1. (15+15+20 points) Consider the following language over $\Sigma = \{a, b\}$:

$$L = \{x \mid x \in \Sigma^* \text{ and there are 'a's (if any) before and after 'b's (if any) in } x, \text{ the number of 'b's the same as the total number of 'a's} \}$$

$$= \{a^m b^i a^n \mid i = m + n \text{ and } i, m, n \geq 0 \}$$

(a) Write the first 5 elements of $L$ starting with the shortest string. Ordering among same length strings doesn’t matter.

(b) Give a recursive definition of $L$. Provide the basis and the recursive step only. The closure is printed below.

**Closure:** A string $w \in L$ iff it can be obtained from the basis elements by a finite number of applications of the operations in the recursive step.

2. (50 points) Let $M_2$ be the following NFA-\(\lambda\):

(a) Give the transition function $t$ for $M_2$ in tabular form. Include a column for the $\lambda$-closure of each state.

(b) Use algorithm 5.6.3 to construct a state diagram of a DFA that is equivalent to $M_2$. Give the transition function and draw the state diagram of the equivalent DFA.