Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester: VI (Computer Engineering/Information Technology)

Regular Examination April – June 2016

2CE601/2IT601: Theory of Computation

Time: 3 Hours **Total Marks: 70**

Instruction:

- This paper contains two sections. Attempt each section in separate answer sheet.
- Figure to right indicate full marks.
- Be precise and to the point in answer.
- Assume suitable data if require.

Section - I

Que. – 1

A Suppose A is a set having 5 elements. 4

a. How many reflexive relations are there on A?
b. How many symmetric relations are there on A?
c. How many relations are there on A that are both reflexive and symmetric?
d. How many Anti symmetric relations are there?

B By using the induction theorem show that $1^2+2^2+\cdots+n^2 = n(n+1)(2n+1)/6$ 4

C Proof by contradiction that the square root of 2 is irrational i.e. there are no positive integers m and n satisfying $m/n = \sqrt{2}$. 4

OR

Que. – 1

A Define strong principle of mathematical induction and by using this show that integer bigger than 2 have prime factorizations. 4

B Define tautology, contingency and contradiction. Using identities prove that: $Q \vee (P \wedge \sim Q) \vee \sim P \wedge \sim Q$ is a tautology 4

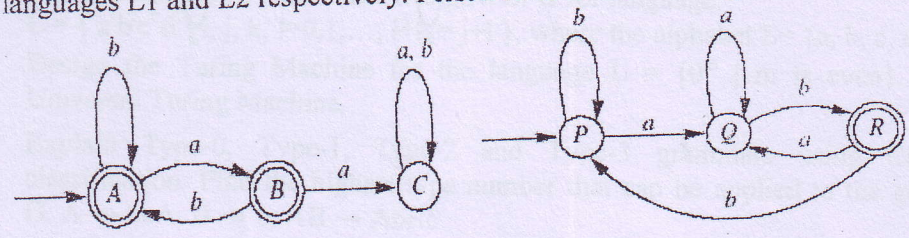
C Of the 200 candidates who were interviewed for a position at a call center, 100 had a two-wheeler, 70 had a credit card and 140 had a mobile phone. 40 of them had both, a two-wheeler and a credit card, 30 had both, a credit card and a mobile phone and 60 had both, a two wheeler and mobile phone and 10 had all three. How many candidates had none of the three? 4

Que. – 2

A In each case, find a string of minimum length in {a, b}* not in the language corresponding to the given regular expression. 6

1. b* (a + ba)* b*
2. a* (baa*)* b*

B Let M1 and M2 be the DFAs as shown in the following diagram, recognizing languages L1 and L2 respectively. Perform M1 U M2 to recognize L1 U L2. 3



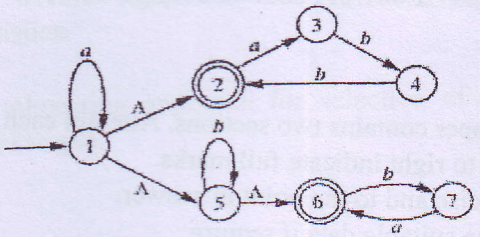
M1 M2

C Construct the DFA for the language of all the strings containing neither substring 00 nor 11 over alphabet set $\Sigma = \{0, 1\}$. 2

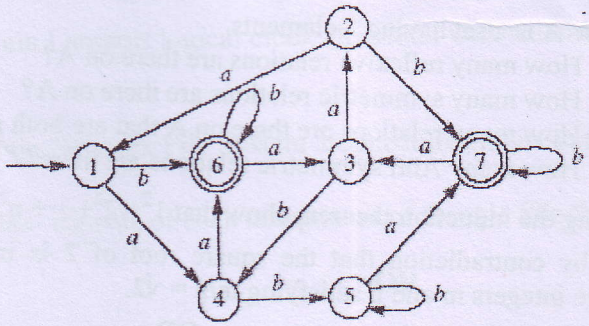
OR

Que. – 2

A Draw an NFA for the NFA-ε as shown in the following figure. 6



B Perform minimization on following DFA : 5

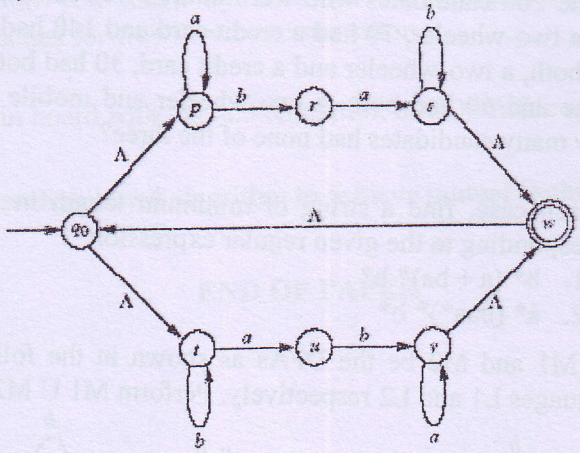


Que. – 3

A Show the step by step procedure to draw an NFA-ε for the regular expression $(0 + 1)(01)^*(011)^*$ using Kleene's Theorem. 6

B Draw the NFA for the regular expression $(a + b)^* (abb + ababa) (a + b)^*$. 3

C Calculate $\delta^*(q0, ab)$ for the following NFA-ε. 3



Section – II

Que. – 4

A Using pumping lemma show that $L = \{a^n \mid n \text{ is a prime number}\}$ is not a regular language. 4

B Remove the useless-productions from the following grammar G: 4

G: $S \rightarrow A \mid C$
$B \rightarrow bB \mid cB \mid a$
$A \rightarrow b$

C Derive the left most derivation and draw the parse tree to the string "aabbbb" for the following grammar G: 4

G: $S \rightarrow AB \mid \varepsilon$
$A \rightarrow aB$
$B \rightarrow Sb$

OR

Que. – 4

A Remove the unit-productions from the following grammar: 4

$S \rightarrow Aa \mid B$
$B \rightarrow A \mid bb$
$A \rightarrow a \mid bc \mid B$

B Remove ε-productions from the following grammar: 4

$S \rightarrow aS \mid AC \mid AB$
$A \rightarrow \varepsilon$
$C \rightarrow \varepsilon$
$B \rightarrow bB \mid bb$
$D \rightarrow c$

C Find the language L generated by the following grammars: 4

a) $S \rightarrow X$
$X \rightarrow aXb \mid aX \mid a$

b) $S \rightarrow aS \mid bS \mid a \mid b$

Que. – 5

A Design the PDA for the following Languages: 8

a. $L = \{n_a(w) = n_b(w)\}$
b. $L = \{a^n b^n \mid n \geq 0\}$

B Using pumping lemma prove that the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$ is not a Context-free Language. 3

OR

Que. – 5

A Design the PDA for the language $L = \{a^n b^m \mid n > m \text{ and } m, n \geq 1\}$ 4

B Design a Turing Machine to compute m-n where m, n are positive integers. 4

C Prove that Context-free Languages are not closed under complementation operation. 3

Que. – 6

A Define Push Down Automata. Design a CFG for language: 4
$L = \{ a^i b^j c^k d^l \mid i, j, k, l=0,1,\ldots; i+k = j+l \}$, where the alphabet $\Sigma = \{a, b, c, d\}$.

B Design the Turing Machine for the language $L = \{0^m \mid m \text{ is even}\}$. Define Universal Turing Machine. 4

C Explain Type-0, Type-1, Type-2 and Type-3 grammars using Chomsky classification. Find the highest type number that can be applied to the grammar G: $A \rightarrow bcA$, $B \rightarrow b$, $AB \rightarrow AbBc$ 4

END OF PAPER