Lecturer:	*(Date)*	**Approved by:**	(Date)
(Signature and Fullname)		*(Signature and Fullname)*	

UNIVERSITY OF TECHNOLOGY - VNUHCM FACULTY OF CSE	**MIDTERM**		Semester / Academic year	1	2022-2023
			Date		Oct. 23 2022
	Course title	Principles of Programming Languages			
	Course ID	CO3005			
	Duration	60 mins	Question sheet code		2022

Notes: - Students can only use course and API materials.
- Submit the question sheet together with the answer sheet
- The total score is 10 points.

1. Construct regular expressions expressing languages over $\{a, b, c\}$, in which for every string w it holds that
   a. Strings made by a's only (can be empty)
   b. Any strings made by $\{a, b, c\}$
   c. The number of a's in w is even
   d. There are $(4i + 1)$ b's in w $(i >= 0)$

2. Develop a CFG to represent a *single declaration* in C++.

   The type can be *int* and fixed array (i.e number of element is an integer constant) of *int t*. The non-array variables can be with/without default values.

   Example: *int a, b = 2, c[4];*

   Assume that the following tokens have been defined by the lexer.

No	Token	Description
1	Semi	;
2	Int	int
3	Integer	2, 3, -7
4	OpenCol	[
5	CloseCol	]
6	Id	identiier
7	Comma	,
22	Assignment	=

3. Given a context-free grammar as follows.

$$E \to E + T|E–T|E/F|T$$
$$T \to T * F|F$$
$$F \to (E)|Int$$

   a. Draw the parse tree for the following expression.

$$2 + 3 * 5 - 4$$
$$2 + (3 * 5 - 4)$$

   b. Compare the precedence between * and – operators. Prove your answer.
   c. What are the association of 4 operators? Prove your answers.

4. Show that the following grammars is ambigous

$$S \to AB|aaB$$
$$A \to a|aA$$
$$B \to b$$