Assignment # 6.1 Key

1. Write a CFG for the following languages:

$L = \{ a^i b^j c^k d^m \mid i = j+k \text{ or } j = k+m \text{ or } i = m \}$

$S \rightarrow S_{i=k}D \mid AS_{j=m} \mid S_{i=m}$

$D \rightarrow Dd \mid \lambda$

$A \rightarrow Aa \mid \lambda$

$S_{i=k} \rightarrow aS_{i=k}c \mid S_{i=j}$

$S_{i=j} \rightarrow aS_{i=j}b \mid \lambda$

$S_{j=m} \rightarrow bS_{j=m}d \mid S_{j=k}$

$S_{j=k} \rightarrow bS_{j=k}c \mid \lambda$

$S_{i=m} \rightarrow aS_{i=m}d \mid S_{jk}$

$S_{jk} \rightarrow bS_{jk} \mid S_{jk}c \mid \lambda$

COT 4210 © UCF

Assignment # 6.2a Key

2. Convert the following grammar to a CNF equivalent grammar. Show all steps.
   G = ({ S, E , F, A } , { a , (,) , -, +, ; } , R, S), where R is:
   S → E; S | E
   E → E – F | E + F | F
   F → aA | (E)
   A → aA | λ

   Remove lambda rules

   Nullables = { A }

   S → E; S | E
   E → E – F | E + F | F
   F → aA | a | (E)
   A → aA | a

Assignment # 6.2b Key

Remove Unit Rules
Chain(S) = {S, E, F}; Chain(E) = {E, F}; Chain F = {F}; Chain (A) = {A}
S → E; S | E | E – F | E + F | aA | a | (E)
E → E – F | E + F | aA | a | (E)
F → aA | a | (E)
A → aA | a

Remove Non-Productive Symbols
Productive = { S, E, F, A}
NO Change

Remove Unreachable Symbols
Reachable= {S, E, F, A}
NO CHANGE

Assignment # 6.2c Key

Convert to CNF

G’ = ({ S, E , F, A } , { a , (,) , -, +, ; } , R’, S), where R’ is:

R’:

S → E<<;>S> | E | E <<–>F> | E <<+>F> | <a> A | a | <(> <E<)>>
E → E <<–>F> | E <<+>F> | <a> A | a | <(> <E<)>>
F → <a> A | a | <(> <E<)>>
A → <a> A | a

<<;>S> → <;> S
<E<)>> → E<)>
<<–>F> → <–>F
<<+>F> → <+>F
<a> → a
<;> → ;
<+> → +
<–> → -
<(> → (
<)> →)

Assignment # 6.3a Key

3. Present the **CKY** recognition matrix for the string **a a a b b b** assuming the Chomsky Normal Form grammar **G = ({ S,T,U,A,B} , { a,b} , R, S)**, where **R** is specified by the rules

S -> S T | U A | a

T -> B U | b

U -> A S

A -> a

B -> b

Assignment # 6.3 Key

	a	a	a	b	b	b
1	S, A	S, A	S, A	T, B	T, B	T, B
2	U	U	S			
3	S	U	S			
4	S	U	S			
5	S	U				
6	S					

S -> S T | U A | a
T -> B U | b
U -> A S
A -> a
B -> b

aaabbb ∈L(G) since S is in bottom cell.