Q1. (A). Write a regular expression and a CFG for the following languages over the alphabet $\Sigma = \{0,1\}$ (select four only): (12 marks)

1. The language of all words that have an even number of 0's
2. The language of all words that have the substring 0110.
3. The language of all words of odd lengths.
4. The language of all possible strings.
5. The language contains all the strings of 0's and 1's in which all 1's (if any) comes before 0's (if any).

(B). Draw a DFA for the languages accepted by the following regular expressions:

(Select two only): (5 marks)
1. $(a+b)((a+b)(a+b))^*$
2. $((a+b)a)^*$
3. $(a+b)^*a\,(A+bbbb)$

(C). Decide whether or not the following CFG generate any word: (5 marks)

$S \rightarrow aXX \quad X \rightarrow aS | bS | a$

Q2. (A). Draw a PDA for the following CFG: (5 marks)

$S \rightarrow aXX \mid \Lambda \quad X \rightarrow aS \mid bS \mid a$

(B). Draw the total language tree for the following CFG: (6.5 marks)

$S \rightarrow Xa \mid bX \mid aXaX \quad X \rightarrow a \mid b$

(C). Drive the word = abba from the following CFG: (5 marks)

$S \rightarrow AA \quad A \rightarrow aB \quad B \rightarrow bB \mid \Lambda$

Q3. (A). Use the CYK table to decide whether or not the word = aba is generated by the following CFG: (6.5 marks)

$S \rightarrow aX \quad X \rightarrow aX | bX | \Lambda$

(B). Convert the following CFGs to GNFs (Select tow only): (15 marks)

1. $S \rightarrow AX | BX \quad X \rightarrow XX \mid a \mid b \quad A \rightarrow a \quad B \rightarrow b$
2. $S \rightarrow SS \mid aXb \quad X \rightarrow ba \mid bba \mid abb$
3. $S \rightarrow aX \mid bY \quad X \rightarrow Sa \quad Y \rightarrow bY \mid b \mid \Lambda$

(C). Convert the following NFA to DFA: (5 marks)

(D). Convert the following DFA to PDA: (5 marks)