CSC610 Midterm **20** points Student Name:
Points are shown within [ ]

0. [1] True/False (Assign True to True statements; assign false otherwise)

a. For every DFA, there is an NFA. **True**
b. For every ∑*, there is a DFA. **True**

1. [1] Multiple Choice/single answer (select the best answer):

1.1 For every Deterministic Finite Automaton ___**D**___ .
A. there is an infinite language
B. there is a finite language
C. there is a regular expression that cannot be defined by a CFG
D. there is a Non-deterministic Finite Automaton (NFA)
E. there is a non-regular language
F. A and C.
G. B and C
H. A and E

1.2 L = { **$c^n d^* h^* b^* a^n d^*$: where n >0** } is a set of strings that __**H**_____
A. includes ccddhhbbaadd
B. includes cccdddhhhbbbaaaddd
C. includes cccdddhhhbbbaadddd
D. can be accepted by an NFA
E. can be defined by a CFG
F. All of the above
G. A & E
H. A, B & E
I. A & D
J. B & E

2. [2] Write a CFG for **L_2 = { $d^* c^n f j^n b^* d$: where n > 0 }**

CFG:

S → DXBd

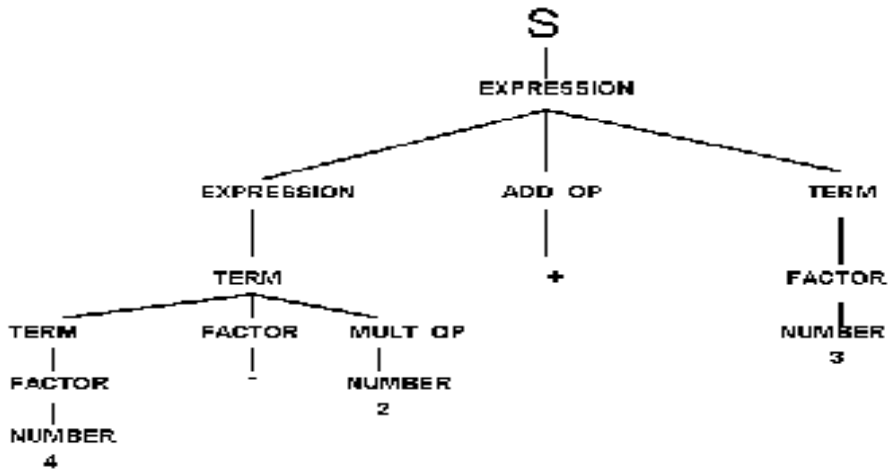
D → dD | ^

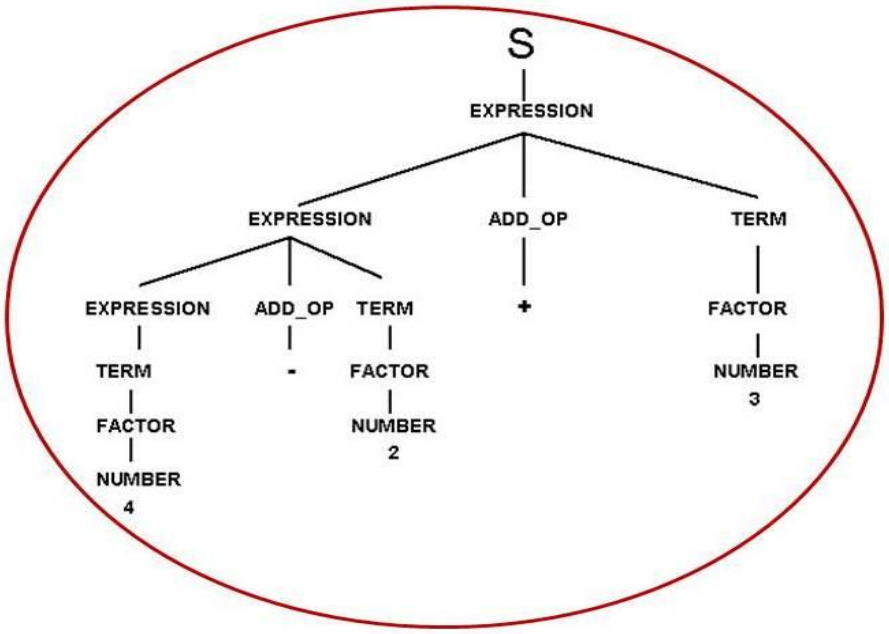
X → cXj | cfj

B → bB | ^

3. [1] Which of the parse trees is generated by the following CFG (Context-Free Grammar)? Select the correct parse tree (by circling the tree or writing "answer" next to the tree).

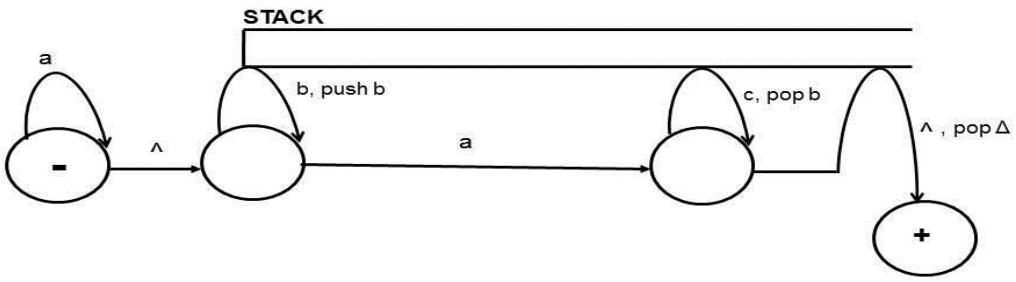
```
S          → STATEMENT | EXPRESSION
STATEMENT  →  IDENTIFIER ASSIGN_OP EXPRESSION
EXPRESSION  → TERM | EXPRESSION  ADD_OP  TERM  |  ( EXPRESSION )
TERM       → FACTOR  |  TERM  MULT_OP  FACTOR  | ( EXPRESSION )
FACTOR  →  IDENTIFIER  |  NUMBER  |  -  FACTOR  |  ( EXPRESSION )
ADD_OP  →  +  |  -
ASSIGN_OP →  =
MULT_OP →  *  |  /
NUMBER  →  1  |  2  |  3  |  4  |  5  |  6  . . .
```



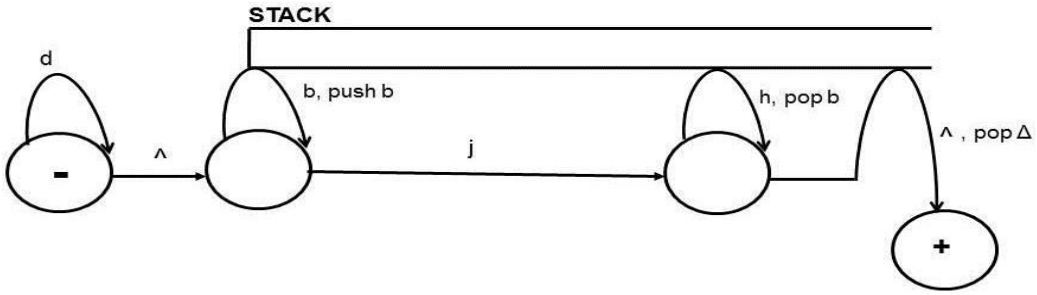


4. [1] Draw a PDA or One-Stack Automaton for L_4 = **{ a*b^{n}ac^n : where n >= 0 }**
or = **{ d*b^{n}jh^n : where n >= 0 }**

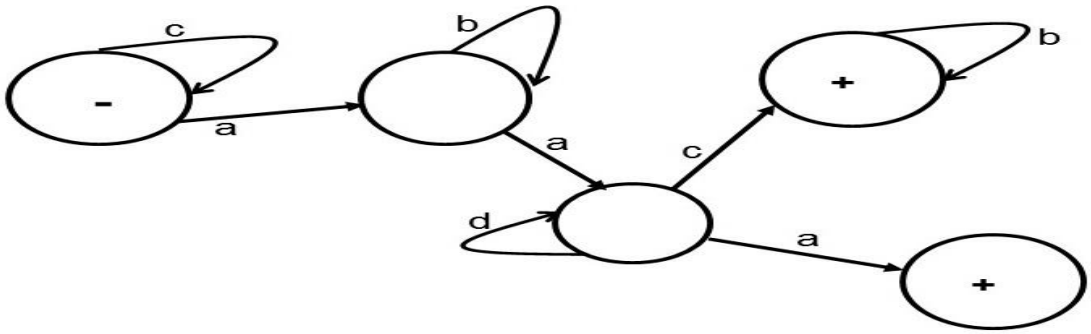
One-Stack Automaton for { a*b^{n}ac^n : where n >= 0 }



One-Stack Automaton for { d*b^{n}jh^n : where n >= 0 }



5. [1] Write the regular expression for the following NFA.



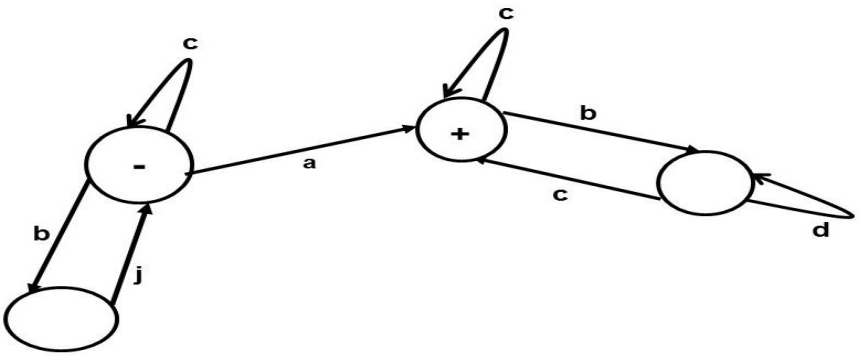
c*ab*ad*a + c*ab*ad*cb*

6. [1] Write a CFG for L_6 = **{ d*a^{n}cb^{n}d*: where n > 1 }**

CFG:

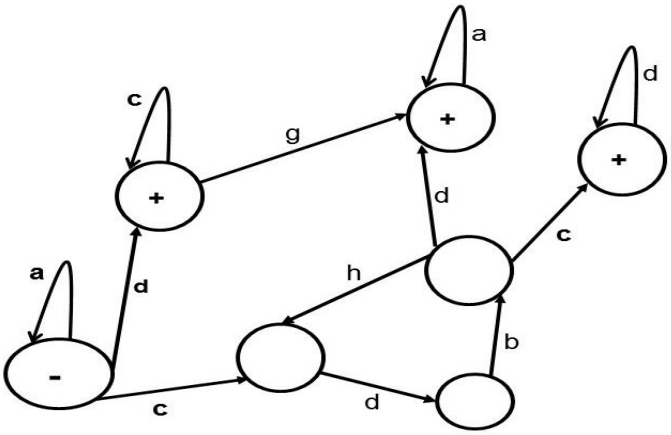
S → DXD
D → dD | ^
X → aXb | aacbb

7a. [2] Write the regular expression for the following NFA.



(c+bj)*a(c+bd*c)*

7b. [2] Write the regular expression for the following NFA



a*dc* + a*dc*ga* + a*c(dbh)*db(hdb)*da* + ac(dbh)*db(hdb)*cd*

8. [2] Write a CFG for L_8 = **{ a*c^{n}dedh^{n}d*a* : where n > 1 }**

S → AXDA

A → aA | ^

D → dD | ^

X → cXh | ccdedhh

9. [2] **Write a CFG for L_9 = { $a^n d^n g h b^m c^m$: where n > 0, m >1 }**

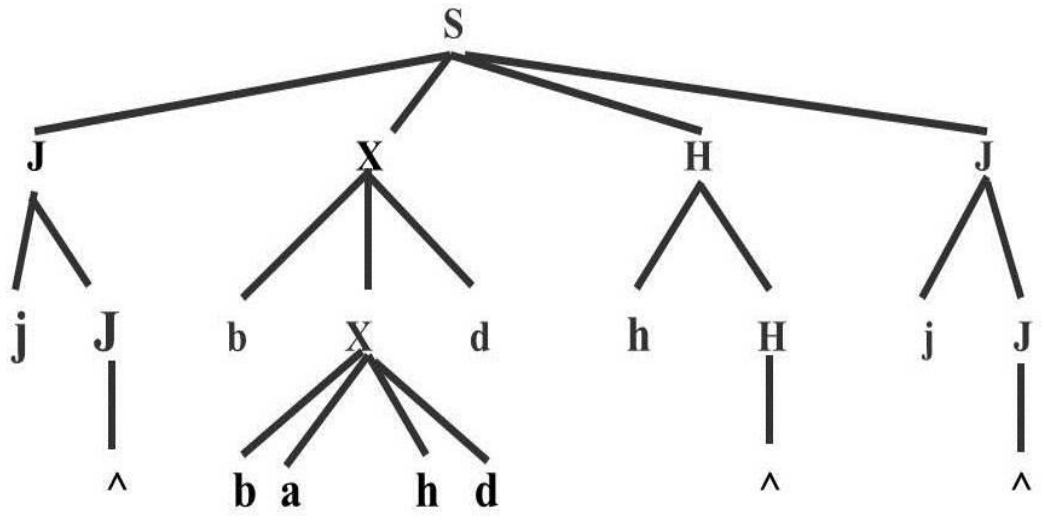
S → XghY
X → aXd | ad
Y → bYc | bbcc

10. **[2] Write a CFG for L_{10} = { $j*b^n ahd^n h*j*$: where n > 0 }**
and give a parse tree for **jbbahddhj**

CFG:

S → JXHJ
J → jJ | ^
X → bXd | bahd
H → hH | ^

A parse tree for jbbahddhj



11. [2] Draw a PDA or One-Stack Automaton for L_{11} ={ d*ca^{n}cd*j^{n}b* :where n > 0 }