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**GOOD LUCK!**

You may attempt all questions. However, the maximum you can score in this exam is 100 points.

- The exam consists of 5 questions, in 8 pages (including this page) for a total of 110 points.
- Read the questions carefully and underline the necessary steps.
- Keep your answers brief and precise.
- Write your answers in the space provided.
- When answering the question carefully at the beginning of the exam, double-check the questions and answers you have written only in the first 15 minutes of the exam for 90 minutes or until you run out of time.
- Make sure you have filled in your name and ID number in the space above.

**INSTRUCTIONS**

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**Duration:** 1 hour, 10 minutes.

CESE-304 Compiler Design

Fall 2000
Mid-term Exam

OC 31, 2000
1. If not, explain why not.

2. If not, explain why not.

3. If not, explain why not.

4. If not, explain why not.

5. (6 points) If A is a regular language, is $B$ a regular language? If so, write a regular expression corresponding to $B$.

6. (7 points) If L is a regular language, is $\langle L \rangle$ a regular language? If so, write a regular expression corresponding to $\langle L \rangle$.

7. (7 points) If $L_q$ is a regular language, is $L_{q'}$ a regular language? If so, write a regular expression corresponding to $L_{q'}$.

8. (7 points) If $L_q$ is a regular language, is $L_{q'}$ a regular language? If so, write a regular expression corresponding to $L_{q'}$.

9. Consider the following two languages:

   $L_1 = \{ w \in \{0, 1\}^* \mid w$ contains at least one $1$ \}

   $L_2 = \{ w \in \{0, 1\}^* \mid w$ contains at least one $1$ and it is followed by at most one $0$ \}

   Consider the following two languages:

   $L_3 = \{ w \in \{0, 1\}^* \mid \text{number of } 1s \text{ is same as the number of } 0s \}$

   $L_4 = \{ w \in \{0, 1\}^* \mid \text{number of } 1s \text{ is one}\}$

   Consider the following two languages:

   $L_5 = \{ w \in \{0, 1\}^* \mid \text{number of } 1s \text{ is immediately followed by at least one } 0\}$

   $L_6 = \{ w \in \{0, 1\}^* \mid \text{number of } 1s \text{ is immediately followed by at least one } 0\}$
Consider the following exchange rate: £1 = 1.50 FRF. Convert the amount of money in pounds to francs. Round your answer to the nearest whole number.

£200 = __ FRF
c. (5 points) Is C a TI instance?

\[
= (B) \text{MOTTO} B
\]

\[
= (A) \text{MOTTO} B
\]

\[
= (S) \text{MOTTO} B
\]

4. (6 points)

\[
= (S) \text{YSTH} B
\]

\[
= (B) \text{YSTH} B
\]

\[
= (A) \text{YSTH} B
\]

(6 points)

\[
B^* \leftarrow B
\]

\[
A^* \leftarrow A
\]

\[
B \leftarrow S
\]

\[
A \leftarrow S
\]

3. [Total: 26 points] Consider the context-free grammar G:

```
S \rightarrow AB
A \rightarrow aA | \epsilon
B \rightarrow bB | \epsilon
A \rightarrow cA | \epsilon
B \rightarrow dB | \epsilon
```
entire 8 points, reduce entire 4 points; and the goto table (3 points).

Your work must show the item set construction (10 points); the SLR action table (hint:

\[
\begin{align*}
\text{\textit{c}} & \leftarrow \text{i} \\
\text{\textit{a}} & \leftarrow \text{v} \\
\text{\textit{b}} & \leftarrow \text{s} \\
\text{\textit{q}} & \leftarrow \text{s}
\end{align*}
\]

Grammar (same as G3):

\textbf{Total: 25 points} Give the SLR parsing table (action and goto table) for the following
Continued on next page]

a. (4 points) Consider an operator \( \cdot \) defined over expressions such that \( a \cdot b \) is associative/non-associative, equivalent to \( (a \cdot b) \cdot c \) and not same as \( a \cdot (b \cdot c) \). Is \( a \cdot b \cdot c \) left-associative/non-associative?

b. (4 points) Consider an operator \( \lor \) defined over expressions such that \( a \lor b \) is associative/non-associative, equivalent to \( (a \lor b) \lor c \) and not same as \( a \lor (b \lor c) \). Assume that the new operators are defined using the syntax

\[ +, \cdot, \lor, \land \]

and that \( a+b+c \) is equivalent to \( (a+b)+c \) and not \( a+(b+c) \). Then the users also specify the associative and precedence of these operators.

Using the new operators allow users to define new infix operators in their programs?

Total 25 points
can be used to represent the user-defined ones.

Hint: When only 2 precedence levels and 2 associativity directions are abstract operations

use a lex, and what the symbol table would contain

Describe how the grammar for expressions would look like, how you would encode this

user-defined operators using lex and Bison. You need not write lex or Bison code.

d. (10 points) Describe how you will build a scanner and parser for a language that allows