Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – APRIL / MAY 2017

SUBJECT: FORMAL LANGUAGES AND AUTOMATA THEORY (CS233)

(BRANCH: Computer Science)

Saturday, 13 May 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**

1A. Draw a DFA for Language L = { w: |w| mod 2 =0 and |w|≠ 6 }

1B. Define NFA and language accepted by NFA.

1C. Write a procedure to convert NFA-to-DFA shown in fig Q1.C. Hence convert the following NFA to DFA

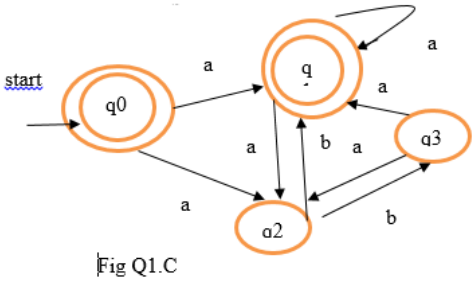

Fig Q1.C

1D. Find the Grammars for following languages

(i) $L= \{a^n b^{n-3} \mid n \geq 3\}$

(ii) $L= \{aa^n b^n b \mid n \geq 0\}$

(iii) $L= \{b^m a b^n \mid m, n > 0\}$ **(4+4+6+6)**

2A Draw DFA for following transition function on Σ= {0, 1} and hence minimize the following DFA

δ(A,0)=B	δ(B,0)=D	δ(C,0)=F	δ(D,0)=D	δ(E,0)=F	δ(F,0)=G	δ(G,0)=G
δ(A,1)=C	δ(B,1)=E	δ(C,1)=F	δ(D,1)=E	δ(E,1)=F	δ(F,1)=F	δ(G,1)=G

Where A is the initial state and B, C, D and E are the final states. Write all the pairs of indistinguishable states.

2B. Write the Regular Expression for the following languages on Σ= **{a, b}**.

(i) **$L = \{a^n b^m : n \geq 4, m \leq 3\}$**

(ii) **L = {w : |w| mod 3 = 0}**

2C. Give an **NFA** that accepts the language **L((a+b)*b(a+bb)*)**.

(10+6+4)

3A. What are the string of language for following grammars where S is the starting production?

(i) S→aAbb
A→bbA |b

(ii) S→aSaa |A
A→aAa |aa

3B. Construct right linear and left linear grammars for the following languages

(i) $L= \{ a^n b^m : n \geq 2 , m \geq 3\}$

(ii) L = { w ϵ {a,b}*: $n_a(w)$ and $n_b(w)$ are both even}

3C. Define closure properties of regular languages

3D. Define right-quotient of a language.
Find L1/L2 for the languages
$L1=\{a^nb^m : n \geq 1, m \geq 0\} \cup \{ba\}$
$L2 = \{b^m : m \geq 1\}$ **(6+6+4+4)**

4A. Prove that the following language is not regular.
$L= \{a^nb^ra^k : k \geq n+r\}$

4B. Define leftmost derivation and rightmost derivation. Consider the grammar with productions
$S \rightarrow aAB$
$A \rightarrow bBb$
$B \rightarrow A \mid \lambda$
Find leftmost derivation and rightmost derivation for the the string **abbbb**

4C. Find context free grammar for the following language with $n \geq 0$ and $m \geq 0$
(i) $L= \{ a^nb^m : n \leq m+3 \}$
(ii) $L= \{a^nb^m : 2n \leq m \leq 3n\}$ **(6+8+6)**

5A. Show that language **L = {ww : w ϵ {a, b}*}** is not a Context Free Language?

5B. Define ambiguous grammar. Consider the grammar G = (V, T, E, P) with
V = {E, I}
T = { a, b, c, +, *, (,) } and productions are
$E \rightarrow I$
$E \rightarrow E+E$
$E \rightarrow E*E$
$I \rightarrow a \mid b \mid c$
Show that derivation trees for a + b * c is ambiguous.

5C. Remove λ-productions, unit productions and useless symbols from the following grammar.
$S \rightarrow aAC \mid bBD \mid AB \mid C$
$A \rightarrow aA \mid \lambda$
$B \rightarrow bB \mid \lambda$
$C \rightarrow ABC \mid \lambda$
$D \rightarrow bDC$ **(4+8+8)**

6A. Convert the following grammar to CNF
$S \rightarrow aXbX$
$X \rightarrow aY \mid bY \mid \lambda$
$Y \rightarrow X \mid c$

6B. Define Push Down Automata. Show that following language is deterministic context free language on $\sum$**={a,b}**
$L= \{ a^nb^n : n \geq 0 \}$

6C. Construct Turing machine to accept the following language
$L = \{ \mathbf{a^nb^nc^n \mid n > 0} \}$. Show how it accepts **aabbcc** **(6+6+8)**

7A. Write a note on Universal Turing Machine.

7B. Find Context sensitive grammar for following language
$L =\{ a^nb^mc^nd^m : n \geq 1\ m \geq 1\}$

7C. Write a note on Chomsky Hierarchy with an example. **(6+6+8)**

8A. Write a note on Multi-tape Turing machine

8B. What do you mean by Post-Correspondence problem. Give an example

8C. Write a note on context sensitive grammars and the language accepted by it. Give one example. **(8+6+8)**