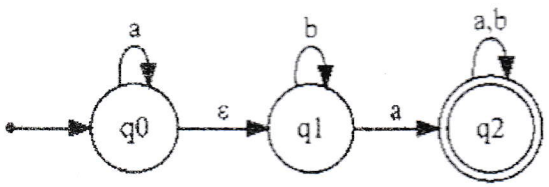
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	BCT	Pass Marks	24
Year / Part	II / I	Time	3 hrs.

Subject: - Theory of Computation (*ENCT 203*)

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define equivalence and partial-equivalence relation. Using mathematical induction show that for every integer n > = 0 the number $4^{(2n+1)} + 3^{(n+2)}$ is a multiple of 13. [2+2]
2. Write regular expression for the language which generates the string containing odd number of 1 followed by even number of 0 or even number of 0 followed by odd number of 1 over Σ{0,1}. [2]
3. Using principle of resolution show that the hypothesis "If it is raining then, Prem has his umbrella,". "Prem does not have his umbrella or he does not get wet,". "It is raining or Prem does not get wet" imply that " Prem does not get wet." [3]
4. Design a DFA over {0,1} that can recognize the string containing number of 1 multiple of 3 and number of 0 multiple of 2. Check your design for w = 1010111001 [4]
5. Explain how can you minimize the state of DFA with example. Convert the following automata into its equivalent DFA. [3+3]



6. Using pumping lemma show that the language L: a^n where n is a prime number is not regular. [3]
7. Write down the CFG for the language L= $\{a^{2n}b^nc^m: n, m>0\}$ over an alphabet {a,b,c}. Use leftmost derivation and right derivation to generate the string "aaaabbcc" and also draw the parse tree for the same. [4]
8. Define Instantaneous Description (ID) of PDA. Design a push down automata to accept the language L: $\{a^nba^n$, for n > = 0}. Show how your design can be used to recognize w = aaaabaaaa. [5]
9. Explain the closure properties of context free language with suitable example. [3]
10. How working of TM different from PDA? Design a Turing machine that recognizes the language L:$a^nb^nc^n$ for n>=0. [1+3]
11. Design a Turing machine that accepts the language of odd number written in binary. [5]
12. Explain Turing machine with storage in the states. How such computing model help during language recognition. Design a Turing machine which reverses the given string w over alphabet {a, b}. [3+3]
13. Explain the encoding process of Universal Turing Machine. [3]
14. State halting problem. Explain the closure properties of recursively enumerable languages. [1+2]
15. How the tokens are generated by the lexical analyzer. Explain. [2]
16. How syntax analyzer helps to check whether the particular block of code is syntactically correct or not. Explain with suitable example. [3]

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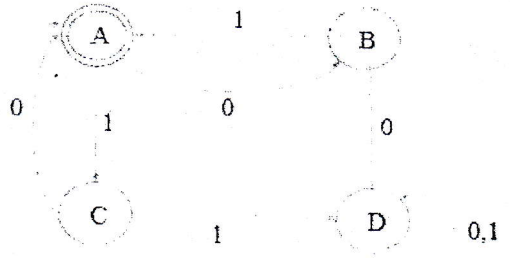
1. a) Define countably infinite and uncountable set with example. Show that given proposition is a tautology $((P \rightarrow Q) \wedge (Q \rightarrow R)) \rightarrow (P \rightarrow R)$. [2+2]

   b) State converse, inverse and contrapositive for the statement "I will to swimming only if it is sunny". Prove that $4^n - 1$ is divisible by 3 using the principle of mathematical induction. [1+2]

   c) Write regular expression that can generates the string that contains at least one a and two b's over $\sum(a, b)$. [2]

2. a) Differentiate between DFA and NFA. Obtain the regular expression for the given automata. [2+3]



   b) Design a DFA with $\sum = \{0, 1\}$ that accepts all strings containing even number of zero's and odd number of on, s. Verify your design using suitable example. [3+1]

   c) Minimize the given DFA. [3]

Q/Σ	0	1
→A	B	C
B	A	D
*C	E	F
*D	E	F
*E	E	F
F	F	F

3. a) Show that the context free language are not closed under intersection and complementation but closed under Kleene star. [4]

   b) Design a PDA for the language that accepts all the string of $L=a^m b^n$ with m, n>0 and m > = n and check the string w = aaaaabbb. Also draw parse tree. [4]

c) Define Greibach Normal Form (GNF). Convert the following CFG into CNF. [1+4]

G = (V, Σ, R, S)
V= {S, A, C}
Σ= { a, b}
R consists of:
S→AAC
A→aAb | ε
C→aC | a and S is the start symbol.

4. a) Design a TM that recognize the language that can recognize the language L: $a^n b^n c^n d^n$ for n> = 0. Check for the string w = aaabbccddd for your design. [6]

b) Design a Turing machine that can generate the complement of the binary string. [3]

c) Explain the configuration and working of multi-tape Turing machine. How Turing machine is helpful with storage in states? [3+2]

5. a) Define space and time complexity for the TM. Explain about NP-Complete problems. [3]

b) State Church Turing Thesis. Show that the complement of recursive language is recursive. [1+2]

6. a) List down the different phases of compiler design. Explain how tokens are generated by lexical analyzer for the following instructions: [3]

```
#include<stdio.h>
int func(int a, int b)
{
if(a>b)
 return a,
else
return b,
}
```

b) How syntax analyzer and CFG related with each other? Explain with an appropriate example. [3]

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1. a) State Diagonalization principle. Using the principle of mathematical induction. [1+3]

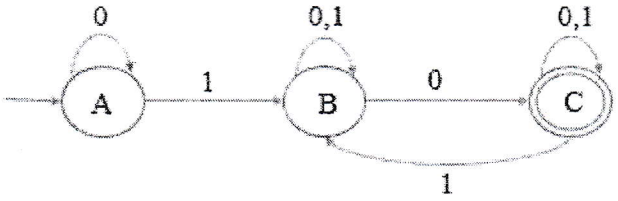
   Show that $1^3 + 2^3 + 3^3 \ldots\ldots\ldots\ldots\ldots + n^3 = \left[\frac{n(n+1)}{2}\right]^2$.

   b) Using rules of inference, show that the premises "If you send me an e-mail message, then I will finish writing the program," "If you do not send me an e-mail message, then I will go to sleep early," and "If I go to sleep early, then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." [3]

   c) What are power of an alphabet and positive closure of an alphabet? [2]

2. a) Explain the processing of a string by finite automata along with its block diagram. Construct DFA that accepts all the string that doesn't contain two consecutive b over $\sum(a, b)$ and process the string w = baaaababb. [2+3]

   b) Write down the procedure to check the equivalence of two automata. Convert the given NFA into equivalent DFA. [1+4]



   c) Explain the decision properties of regular languages. [3]

3. a) Construct CFG for the language L: $a^n b^m c^m d^n$. Test your grammar to generate w = aabbbcccdd and draw parse tree for the same. [4]

   b) Convert the following CFG, into CNF: G = (V, Σ, R, S) where V = {S, A, B}, Σ = {a, b}, R = {S→A, S→B, A→aBa, A→ε, B→bAb, B→ ε } and S is starting symbol. [5]

   c) State pumping lemma for context free language and show that L={ww | where w = {0,1}* is not CFL. [4]

4. a) Design a TM that recognize the L ={$a^n cb^n$}. Also show how the string w = aaaacbbbb is accepted by your Turing machine. [6]

   b) Design a Turing machine that can compute a function f(x) = 2x [4]

   c) Explain the properties of recursive language. [4]

5. a) How encoding is done in Turing Machine? Explain. [3]

   b) Explain NP-Complete problems. [2]

6. a) How lexical analyzer and DFA related with each other? Explain with an appropriate example. [3]

   b) Construct the parse tree for the following. r=a+b*c/(d*e) [3]