Due: April 28, 2011 (in class)

1. In the following grammar fragment, factorize and eliminate left recursion wherever possible:

```
Numeral ::=   Digits | Digits . Digits
            | Digits e Sign Digits
            | Digits . Digits e Sign Digits
Digits  ::=   Digit | Digits Digit
Digit   ::=   0 | 1 | 2 | 3
```

2. Find the First and Follow sets for the following grammars:

```
a. A       ::= a Q
   Q       ::= b Q | empty
b. S       ::= ABC
   A       ::= a | Cb | empty
   B       ::= c | dA | empty
   C       ::= e | f
c. Exp     ::= - Exp | (Exp) | Var ExpTail
   ExpTail ::= -Exp | empty
   Var     ::= id VarTail
   VarTail ::= (Exp) | empty
```

3. Construct the LL(1) table for the following grammar

```
Expr  -> - Expr
Expr  -> (Expr)
Expr  -> Var ExprTail
ExprTail -> -Expr
ExprTail -> empty
Var      -> id VarTail
VarTail  -> (Expr)
VarTail  ->  empty
```

4. Which of the following grammars are LR(1)? LALR(1)? SLR(1)? In each case, justify your categorization.

```
a.  S   ::= id := E
    E   ::= E + P | P
    P   ::= id | (E) | id := E
b.  S   ::= id := A
    A   ::= id := A | E
    E   ::= E + P | P
    P   ::= id | (A)
c.  S   ::= id := A
    A   ::= id := A | E
    E   ::= E + P | P | P +
    P   ::= id | (A)
d.  S   ::= id := A
    A   ::= Pre E
    Pre ::= Pre id := | empty
    E   ::= E + P | P
    P   ::= id | (A)
```