1. First check if $T$ and $T'$ are of the same length. Then use the algorithm in the note to determine if $T'$ is a substring of $TT$.

2. (a) Scan the string $y$ from $b_1$ to $b_n$. Find the first $a_1$ appears in $y$. From this position, find the first $a_2$ appears in $y$. Until we reach the end of string $y$ or find $a_m$ in $y$.
   This algorithm scan each character in $y$ only once. So its running time is $O(n)$.
   (b) First you should prove that if we fix the starting point of $x$ in $y$, then the algorithm in problem (a) will find the shortest substring.
   In this case you can find the shortest substring by starting the algorithm from different locations and compare the length of the found substrings.

3. (This one is easy.)

4. Let the alphabet $\Sigma = \{a_1, a_2, \ldots, a_n\}$, then
   (a) $\bar{a} = (a_1|a_2|\cdots|a_n)$
   (b) $\bar{a}_i = (a_1|a_2|\cdots|a_{i-1}|a_{i+1}|\cdots|a_n)$

5. (a) $(0|1)^*0101(0|1)^*$
   (b) $(0|1)(0|1)^*0(0|1)^*$
   (c) $(00^*100^*)(1000^*)(000^*1)(000^*)$
   (d) $((1^*01^*01^*)^*)((0^*10^*10^*)^*)$