

	Q-1	Q-2	Q-3	Q-4	Q-5	Q-5	Total
Marks Obtained							
Total Marks	10	10	10	10	10	20	70

Q1. [10 pts] CFG=PDA:

Convert the following CNF to its equivalent PDA using the method CFG=PDA.

S \longrightarrow **BB** | **AB** | **BA** | **AA** | Δ

A \longrightarrow **AA** | **a**

B \longrightarrow **AA** | **BA** | **b**

Q2. [10 pts] PDA:

Construct a PDA for **EVEN PALINDROME** = $\{ \Delta, aa, bb, aaaa, abba, baab, bbbb, \dots \}$

Q3. [10 pts] PDA:

Design PDA for the language **EQUAL-EQUAL** = { Δ , ab, ba, aabb, bbaa, abab, baba, baab, abba, aaabbb, }

Q4. [10 pts] GNF:

Convert to GNF. You must convert to intermediary grammar to get full marks.

$S \rightarrow AB \mid \Delta$

$A \rightarrow AB \mid BB \mid a$

$B \rightarrow AB \mid a$

Q5. [10 pts] Pumping Lemma for CFL:

Prove if $a^n b^n c^n d^n$ is a non-CFL.

Q6. [20 pts] Computable Functions:

Design a Turing machine that takes input a positive number x and performs the computable function $f(x) = x^2$. Assume the input is in unary notation, the tape head points in the start of the input. However, you may leave the tape head at any location on the output string when the computation is done. You are also **allowed** to use the sub programs of **INSERT** and **DELETE**. You may assume after **INSERT** operation, tape head points at the newly added cell while after **DELETE** operation, tape head points at the same location. An example is given below for your understanding:

Status of tape on input:

#	1	1	1	Δ	Δ	.	.	.
---	---	---	---	----------	----------	---	---	---



Status of the tape at output:

#	1	1	1	1	1	1	1	1	1	Δ	.
---	---	---	---	---	---	---	---	---	---	----------	---



Extra Page: