

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY  
FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch : Computer Science & Engineering

Stream(s):

1. Computer Science & Engineering
2. Information Security

Course Code & Name: 01CS6101 Mathematical Foundations of Computing Systems

Answer any two full questions from each part  
Limit answers to the required points.

Max. Marks: 60

Duration: 3 hours

PART A

1. a. Discuss Branching Time Logic . (3)  
b. Show by Direct Proof that "If m and n are both perfect squares then product of m and n is also a perfect square. (3)  
c. Solve the recurrence relation  $a_r - 7a_{r-1} + 10a_{r-2} = 0$  for  $r \geq 2$  ; Given  $a_0 = 0$ ;  $a_1 = 41$  using Generating Functions . (3)
2. a. By Mathematical Induction, prove that for every positive integer 'n', the number  $A_n = 5^n + 2 \cdot 3^{n-1} + 1$  is a multiple of 8 . (3)  
b. Prove by contraposition that " If 'n' is an integer and  $3n+2$  is odd, then 'n' is odd ". (3)  
c. Which are the adequate set of connectives? Discuss with an example. (3)
3. a. What is Linear -Time Temporal Logic? (3)  
b. Show that  $\sqrt{2}$  is irrational by giving a proof by contradiction . (3)  
c. Solve the recurrence relation  $a_r - 4a_{r-1} = 2^r$  using characteristic root method . (3)

PART B

4. a. In a factory there are two machines, manufacturing bolts. The first machine manufactures 70% of the bolts and the second machine manufactures the remaining 30%. From the first machine 10% of the bolts are defective and from the second machine 5% of the bolts are defective. A bolt is selected at random, what is the probability the bolt came from the first machine, given that it is defective. (3)  
b. Among 18 students in a room, 7 study mathematics, 10 study science, and 10 study computer programming. Also, 3 study mathematics and science, 4 study mathematics and computer programming, and 5 study science and computer programming. We know that 1 student studies all three subjects. How many of these students study none of the three subjects? (3)

- c. It is known that the probability that a recovered fossil human skull being female is 0.6 . What is the probability that out of 6 skulls, exactly 4, will be female? (3)
5. a. Eight coins are thrown simultaneously. Using Binomial theorem, find the chance of obtaining atleast 6 heads. (3)
- b. In how many ways can the letters of the word ALLAHABAD be arranged ? How many of these permutations are there in which (i) Two L's come together? (ii) Two L's donot come together ? (3)
- c. Two dice are rolled. If the first one top with 5, then find the probability that the total of the two will be greater than 7. (3)
6. a. Find the expected value of a Uniform Random Variable. (3)
- b. Find the coefficient of  $xyz^2$  in the expansion of  $(2x-y-z)^4$  and  $xyz^2$  in the expansion of  $(x-2y+3z^{-1})^4$  (3)
- c. The CEO's of 18 software companies meet to discuss a problem. In how many ways can they sit themselves around a table so that CEO of GE, HCL and Infosys choose to sit together. (3)

### PART C

7. a. If in a Ring 'R' with Unity  $(xy)^2 = x^2y^2$  for all  $x, y \in R$  then R is Commutative. (4)
- b. Prove that " If a graph (connected or disconnected )has exactly two vertices of odd degree, there must be a path joining these two vertices". (4)
- c. What is meant by Discrete Logarithms ? (4)
8. a. Prove that a Subgroup H of a group G is Normal if and only if  $g^{-1}hg \in H$ , for every  $h \in H, g \in G$ . (4)
- b. Discuss Residue arithmetic. (4)
- c. Prove that a graph with atleast one edge is 2-chromatic if and only if it has no circuits of odd length. (4)
9. a. Show that the Graph  $K_5$  is not Coplanar. (4)
- b. Prove that the necessary & sufficient condition that a non-empty subset 'H' of a Group 'G' be a Subgroup is  $a \in H, b \in H \Rightarrow ab^{-1} \in H$ . (4)
- c. Discuss Elliptic Curve Arithmetic. (4)

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