1. Let \( G = (\{S\}, \{a, b\}, P, S) \) be the CFG such that \( P \) is given by
\[
S \rightarrow aSb \mid aaSb \mid \epsilon
\]
(a) Show that \( G \) is ambiguous.
(b) Give an unambiguous CFG \( G' \) such that that \( L(G') = L(G) \). Prove that \( G' \) is unambiguous and that \( L(G') = L(G) \).

2. Define a PDA \( M \) such that \( N(M) \) is the set of all palindromes over \( \{0, 1\} \); i.e., \( N(M) = \{ x \in \{0, 1\}^* \mid x = x^R \} \). Justify your answer.

3. Define a PDA to accept the language
\[
\{0^n1^m \mid n \leq m \leq 2n\}.
\]
You may use either the final-state or empty-stack acceptance criterion. Justify your answer.

4. Prove that for any PDA \( P_1 \) there is a PDA \( P_2 \) with only two stack symbols, such that \( L(P_1) = L(P_2) \).