1. **(30 points)** Design a CFG generating the following language:
\[ \{ a^m c^{2m} b^m a^{n+1} c^{2n+1} b^n | n, m \geq 0 \} \]

2. **(20 points)** Show that the following CFG is ambiguous:
   \[
   S \rightarrow L
   L \rightarrow E | LE
   E \rightarrow \text{if } B \text{ E else } E | \text{if } B \text{ E } x | y
   B \rightarrow 0 | 1
   \]

3. **(30 points)** Given the following CFG:
   \[
   S \rightarrow S_1 | BS_2
   S_1 \rightarrow 0S_10 | A
   A \rightarrow 1A | \epsilon
   B \rightarrow 0B | \epsilon
   S_2 \rightarrow 1S_200 | \epsilon
   \]
   a) **(5 points)** Give a left-most derivation of the string “001000”
   b) **(5 points)** Give a left-most derivation of the string “0110000”
   b) **(10 points)** Draw the parse tree of your derivations
   c) **(10 points)** What is the language generated by this grammar?

4. **(20 points)** Transform the following CFG into Chomsky’s Normal Form:
   \[
   S \rightarrow ASK
   K \rightarrow bS | A | bA | \epsilon
   A \rightarrow aAS | a
   \]