Answer one odd numbered question and one even numbered question. Each question carries 50 marks. Students are allowed to use course notes, books and calculators.

1. Consider grammar $G$ with two production rules $S \rightarrow SSS \mid ab$, where $S$ is the start symbol, and $a$ and $b$ are terminal symbols. Prove that $L(G) \subseteq \{(ab)^n \mid n \in \mathbb{N}\}$.

2. Using standard transformations, construct a regular expression equivalent to the following automaton:

3. Consider grammar $G$ with four production rules $S \rightarrow aSb \mid bSa \mid ab \mid \varepsilon$, where $S$ is the start symbol, and $a$ and $b$ are terminal symbols. Prove that $\{(ab)^n \mid n \in \mathbb{N}\} \subseteq L(G)$. 
4. Using standard transformations, construct a deterministic automaton equivalent to the following non-deterministic one: