Please write or print your solutions on A4 papers. Also, remember to write down your department, student ID, and name. The maximum score for this exercise is 100 points.

1. Regular expressions are very strong in representing data patterns. Please write (in the simplest form) the expression of each criteria:
   
   (a) (5 points) Binary strings containing the sequence 101 embedded within it.
   
   (b) (5 points) Binary strings that do not contain the sequence 101 embedded within it.

2. (10 points) A DFA is state machine that can be used as a recognizer for many problems. Design a DFA to recognize any nonnegative number (in base 10) that is divisible by 9.

3. One of the underlying technology that can be used to construct table driven scanners is the NFA and DFA. Consider the following regular expression: \((P^*Z)\)(T^*Z)ZZZ
   
   (a) (5 points) Construct a NFA for the regular expression.
   
   (b) (10 points) Construct a DFA from the NFA.
   
   (c) (5 points) Minimize the DFA.
   
   (d) (10 points) Write a simple parser (hardcoded) in C or C++ to recognize the above regular expression. This part must be completed to earn score for this whole question.

4. (5 points) Give a BNF grammar for the following language (use S as the start symbol):
   
   \(\{a^{3n}b^{2n} | n > 0\}\)

5. Given the regular grammar:
   
   \[
   \begin{align*}
   S &\rightarrow aT \mid bS \mid a \\
   T &\rightarrow aS \mid bT \mid b
   \end{align*}
   \]
   
   (a) (5 points) Give a leftmost derivation that shows \(S\) produces \(abaabb\).
   
   (b) (5 points) Draw the parse tree for \(abaabb\).

6. Given the following grammar which defines how you may eat at a buffet:
   
   吃到飽 \rightarrow 前菜 主餐 點心
   前菜 \rightarrow 沙拉 | ϵ
   主餐 \rightarrow 肉 | ( 吃到飽 )
   點心 \rightarrow 冰淇淋 | 蛋糕 | ϵ
   
   The start symbol is “吃到飽”.
(a) (5 points) Please construct the **first set** for the grammar.

(b) (10 points) Please construct the **follow set** for the grammar.

(c) (10 points) Please construct the **predict set** for the grammar.

(d) (5 points) Please construct the **LL(1)** parse table for this grammar.

(e) (5 points) Suppose a person eats this way “沙拉(沙拉 (肉 蛋糕))冰淇淋”, please derivate/tabulate the LL(1) parsing process. The starting symbol is **吃到飽**.