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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

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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)**

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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
$L = \{a^n b^m | n \geq 4, m \leq 3\}$ **(8)**

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

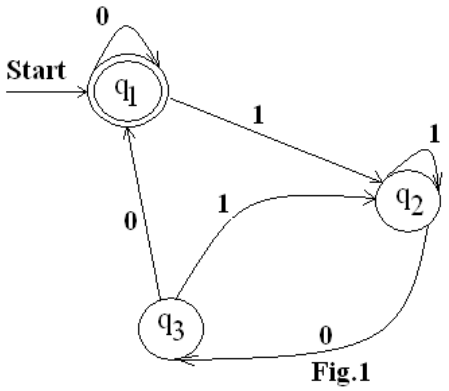

Fig.1

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.
$L = \{a^n b^{n+1} | n = 1,2,3,.....\}$. **(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 $L = \{ WW | W \in \{a, b\}^*\}$ 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)**

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Q.9 a. Prove that following instance of a Post Correspondence Problem (PCP) has n 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)**

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