BRAC UNIVERSITY
Department of Computer Science and Engineering

Examination: Mid Semester Exam | Semester :Summer 2022
Duration: 1 Hour | Full Marks: 30

CSE 221: Algorithms

Set: A

Answer the following questions.
Figures in the right margin indicate marks.

Name:	ID:	Section:

1. a. CO7 **Calculate** the time complexity of the following function: **5**

```
worstCase(n):
        int i, j, k, a, b, sum
        for ( i = 0; i < n; i = i + 3)
                for ( j = n; j >= 1; j = j / 5)
                        for ( k = 1; k <= n; k = k * 5)
                                sum = a + b
```

b. CO7 **Calculate** the time complexity of the following recurrence relation. **5**
[Any method is acceptable as long as steps are shown]

$$T(n) = 2T(n/4) + \sqrt{n}$$

2. Renowned Progressive Rock band 'Porcupine Tree' released an album called 'Closure/Continuation' after about 13 years. Now as a Progressive Rock Music fan you are going to listen to the tracks of the album but in the order of their Youtube views (highest one at first, lowest one at last) instead of the order of the album tracklist.

You have chosen an Algorithm to order them as per your preference. If multiple tracks have the same views, you are going to listen to any of them the Algorithm puts first in the list after ordering. This algorithm also solves your concern about the issues regarding space that your device is facing. Porcupine Tree made the fans wait for 13 years for a new album and so you think you have the patience to wait as much time as the Algorithm may take to order the tracks.

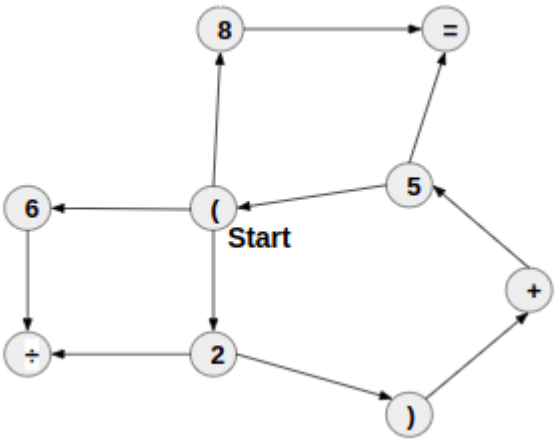
The following table contains the list of the tracks and their Youtube views (in thousand) :

Track	Harridan	Of The New Day	Rats Return	Dignity	Herd Culling	Walk the Plank	Chimera's Wreck	Population Three
Views	15	8	11	112	33	39	88	41

a. CO2 **Specify** the name of the algorithm you have chosen and **simulate** the Algorithm to order the tracks of the album as per your preference. Show your workings in detail. **7**

b. CO5 Suppose you want to run the algorithm again on the ordered list. **Determine** the run-time complexity of the algorithm in this scenario. **3**

3. Consider the graph shown below:



Bill says he has found a valid mathematical equation while running DFS from the node denoted by '('. According to him, the equation is:

$$(6 \div 2) + 5 = 8$$

a. CO3	**Compute** the number of edges this DFS tree (of the equation) contains.	**1**
b. CO3	Is what Bill said right i.e is the equation achievable by running such a DFS? **Validate** it by showing steps. (Neighbor/Edge selection should be done according to the necessity of the verification process)	**5**
c. CO2	**Classify** the edges of the graph into tree edge, back edge and forward edge while running DFS from the node denoted by '('.	**4**

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CSE 221: Algorithms

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Answer the following questions.
Figures in the right margin indicate marks.

Name:	ID:	Section:

1. a. CO7 **Calculate** the time complexity of the following function: **5**

```
worstCase(n):
        int i, j, k, a, b, sum
        for ( i = 1; i < n; i = i + 3)
                for ( j = n; j >= 1; j = j - 2)
                        for ( k = n; k >= 1; k = k / 4)
                                sum = a + b
```

b. CO7 **Calculate** the time complexity of the following recurrence relation. **5**
[Any method is acceptable as long as steps are shown]

$$T(n) = 2T(n/2) + \frac{1}{n}$$

2. Renowned Progressive Rock band 'Porcupine Tree' released an album called 'Closure/Continuation' after about 13 years. Now as a Progressive Rock Music fan you are going to listen to the tracks of the album but in the order of their Youtube views (highest one at first, lowest one at last) instead of the order of the album tracklist.

You have chosen an Algorithm to order them as per your preference. If multiple tracks have the same views, you are going to listen to any of them the Algorithm puts first in the list after ordering. This algorithm also solves your concern about the issues regarding space that your device is facing. Porcupine Tree made the fans wait for 13 years for a new album and so you think you have the patience to wait as much time as the Algorithm may take to order the tracks.

The following table contains the list of the tracks and their Youtube views (in thousand) :

Track	Harridan	Of The New Day	Rats Return	Dignity	Herd Culling	Walk the Plank	Chimera's Wreck	Population Three
Views	17	10	15	88	35	41	90	38

a. CO2 **Specify** the name of the algorithm you have chosen and **simulate** the Algorithm to order the tracks of the album as per your preference. Show your workings in detail. **7**

b. CO5 Suppose you want to run the algorithm again on the ordered list. **Determine** the run-time complexity of the algorithm in this scenario. **3**

3. Bill has this weird characteristic of playing with different types of graphs. This time he comes up with an undirected simple graph of 10 nodes. Nodes are labeled from 3 to 12. Some of the edges are:
(5,6), (5,10), (6,11), (7,11). He created other edges following two rules.

a. All the nodes that are labeled with a number which is a multiple of 3 have edges among them.
b. All the nodes that are labeled with a number which is a multiple of 4 have edges among them.

a. CO3	**Draw** the graph to show all the edges.	**1**
b. CO3	Bill says, there are at least four triangles in the graph. Do you agree? **Support** your answer by showing the nodes which form these triangles.	**2**
c. CO2	**Simulate** a BFS algorithm on the graph to find the shortest distance from Node 3 to all others nodes.	**6**
d. CO3	Bill told you to keep on adding edges between the nodes according to your wish, keeping the graph simple (without adding multiple edges between any two nodes, self edges). **Compute** the number of more edges that you can add.	**1**