

Ambedkar College of Arts and Science, Wandoor

Class Test 1

Data Structures and Algorithms — MAT5EJ302(1)

B.Sc. Mathematics Honours (CUFYUGP 2024) — Semester V

Name: _____ ID No.: _____

Date: _____ Time: 20 Mins **Maximum Marks: 20**

Answer all questions in the space provided. Show all working for Part B.

Part A — Short Answer ($5 \times 2 = 10$ marks)

1. Define an *algorithm*. State the two central questions asked about any algorithm. [2]

2. Write down the recurrence relation for the Fibonacci numbers F_n . State the time complexity of computing F_n using the naive recursive algorithm. [2]

3. State the formal definition of Big-O notation: what does it mean to say $f(n) = \mathcal{O}(g(n))$? [2]

4. Compute: (a) $38 \bmod 7$ (b) $-15 \bmod 8$ [2]

5. Using the property $(x \cdot y) \bmod N = ((x \bmod N) \cdot (y \bmod N)) \bmod N$, compute $47 \times 53 \bmod 11$ by first reducing 47 and 53 modulo 11. [2]

Part B — Medium Answer (2 × 5 = 10 marks)

6. Trace the *iterative* Fibonacci algorithm to compute F_7 . Fill in the table below, showing the values of **a**, **b**, **c** at each step of the loop, and state the time and space complexity of this algorithm. [5]

<i>i</i>	<i>a</i>	<i>b</i>	<i>c</i>
1	0	1	—
2			
3			
4			
5			
6			
7			

$F_7 =$ _____

Time complexity: _____

Space complexity: _____

7. Determine the Big-O complexity of the following code, where the inner loop runs from i to n . Show your reasoning. [5]

```
for i = 1 to n:
  for j = i to n:
    print(i + j)
```