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08SCS151

First Semester M.Tech. Degree Examination, June/July 2011
Theoretical Foundation of Computer Science

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions.*

1 a. Define the following :
i) String ii) Problem iii) Power set iv) Length of string v) Language of DFA (05 Marks)

b. Write a DFA for L = { w | w has odd number of 1's followed by even number of 0's }. (05 Marks)

c. Write a procedure to convert a NFA to a DFA. Convert the following NFA to DFA.

	0	1
→p	{ p, q }	{ p }
q	{ r }	{ r }
r	{ s }	ϕ
*s	{ s }	{ s }

(10 Marks)

2 a. Show that for every DFA A = (Q, Σ, δ, q_0 , F) there is a regular expression R, such that L(R) = L(A). (06 Marks)

b. Construct a transition diagram and find the regular expression for the following automaton

	0	1
→q_1	q_2	q_3
*q_2	q_1	q_3
*q_3	q_2	q_2

(06 Marks)

c. Draw the table of distinguishabilities and then construct the minimum-state equivalent DFA for the following automaton. (08 Marks)

	0	1
→A	B	E
B	C	F
*C	D	H
D	E	H
E	F	I
*F	G	B
G	H	B
H	I	C
*I	A	E

3 a. Using pumping lemma, show that L = { $a^{n!}$ | n ≥ 0 } is not regular. (06 Marks)

b. If L is a regular language over alphabet Σ, and h is a homomorphism on Σ, then show that h(L) is also regular. (08 Marks)

c. Using closure properties, show that L = {$a^n b^l c^{n+l}$ | n, l ≥ 0 } is not regular. (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

4 a. Show that the following grammar is ambiguous. Construct an unambiguous grammar for the same:

$S \rightarrow iCtS \mid iCtSeS \mid a$

$C \rightarrow b$ (08 Marks)

b. Define the following:
i) Language of a grammar ii) Derivation tree (04 Marks)

c. Write the grammar for the following language:
i) $L(G) = \{ a^n b^{n-3} : n \geq 3 \}$ ii) $L(G) = \{ a^n b^m c^m d^n : m, n \geq 1 \}$
iii) $L = \{ w : n_a(w) = n_b(w) \}$ iv) $L = \{ ww^R : w \in (a+b)^* \}$ (08 Marks)

5 a. Design a PDA to accept the language corresponding to the grammar

$S \rightarrow AA \mid 0$

$A \rightarrow SS \mid 1$

by empty stack and final state methods. (08 Marks)

b. If there is a PDA to accept a language 'L' by final state then show that there is a PDA to accept the same language 'L' by empty stack. (07 Marks)

c. Convert the following PDA to CFG :
$M = (\{p, q\}, \{0, 1\}, \{x, z_0\}, \delta, q, z_0)$ and δ is given by

$\delta(q, z_0, 1) = (q, xz_0)$

$\delta(q, x, 1) = (q, xx)$

$\delta(q, x, 0) = (p, x)$

$\delta(q, x, \epsilon) = (q, \epsilon)$

$\delta(p, x, 1) = (p, \epsilon)$

$\delta(p, z_0, 0) = (q, z_0)$ (06 Marks)

6 a. Write an algorithm to eliminate ϵ-production from a grammar. Eliminate ϵ-production for the following grammar:

$S \rightarrow AB \mid aS$

$A \rightarrow \epsilon$

$B \rightarrow \epsilon$

$D \rightarrow b$ (08 Marks)

b. Convert the following grammar to GNF:

$S \rightarrow AA \mid 0$

$A \rightarrow SS \mid 1$ (06 Marks)

c. State and prove the pumping lemma for context free languages. (06 Marks)

7 a. Explain the model of Turing machine. (06 Marks)

b. Obtain a Turing machine to accept a string 'w' of a's and b's such that $n_a(w) = n_b(w)$. (07 Marks)

c. Obtain a Turing machine to perform $x + y$, where x and y are positive integers. (07 Marks)

8 a. Discuss how to use computer to simulate a Turing machine and compare the running times of computer and Turing machine. (10 Marks)

b. State and prove Rice theorem. (10 Marks)

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