INT201, Assignment 2

Question 1

Given a CFG $G = (V, \Sigma, R, S)$ with set of variables $V = \{S\}$, where S is the start variable; set of terminals $\Sigma = \{0, 1, (,), \cup, *, \emptyset, \varepsilon\}$. ; and rules:

$$S \to S \cup S | SS | S^* | (S) | 0 | 1 | \emptyset | \varepsilon$$

Using this G, solve the following questions. (**20 marks**)

(1) Give a derivation for the string $(0 \cup (10)^* 1)^*$. (**11 marks**)

(2) Give the corresponding parse tree for the string $(0 \cup (10)^* 1)^*$. (**9 marks**)

Question 2

Consider the following CFG $G = (V, \Sigma, R, S)$, where $V = \{S, T, X\}$, $\Sigma = \{a, b\}$, the start variable is S, and the rules R are:

$S \to aTXb$

$T \to XTS|\varepsilon$

$X \to a|b$

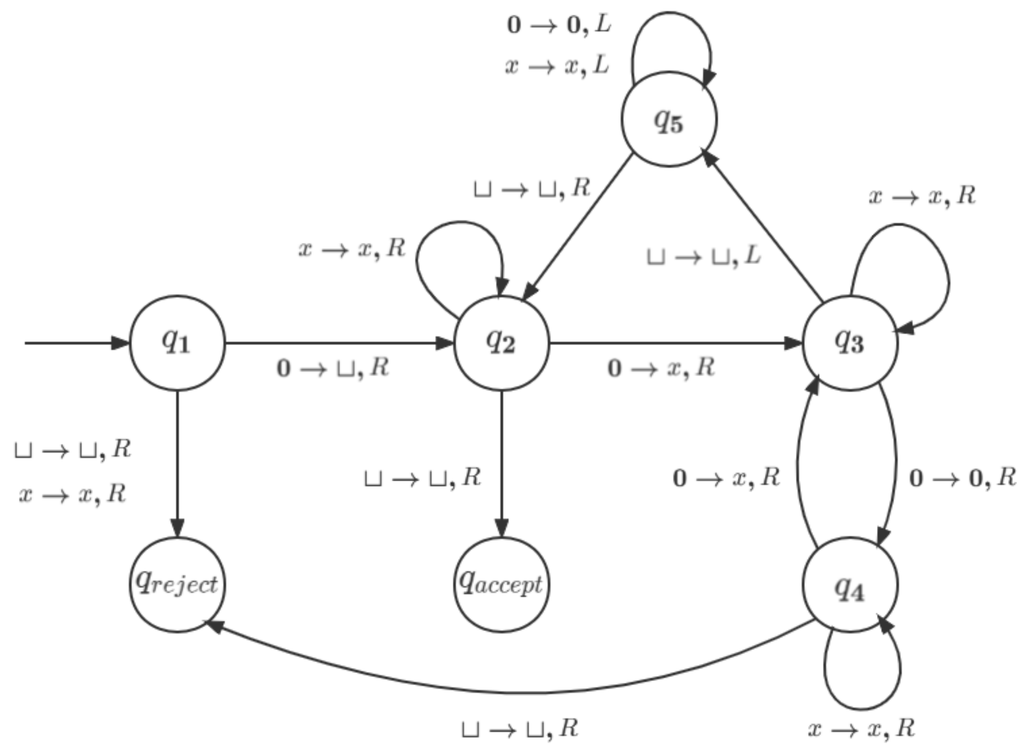
Convert this G to an equivalent PDA. (**20 marks**)

Question 3

Use the pumping lemma to prove that the language $A = \{0^{2n}1^{3n}0^n \mid n \geq 0\}$ is not context free. (**20 marks**)

Question 4

The Turing machine M below recognizes the language $A = \{0^{2^n} | n \geq 0\}$.



Give the sequence of configurations when the input string is 000000. (**20 marks**)

Question 5

Given the language $E_{CFG} = \{\langle G \rangle \mid G \text{ is a CFG with } L(G) = \emptyset\}$, prove that it is decidable (briefly describe the proof idea). (**20 marks**)