



Faculty	Faculty of Computing		
Assessment Type	Internal Assessment	Paper Code	C-MAT –Int1
Module Name	Mathematics -1	Module Code	C6-DMA-19
Day	Wednesday	Date	14 July 2021
Total Marks	50	Time	2 weeks

## Instructions

**Answer all the questions**

**Submit through blackboard on or before 14 July 2021**

### Question 1

Find the generating functions for the following sequences;

- (a) 3, 0, 8, 1, 0,  $\frac{1}{7}$ , 100, ... [3]
- (b) 4, 4, 4, 4, 4, ... [3]
- (c) Write the generating function in (b) above in its closed form. [4]

### Question 2

- (a) Explain the meaning of asymptotic behaviour. [2]
- (b) Let  $a$  and  $b$  be discrete numeric functions defined by;
 
$$a_r = 2^r$$

$$b_r = r + r^2$$
  - (i) Plot the linear graphs for  $a_r$  and  $b_r$ . [6]
  - (ii) Determine which numeric function here asymptotically dominates. [2]

### Question 3

- (a) Distinguish between a terminal and a non-terminal symbol. [2]
- (b) Using examples explain what a type-0 and a type-1 grammar are. [2]
- (c) Solve the recurrence relations for a discrete numeric function defined such that;  
 $a_{n+1} = 4a_n - 2$ , and has  $a_0 = 1$ 
  - (i) Complete the sequence by finding the  $a_1, a_2, a_3$ , and  $a_4$  terms of the function. [4]
  - (ii) Write the corresponding generating function for the numeric function in (i). [2]

### Question 4

A counter is a finite state machines that counts from 00, 01, 10, 11 and start all over again on consecutive inputs of clock signal = 1. The counter does not change its state when the clock signal = 0. You are required to model the count described here using:

- (a) State transition table [5]
- (b) State transition diagram [5]

### Question 5

Determine the generating function for the discrete numeric function  $a_r$  where,

$$a_r = \begin{cases} 2^r, & \text{if } r \text{ is even} \\ -2^r - 2r, & \text{if } r \text{ is odd} \end{cases} \quad [10]$$