



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI-ABUJA**  
**FACULTY OF COMPUTING**  
**DEPARTMENT OF COMPUTER SCIENCE**

**2025\_1 EXAMINATION**

**Course Code: CIT 310**

**Course Title: Algorithms and Complexity Analysis**

**Credit: 3 Units**

**Time allowed: 2½ Hours**

**Instruction: Answer Questions ONE (1) and any other THREE (3)**

**Question One**

- a. Given the following recursive algorithm:

$$F_0 = 1, F_1 = 1$$

$$F_n = F_{n-1} + F_{n-2}, \text{ for } n \geq 2$$

Find  $F_7$  by simulating it manually **(6Marks)**

- b. Write two (2) pseudo-codes to differentiate between Linear Recursion and Tree recursion **(8Marks)**

- c. Define a function  $F(n)$  to calculate the  $n$ th Fibonacci number **(4Marks)**

- d. Given that the greatest common divisor, gcd is expressed as:

$$\text{gcd}(p, q) = \begin{cases} p & \text{if } q = 0 \\ \text{gcd}\left(q, \text{remainder}\left(\frac{p}{q}\right)\right) & \text{if } p \geq q \text{ and } q \neq 0 \end{cases}$$

Compute  $\text{gcd}(48, 12)$  **(4Marks)**

- e. List three (3) applications of Tower of Hanoi **(3Marks)**

**Questions Two**

- a. With the help of a diagram, explain indirect recursion **(6Marks)**

- b. Explain the principle of Selection Sort **(5Marks)**

- c. Briefly describe in steps how Dynamic Programming works **(4Marks)**

**Questions Three**

- a. Given the Binary Search Tree below with key  $[x] = 37$ . State the value of key  $[y]$  **(4Marks)**

- b. Explain the steps to perform Binary Search for '13' from the array of numbers **(6Marks)**

- c. State the importance of writing algorithms **(5Marks)**

**Question Four**

- a. Write a recursive function to calculate  $n$ th Fibonacci number **(5Marks)**

- b. Write short notes on Randomized Algorithm and mention two types **(8marks)**

- c. Explain why the Worst-Case analysis is important in analysis of algorithms **(2Marks)**

**Question Five**

- a. Using the substitution method, show that  $T(n) = T\left(\frac{n}{2}\right) + n$  is asymptotically bounded by  $O(\log n)$  **(5Marks)**

- b. With a suitable diagram, describe the Omega notation **(6Marks)**

- c. Explain two factors used to analyse the efficiency of an algorithm **(4marks)**

**Question Six**

- a. Given a function  $f(n) = n^2 + 7n + 5$ .

Explain what it means to say that " $f(n)$ " is **asymptotically equivalent** to  $n^2$  as  $n \rightarrow \infty$ " **(6Marks)**

- b. Briefly differentiate between an algorithm and a pseudo-code **(6Marks)**

- c. Mention and describe the two types of algorithms that are equivalent to each other **(3Marks)**