KUMARAGURU college of technology
character is life

Register Number: ……..

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

Fifth Semester

COMPUTER SCIENCE AND ENGINEERING

CSE111: Theory of Computation

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The regular expression that represents the language consisting of all strings that has a single string 01 followed by any number of 0's is

   a) 01*0 b) 0*10

   c) 010* d) 001*

2. The smallest finite automata which accepts the language { *x/ length of x is divisible by 2*}

   a) 2 states b) 3 states

   c) 4 states d) 5 states

3. Which of the following regular expression identities are true?

   a) (r*)* = r* b) (r+s)* = r* + s*

   c) (r*s*)* = (r*+s*) d) r* + s* = r*s*

4. Consider the context-free grammar S→aS | b ; Match the language for this grammar

   a) L= $\{a^i b^j \mid i=1,2,\ldots., j=1,2\}$ b) L=$\{a^i b^j \mid i=0,1,2\ldots, j=1\}$

   c) L=$\{(ab)^i aa \mid i=0,1,2\ldots\}$ d) L= $\{a^i b^j \mid i=1,2,\ldots., j=2^2\}$

5. The productions must be in _____ form if it is a regular grammar.

   a) A→aB | a b) A→ Ba

   c) A→ a d) A→Bc

6. The context-free languages are not closed under

   a) Reversal b) Intersection

   c) Homomorphism d) Both b and c

7. The language accepted by Turing machine is

   a) CFG b) Non-regular

   c) Recursive language d) All the above

8. Consider the following statements about the context free grammar

G = {S -> SS,S ->ab,S -> ba,S ->ε}

I. G is ambiguous

II. G produces all strings with equal number of a's and b's

III. G can be accepted by a deterministic PDA.

Which combination below expresses all the true statements about G?

a) I only
b) I and III only
c) II and III only
d) I, II and III

9. If the language L is context-free then there is a_____ for L.

a) CFG
b) PDA by intermediate state
c) PDA by non-empty stack
d) PDA for Initial State

10. Which of the following is un-decidable

a) L_d language
b) Ambiguity for CFG's
c) PCP
d) All the above

PART B (10 x 2 = 20 Marks)

11. Distinguish between NFA and DFA.

12. Sketch the DFA given $M = (\{q1 , q2\},\{0,1\},\delta, q1 ,\{q2\})$and d is given by

$\delta (q1 ,1) = q1$

$\delta (q2 ,0) = q1$

$\delta (q1 ,0) = q2$

$\delta (q2 ,1) = q2$

Determine a Language $L(M)$, that the DFA recognizes.

13. Define regular expression. Give an example.

14. Give the regular expression for

i) the set of all strings of vowels starts with aa and ends with uu..

ii) the set of all strings over {a,b} containing three consecutive a's followed by three consecutive b's.

15. Convert the following grammar to a PDA that accepts the same language by empty stack.

$S \rightarrow 0S1 \mid A \qquad A \rightarrow 1A0 \mid S \mid \varepsilon$

16. What is ambiguous grammar? Give an example

17. Define homomorphism. Are regular languages closed under homomorphism?

18. What is Chomsky Normal Form? Give an example

19. Show that the following problem is un-decidable :

"Given two CFGs *G1* and *G2* is $L(G1) \cap L(G2) = \phi$?"

20. Does the following instance of PCP have a solution?

List A	List B
bbab	a
ab	abbb
baa	aa
b	bbb

PART C (5 x 14 = 70 Marks)

21. a) (i) Construct a DFA equivalent to the NFA N=({p,q,r,s}, {0,1}, δ, p, {q,s}) (10)

Input symbols/ States	0	1
→p	{p,s}	{q}
*q	{r}	{q,r}
r	{s}	{s}
*s	Φ	{p}

Trace the DFA for the input string 00101.

(ii) Draw NFA for the string (01*/ 0*0) (4)

(OR)

b) (i) Consider the following Є-NFA. (12)

Input symbols/ States	Є	a	b
→p	{r}	{q}	{p,r}
q	Φ	{p}	Φ
*r	{p,q}	{r}	{p}

a. Compute the Є-closure of each state.

b. Give all strings of length two or less accepted by the automaton.

c. Convert the automaton to a DFA.

(ii) State the advantages of DFA (2)

22. a) Construct a minimum state automaton equivalent to a given automaton M whose transition table is given below:

	a	b
->A	B	C
B	B	D
C	B	C

D	B	E
*E	B	C

(OR)

b) (i) State and explain pumping lemma for regular languages (7)

(ii) Write down the steps involved in Converting regular expression to automata with an example. (7)

23. a) (i) Build a parse tree corresponding to a terminal string 00110101 belonging to the following grammar G (7)

S->0B / 1A

A-> 0 / 0S / 1AA

B ->1 / 1S / 0BB. Find left most derivation for the string.

(ii) Prove the equivalence of PDA with empty stack and with final state. (7)

(OR)

b) Construct a PDA by empty stack to accept the language

$L = \{wCw^R \mid w \in \{a,b\}^+\}$.

Construct an equivalent PDA to accept by final state.

24. a) (i) Find a grammar in Chomsky normal form equivalent to (10)

$S \rightarrow ABA$, $A \rightarrow aA \mid \varepsilon$, $B \rightarrow bB \mid \varepsilon$

(ii) Rephrase the following grammar into GNF (4)

S → ABA|AB|BA|AA|A|B

A→ aA|a

B → bB|b

(OR)

b) Design a Turing machine to do multiplication.

25. a) Describe how a Turing Machine can be encoded with 0 and 1 to count the number of 0s and 1s in the input string.

(OR)

b) (i) Prove the following (7)

"If L1 and L2 are recursive languages, then L1 U L2 is recursive language".

(ii) "If both a language L and its complement are recursively enumerable, then L is recursive". (7)

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