

Question 1 [20Marks]

Computable Functions - Even Parity Generator: Design a Turing Machine to calculate the parity of a binary number, i.e., add a 0 at the end if the number of 1's in the input string is even or a 1 if this number is odd. You should append the parity bit at the extreme right of the binary number and leave the tape head in the beginning of the binary number, i.e., the extreme right.

Question 2 [20Marks]

Turing Machine: Construct a Turing machine to perform the multiplication operation $f(m,n)=m*n$. You must leave your tape head at the first letter of the output and the final TM should only have the answer on it and nothing else.

Question 3 [20Marks]

2PDA: Design a 2PDA for $a^n b^m c^n d^m$.

Question 4 [10Marks]

PM: Design a PM for the language $a^n b^n a^{2n}$ for $n \geq 0$.

Question 5 [10Marks]

PDA: Construct a PDA for language $L = \{0^n 1^m \mid n, m \geq 1, m > n+2\}$

Question 6 [1+2+2+1+1+3 = 10Marks]

CNF: Convert the following CFG to CNF

$S \rightarrow ASA \mid aB$

$A \rightarrow B \mid S$

$B \rightarrow b \mid bD \mid \Delta$

$C \rightarrow CC \mid aa \mid AB$

$D \rightarrow DD$

Question 7 [10Marks]

CFG=PDA: Convert the resultant CNF of the last question to its equivalent PDA using the method CFG=PDA.

Question 8 [10Marks]

Pumping Lemma: Prove using Pumping Lemma if the language $a^n b^n c^n$ is a context-free language.

Extra Sheet