Bihar Engineering University, Patna

B.Tech. 5th Semester Examination, 2023

Course: B.Tech. *Time: 03 Hours*

Code: 105503 *Subject : Formal Language and Automata Theory* *Full Marks: 70*

Instructions:-

(i) The marks are indicated in the right-hand margin.
*(ii) There are **NINE** questions in this paper.*
*(iii) Attempt **FIVE** questions in all.*
(iv) Question No. 1 is compulsory.
(v) Assume suitable missing data

Q.1 ***Choose the correct answer of the following (Any seven question only):*** **[2 x 7 = 14]**

(a) Let S be an infinite countable set. Then its power set will be
(i) countable (ii) not countable
(iii) can't be determined (iv) None of the above.

(b) Assuming $P \neq NP$, which of the following is true?
(i) NP-complete = NP (ii) NP-complete $\cap$ P = ϕ
(iii) NP-hard = NP (iv) P = NP-complete

(c) Which of the following pairs of regular expressions is not equivalent?
(i) 1(01)* and (10)* 1 (ii) x(xx)* and (xx)* x
(iii) (ab)* and a*b* (iv) x+ and x* x+

(d) The logic of Pumping Lemma is a god example of
(i) the pigeon-hole principle (ii) the divide and conquer technique
(iii) recursion (iv) iteration

(e) A PDM behaves like a TM when the number of auxiliary memory it has is
(i) 0 (ii) 1 or more
(ii) 2 or more (iv) None of the above

(f) The recognizing capability of DPDA and NPDA is
(i) different (ii) same
(iii) can't be decided (iv) None of the above

(g) If L is a recursive language, then will its complement be also recursive? It is a
(i) decidable problem (ii) un-decidable problem
(iii) can't be said (iv) None of the above

(h) If a language and its complement both are recursively enumerable then the language is
(i) regular (ii) context-free
(iii) context-sensitive (iv) recursive

(i) CFG is not closed under
(i) union (ii) kleene star
(iii) complementation (iv) product

(j) The intersection of a context-free language and a regular language is
(i) need not be regular (ii) need not be context-free
(iii) is always context-free (iv) None of the above

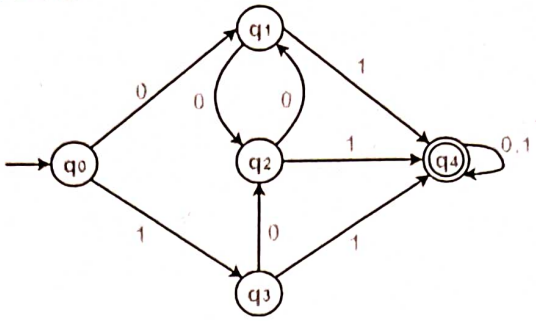
Q.2 (a) Write a Regular Exp. for L= {w $\in$ {0,1}*:w has no pair of consecutive zeros}. **[7]**

(b) Construct a DFA equivalent to the NFA given by M = ({p,q,r,s}, {0,1}, δ, p, {s}), where δ is defined in the following table. **[7]**

	0	1
p	{p,q}	{p}
q	{r}	{r}
r	{s}	-
s	{s}	{s}

Q.3 (a) Construct a DFA which will accept the set consisting of all strings with no more than three a's, where the input alphabet is $\Sigma=\{a,b\}$. [7]

(b) Minimize the given DFA. [7]



Q.4 (a) If L_1 and L_2 are regular languages then prove that there exists an algorithm to determine whether or not $L_1 = L_2$. [7]

(b) State the pumping lemma theorem for regular sets. With the help of pumping lemma, prove that $L= \{w \in \Sigma^*: n_a(w) < n_b(w)\}$ is not regular. [7]

Q.5 (a) Convert the given CFG into GNF form: - [7]

$S \rightarrow XB \mid AA$

$A \rightarrow a \mid SA$

$B \rightarrow b$

$X \rightarrow a$

(b) Design a PDA for the language $L=\{ WW^R: W \text{ is in } (0+1)^* \}$. [7]

Q.6 (a) Write the closure properties of regular languages and context free languages. [7]

(b) Define LBA. Find LBA for the language $L=\{a^n b^n c^n : n \geq 1\}$. [7]

Q.7 (a) What do you mean by, "Turing Machines as Transducers"? Design a Turing machine which will compute addition of two positive integers. [7]

(b) How will you check that a given CFG is ambiguous or not? Is it decidable or undecidable problem? Give the proof to support your answer. [7]

Q.8 (a) Design a Turing Machine to accept the language $L=\{0^n1^n: n>=1\}$. [7]

(b) Define Recursive and Recursive Enumerable languages. Show the relation among them with the help of Venn- diagram. [7]

Q.9 Write short notes on ***any two*** of the following: **[7×2=14]**

(a) Post correspondence problem

(b) Halting Problem

(c) Church-Turing Thesis

(d) Chomsky Normal Form