Automata a Grammars

Seminar 8

1. Reduce the following grammars. What type of grammars can be reduced?
   a) $G_1 = (\{S, A, B, C\}, \{a, b\}, S, P)$ where
   $P = \{ \quad S \to aSb|aAbb|\lambda$
   $A \to ABa|Bb$
   $B \to aAb|BB$
   $C \to CC|cS \}$

   b) $G_2 = (\{S, A, B, C, D, E\}, \{a, b, c\}, S, P)$ where
   $P = \{ \quad S \to aA|bB|aSa|bSb|\lambda$
   $A \to bCD|Dba$
   $B \to bB|AC$
   $C \to aA|AC$
   $D \to DE$
   $E \to \lambda \}$

2. Transform the following into Chomsky and Greibach normal form. Try to construct an LL(1) analyzer for languages generated by given grammars.
   a) $G_3 = (\{S, A, B\}, \{0,1\}, S, P)$ where
   $P = \{ \quad S \to A|0SA|\lambda$
   $A \to 1A|1|B1$
   $B \to 0B|0|\lambda \}$

   b) $G_4 = (\{S, A, B\}, \{0,1\}, S, P)$ where
   $P = \{ \quad S \to 0A10B10$
   $A \to 1A0|\lambda$
   $B \to 1B00|\lambda \}$

   c) $G_5 = (\{S, E, F\}, \{(,),*,+,1\}, S, P)$ where
   $P = \{ \quad S \to (E)$
   $E \to F + F|F * F$
   $F \to S|1 \}$

3. Decide whether the following grammars are context-free or not.
   a) $L = \{ww \mid w \in \{a, b\}^*\}$
   b) $L = \{a^i b^i \mid i = 0,1,2, \dots\}$
   c) $L = \{a^i b^j a^i \mid i, j = 0,1,2, \dots\}$
   d) $L = \{a^i b^j a^k \mid i, j, k = 0,1,2, \dots\}$
   e) $L = \{a^i b^i c^i \mid i = 0,1,2, \dots\}$
   f) $L = \{a^i b^j c^k \mid i, j, k = 0,1,2, \dots \wedge i \leq j \leq k\}$
   g) $L = \{ww^R \mid w \in \{a, b\}^*\}$
   h) $L = \{ww \mid w \in \{a, b\}^* \wedge |w|_a = |w|_b\}$
   i) $L = \{a^{i^2} \mid i = 0,1,2, \dots\}$
   j) $L = \{a^{i^2+i+1} \mid i = 0,1,2, \dots\}$
   k) $L = \{a^{2^i} \mid i = 0,1,2, \dots\}$
   l) $L = \{a^p \mid p$ is a primenumber $\}$