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FACULTY OF ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
BACHELOR OF SOFTWARE ENGINEERING
ECX5265 – SOFTWARE CONSTRUCTION

Date: March 13, 2012 **Time: 1400 – 1700 hrs**

Important:

1. This question paper consists of **seven** questions.
2. Answer **all** questions in **Part A** (60 marks) and **TWO** from **Part B** (40 marks).

Part A

Consider the following description of a compiler to answer Q1 to Q3.

The following "simple integer expression" grammar is used to do some basic arithmetic operations (only ×, +, −) with standard precedence level for one digit integers. As examples, this grammar produces such forms as 3, (5+8) and 2+3×4-1.

$$exp \rightarrow exp\ \ addop\ \ term \mid term$$
$$addop \rightarrow + \mid -$$
$$term \rightarrow term\ \ mulop\ \ factor \mid factor$$
$$mulop \rightarrow \times$$
$$factor \rightarrow (\ exp\ ) \mid number$$

Q1

(a) What are the terminals and the non-terminals in this grammar? [02]

(b) Define the token table for this compiler. [03]

(c) Briefly explain how the lexical analyzer would process an input string of this language. [05]

(d) Write the stream of tokens generated by the lexical analyzer for the input string (5+8). [02]

Q2

(a) Explain why the grammar is not LL(1). [02]

(b) Convert this grammar into LL(1). [04]

(c) Construct FIRST and FOLLOW sets for the above (b). [16]

(d) Show that the resulting grammar in (b) is LL(1). [04]

(e) Construct the LL(1) parsing table for the resulting grammar in (b). [10]

Q3

(a) What is the *context handling* in this compiler? [02]

(b) Define the instructions for the code generation phase of this compiler. Assume a stack-based (post-fix) system. [05]

(c) By using the instructions in (b), write the result of the code generation phase when the input string is: 2+3×4-1 [05]

Part B

Q4

(a) Draw NFA for the regular expression $(10)^*(01|1^*)$. [05]

(b) Convert the NFA obtained in (a) to a DFA. [15]

Q5 Consider the grammar.

$$E \to BA$$
$$A \to \&BA \mid \varepsilon$$
$$B \to TRUE \mid FALSE$$

; Where *E*, *A*, *B* are non-terminals and others are terminals.

(a) Derive the string: *TRUE & FALSE & TRUE* [02]

(b) Define the Chomsky Normal Form (CNF) for CFGs. [02]

(c) Convert the given grammar into CNF. [14]

(d) Derive the above string in (a) using your new grammar in (c) [02]
*{Clearly indicate whether you use **leftmost** or **rightmost** derivation when answering (a) and (d)}*

Q6 Consider the following grammar.

$$S \to aSb \mid ab$$

(a) Find the LR(1) sets of items. [08]

(b) Compute the LR(1) parsing table (Action - Goto) for the corresponding shift-reduce parse engine. [08]

(c) Show the parsing steps (Input – Action) for the string: $aabb$ [04]

Q7 A Turing Machine accepts only the strings of the form $a^n b^n c^n$ for (n > 0) and the blank symbol B.

(a) Draw the transition graph. [14]

(b) List the moves made for input $aabbcc$ using instantaneous descriptions. [6]