

After pursuing this course the student will be able to:

- CO1: Apply the concept of set theory, relations, and functions in the context of various fields of computer science e.g. Database, Automata, compiler etc.  
CO2: Evaluate Boolean function and analyze algebraic structure using the properties of Boolean algebra.  
CO3: Convert formal statement to logical argument and correlate these arguments to Boolean logic, truth tables, rules of propositional logic and predicate calculus.  
CO4: Apply the fundamental principal of counting, combination, and recurrence relations to find the complex patterns and sequence in given datasets.  
CO5: Apply graph theory concepts for designing solutions of various computing problems, e.g. shortest path graph colouring job sequencing etc.  
CO6: Explain the basic concepts of automata theory and formal languages e.g. Finite automata, regular expressions, context-free grammars etc.

Note: attempt all the questions.

Q.1 A food and drink vending machine accepts \$1 coin and notes of \$1 and \$5 bills only.

- (a) Find the recurrence relation for the number of ways to deposit "n" dollars in the machine, where the order in which coins and bills are deposited matters.  
(b) What are initial conditions?

(c) How many ways are there to deposit \$10 for a bottle of coke? [1+1+1, CO1]

Q.2 Identify the generators of cyclic group  $[ \{1, 3, 5, 9, 11, 13\}, *_{14} ]$ . And check  $\langle 11 \rangle$  is a generator of this group or not. [2+1, CO2]

Q.3 A standard deck of card has 52 cards. Cards can be classified into suits or denominations, 4 suits hearts, diamonds, spades, and clubs. 13 cards are in each suit. A poker hand consists of a sample of size 5 drawn from the deck. [2+2+2, CO4]

- a. how many poker hands consist of 2 aces, 2 kings, and a card of different denomination.  
b. how many poker hands have three cards from one denomination and two from another (a full house)  
c. a royal flush is a hand consisting of an ace, king, queen, jack, and ten, where all cards are from the same suit. How many royal flushes are possible?

Q.4 [1+1, CO4]

a. How many different words can you make by rearranging the letters of the word "EFFERVESCENCE".

b. How many different 4 letter words can be made from the letters of "EFFERVESCENCE", if letters can not be repeated?

Q.5 There is 9 line segments drawn in a plane. Is it possible that each line segment intersects exactly 3 others? [3, CO5]

Q.6. The distances between various cities are given in the tables below

	A	B	C	D	E
A		1	2	3	3
B	1		4	2	5
C	2	4		7	4
D	3	2	7		13
E	3	5	4	13	

(a) Draw the corresponding graph of the table

(b) How many Hamiltonian cycles exist in the graph? [1.5+1.5, CO5]

Q.7 Controller of examination has to schedule exams in a university. For this purpose, he needs to call the meeting of the members of his department. The department has six committees. How many different meeting times must be used to ensure that no member is scheduled to attend two meetings at the same time, if the committees are: [3, CO5]

C1 = {Jiya, Riya, Prachi}

C2 = {Riya, Mainka, Zayed}

C3 = {Jiya, Zayed, Prachi}

C4 = {Mainka, Zayed, Prachi}

C5 = {Jiya, Riya}

C6 = {Riya, Prachi, Zayed}

Q.8 Construct a DFA over  $\Sigma = \{0, 1\}$  such that all strings accepted with exactly two 0's and more than two 1's. [4, CO6]

Q.9 Design a NFA over  $\Sigma = \{a, b\}$  such that it accepts all the strings starts and ends with 'a'. Convert this NFA into DFA. [4, CO6]

Q.10 Design a Mealy machine for 2's complements and convert it into Moore machine. [Hint: for example 2's complement of binary number 10010 is 01101+1=01110]. [4, CO6]

