

International Islamic University Chittagong
Department of Computer Science and Engineering

B. Sc. in CSE Midterm Examination, Autumn 2022

Course Code: CSE 4747

Course Title: Mathematical Analysis for Computer Science

Total marks: 30

Time: 1 hour 30 minutes

[Answer all the questions. Figures in the right-hand margin indicate full marks.]

- | | | CO | DL |
|-----|--|----|----------------|
| 1. | | | |
| a) | Find the solution of the following non-homogeneous recurrence equation $a_n = 2a_{n-1} - a_{n-2} + 2^n$ with $a_0 = 1$ and $a_1 = 2$. | 4 | CO1 C2, C3 |
| b) | Argue in favor of the recurrence relations that Josephus number $J(n)$ satisfies. | 3 | CO1 C2, C4 |
| d) | Estimate how many slices of pizza can a person obtain by making N straight cuts with a knife. Justify your recurrent solution. | 3 | CO1 C3 |
| 2. | | | |
| a) | Design a recurrent problem focusing on the following series as a closed form or solution. You need to specify the problem formulation and demonstrate the complete derivation of the solution. | 4 | CO1 C2, C3, C4 |
| | $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{1}{6}n(n+1)(2n+1)$ | | |
| | Or, | | |
| | A Bank offer loans on the following terms: He loans a client m taka in the morning. This puts the client m dollars in the debt to bank. Each evening bank first charges a service fee which increase the client debt by f taka and then bank charges interest, which multiplies the debt by a factor of p . For example, Bank might charge a "modest" ten cent service fee and 1% interest rate per day, then f would be 0.1 and p would be 1.01. Now figure out the followings: | | |
| i. | What is the client's debt at the end of the second day? | | |
| ii. | Write a formula for the client's debt after k days and find and equivalent closed form? | | |

- b) Find a closed form for the following expression:

3 C01 C3

$$\sum_{i=0}^n \sum_{j=1}^m (2m)^i$$

Or,

Find the closed form of the following equation

$$\sum_{i=2}^n \sum_{j=2}^n \frac{2i + 2j - 4}{(1-i)(1-j)}$$

- c) Solve the following expression:

3 C01 C3

$$\sum_{i=1}^n \sum_{j=1}^i \sum_{k=0}^j x^2 = x^2 + 1$$

3.

- a) Assume that you are one of the selection committee members of the Bangladesh Cricket Board (BCB) and you need to select a team of n players for today's T20 match against Afghanistan. Now, use generating function to determine in how many ways can you form a team with n players considering the following constraints.

4 C02 C2, C3, C4, C5

- ❖ The number of wicketkeepers is at most one.
- ❖ There can be at most three pacers.
- ❖ There can be at most two spinners.
- ❖ The number of all-rounders must be a multiple of 3.
- ❖ The number of middle-order batsmen must be a multiple of 4.
- ❖ The number of opening batsmen must be even.

According to your solution, determine the number of ways when the number of players is eleven,

- b) Write down a faster alternative of the following code segment i.e. optimize it:

1 C02 C3

```
int N=100;
float sum = 0;
for (int i = 1; i <= N; i++)
    sum += i;
```

- c) In how many different ways you can place two black bishops and one black rock on a chessboard so that no two pieces any rows?

2 C02 C2

d) You would like to buy a bouquet of flowers. You find an online shop that will make bouquets of lilies, roses, and tulips, subject to the following constraints:

- ❖ there must be at most 2 lilies,
- ❖ there must be an even number of tulips,
- ❖ there can be any number of roses.

3 CO2 C2,
C3,
C4,
C5

Now, use generating function to determine in how many ways can the online shop form a bouquet with n flowers.

Or,

There are 4 prizes you have distribute to the winner. There are 5 participants when

- i) Any participant will not get more than one prize?
- ii) A participant may get any number of prizes?
- iii) Any participant will not get all the prizes?