Subject: FINITE AUTOMATA & FORMULA LANGUAGES

Time: 3 Hours **Max. Marks: 100**

JUNE 2011

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2×10)**

a. The grammar with production rule is $\{S \to aSbb, S \to abb\}$ is

(A) type-3 grammar **(B)** type-2 grammar
(C) type-1 grammar **(D)** type-0 grammar

b. Which of the following statement is wrong?

(A) A Turing Machine cannot solve halting problem.
(B) Set of recursively enumerable languages is closed under union.
(C) A Finite State Machine with 3 stacks is more powerful than Finite State Machine with 2 stacks.
(D) Context sensitive grammar can be recognized by a linearly bounded memory machine.

c. Recursively enumerable languages are not closed under

(A) Complementation **(B)** Union
(C) Intersection **(D)** None of the above

d. Regular expression (x/y) (x/y) denotes the set

(A) {xy, xy} **(B)** {xx, xy, yx, yy}
(C) {x, y} **(D)** {x, y, xy}

e. Which of the following string can be generated by the productions: $S \to aS/bA, A \to d/ccA$

(A) aabccd **(B)** adabcca
(C) abcca **(D)** abababd

f. Regular sets are closed under

(A) Union
(B) Concenteration
(C) Kleene's closure
(D) All of the above

g. A Finite State Machine with finite is length tape and unidirectional head movement is considered as

(A) Turing machine
(B) Pushdown automata
(C) Context free languages
(D) Regular languages

h. Which of the following language is not regular?

(A) $\{a^n b^n | n \geq 0\}$
(B) $\{a^n | n \geq 1\}$
(C) $\{a^n b^m | n \geq 0, m \geq 10\}$
(D) $\{abc\}$

i. Consider the following production rules
$S \rightarrow a/aS$
$S \rightarrow b$
Which of the following regular expression is generated by the above production rules

(A) (ab)*
(B) a(ab)*b
(C) aa^*b^+
(D) aa*b

j. Consider the following grammar
$S \rightarrow SS$
$S \rightarrow 0S1$
$S \rightarrow 1S0$
$S \rightarrow \in$
The grammar will generate

(A) regular language
(B) context-free language
(C) context sensitive language
(D) recursively enumerable language.

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Prove by mathematical induction n^4-4n^2 is divisible by 3 for $n \geq 0$. **(8)**

b. Discuss diagonalization Principle with example. **(8)**

Q.3 a. Draw the state diagram for NFA accepting language
$L = (ab)^* (ba)^* \cup aa^*$. **(8)**

b. Design the deterministic finite automata for the language
$L = \{w: n_a(w) =< 3, w \in (a,b)^*\}$ **(8)**

Q.4 a. Write the regular expression for the language
$L = \left\{a^n b^m \middle| n \geq 4, m \leq 3\right\}$ **(8)**

b. Find a regular expression corresponding to the state diagram given in Fig.1.

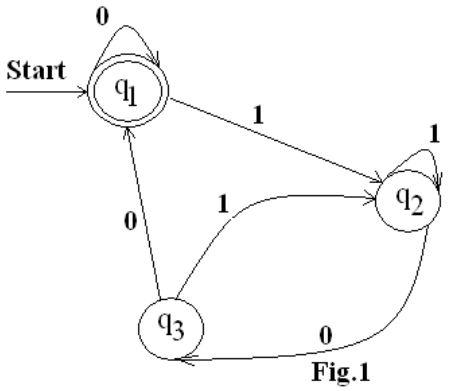

Fig.1

Q.5 a. Prove that $L = \{ a^n b a^n$ for $n = 0, 1, 2, \ldots\}$ is not regular. **(8)**

b. $\sum = \{0, 1\}$, and $\sum = \{1, 2, 3\}$. Define h by
$h(0) = 3122$
$h(1) = 132$
If L is regular language denoted by
$r = (0 + 1^*)(00)^*$
then find the regular expression for language $h(L)$. **(8)**

Q.6 a. Write a context free grammar, that generates palindrome of binary numbers. **(8)**

b. Construct the pushdown automata for the following language.
$L = \left\{a^n b^{n+1} \middle| n = 1,2,3,.....\right\}$. **(8)**

Q.7 a. Change the following grammar to CNF
$G = (\{S\},\{a,b,c\},\{S \rightarrow a/b/CSS\},S)$ **(8)**

b. Prove that language $L = \{ WW \middle| W \in \{a, b\}^*\}$ is not context-free. **(8)**

Q.8 a. Design a Turing Machine that accepts the language of all strings that contain aba as a substring. **(8)**

b. Discuss 'Church's thesis? Why Church's thesis is not considered as a theorem in mathematics. **(8)**

Q.9 a. Prove that following instance of a Post Correspondence Problem (PCP) has no solution over $\sum = \{0, 1\}$, X and Y be lists of three strings as follows: **(8)**

	List X	List Y
i	X_i	Y_i
1	10	101
2	011	11
3	101	011

b. Prove that if a language L and its complement *L'* are both recursively enumerable, then L (and hence *L')* is recursive. **(8)**