DFS and BFS travel sequence from the node A. 8



   (b) Arrange the following growth rates in increasing order : 2
   $0(3^n)$, $0(n^2)$, 0(1), 0(nlog n)

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS
(Revised)
Term-End Examination

01144 **December, 2014**

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question number **1** is **compulsory**. Answer any **three** from the rest. Pseudo code should be nearer to C-programming language notation.*

SECTION A

1. (i) Given a list of integers (shown below), determine the number of comparisons and assignment operation used by bubble sort to sort the list. Show the process of sorting.

35	8	7	15	25	30	10	12

Perform worst case analysis. *10*

(ii) Prove or disprove the following using the basic definition of O (big Oh) : *2*

$$5n^2 + 8n + 15 = O(n^2)$$

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(iii) Group the following function by complexity category : 2

2^n, n, n!, $\sqrt{n}$, 4n + 12

(iv) Apply DFS and BFS to the complete graph on four vertices. List the vertices in the order they would be visited. 6

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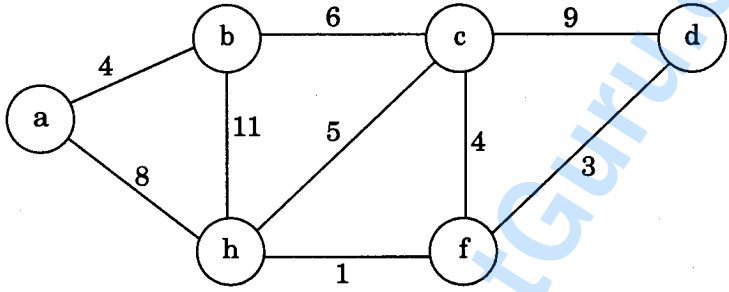
SECTION B

2. Write Prim's algorithm and apply to find minimum cost spanning tree for the following graph : *10*



3. Illustrate the working of binary search tree while searching for the element 14 in the following sorted array :

8	14	20	25	35	45	50	85	95	100

Also analyze the algorithm for best and worst cases. *10*

4. (i) What is recurrence relation ? Write a recurrence equation for any algorithm which follows Divide and Conquer strategy and explain it. *5*

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(ii) Define the following terms : 5

- Backtracking
- Dynamic Programing
- Time Complexity
- Asymptotic Analysis
- Upper Bound

5. (i) Suppose you are given currency notes of all denominations, e.g. (2, 5, 10, 15, 20, 100, 500). Further it is assumed that currency notes of each denomination are available in sufficient numbers for the purpose of using the minimum number of notes. The problem is to find the minimum number of currency notes to make the amount of 437 using the Greedy approach. Show the sequence of steps for selection and rejection of notes. 6

(ii) Define the following terms : 4

- Connected Graphs
- Path
- Cycle
- Tree

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No. of Printed Pages : 3

BCS-042

BACHELOR OF COMPUTER APPLICATIONS
(Revised)

02063 **Term-End Examination**

June, 2015

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question number **1** is **compulsory**. Answer any **three** questions from the rest.*

1. (a) Write an algorithm to compute a^n by left to right binary exponentiation method and illustrate through an example. *6*

(b) Do the complexity analysis of the above algorithm. *4*

(c) Put the following classes of algorithm in the increasing order of growth : *2*

$O(2^n)$, $O(n \log_2 n)$, $O(\log_2 n)$, $O(n)$.

(d) Using the definition of Big Oh, show that *4*

$6n^2 + 20\,n = O(n^3)$.

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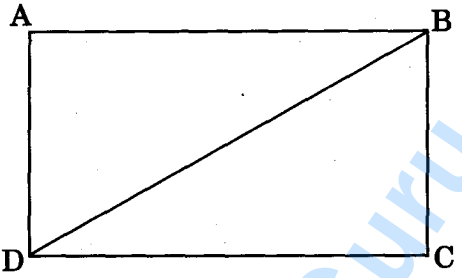
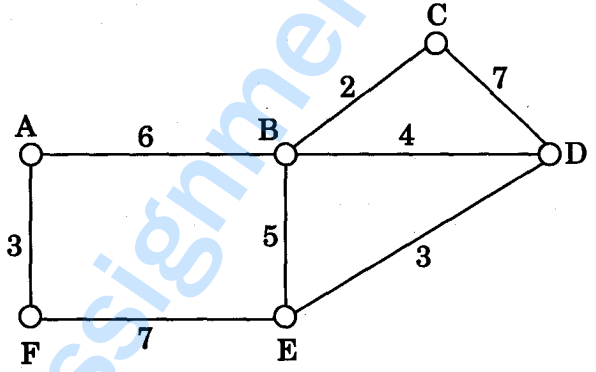
(e) What is the difference between a graph and a tree ? Draw four spanning trees of the following graph : 4



2. Apply Kruskal's algorithm to find a minimum cost spanning tree of the following graph : *10*



3. (a) Apply the Merge Sort algorithm to sort the following list : *6*

15 5 8 7 4 20 25

(b) Describe any two methods of solving the recurrence relation. *4*

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4. Explain the following terms with examples : *10*

(a) Complete graph

(b) Combinatorial problems

(c) Branch and bound technique

(d) Loose bound

(e) Average case

5. (a) Find the optimal solution to the knapsack instance (fractional) : *6*

$n = 5,\ M = 10$

$(P_1, P_2, P_3, P_4, P_5) = (14, 24, 32, 18, 20)$

$(W_1, W_2, W_3, W_4, W_5) = (7, 8, 4, 3, 5)$

(b) What is a single source shortest path problem ? What are the proposed solutions ? *4*

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BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2015

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. **1** is **compulsory**, carrying 20 marks. Answer any **three** questions from the rest.*

1. (a) Using the definition of Ω, show that $6n^2 + 20n \neq \Omega(n^3)$. *4*

(b) Given a list of n distinct integers. Write an algorithm to determine the position of an integer in the list using a linear search and count the number of comparison operations required. *6*

(c) By applying induction method, show that for all positive integers n

$$1^2 + 2^2 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}.$$ *6*

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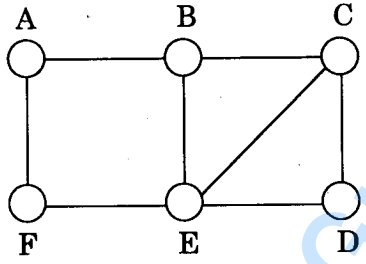
(d) Illustrate the representation of the following graph through adjacency list and adjacency matrix : 4



2. (a) Find the optimal solution to the knapsack (fractional) problem n = 5 and m = 10, where n is the number of objects and m is the capacity of knapsack. 6

Profit and weight of each object are given below :

$(P_1, P_2, P_3, P_4, P_5) = (10, 30, 35, 20, 40)$

$(W_1, W_2, W_3, W_4, W_5) = (3, 5, 2, 6, 1)$.

(b) Write Prim's algorithm to find the minimum cost spanning tree. 4

3. (a) Apply QuickSort to sort the following array. Show all the steps. 6

15	5	10	8	7	2	20	30

(b) What are the worst case and best case in QuickSort algorithm ? 4

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4. Define the following terms : *10*

(a) Optimization

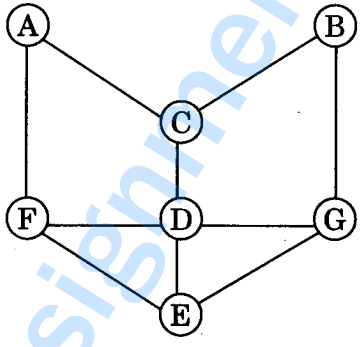
(b) Dynamic programming

(c) Recurrence relation

(d) Asymptotic bounds

(e) Unconnected graph

5. For the given graph, apply DFS traversal scheme and write DFS sequence. Also write the time complexity of DFS and BFS algorithms. *10*



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No. of Printed Pages : 3

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

June, 2016

00006

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. 1 is **compulsory**, carrying 20 marks. Answer any **three** questions from the rest.*

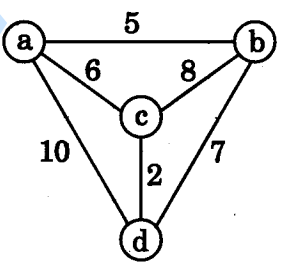
1. (a) What is an algorithm ? Briefly explain time complexity and space complexity of an algorithm. *5*

(b) Define notation Ω (Big Omega). If $f(n) = 2n^3 + 3n^2 + 1$ and $g(n) = 2n^2 + 3$, then show $f(n) = \Omega(g(n))$. *4*

(c) Arrange the following growth rates in increasing order : *2*

$O(n^2)$, $O(3^n)$, $O(n)$, $O(\log n)$

(d) Draw all minimum spanning trees of the following weighted connected graph : *4*



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(e) Write linear search algorithm and explain its best case, worst case and average case time complexity. 5

2. (a) Given the following list of 8 integers, sort them using insertion sort. Determine the number of comparisons required by the algorithm. Also find the total number of assignment operations in this process. 8

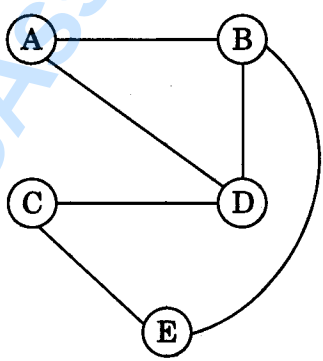
10	7	12	6	8	15	25	11

(b) Write any four characteristics of greedy algorithm. 2

3. (a) What is recurrence relation ? Draw a recursion tree for recurrence

$$T(n) = 2T(n-1) + 1.$$ 4

(b) Write adjacency list and adjacency matrix representation of the following graph : 6



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4. (a) Write binary search algorithm and search the value 28 in the following list, using binary search algorithm and show the steps : 5

1, 7, 18, 27, 28, 30, 39

(b) Write Prim's algorithm for finding minimum spanning tree. Find the complexity of this algorithm. 5

5. (a) Define the following terms : 4

(i) Connected graph

(ii) Cycle in an undirected graph

(b) Consider the following fractional knapsack problem :

M = 20;

Profits

$(P_1, P_2, P_3) = (25, 24, 15)$

$(w_1, w_2, w_3) = (18, 15, 10)$

Show the running of the greedy algorithm for fractional knapsack. 6

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No. of Printed Pages : 3

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2016

00905

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. 1 is* ***compulsory*** *and carries 20 marks. Answer any* ***three*** *questions from the rest.*

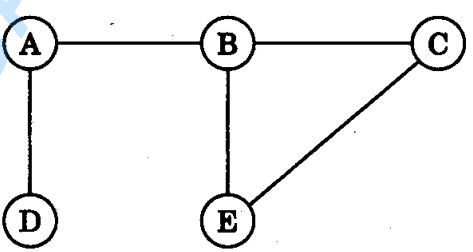
1. (a) Define O (big oh) notation and prove or disprove the following using the basic definition of O (big oh) : *4*

$$2n^3 + n^2 + 10 = O(n^3)$$

(b) Order the following functions in increasing order of O( ) notation : *3*

$$3^n,\ n,\ n!,\ n^2 + 5,\ 2n^2 + 3,\ 5n + 2$$

(c) Traverse the following graph using Depth First Search (DFS), the starting node is A. *5*



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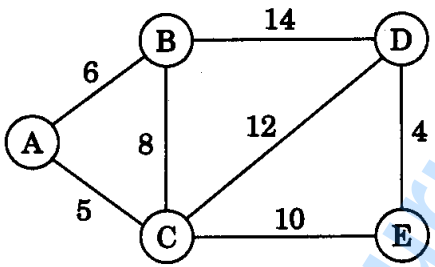
(d) Write Prim's algorithm and apply it to find the minimum cost spanning tree for the following graph : 8



2. (a) What is a recurrence relation ? Define Fibonacci sequence using a recurrence relation. 4

(b) Write bubble sort algorithm and find its time complexity. 6

3. (a) Suppose you are given scoring shots (0, 1, 2, 3, 4, 5, 6); a cricketing batsman can score on one shot. Further it is assumed that there is no limit to a batsman to score on any shot. The problem is to find the minimum number of shots to score 100 runs, using Greedy approach. Show the sequence of steps for selection and rejection of shots. 8

(b) Explain best case and worst case in linear search algorithm. 2

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4. (a) Define the following terms in an undirected graph, where V is the set of vertices and E is the set of edges : 4

(i) Path

(ii) Cycle

(iii) Tree

(iv) Spanning Tree

(b) Sort the following list using Quick-Sort algorithm. Show the intermediate steps in the process : 6

2	8	7	3	5	6	4

5. (a) Define the following terms : 6

(i) Asymptotic lower bound of a function

(ii) Space complexity

(iii) Asymptotic upper bound of a function

(b) Write the general form of a recurrence relation for a divide-and-conquer algorithm and explain the different parts of this recurrence relation. 4

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No. of Printed Pages : 3

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

03931

June, 2017

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. **1** is **compulsory**. Answer any **three** questions from the rest.*

1. (a) Write the linear search algorithm and analyse its time complexity in worst case. *4*

(b) Arrange the following functions in increasing growth order : *2*

(i) $O(n^3)$

(ii) $O(2^n)$

(iii) $O(\log n)$

(iv) $O(\sqrt{n})$

(c) Write the recursive algorithm to calculate x^n using Divide and Conquer. *4*

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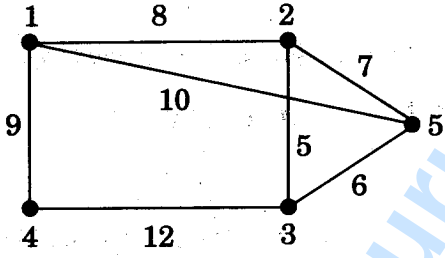
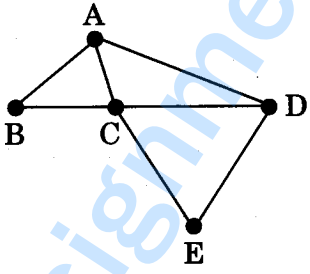
(d) What is Minimum Cost Spanning Tree (MCST) ? Apply Prim's algorithm to find MCST for the following graph : 4

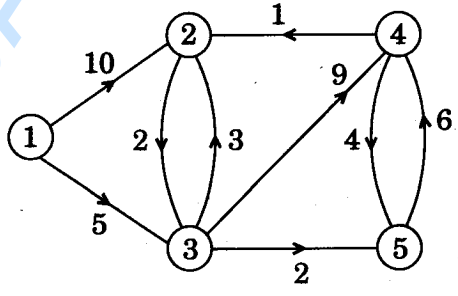


(e) Show that the worst case time complexity of Quick sort is $O(n^2)$, where n is the size of array elements. 3

(f) Create adjacency list for the following graph : 3



2. (a) Apply Dijkstra's algorithm to find the single source shortest path for the following graph : 5



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(b) Apply the Merge sort algorithm to sort the following list : 5

15, 8, 6, 12, 20, 7, 18, 5

3. (a) What is recurrence relation ? Draw a recurrence tree for recurrence

$$T(n) = 3T\left(\frac{n}{2}\right) + n.$$ 5

(b) Write the Breadth First search algorithm and calculate its time complexity. 5

4. (a) Find the time complexity of the following code : 5

```
for (i = 1; i < = n; i ++)
    {
        if (A[i] > B[i])
         print A[i];
    }
```

(b) Find the optimal solution to the fractional knapsack problem for n = 5,

M(capacity of knapsack) = 10 and

$(p_1, p_2, p_3, p_4, p_5) = (12, 32, 40, 30, 50)$

$(w_1, w_2, w_3, w_4, w_5) = (4, 8, 2, 6, 1)$ 5

5. Explain the following terms with examples : 10

(a) Space Complexity

(b) Asymptotic Notation

(c) Binary Search

(d) Master Method for Solving Recurrence

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

03880

Term-End Examination

December, 2017

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. 1 is* ***compulsory.*** *Answer any* ***three*** *questions from the rest.*

1. (a) Arrange the following functions in increasing order of growth rates : *2*

(i) $O(\log n)$

(ii) $O(n^3)$

(iii) $O(5^n)$

(iv) $O(n \log n)$

(b) What is an Algorithm ? Briefly explain the meaning of complexity of an algorithm. *5*

(c) Define O (big oh) notation. Prove or disprove the following : *5*

$$2n^2 + 3n + 1 = O(n^2)$$

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(d) Write a binary search algorithm and analyse its time complexity in best case and in worst case. 5

(e) Create an adjacency matrix for the following graph : 3

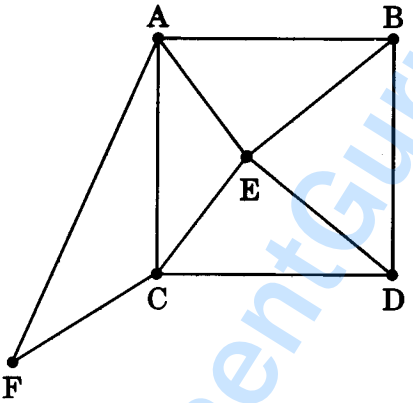

Figure 1

2. (a) Write an algorithm for Depth-First Search (DFS) and traverse the following graph using DFS : (Starting vertex is A) 7

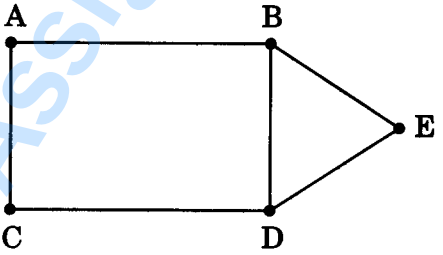

Figure 2

(b) Explain the difference between directed and undirected graphs. 3

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3. (a) Apply the Quick-sort algorithm to sort the following list : 5

5, 9, 8, 4, 2, 15, 6

(b) Find the minimum cost spanning tree from the following graph using Kruskal's algorithm : 5

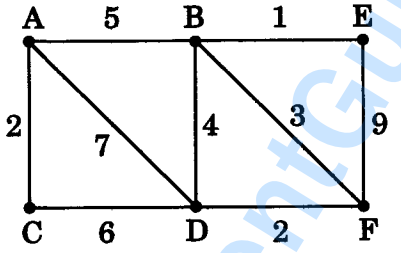

Figure 3

4. (a) By using mathematical induction, prove that

$$P(n) = 1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}.$$

5

(b) Consider the following fractional Knapsack problem :

M = 15 and

$(P_1, P_2, P_3) = (25, 24, 15)$ and

$(W_1, W_2, W_3) = (18, 15, 10)$

Show the running of the greedy algorithm for the fractional Knapsack problem. 5

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5. Explain the following terms with examples : *10*

(a) Combinatorial Problem

(b) Complete Graph

(c) Backtracking

(d) Asymptotic Notations

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No. of Printed Pages : 3

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

June, 2018

01675

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. 1 is* ***compulsory*** *and carries 20 marks. Answer any* ***three*** *questions from the rest.*

1. (a) Define O (Big-"Oh") notation. By using basic definition of O, show that $(3x^2 + 4x + 1) = O(x^2)$. 4

(b) The recurrence relation for Fibonacci sequence is given by $t_n = t_{n-1} + t_{n-2}$, such that $t_0 = 0$ and $t_1 = 1$. Find the solution of this recurrence. 5

(c) Find the optimal solution to the fractional knapsack instance n = 5, capacity(M) = 10;

$(p_1, p_2, ..., p_5) = (12, 32, 40, 30, 50)$

$(w_1, w_2, ..., w_5) = (4, 8, 2, 6, 1)$ 5

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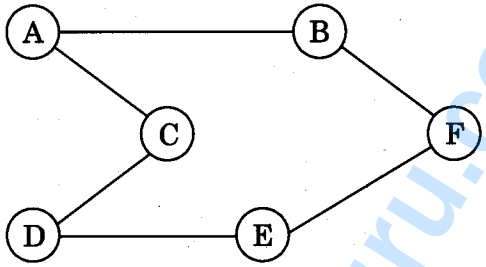
(d) Write Adjacency list and Adjacency matrix representation for the following graph : 3

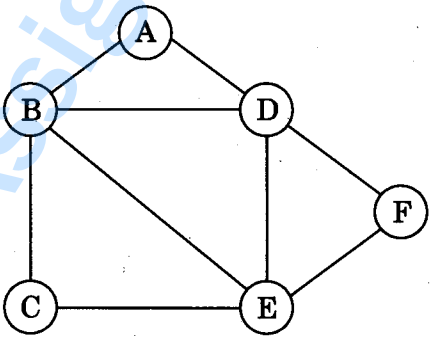


(e) Find time complexity of the following code :

```
for (i = 1; i <= n; i ++)
for (j = 1; j <= n; j = j * 2)
Sum[i] = Sum[i] + i × j.
```

3

2. (a) Differentiate between Depth-First Search (DFS) and Breadth-First Search (BFS) in terms of time and space complexity. Traverse the following graph using (i) DFS, (ii) BFS, the starting node is A. 5



(b) List all the steps to be used to search 30 in the following list using binary search : 5

6 8 10 12 30 32 35

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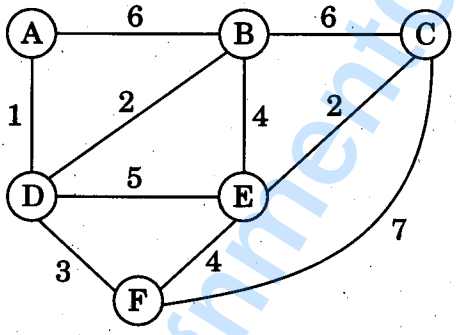
3. (a) Write Quick-sort algorithm and find its time complexity in worst case. 5

(b) Multiply 10265 × 2573 using Divide and Conquer technique. Apply Karatsuba method. 5

4. Write any two applications of spanning tree. Write Prim's algorithm and apply it to find the minimum cost spanning tree for the following graph : 10



5. (a) Write all the (3) cases of Master method for solving Recurrence. Apply Master method to solve the following recurrence : 6

$$T(n) = 3T\left(\frac{n}{4}\right) + n \log n$$

(b) Write algorithm of bubble sort. 4

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

00063

Term-End Examination

December, 2018

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no. 1 is* ***compulsory*** *and carries 20 marks. Answer any* ***three*** *questions from the rest.*

1. (a) Define Ω (Big 'Omega') notation. By using basic definition of Ω show that

$$f(n) = \Omega(g(n)),$$

where $f(n) = 2n^3 + 3n^2 + 1$, and

$$g(n) = 2n^2 + 3.$$ *4*

(b) What is an algorithm ? Explain the meaning of time complexity and space complexity of an algorithm. *6*

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(c) Arrange the following functions in increasing order of growth

n^3, $2n^2 + 3$, $5n + 2$, 5^n, 2^n. 3

(d) Define the following terms : 4

(i) Spanning tree

(ii) Adjacency matrix

(e) Find the time complexity of the following loop : 3

```
for (i = 1; i <= n; i ++)
    {
       i = i * 2;
    }
```

2. (a) Write algorithm to multiply two square matrices of order n × n and find its time complexity. 5

(b) Using Insertion sort, sort the following list and show all the intermediate steps : 5

8 6 4 15 9 25 2

3. (a) Find the optimal solution to the knapsack instance n = 5, capacity M = 15,

$(p_1, p_2, ..., p_5) = (15, 35, 48, 30, 40)$

$(w_1, w_2, ..., w_5) = (4, 8, 5, 6, 2)$. 7

(b) Prove that

$P(n) : 1^2 + 2^2 + ... n^2 = \frac{n(n+1)(2n+1)}{6}$, by using mathematical induction. 3

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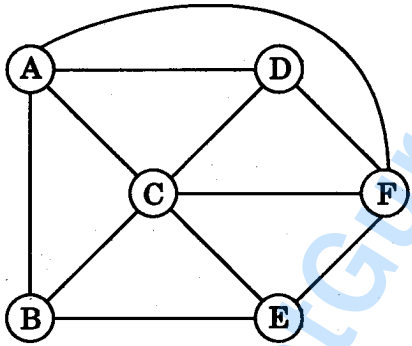
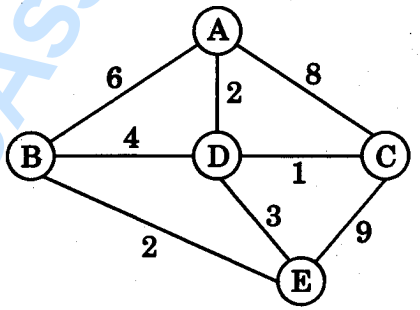
4. (a) Write pseudo code for Breadth-First Search (BFS). Traverse the following graph using BFS, the starting node is A. 7



(b) Solve the following recurrence relation using recursion tree method : 3

$$T(n) = 4T\left(\frac{n}{2}\right) + n$$

5. (a) Write Kruskal's Algorithm to find Minimum Cost Spanning Tree (MCST) of the following graph : 6



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(b) Write an algorithm to search an element (say x) using Binary Search. Analyze its time complexity in worst case. *4*

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS

(BCA) (Revised)

Term-End Examination, 2019

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours] **[Maximum Marks : 50**

Note : Question **no.1 is compulsory.** Attempt **any three** questions from the rest.

1. (a) Arrange the following functions in increasing growth order : [2]

   (i) $0(n^2)$

   (ii) $0(\log n)$

   (iii) $0(2^n)$

   (iv) $0(n \log n)$

   (b) Define θ (Theta) Notation. Let $f(n)$ and $g(n)$ are two Positive Functions. Prove or Disprove the following : [5]

   (i) $f(n) + g(n) = \theta(\min\{f(n), g(n)\})$

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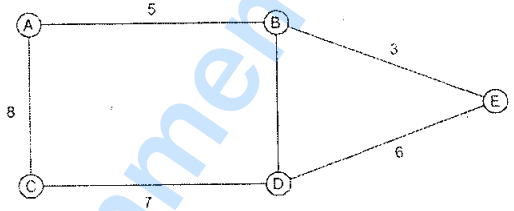
(ii) $3n^2 + 5 = \theta(n^2)$

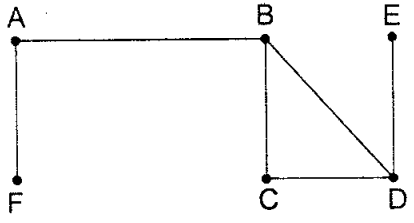
(c) Write Prim's Algorithm to solve the Minimum cost spanning tree (MCST) problem. Analyze the time complexity of the algorithm also. Apply Prim's Algorithm for the following graph and find the Minimum Cost of the Spanning tree. [7]

(Starting Vertex 'A')



(d) Apply Recursion Tree Method to find the asymptotic upper bound for the following Recurrence : $T(n) = 2T\left(\frac{n}{2}\right) + n$ [4]

(e) Create Adjecency list for following graph : [2]



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2. (a) Find the optimal solution to Knapsack (fractional) problem x = 5 and M = 10, where x is the number of objects and M is the capacity of Kanpsack. Profit and weight of each object are given below : [6]

$(P_1, P_2, P_3, P_4, P_5) = (10, 30, 35, 20, 40)$

$(W_1, W_2, W_3, W_4, W_5) = (3, 5, 2, 6, 1)$

(b) Multiply 2432 × 5219 using Divide and Conquer Method (use Karatsaba Method). [4]

3. (a) Apply PARTITION procedure of QUICKSORT for the following array to find the final position of the last element 9 (Pivat element). Show all the intermediate steps. [5]

2	10	15	7	6	20	9

(b) Write DFS algorithm and find its time complexity. [5]

4. (a) Find the complexity of the following code : [3]

```
for (i = 1; i < = nj i++)
{ for (j = 1; j < = n jj++)
```


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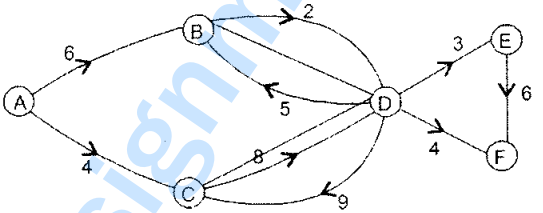
```
{
        if A [ j ] > B [ i ]
        Print A [ j ];
}
}
```

(b) Explain the concept of RELAXING an edge in Dijkstra's Algorithm. Apply Dijkstra's Algorithm to find the shortest path for the following graph. (Starting Vertex is 'A') [7]



5. (a) Write an algorithm to search an element (Say x) Using Binary Search. Analyze the time complexity of the algorithm in Worst Case. [5]

(b) Discuss all the three cases of Master Method to solve the Recurrence T (n) = $aT\left(\frac{n}{b}\right) + f(n)$

Where $a \geq 1$, $b > 1$. [5]

---- x -----

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination, 2019

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours **Maximum Marks : 50**

Note : Question no. 1 is **compulsory**. Answer **any three** questions from the rest.

1. (a) Let f(n) and g(n) are two positive functions, using basic definition of Big Oh ("O") and Theta (θ), prove/disprove the following : [5]

(i) $\max\{f(n), g(n)\} = \theta(f(n) + g(n))$

(ii) $2^n = O(2^{n+1})$

(b) Solve the following Recurrence using Recursion tree method : [5]

$T(n) = 2T(n-1) + 1$

Find tight solution of the Recurrence.

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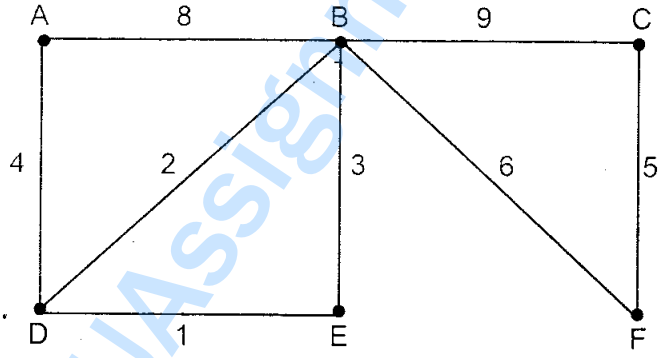
(c) Explain general algorithm to solve any problem using Greedy techniques. Write any two characteristics of Greedy Algorithm. [5]

(d) Write Algorithm to solve Knapsack (fractional) problem using Greedy Method. Find the running time of the algorithm also. [5]

2. (a) Define minimum spanning tree. Apply Kruskal's Algorithm to find minimum cost spanning tree for the following graph : [6]



(b) Write bubble sort algorithm and find its time complexity in worst case. [4]

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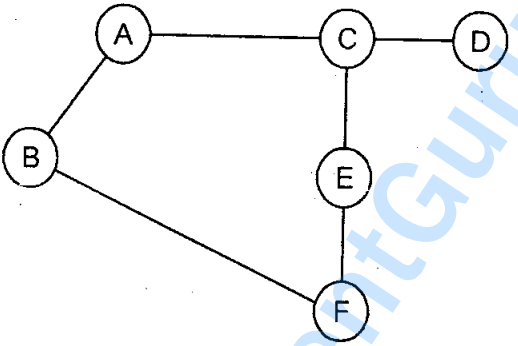
3. (a) For the following graph write DFS (sequence of traversal) from the node A : [4]



(b) Apply master method to solve the following recurrence relation : [6]

(i) $T(n) = 2T\left(\frac{n}{2}\right) + n$

(ii) $T(n) = 3T\left(\frac{n}{4}\right) + n\log n$

4. Explain Dijkstra's Algorithm to find a single source shortest path in a given graph. Apply Dijkstra's Algorithm and find the shortest path from source vertex 'A' to rest of the vertices : [10]

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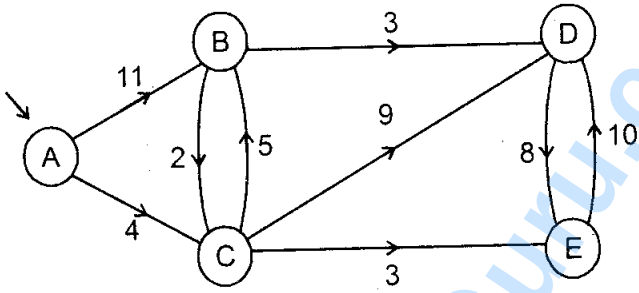

5. Differentiate between the following with respect to method of solving a problem and time complexity : [10]

(a) Depth-First-Search (DFS) Vs. Breath-First-Search (BFS)

(b) Bellman-Ford Algorithm Vs Dijkstra's Algorithm for single source shortest path.

----- x -----

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours] *[Maximum Marks : 50*

Note: Question number 1 is compulsory. Answer any three questions from the rest.

1. (a) For funtction defined by: 4

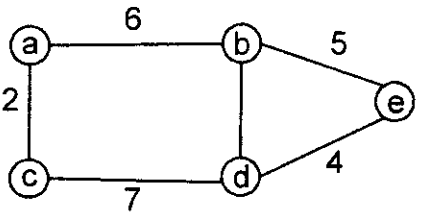
$f(n) = 5n^3 + 6n^2 + 7n + 8$; show that:

(i) $f(n) = O(n^3)$

(ii) $f(n) \neq O(n)$

(b) Write an algorithm to search the smallest number in a given array. Also calculate its time complexity. 6

(c) Draw all the spanning trees for the following weighted graph: 5



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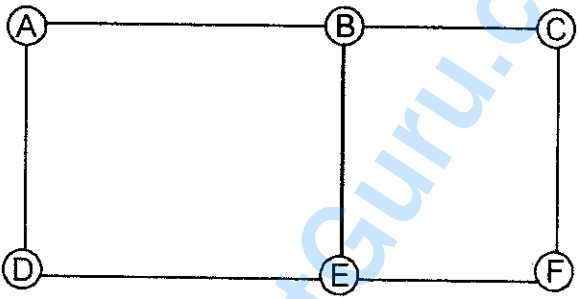
(d) For the given graph, write DFS traversal sequence from the node A: 5



2. (a) Sort the following list of elements using Quick sort. Also show intermediate steps of the operation. 6

29, 6, 27, 8, 6, 2, 45, 90

(b) Define optimization problem. Give any two examples of optimization problem with explanation. 4

3. (a) Find the optimal solution to the following fractional Knapsack problem using Greedy Technique: 7

(i) No. of object $n = 6$

(ii) Max. weight = 25

(iii) Value of each item =

$(P_1, P_2, P_3, P_4, P_5, P_6) = (10, 20, 30, 35, 45, 55)$

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(iv) Weight of each item =

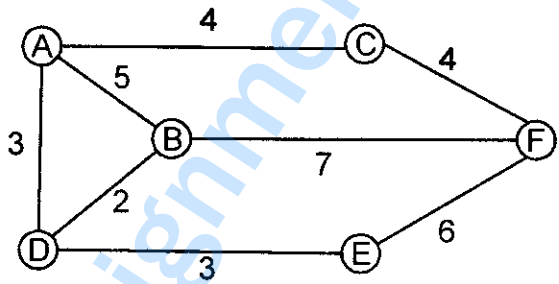
$(W_1, W_2, W_3, W_4, W_5, W_6) = (5, 10, 12, 13, 15, 20)$

(b) Write recurrence relation for binary search algorithm. 3

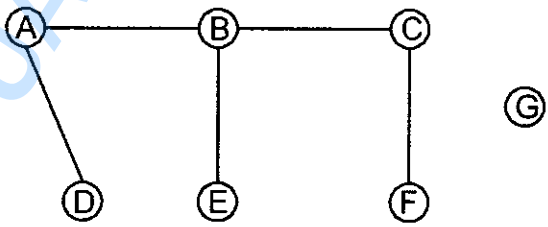
4. (a) Solve the following recurrence relation: 3

$$T(n) = 3T(n/2) + n$$

(b) Find minimum cost spanning tree for the following graph using Kruskal's algorithm: 7



5. (a) Find Adjacency Matrix for the following graph: 3



(b) Find the complexity of following code:

int P = 100;

while (P)

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```
{ For (i = 1; i < n ; i++)
      SUM [i]= P – 1;
  P = P – 1;
```

Make necessary assumptions required. 4

(c) Describe any two methods to solve recurrence relations.

—x—

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA)

Term-End Examination

December, 2020

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours *Maximum Marks : 50*

Note : *(i) Question* ***No. 1*** *is compulsory which carries 20 marks.*

(ii) Answer any ***three*** *questions from the rest.*

1. (a) Arrange the following growth rates in the increasing order of running time : 2

$$O(3^n), O(n^3), O(n), n!, \log^n$$

(b) Define recurrence relation and initial condition for the merge sort algorithm and explain. 4

(c) Where is Ω (omega) notation used ? For the function defined by : 4

$$f(n) = 5n^3 + 5n^2 + 1$$

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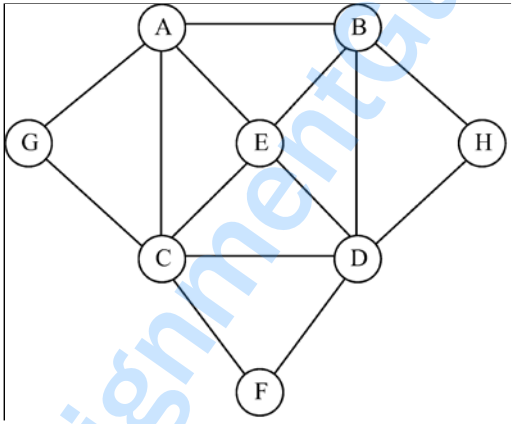
and $g(n) = 5n^2 + 5$

show that :

$$f(n) = \Omega\, g(n)$$

(d) Traverse the following graph using DFS taking A as a starting vertex and write the sequence of vertices in the order of their discovery. 3



(e) (i) Apply the linear search algorithm to search for the number (4) in the following list of integer numbers. Show the starting three steps : 3

5 15 8 4 25 30 17 20

(ii) Analyze the worst case complexity of the above algorithm. 4

2. (a) Find node degree of all nodes of a graph in Q. 1 (d). 3

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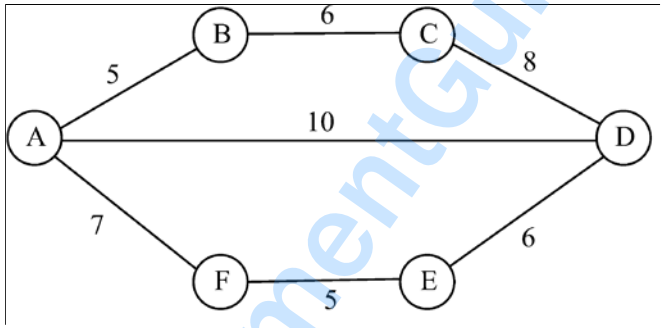
(b) Write the Bellman Ford algorithm and apply the same to find the shortest path from a source vertex A to all the remaining vertices of the following directed graph. Show all the intermediate steps. 7



3. (a) For the two values of n = 1, 4, calculate the corresponding values of $n \log_2 n$. 2

(b) Define a fractional knapsack problem. Find the optimal solution to the following instance of a knapsack problem. Show the stepwise running of the algorithm for the following example : 8

No. of objects n = 5, M = 13

Capacity of a knapsack :

$(P_1, P_2, P_3, P_4, P_5) = (12, 32, 40, 30, 50)$

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where P_i is a profit and :

$$(W_1, W_2, W_3, W_4, W_5) = (4, 8, 2, 6, 1)$$

where W_i is a weight.

Each object has a profit P_i and weight W_i.

4. (a) Apply binary search algorithm to search for a key value = 23 in the following list : 5

6 9 13 15 23 27 35 45

(b) Perform the worst case analysis of the above algorithm and also specify an example in which worst case will occur. 5

5. (a) Apply Karatsuba's method in multiplying 2376201 and 219237 using divide and conquer technique. 5

(b) Define mathematical induction. Prove the following preposition using induction : 5

$$1^2 + 2^2 + 3^3 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}$$

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BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

June, 2021

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no.* ***1*** *is* ***compulsory*** *and carries 20 marks. Answer any* ***three*** *questions from the rest.*

1. (a) Arrange the following classes of algorithms in increasing order of growth : *3*

(i) $O(n^3)$

(ii) $O(n \log n)$

(iii) $O(n^2)$

(iv) $O(\sqrt{n})$

(b) Write the recurrence relation for the following recursive function : *5*

```
Fib (int n)
  {
    if (n == 0) return 0;
    if (n == 1) return 1;
    else
    return (Fib (n – 1) + Fib (n – 2));
  }
```


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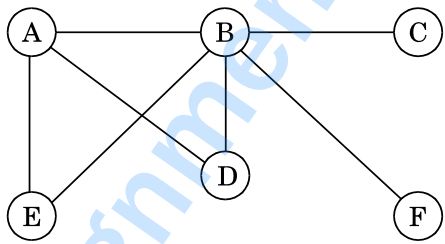
(c) Sort the following list of elements using 'Insertion Sort'. Also, show intermediate steps.

28, 6, 29, 90, 5, 42, 80 *6*

(d) Write the recurrence relation for the best case of Quicksort algorithm and solve it using Master method. *6*

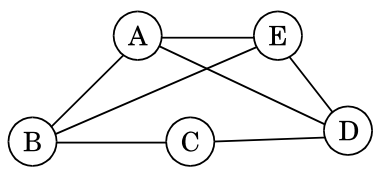
2. (a) Write the pseudocode for computing GCD (m, n) and find its time complexity. *4*

(b) Write the pseudocode for Breadth First Search (BFS) and traverse the following graph using BFS from starting node A. *6*



3. (a) What is Greedy Technique ? Explain the types of problems solved by using this technique. *4*

(b) Find the adjacency list for the following graph : *3*



(c) With the help of an example, explain the 'Merge-Sort' technique. *3*

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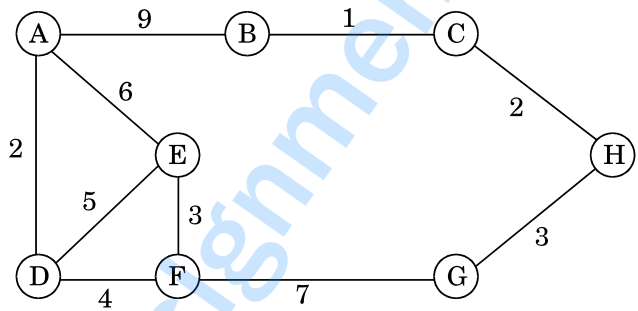
4. (a) What is a single source shortest path problem ? Briefly explain the generic algorithm for solving it. *5*

(b) Explain the following terms with an example for each : *5*

(i) Complete Graph

(ii) Dynamic Programming Technique

5. (a) Find the minimum cost spanning tree for the following graph using Kruskal's algorithm : *7*



(b) Define Recurrence Relation and Initial Condition for Factorial Function. *3*

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No. of Printed Pages : 4

BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA)

(Revised)

Term-End Examination

December, 2021

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours *Maximum Marks : 50*

Note : *(i) Question **No. 1** is compulsory which carries 20 marks.*

*(ii) Answer any **three** questions from the rest.*

1. (a) State True or False :

$O(n \log_2 n)$ is better than $O(n^2)$ but not as food as $O(n)$. 2

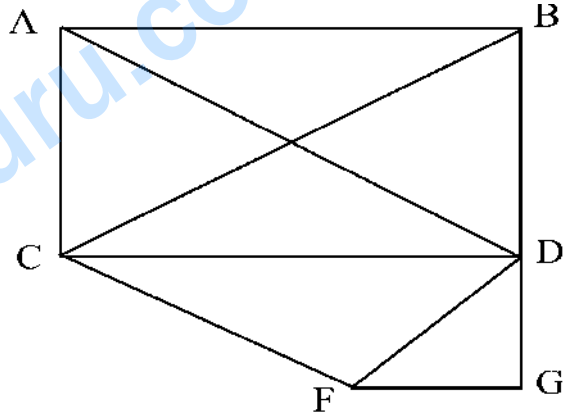
(b) Write the names of the following symbols : 2

$\theta, \Omega, \forall, \in$

(c) Define O (big Oh) notation. By using the basic definition O (big Oh), show that : 4

$$6x^2 + 6x + 1 = O(x^2)$$

(d) Create an adjacency matrix for the following graph : 3



(e) Multiply 10056 × 2037 using divide and conquer technique. Apply Karatsuba's method. 4

(f) Briefly explain any ***two*** different approaches to solve the recurrence relation. 5

2. (a) Arrange the following growth rate in increasing order : 2

$O(2^n)$, $O(n^3)$, $n!$, $\sqrt{n}$

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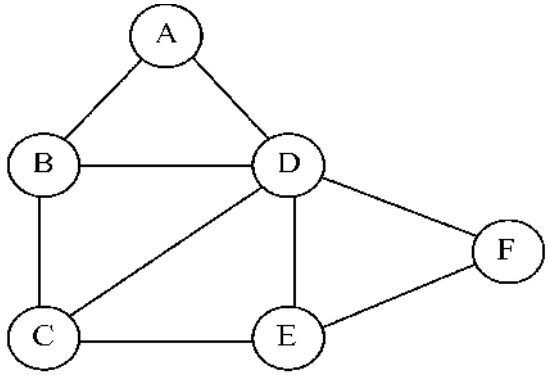
(b) (i) Traverse the following graph using BFS. The starting node is A : 4



(ii) Perform the complexity analysis of the above algorithm. 4

3. (a) Explain the basic concept of quick sort algorithm and apply it to sort the following list of numbers : 7

15 10 5 4 25 35 7 8

Show all the intermediate steps.

(b) Define the term backtracking and enlist any ***two*** problems that can be solved by backtracking. 3

4. (a) Write a recurrence relation for the following recursive factorial function : 3

```
int fact (int n)
  {
    if (n = = 1)
       return 1
else
    return n * fact (n – 1)
  }
```

(b) State Horner's rule for polynomial evaluation and apply the rule for evaluating the following polynomial expression : 7

$$p(x) = 6x^7 + 7x^6 - 5x^5 + 3x^3 + 6x^2 + 8x + 7$$

Show stepwise iteration.

5. (a) How many comparisons are needed for binary search algorithm in a set of 64 elements ? 3

(b) Write Prim's algorithm to solve minimum cost spanning tree problem and explain. 7

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BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

June, 2022

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no.* ***1*** *is* ***compulsory*** *and carries 20 marks. Answer any* ***three*** *questions from the rest.*

1. (a) Define basic efficiency classes in context of running time. *3*

(b) Perform linear and binary search to find 15 in a given list of numbers as below :

5 7 9 12 13 15 21 25

Count the number of comparisons in both the search methods. *6*

(c) Define a recurrence relation. Draw a recurrence tree for the following recurrence relation : *5*

$T(n) = 2T(n/2) + 1$

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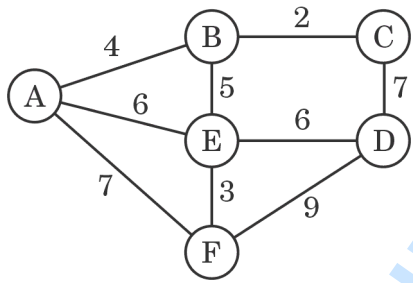
(d) Apply Kruskal's algorithm to find out the minimum cost spanning tree. *6*



Starting vertex is A.

2. (a) Arrange the following functions in increasing order : *2*

$$\log_2^n,\ n\log_2^n,\ n^2,\ 5n + 7$$

(b) List any two applications of BFS/DFS. *2*

(c) Write the algorithm for left to right binary exponentiation evaluation and apply the algorithm for evaluating a^{280}. Show all the steps. *6*

3. (a) For the function defined by

$$f(n) = 6n^2 + 8n + 6,$$

show that $f(n) = O(n^2)$. *4*

(b) Show that Dijkstra's algorithm may not work if edges can have negative weight. *3*

(c) Traverse the complete graph on four vertices using BFS and write the sequence of vertices that would be visited by the graph traversal algorithm. *3*

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4. (a) Write a recurrence relation for Fibonacci series problem. *3*

(b) Write and apply Mergesort algorithm to sort the following list of integer numbers. *7*
Show all the intermediate steps.

15, 8, 7, 4, 25, 30, 5, 13

5. (a) Write any two cases of the Master method with formal notations. *4*

(b) Write recurrence relations for matrix multiplication using Strassen's method and solve it using the Master method. *6*

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BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2022

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 hours *Maximum Marks : 50*

Note : *Question no.* ***1*** *is* ***compulsory*** *and carries 20 marks. Answer any* ***three*** *questions from the rest.*

1. (a) Define Θ (big theta) notation. By using a basic definition, show that

$$7n^2 + 8n - 9 = \Theta(n^2).$$ *4*

(b) Apply Bubble sort algorithm to sort the following list of numbers. Show the procedure step-by-step. Calculate the number of exchange and comparison operations required in the algorithm : *4*

15	8	7	11	25	13	12	4

(c) Solve the following recurrence problem using recursion tree method : *6*

$$T(n) = 4T\left(\frac{n}{2}\right) + n$$

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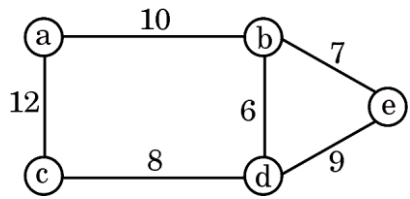
(d) Draw any three spanning trees of the following weighted connected graph : *6*



2. (a) Give an example for each complexity class : *3*

$O(n)$, $O(n^2)$, $O(n \log n)$

(b) (i) Write the Euclid algorithm to compute GCD of two non-negative integers and apply it to find GCD(325, 95). Show all the intermediate steps. *4*

(ii) Perform the complexity analysis of the above algorithm. *3*

3. (a) Compare between Kruskal's and Prim's algorithms. *3*

(b) Apply Strassen's algorithm to multiply two matrices A(4×4) and B(4×4) using divide and conquer technique and explain. *7*

4. (a) Define the term Branch and Bound and write the problem which can be solved through this technique. *3*

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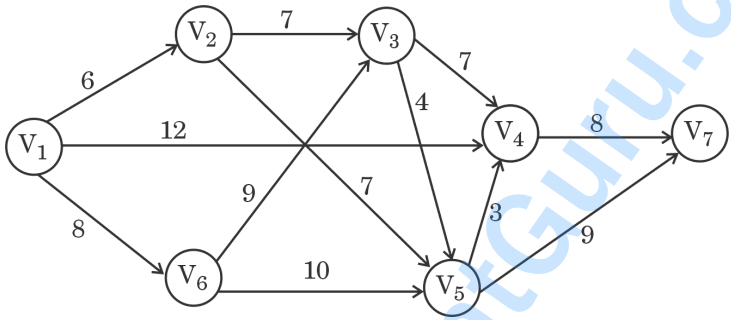
(b) Apply Dijkstra's algorithm to find the shortest path from V_1 to all other nodes. Show all the intermediate steps and explain. *7*



5. (a) Define the terms : path, cycle and a complete graph. *3*

(b) Write a program to generate Fibonacci series of 10 terms and count

(i) the number of times the loop will continue, and

(ii) the number of times the assignment operations will occur. *7*

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BCS-042

BACHELOR OF COMPUTER APPLICATIONS (BCA)

(Revised)

Term-End Examination

June, 2023

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours *Maximum Marks : 50*

Note : *(i) Question **No. 1** is compulsory.*

*(ii) Answer any **three** questions from the rest.*

1. (a) What is complexity of algorithm ? Explain space complexity and time complexity of algorithms with the help of example. 5

(b) Write linear search algorithm and do analysis of this algorithm for best case and worst case. 5

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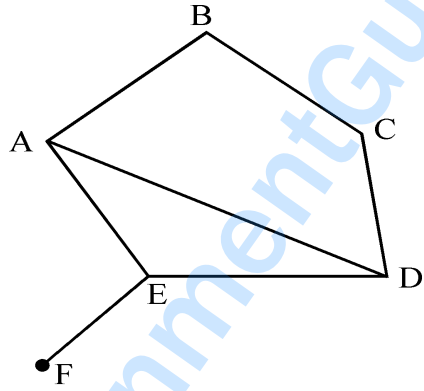
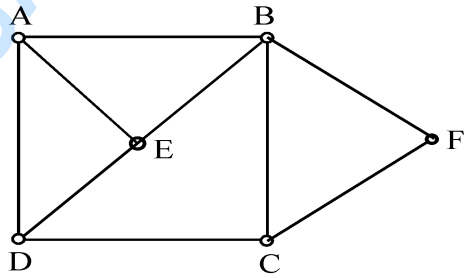
(c) Using mathematical induction method, show that for all positive integers n : 5

$$1^2 + 2^2 + 3^2 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}$$

(d) What is Adjacency matrix ? Write adjacency matrix for the following graph : 5



2. (a) Write Depth-First Search (DFS) algorithm. Also traverse the following graph using DFS from node A. 7



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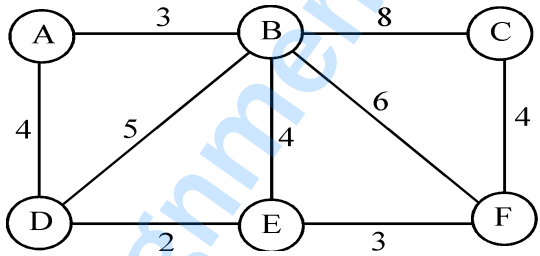
(b) Solve the following recurrence relation using recurrence tree method : 3

$$T(n) = 4T\left(\frac{n}{2}\right) + n$$

3. (a) Write Kruskal's algorithm for finding Minimum Cost Spanning Tree (MCST). Find MCST of the following graph using Kruskal's algorithm. 8



(b) Explain use of Big oh (O) notation in the analysis of algorithms with example. 2

4. (a) Find the optimal solution to the knapsack (fractional) problem for $n = 5$ and $m = 10$, where n is the number of objects and m is the capacity of the knapsack.

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Profit and weight of each object are given below : 6

$(P_1, P_2, P_3, P_4, P_5) = (10, 30, 35, 20, 40)$

$(W_1, W_2, W_3, W_4, W_5) = (3, 5, 2, 6, 11)$

(b) In context of algorithm study, explain the following with the help of an example of each : 4

(i) Upper Bound

(ii) Backtracking

5. (a) Sort the following list using Bubble sort algorithm. Show the steps of sorting : 6

30, 8, 7, 14, 20, 28, 10, 6

(b) Write algorithm for adding two matrices of order $m \times n$ and find its time complexity. 4

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