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TCS/TIT-301 1218

Odd Semester Examination 2018-19

B.TECH. (SEMESTER-III)

DISCRETE STRUCTURE

Time: 03:00 Hours Max Marks : 100

Note:- Attempt all questions.

Q1: Attempt **any four** of the following (4 x 5 = 20)

a) Use mathematical induction to show that

$1 + 2 + 2^2 + 2^3 + \ldots\ldots\ldots\ldots + 2^{n-1} = 2^n - 1$, for all non-negative integers n.

b) What is meant by composition of two functions? Let f: R → R. and g: R → R, where R is the set of real numbers. Find fog and gof, where $f(x) = x^2 + 2$ and $g(x) = 2x + 3$.

c) What is an equivalence relation? Show that the relation of 'similarity' on the set of all triangles in a plane is an equivalent relation.

d) Define symmetric difference and disjoint set.

e) Let N be the set of all natural numbers. The relation R on set NxN is defined as:

(i) $(a, b)\ R\ (c, d) \leftrightarrow ad = bc$

(ii) Prove that R is an equivalence relation.

Q2: Attempt **any four** of the following (4 x 5 = 20)

a) If (S, *) be the commutative semigroup. Show that if a*a = a, and b*b = b, then (a*b) * (a*b) = a*b.

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b) Find the number of 4 letter words, with or without meaning, which can be formed out of the letters of the word ROSE, where the repetition of the letters is not allowed.

c) Out of 80 Students in a Class, 60 play Football, 53 plays Hockey and 35 play both the games. Find how many students-

(i) Do not play any of the games?

(ii) Play only Hockey?

d) Show that the set of N natural numbers is a semigroup under the operation x * y = max(x, y). Is it a monoid?

e) Define permutation group. Let A = {1, 2, 3, 4, 5}. Find (1 3) 0 (2 4 5) 0 (2 3).

Q3: Attempt **any two** of the following (2 x 10 = 20)

a) Consider the subsets {2, 3}, {4, 6} and {3, 6} in the poset ({1, 2, 3, 4, 5, 6}, 1), find for each subsets, if exists

(i) Upper bound and lower bound

(ii) Greatest lower bound and least upper bound

b) The set P({a, b, c}) is partially ordered with respect to the subset relation. Find a chain of length 3 in P({a, b, c}).

c) Let A = {1, 2, 3, 4} and consider the relation

R = {(1, 1), (2, 1), (2, 2), (3, 1), (3, 3), (3, 4), (4, 4)}

Show that R is a partial ordering, and draw its Hasse diagram.

Q4: Attempt **any TWO** of the following (2 x 10 = 20)

a) Express the following statements using predicates and quantifiers:

(i) For every student in this class, that student has studied mathematics.

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(ii) Some students in this class have visited United States.

(iii) Every student in this class visited either Canada or United States.

b) Prove the following:

(i) Show that $[(P \vee \sim Q) \wedge (\sim P \rightarrow \sim Q)] \vee Q$ is a tautology.

(ii) Show that $(\sim P \wedge Q) \rightarrow (Q \rightarrow P)$ is not a tautology.

c) Solve the following:

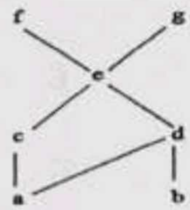
(i) Show that $(P \rightarrow C) \wedge (Q \rightarrow C)$ is logically equivalent to $(P \vee Q) \rightarrow C$

(ii) Differentiate between tautology and contradiction.

Q5: Attempt **any TWO** of the following (2 x 10 = 20)

a) Let H_n denote the number of moves needed to solve the Tower of Hanoi problem for n disks with initial condition as H_1 = 1. Set up a recurrence relation for the sequence $\{H_n\}$

b) Let S = {a, b, c, d, e, f, g} be ordered as in the given diagram, and let X = {c, d, e}.



(i) Find upper and lower bounds of X.

(ii) Identify the supremum of X and the infimum of X, if either exists.

c) Find the number of arrangements of the letters of the word INDEPENDENCE. In how many of these arrangements,

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(i) do the words start with P

(ii) do all the vowels always occur together

(iii) do the vowels never occur together

(iv) do the words begin with I and end in P?

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