1. (30 points) Give regular expressions that generate the following languages. In all cases, the alphabet is $\Sigma = \{0,1\}$.
   a. $\{w \mid w \text{ contains the substring } 10\}$
   b. $\{w \mid w \text{ contains the substring } 10 \text{ and ends in } 0\}$
   c. the set of all strings except the empty string and the string 0
   d. $\{w \mid w \text{ contains an odd number of } 0\text{’s or at least two } 1\text{’s}\}$
   e. $\{w \mid w \text{ contains an odd number of } 0\text{’s and at least two } 1\text{’s}\}$
   f. $\{w \mid w \text{ contains a } 1 \text{ among the last six positions}\}$ (note: if length of w is less than 6, then w should contain a 1 at any position)

2. (15 points) Describe the language accepted by the following regular expression using the $\{w \mid \ldots\}$ notation and then convert the regular expression to an NFA using the procedure discussed in class (see lecture slides and pages 66-67 in either edition of the text): $0((0 \cup 1)(0 \cup 1))^* \cup (0 \cup 1)^*1 \cup \epsilon$

3. (15 points) Convert the DFA in Exercise 1.21 (b) in the textbook (2nd edition) (Exercise 1.16 (b) in the 1st edition) to a regular expression using the GNFA procedure discussed in class (see lecture slides and pages 69-73 in either edition of the text).

4. (30 points) Show that the following languages over $\Sigma = \{0,1\}$ are not regular:
   a. $\{1^n w \mid w \in \Sigma^*, n \geq 0, \text{ and the length of } w \text{ is at most } n\}$
   b. $\{1^i 0^j 1^k \mid i, j \geq 1 \text{ and } k = i + j\}$
   c. $\{w \mid w \in \Sigma^* \text{ and } w = w^R\}$ where R denotes the string reversal operation.

5. (10 points) Problem 1.40 (b) in the 2nd edition of the textbook (Problem 1.32 (b) in the 1st edition).