Examination	: second Sessional	Seat No.	:
Date	: 4/09/2017	Day	:Monday
Time	: 11:30 to 12:45 pm	Max. Marks	: 36

INSTRUCTIONS:	
1.	Figures to the right indicate maximum marks for that question.
2.	The symbols used carry their usual meanings.
3.	Assume suitable data, if required & mention them clearly.
4.	Draw neat sketches wherever necessary.
5.	"^" and "ε" indicates null symbol.

Q. Do as directed.

Q.1 (a) Give context-free grammar for the following language.- **[02]**

$$L = \{a^n b^j a^j b^n : n, j \geq 0\}$$

(b) Prove following grammar is ambigious. **[02]**

$$S \rightarrow 0S1 \mid 01S \mid \epsilon$$

(c) For the two grammars in figure1 and figure2, state whether or not the grammar is in Chomsky Normal Form. If it is not, explain why not. **[02]**

$S \rightarrow AB \mid AA \mid BB$	$S \rightarrow 0P \mid 1Q \mid PQ$
$A \rightarrow 0 \mid BA$	$P \rightarrow 1 \mid QP$
$B \rightarrow 1$	$Q \rightarrow 0 \mid PQ$
Figure1	Figure2

(d) Give CFG corresponding to the regular language described as $0^*1(0+1)^*$ **[02]**

(e) **[02]**

For each of the following languages L, state whether it is **regular, context-free but not regular, or neither.**

1) Strings in which the number of zeros is even.
2) $\{0^n 1^m 0^k 1^{n+m} : n, m, k \geq 0\}$
3) Nonempty strings in which the first and last symbols are different.
4) $ww \mid w \in (a+b)^* \ ¿$

(f) Fill in the blanks:- **[02]**

1) A _____ pushdown automaton has **at most one** legal transition for the same combination of input symbol, state, and top stack symbol. [Deterministic /non deterministic]
2) Two formal grammars G1 and G2 are said to be_____ ,if they generate the same formal languages. [Ambigious/ copy / equivalent].

Q.2 Attempt Any Two of following questions.

(a) Prove that- following language is non regular, using pumping lemma. **[06]**

$$\{ www \mid w \in \{a, b\}^* \}$$

(b) Convert the following CFG into an equivalent CFG in Chomsky normal form. **[06]**

$$S \rightarrow abAB$$
$$A \rightarrow bAB \mid \varepsilon$$
$$B \rightarrow BAa \mid A \mid \varepsilon$$

(c) Prove that - the following language is not regular, using Myhill Nerode theorem . **[06]**

$$\{ a^n b^n \text{ with } n>=0\}$$

Q.3 (a) Consider the following CFG G:

$$S \rightarrow aB \mid bA \mid D \mid E$$
$$A \rightarrow a \mid aS \mid bAA \mid c$$
$$B \rightarrow b \mid bS \mid aBB \mid c$$
$$D \rightarrow dD \mid Dd \mid d$$
$$E \rightarrow EE \mid EdE$$

[2]
[2]

1) List the 4 tuples and its elements in given G .
2) Give a left-most derivation of the string 'aabb'.

(b) Construct non deterministic pushdown automata for the following language **[08]**
Note :- give PDA with acceptance by final state.

$$\{ a^i b^j c^k \mid i,j,k \geq 0, i+k=j \}$$

OR

Q.3 (a) Suppose we have three languages L1, L2 and L3. Consider L2= $\{a^n b^n$ with n>=0$\}$. **[06]**
Now answer following questions:-
1) If L1= L2 ∩ L3.
Show values for L1 and L3 such that L1 and L3 are **both context-free** and
they satisfy above relation.
2) If L1= L2 ∩ L3.
Show values for L1 and L3, such that L1 is **context-free** and L3 is
regular and they satisfy above relation .

(b) Consider the grammar given below-

$$S \rightarrow A1B$$
$$A \rightarrow 0A \mid \epsilon$$
$$B \rightarrow 0B \mid 1B \mid \epsilon$$

Construct a top down PDA using given grammar. Give PDA with acceptance by empty
stack. Also show the computation tree of PDA on the string "1" .

[06]