(vii) $\{ a^n b^{2n} \mid n>=1\}$ is accepted by
(a) a (b) a NFA (c) a PDA (d) none of these.

(viii) Pumping Lemma for CFL is used to show that
(a) Language is regular (b) Language is Context Free
(c) Language is Context Sensitive (d) Language is not Context Free.

(ix) Which of the following statements in true?
(a) If a language is context free it can always be accepted by a deterministic push-down automaton
(b) The union of two context free languages is context free
(c) The intersection of two context free languages is context free
(d) The complement of a context free language is context free.

(x) Which of the following regular expressions over {a, b} denotes all words containing exactly one 'a'
(a) $(a + b)^*$ (b) $(ab)^*$ (c) b^*ab^* (d) ab^*.

Group - B

2. (a) A long sequence of pulses enters a two I/P, two O/P synchronous sequential circuit, which is required to produce an O/P pulse z=1, whenever the sequence 1111 occurs. Overlapping sequences are accepted; for example, if the input is 01011111……., the required O/P is 00000011…… .
i) Draw a state diagram.
ii) Select an assignment and show the excitation and O/P tables.

(b) In response to an unknown input sequence, the machine of the following table given below produces the output sequence 0101000, Find the input sequence to the machine if it is known that its initial state is A and its final state is E .

PS	NS, z	
	x=0	x=1
A	B,0	C,0
B	D,0	E,1
C	A,1	E,0
D	E,0	D,0
E	A,1	E,1

(3+3) + 6 = 12

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Group - E

8. (a) Convert the grammar
$S \rightarrow 0S1 \mid A$
$A \rightarrow 1A0 \mid S \mid \varepsilon$
To a PDA that accepts the same language by empty stack.

(b) Construct a PDA for the language $L=\{a^n b^{2n} \mid n>0\}$ where acceptance is by final state.

(c) Design a PDA to accept the following language
$L=\{a^i b^j a^k \mid i \neq j \text{ and } j \neq k\}$.

4 + 4 + 4= 12

9. (a) Clearly state the components of the formal notation for a Turing machine.

(b) Design a Turing machine for the regular expression 011^*.

(c) Write short note on Multitape Turing Machine.

3 + 6 + 3 = 12

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2016

SWITCHING THEORY AND AUTOMATA
(INFO 2201)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following: **10 x 1=10**

(i) If n is the number of states in NFA then equivalent DFA can have maximum of
(a) n states (b) n-1 states
(c) 2^n states (d) 2^n -1 states.

(ii) Which is correct?
(a) $a^+ = a^* a^*$ (b) $a^* = a^+ a$
(c) $a^+ = a^* a$ (d) $a^* = a^+ a^*$.

(iii) Which is the language generated by the grammar S→aSb, S→A, A→aA?
(a) $a^m b^m$ (b) Φ
(c) $a^n b^m$ (d) $a^m b^n$.

(iv) Let R1 and R2 be regular sets defined over alphabet ∑ then
(a) R1 ∩ R2 is not regular (b) R1 U R2 is not regular
(c) ∑ ∩ R2 is not regular (d) R2 * is not regular.

(v) Which of the following sets is regular?
(a) $\{ a^n |$ n is a prime$\}$ (b) $\{ a^{2n} |$ n>=1$\}$
(c) $\{ a^n b^n c^n |$ n>=1$\}$ (d) $\{$ ww| w is in $(a, b)^+\}$.

(vi) The regular sets are closed under
(a) Union (b) Concatenation
(c) Kleene closure (d) all of these.

3. (a) Consider the following machine:

PS	NS, Z			
	I1	I2	I3	I4
A	__	__	E,1	__
B	C,0	A,1	B,0	__
C	C,0	D,1	__	A,0
D	__	E,1	B,__	__
E	B,0	__	C,__	B,0

i) Draw the merger graph.
ii) Draw the compatibility graph.
iii) Find the minimal closed covering with justification

(b) Prove that the following sequential machine has a finite memory iff its testing graph G is loop free.

PS	NS, z	
	x=0	x=1
A	B,0	C,0
B	D,0	E,1
C	A,1	E,0
D	E,0	D,0
E	A,1	E,1

(3+2+2) + 5 = 12

Group - C

4. (a) Construct a NFA with ∈transition for $r=(11+0)^*(00+1)^*$ and convert it to its equivalent DFA

(b) Using Ardens' theorem find out the regular expression for the following FA:

Current States	**I/P Symbol**	
	a	**b**
p	p,q	---
q	r	q,p
r	q	-----

Here, p is the initial state and *r* is the final state.

(3 + 5) + 4 = 12

5. (a) Construct a Moore machine equivalent to the following Mealy machine:

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PS	NS, Z			
	I1	I2	I3	I4
A	__	__	E,1	__
B	C,0	A,1	B,0	__
C	C,0	D,1	__	A,0
D	__	E,1	B,__	__
E	B,0	__	C,__	B,0

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r	q	-----

Here, p is the initial state and *r* is the final state.

(3 + 5) + 4 = 12

5. (a) Construct a Moore machine equivalent to the following Mealy machine:

PS	Input Symbol			
	a=0		a=1	
	NS	o/p	NS	o/p
q1	q3	0	q2	0
q2	q1	1	q4	0
q3	q2	1	q1	1
q4	q4	1	q3	0

(b) Show that the language $\{0^n10^n: n >= 1\}$ is not a regular language.

(c) Write regular expressions for the following languages:
(i) the set of strings over alphabet (a, b, c} containing at least one 'a' and at least one 'b'
(ii) L= $\{a^n b^m \mid (n+m)$ is even$\}$

4 + 4 + (2+2) = 12

Group - D

6. (a) Design Context Free Grammar for the following languages:
i) Regular Expression, r= $(0+1)^*00(0+1)^*$
ii) $L(G)=\{a^{2n} b^m | n\geq 0, m\geq 0\}$

(b) Show whether the language defined as L= $\{a^n b^n c^n \mid n>=1\}$ is context free or not.

(c) Remove all useless productions for the Grammar
S→aA/aBB, A→aaA/e, B→bB/bbC, C→B.
where S is the Start Symbol

(3+3) + 3 + 3 = 12

7. (a) Consider the following grammar:
S → AS B | ε
A →a AS| a
B → SbS| A | bb
i) Eliminate unit productions
ii) Convert the grammar into Chomsky normal form.

(b) Consider the grammar
S->aB|bA, A->a|aS|bAA, B->b|bS|aBB where S is the Start symbol
For the string aaabbabbba, find
a) Leftmost derivation
b) Rightmost derivation
c) Parse tree.

(3+3) + (3×2) = 12

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PS	Input Symbol			
	a=0		a=1	
	NS	o/p	NS	o/p
q1	q3	0	q2	0
q2	q1	1	q4	0
q3	q2	1	q1	1
q4	q4	1	q3	0

(b) Show that the language $\{0^n10^n: n >= 1\}$ is not a regular language.

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