Problem 1
Give regular expressions for the following languages:
(a) $L_1 = \{w \in \{0,1\}^* \mid w$ contains an even number of 1’s$\}$
(b) $L_2 = \{w \in \{0,1\}^* \mid$ every odd position in $w$ is a 1$\}$
(c) $L_3 = \{w \in \{0,1,\ldots,9\}^* \mid w$ is a valid decimal number, i.e., no leading zeros are allowed$\}$

Problem 2
Let $R = (0 \cup 11)^* \cup (10)^*$. Use the construction from the proof of Lemma 1.55 to construct an NFA $N$ such that $L(N) = L(R)$. Apply the construction literally (do not optimize the resulting NFA – keep all those $\varepsilon$ arrows in the NFA).

Note: The construction from class differs slightly from the one given by the book (the only difference is in the Kleene’s star operation). Follow either the book’s construction or the one from class – just be consistent.

Problem 3
Consider the 2-state DFA recognizing all strings over $\{0,1\}$ with an odd number of 1’s. Apply the construction from the proof of Lemma 1.60 to construct an equivalent regular expression. In particular:

- Draw the state diagram of the first GNFA.
- After each iteration draw the state diagram of the current GNFA. You may simplify the regular expressions on the transitions.
- State the resulting regular expression.

Problem 4
(a) Exercise 1.25, page 87. Do not forget to define the computation.
(b) Exercise 1.27, page 88.

Problem 5
Problem 1.43, page 90.