Homework V problems:

1. Consider the CFG $G = (\{S, A\}, \{a, b\}, P, S)$ where $P$ consists of five $S$-productions and four $A$-productions as given below

   \begin{align*}
   S & \rightarrow aaS | bbS | abA | baA | \lambda \\
   A & \rightarrow aaA | bbA | abS | baS 
   \end{align*}

   What is $L(G)$? Prove your answer.
2. Construct a grammar for palindromes over \( \{a, b\} \) of length a multiple of 3.

3. Construct grammars for the following:
   (a) \( \{w \in \{a, b\}^* \mid |w| \text{ is even} \} \)
   (b) \( \{w \in \{a, b\}^* \mid |w| \text{ is odd} \} \).

4. Construct grammars for the following:
   (a) \( \{w \in \{a, b\}^* \mid |w|_a \text{ is even} \} \)
   (b) \( \{w \in \{a, b\}^* \mid |w|_b \text{ is odd} \} \).

5. Construct CFGs for the following languages
   (a) \( \{a^i b^i c^i c^j \mid i, j \geq 0\} \)
   (b) \( \{a^i b^j \mid 0 \leq i \leq j\} \).

6. Suppose all the productions of a CFG \( G \) are of the form
   \( A \to a B \), \( A \to B a \), \( A \to a \).

   Does it follow that \( L(G) \) is regular? Prove or give a counterexample.

7. Do Problem 2, Section 5.1 of the text.

8. Do Problem 22, Section 5.1 of the text.

9. Do Problem 6, Section 5.2 of the text.

10. Do Problem 8, Section 5.2 of the text.