$\boxed{\textbf{A 226}}$

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Fifth Semester

Computer Science and Engineering

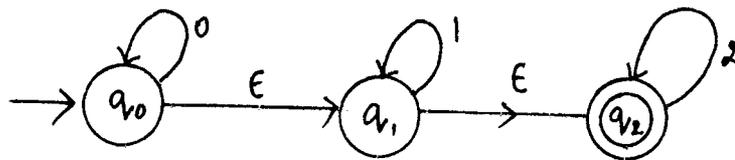CS 332 — THEORY OF COMPUTATION

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Obtain $\in$-closure of each state in the following NFA with $\in$-move.

2. Define regular expression and give an example.

3. For the grammar $S \rightarrow aCa$, $C \rightarrow aCa/b$, find $L(G)$.

4. Show that $id + id * id$ can be generated by two distinct leftmost derivation in the grammar $E \rightarrow E + E / E * E /(E)/id$.

5. Give an example of a PDA.

6. Explain the acceptance of a PDA with empty stack.

7. Describe the non-deterministic Turing machine model. Is it true the non-deterministic Turing machine model's are more powerful than the Basic Turing machines? (In the sense of language acceptance).

8. When a language is said to be recursive? Is it true that every regular set is not recursive?

9. When a problem is said to be decidable or undecidable? Give an example of an undecidable.

10. What do you mean by Universal Turing machine?

PART B — (5 × 16 = 80 marks)

11. (i) Design Turing machine for computing $f(m,n) = m - n$ (proper subtraction).

(10)

(ii) Explain how the multiple tracks in a Turing machine can be used for testing given positive integer is a prime or not.
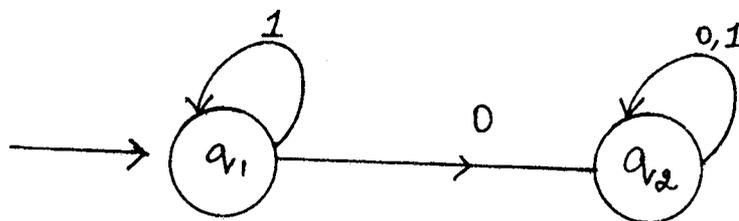
(6)

12. (a) (i) Construct DFA equivalent to the NFA given below :

(10)

	0	1
p	$\{p, q\}$	p
q	r	r
r	s	—
s	s	s

(ii) Check whether the language $L = \{o^n 1^n / n \geq 1\}$ is regular or not? Justify your answer.

(6)

Or

(b) (i) Construct an NFA equivalent to the regular expression $((0+1)(0+1)(0+1))^*$.

(8)

(ii) Obtain the regular expression denoting the language accepted by the following DFA by using the formula R_{ij}^k.

(8)

13. (a) (i) Let $G = (V, T, P, S)$ be a context-free grammar. Then prove that if $S \overset{*}{\Rightarrow} \alpha$ then there is a derivation tree in G with yield α.

(10)

(ii) Find a context free grammar with no useless symbols equivalent to

$S \to AB / CA$, $B \to BC / AB$

$A \to a$, $C \to aB / b$.

(6)

Or

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(b) **(i)** Obtain the Chomsky normal form equivalent to the grammar

$S \to bA/aB$, $A \to bAA/aS/a$, $B \to aBB/bS/b$. (4)

(ii) Convert the grammar $S \to AB$, $A \to BS/b$, $B \to SA/a$ into Greibach normal form. (12)

14. **(a)** **(i)** Prove that L is $L(M_2)$ for some PDA M_2 if and only if L is $N(M_1)$ for same PDA M_1. (12)

(ii) Define deterministic push down automata DPDA. Is it true that DPDA and PDA are equivalent in the sense of language acceptance is concern? Justify your answer. (4)

Or

(b) **(i)** Construct a context-free grammar G which accepts $N(A)$ where $A = (\{q_0, q_1\}, \{a, b\}, \{z_0, z_1\}, \delta, q_0, z_o, \phi)$, δ is given by

$$\delta(q_0, b, z_0) = \{(q_0, zz_0)\}$$

$$\delta(q_0, \in, z_0) = \{(q_0, \in)\}$$

$$\delta(q_0, b, z) = \{(q_0, zz)\}$$

$$\delta(q_0, a, z) = \{(q_1, z)\}$$

$$\delta(q_1, b, z) = \{(q_1, \in)\}$$

$$\delta(q_1, a, z_0) = \{(q_0, z_0)\}.$$

(10)

(ii) State pumping lemma for context-free language σ show that language $\{a^i b^j c^i d^j / i \geq 1$, and $j \geq 1\}$ is not context-free. (6)

15. **(a)** Define the language L_u. Check whether L_u is recursively enumerable? or L_u is recursive? Justify your answers. (16)

Or

(b) **(i)** Show that the language L_d is neither recursive nor recursively enumerable. (12)

(ii) Describe how a Turing machine can be encoded with 0 and 1 and give an example. (4)

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