Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech.**
PCS4I104

4th Semester Regular / Back Examination 2017-18
FORMAL LANGUAGE & AUTOMATA THEORY
BRANCH : CSE
Time : 3 Hours
Max Marks : 100
Q.CODE : C1008
Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Part-A(Answer all questions)

Q1 **Answer the following questions :** **(2 x 10)**

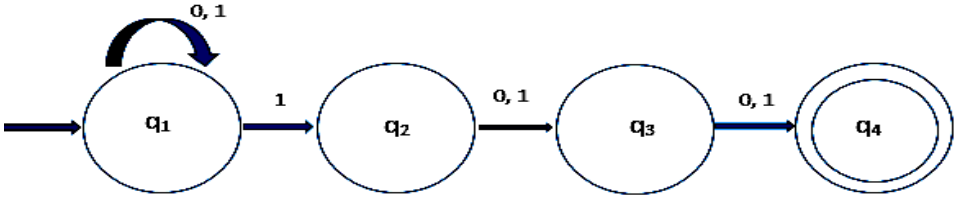
a) What do you mean by an alphabet and a string?
b) Give the formal definition of Greibach Normal Form.
c) Define Kleene closure of a language.
d) If the number of states in an NFA is n, then what is the number of states in its equivalent DFA?
e) Construct an NFA for the regular expression (aUb)*aba.
f) What do you mean by instantaneous description of a Turing Machine?
g) Design a DFA that accepts odd number of ones.
h) Differentiate between P and NP class of problems.
i) Give example of a total and a partial function.
j) What is meant by Halting Problem of a Turing Machine?

Q2 **Answer the following questions :** **(2 x 10)**

a) Discuss the significance of a stack in PDA.
b) What do you mean by Pigeonhole Principle?
c) Distinguish between a DPDA and NPDA.
d) What is the time complexity of CYK algorithm?
e) Define a Post Correspondence Problem (PCP).
f) Give two examples of NP-Complete problems.
g) What do you mean by €-closure (epsilon closure) of a state?
h) Define a primitive recursive function.
i) What is meant by leftmost and rightmost derivation? Give example.
j) What is the difference between a recursive language and a recursively enumerable language?

Part-B(Answer any four questions)

Q3 **a)** Design a PDA that recognizes the language A= $\{0^n1^n \mid n>=0\}$. **(5)**
b) Prove that the class of regular languages is closed under union operation. **(5)**
c) Convert the following NFA to DFA. **(5)**



Q4 **a)** Design a minimized DFA for the regular expression (a*b)(a U b)* **(8)**

b) State and prove pumping lemma for Regular languages. Using pumping lemma prove that the language $L=\{0^n1^n \mid n>=0\}$ is not regular. **(5)**

c) Differentiate between a deterministic Turing Machine and a non-deterministic Turing Machine. **(2)**

Q5 **a)** Give the formal definition of Chomsky's Normal Form (CNF). Define ambiguity in grammars with a suitable example. **(5)**

b) Design the DFA's for the language that accepts all strings **(5)**

i) Starting with 1 and ending with 0.

ii) Starting with 0 and having odd length or starting with 1 and having even length.

c) Define Ackermann's function. Using the function, find out the values of A (2,1) and A (2,2). **(5)**

Q6 **a)** Design a Turing Machine to accept the language L= {w#w | w € {0,1}*}. **(10)**

b) Convert the following context free grammar to Chomsky's Normal Form (CNF): **(5)**

S ⟶ ASA | aB

A ⟶ B | S

B ⟶ B | €

Q7 **a)** Design the NFA's accepting strings over the alphabet {0,1} **(5)**

i) Not containing the substring 110.

ii) Containing the substring 110.

b) Design a PDA that recognizes the language L= $\{a^ib^jc^k \mid i,j,k>=0$ and i=j or i=k$\}$. **(5)**

c) Show that the following functions are primitive recursive. **(5)**

i) f (x,y)= x*y

ii) f (x,y)= x^y

Q8 **a)** Compute the Godel number for the following sequence: **(5)**

i) 1,1,2,0 ii) 4,0,0,1 iii) 0,0,1,1 iv) 1,0,3,0

b) Design a DFA over the alphabet {a,b} accepting strings that does not contain exactly two a's. **(5)**

c) Explain the Chomsky's hierarchy with a suitable diagram. **(5)**

Q9 **Write short answer on any THREE :** **(5 x 3)**

a) Class NP-Complete

b) Decidability

c) Pumping Lemma for context free languages

d) CYK algorithm