The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	:	Bachelor of Science Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**EEX6335 – Compiler Design**
Academic Year	:	2024/25
Date	:	14th February 2026
Time	:	09:30 – 12:30 h
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Three (3)** questions in **Three (3)** pages.
3. Answer **all** questions.
4. Clearly state your assumptions, if any.
5. Answer for each question should commence from a new page.
6. Answers should be in clear handwriting and do not use Red colour pen.
7. This is a Closed Book Test (**CBT**).

Q1 [60 marks]

An embedded sensor control domain-specific language (DSL) is a specialized programming language to manage industrial sensors in IoT systems. These DSLs bridge the gap between high-level operational requirements and low-level embedded hardware. The context free grammar (CFG) for a DSL is developed as follows:

$$
\begin{aligned}
\textit{program} &\rightarrow \textit{device id } \{ \textit{ stmtlist } \} \\
\textit{stmtlist} &\rightarrow \textit{stmt stmtlist} \mid \varepsilon \\
\textit{stmt} &\rightarrow \textit{set param} = \textit{num ;} \mid \textit{activate ;} \\
\textit{param} &\rightarrow \textit{temp_threshold} \mid \textit{sample_rate}
\end{aligned}
$$

where *program* is the start term and ε denotes the empty string.

This DSL supports the following features:

Keywords	*device, set, activate*
Identifiers (only alphanumeric)	*id*
Parameters	*temp_threshold, sample_rate*
Positive integers (except 0)	*num*
Assignment operator	=
Block braces	{ }
Statement terminator	;

(a) Define token specifications using regular expressions. [06]

(b) Tokenize the following input stream: [08]

```
device Sensor1 {
    set sample_rate = 1000;
    set temp_threshold = 75;
    activate;
}
```

(c) Define the grammar for the given DSL by clearly stating the relevant set of parameters. [08]

(d) Validate the above input stream by using the given CFG. [08]

(e) Draw the complete parser tree that the parser would build for the above input stream. [12]

(f) State whether the grammar is suitable for LL(1) parsing. Justify briefly. [05]

(g) Identify two types of semantic errors that may be occurred in this language. [04]

(h) Generate Intermediate Code (three Address-Code) for: [04]

set sample_rate = 1000;

(i) Write LEX implementation syntax for the given DSL. [05]

Q2 [20 marks]

Consider the following context-free grammar with x and y are terminals, all others are non-terminals, including the start symbol, S.

$$\begin{aligned} S &\rightarrow AB \\ A &\rightarrow Sy \mid x \\ B &\rightarrow yS \mid y \end{aligned}$$

Answer the following:

(a) Find the FIRST and FOLLOW sets of the non-terminals. [02]

(b) Draw the DFA of LR(0)-items (numbering the states for later reference). [14]

(c) This grammar is not SLR(1). Explain and identify corresponding conflicts in terms of in which state(s) they occur and what conflicting reactions occur under which input. [04]

Q3 [20 marks]

Consider the following grammar G1:

$$S \rightarrow a \mid S\#S \mid S@S$$

Where, S is the start symbol and all others (including $\$$ which represents the end of the sequence of tokens) are terminals.

(a) Give a concrete argument why the grammar is ambiguous. [04]

(b) Assume that

- the operator # has *low* precedence and is *right-associative*
- the operator @ has *high* precedence and is *left-associative*

Give a new grammar G2 which describes the same language as G1 and follows the rules just given. You may introduce new non-terminals. [07]

(c) Now, consider the grammars G1 and G2, as well as the following grammar G3:

$$S \rightarrow a \mid S\#S \mid S@S \mid +S+$$

where the symbol + is new terminal.

i) Which of the languages L(G1), L(G2), and L(G3), are *regular* and which not, briefly explain. [06]

ii) Give a regular expression for those which languages which happen to be regular. [03]

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