

**Programme: B.Tech (CSE)**  
**Course: Discrete Mathematics**  
**Course Code: 3PCCCS204**  
**Enrolment no. \_\_\_\_\_**

**Full Marks: 70**  
**Time: 3 Hrs.**

**Section I**

**1. Short Answer type questions.**

**4 x 5 = 20**

- a. If  $f, g, h: \mathbb{R} \rightarrow \mathbb{R}$  be functions defined by  $f(x) = x^3 - 4x, g(x) = \frac{1}{x^2+1}, h(x) = x^4$ . Find  $f \circ g \circ h, g \circ g$  and  $h \circ g$ . **Analyze CO1**
- or
- Define one-one and onto function and give an example for each. **Understand CO1**
- b. Establish the following formula by mathematical induction  $1 + 3 + 5 + \dots + (2n - 1) = n^2$ . **Apply CO2**
- or
- Find the number of permutations that can be formed from the letters of the word "COTTON" so that the two Ts don't come together. **Evaluate CO2**
- c. Construct the truth table of  $(\sim(p \wedge q) \vee r) \rightarrow \sim p$ . **Evaluate CO3**
- or
- Discuss all derived Connectors with truth table. **Remember CO3**
- d. Find the order of elements of the group  $\{0, 1, 2, 3, 4, 5\}$  with respect to the operation addition module. **Evaluate CO4**
- or
- Find the inverse of the permutation  $f = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & 5 & 4 \end{pmatrix}$  and prove that  $ff^{-1} = I$ . **Analyze CO4**

**Section II**

**Long Answer type questions.**

**3 x 10 = 30**

2. Show that  $(0,1)$  is an uncountable set. **Evaluate CO1**
- or
- State and prove De-Morgan's law. **Analyze CO1**
3. Construct the truth table for the following statement  
i.  $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$  (ii)  $p \leftrightarrow (\sim p \vee \sim q)$ . **Analyze CO3**
- or
- From the following formula, find out Tautology, Contingency and Contradiction  
(i)  $p \rightarrow p \wedge (p \vee q)$  (ii)  $(p \wedge \sim q) \vee (\sim p \wedge q)$  (iii)  $\sim(p \vee q) \vee (\sim p \vee \sim q)$  **Apply CO3**
4. A non-empty connected graph  $G$  is Eulerian iff its vertices are all of even degree. **Analyze CO4**
- or
- Prove that for any simple graph, chromatic number  $\chi(G) \leq \Delta(G) + 1$ , where  $\Delta(G) = \max\{\deg(v) \mid v \in G\}$ . **Analyze CO4**

**Section III**

**Application based questions**

**1 x 20 = 20**

5. a. State and prove fundamental theorem of arithmetic. **Analyze CO2**
- b. Show that product of any three consecutive integer is divisible by  $3!$ . **Apply CO2**
- or
- a. Prove that if  $a$  and  $b$  are any two integers, not both zero, then  $\gcd(a,b)$  exists and is unique. **Apply CO2**

b. State and prove pigeonhole principle.

**Apply**

**CO2**

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### **Course Outcomes**

**After successful completion of course the student should be able to:**

**CO1: Know how to represent various statements using set, relations, functions, permutations and combinations, groups, graphs and trees**

**CO2: Use logical notations to formulate and reason about fundamental mathematical concepts such as sets, relations, functions and algebraic structures**

**CO3: Analyse the growth of functions and real world problems using various concepts like recurrence relations, graph coloring, etc.**

**CO4: Model and solve real world problems using graphs and trees.**