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BMS College of Engineering, Bangalore-560019

(Autonomous Institute, Affiliated to VTU, Belgaum)

December 2016 Semester End Main Examinations

Course: **Theoretical Foundations of Computation** Duration: **3 hrs**
Course Code: **15IS3DCTFC** Max Marks: **100**
Date: 22.12.2016

Instructions: **1. Answer any five full questions choosing one from each unit.**
2. Assume missing data (if any) suitably

UNIT 1

1. a) Define the following terms with an example for each. **04**
i) Alphabet ii) String iii) Language iv) Power set

b) Consider the following ϵ-NFA with p as initial state and r as final state **08**
i. Compute the ϵ-closure of each state
ii. Give all the strings of length three or less accepted by automata
iii. Convert the automata to DFA.

	ϵ	a	b	c
p	{q,r}	ϕ	{q}	{r}
q	ϕ	{p}	{r}	{p,q}
r	ϕ	ϕ	ϕ	ϕ

c) Discuss the applications of ϵ-NFA with an appropriate example. **04**

d) Construct DFA accepting the following language over the alphabet {a, b} where L = $\{ab^2wba^2 : w \in (a, b)^*\}$ **04**

UNIT 2

2. a) For each of the following Regular Expressions draw the ϵ- NFA recognizing the corresponding language **04**
i. (a+b)* (a+b)*
ii. a* (a+b) b*

b) State and prove Kleene's theorem. **08**

c) Define distinguishable and indistinguishable states. Identify indistinguishable states and minimize the following DFA using table filling algorithm. **08**

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

OR

3. a) Transition table for a DFA is given below **08**

δ	0	1
→p	q	p
q	r	p
*r	r	q

(a) Give all the Regular expressions $R_{ij}^{(0)}$.

(b) Give all the Regular expressions $R_{ij}^{(1)}$.

Simplify the expressions as much as possible.

b) State and prove pumping lemma for regular languages **06**

c) Discuss any three closure properties of regular languages. **06**

UNIT 3

4. a) What is meant by ambiguity? Show that the following grammar is ambiguous. Further find an equivalent unambiguous grammar. **06**

S→A|B
A→aAb| ϵ
B→abB| ϵ

b) Explain any two applications of CFG. **06**

c) Given below is a CFG G. Find a CFG G' in GNF generating L(G)-{ ϵ} **08**

S→AB|ABC
A→BA|BC|a| ϵ
B→AC|CB|b|c
C→BC|AB|A|c

OR

5. a) Prove that L={WW | W ϵ {0,1}*} is not a CFL. **06**

b) Construct CFGs that generates the following languages **06**

(i) L={uvw|u,v,w ϵ {a,b}* and |v|=2}

(ii) $L=\{a^n b^m \mid n!=m\}$

(iii) L={W| W is a palindrome}

c) Convert the following grammar into CNF. **08**

S→ABaC
A→BC
B→b| ϵ
C→B| ϵ
B→d

UNIT 4

6. a) Define DPDA. Construct a PDA to accept the Language $L=\{a^{2n}b^n \mid n \geq 0\}$ **07**

b) Write a note on language accepted by PDA **05**

c) Discuss the steps involved in converting CFG to PDA and Convert the following CFG to PDA **08**

S→aABB|aAA
A→aBB|a
B→bBB|A
C→a

UNIT 5

7. a) Consider the turing machine defined by Q = $\{q_0, q_1\}$, $\sum = \{a,b\}$, $\Gamma = \{a, b, B\}$, F = $\{q_1\}$ and δ is defined by – **06**

$\delta (q_0, a) = (q_1, a, R)$
$\delta (q_0, b) = (q_1, b, R)$
$\delta (q_0, B) = (q_1, B, R)$
$\delta (q_1, a) = (q_0, a, L)$
$\delta (q_1, b) = (q_0, b, L)$
$\delta (q_1, B) = (q_0, B, L)$

Can this turing machine be called a standard TM? Justify your answer.

b) Let x and y are two positive integers represented using unary notation. Design a Turing Machine that computes the function (x,y Є 1+) **09**

$f(x, y) = x - y$ if $x \geq y$
$f(x, y)=0$ if $x < y$

c) Define post correspondence problem (PCP) and solve PCP given below. **05**

	List A	List B		List A	List B
	Xi	Yi		Xi	Yi
1	11	111	1	110	110110
2	100	001	2	0011	00
3	111	11	3	0110	110

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