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NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa, 403401

Programme Name: B.Tech.

Mid Semester Examinations, October-2021

Course Name: Discrete Mathematics | Course Code: CS 203

Date: 7th October | Time: 10 AM

Duration: 1 Hour 30 Minutes | Max. Marks: 50

ANSWER ALL QUESTIONS

Q1. Let A, B, and C be sets. Show that $(A - B) - C = (A - C) - (B - C)$. **(5 M)**

Q2. Suppose that the universal set is $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. Express each of these sets with bit strings where the i^{th} bit in the string is 1 if **i** is in the set and 0 otherwise. **(5 M)**

$A = \{1, 3, 4, 8, 10\}$ and $B = \{2, 3, 4, 7, 8, 9\}$

Use bit strings to find the union and intersection of these sets.

Q3. Determine whether each of these functions is a bijection from R to R. **(5 M)**

b) $f(x) = x^2 + 1$

d) $f(x) = (x^2 + 1)/(x^2 + 2)$

Q4. Suppose that g is a function from A to B and f is a function from B to C. Prove each of these statements. **(5 M)**

a) If $f \circ g$ is onto, then f must also be onto.

b) If $f \circ g$ is one-to-one, then g must also be one-to-one.

Q5. Let f be a function from A to B. Let S be a subset of B. **(5 M)**

Show that $f^{-1}(\overline{S}) = \overline{f^{-1}(S)}$

Q6. Use quantifiers to express the statement that "There does not exist a woman who has taken a flight on every airline in the world."

Let P(w, f) be "women (w) has taken flight (f) " and Q(f, a) be "f is a flight on airline a" **(5 M)**

Q7. Prove that 2 divides $n^2 + n$ whenever n is a positive integer. **(5 M)**

Q8. **(5 M)**

(a) What Google search would you use to look for men's shoes or boots not designed for work?

(b) How many onto (or subjective) functions are there from an n-element

Q9. Let p, q, r, s represent the following propositions. **(5 M)**

p: $x \in \{8, 9, 10, 11, 12\}$

q: x is a composite number

r: x is a perfect square

s: x is a prime number

The integer $x \geq 2$ which satisfies $(p \Rightarrow q) \wedge (\neg r \vee \neg s)$ is.

Q10. Give an inductive proof that the Fibonacci numbers F_n and F_{n+1} are relatively prime for all $n \geq 2$.

The Fibonacci numbers are defined as follows,

$F_0 = 0$, $F_1 = 1$, $F_n = F_{n-1} + F_{n-2}$ (for $n \geq 2$). **(5 M)**