Sub Code:ECS303

Paper Id: 910048 Roll No:

B. Tech.
(SEM-III) THEORY EXAMINATION 2019-20
DISCRETE MATHEMATICAL STRUCTURES

Time: 3 Hours ***Total Marks: 100***

Note: **1.** Attempt all Sections. If require any missing data; then choose suitably.
2. Any special paper specific instruction.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. What are the ordered pairs in the less than or equal to relation, which contains (a, b) if $a \leq b$, on the set $\{0, 1, 2, 3\}$?

b. Build a digital circuit that produces the output $(p \vee \neg r) \wedge (\neg p \vee (q \vee \neg r))$ when given input bits p, q, and r.

c. Explain Ring and Field.

d. Show that De Morgan's laws hold in a Boolean algebra?

e. How many functions are there from a set with m elements to a set with n elements? How many of them are one to one?

f. Define planar and bipartite graphs.

g. Is the "divides" relation on the set of positive integers symmetric? Is it antisymmetric?

h. Show that $\neg (p \vee q)$ and $\neg p \wedge \neg q$ are logically equivalent.

i. Define Monoid, Group and abelian group. Give example.

j. Define Graph coloring. What is its application?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. A total of 1240 student have taken a course in Spanish, 887 have taken a course in French, and 122 have taken a course in Russian. Further, 111 have taken courses in both Spanish and French, 31 have taken courses in both Spanish and Russian, and 22 have taken courses in both French and Russian. If 2100 students have taken at least one of Spanish, French, and Russian, how many students have taken a course in all three languages?

b. If H and K are any two subgroups of a group G then show that H U K can be a subgroup if and only if $H \subseteq K$ or $K \subseteq H$

c. Define a totally ordered set. Which elements of the poset $(\{2, 4, 5, 10, 12, 20, 25\}, |)$ are maximal, and which are minimal, where | is divide operation?

d. Determine whether each of the compound propositions $(p \vee \neg q) \wedge (q \vee \neg r) \wedge (r \vee \neg p)$, $(p \vee q \vee r) \wedge (\neg p \vee \neg q \vee \neg r)$, and $(p \vee \neg q) \wedge (q \vee \neg r) \wedge (r \vee \neg p) \wedge (p \vee q \vee r) \wedge (\neg p \vee \neg q \vee \neg r)$ is satisfiable.

e. Use generating functions to solve the recurrence relation $a_k = 3a_{k-1} + 4^{k-1}$ with the initial condition $a_0 = 1$.

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SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Is the "divides" relation on the set of positive integers transitive? What is the reflexive and symmetric closure of the relation $R = \{(a, b) \mid a > b\}$ on the set of positive integers?

(b) Prove that 21 divides $4^{n+1} + 5^{2n-1}$ whenever n is a positive integer.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) Show that following four matrices forms a group under matrix multiplication.

$$A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, B = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}, C = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}, D = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$$

(b) What do you mean by cosets of a subgroup? Consider the group Z of integers under addition and the subgroup H = {…., -12, -6, 0, 6 12, ……} considering of multiple of 6

(i) Find the cosets of H in Z

(ii) What is the index of H in Z.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Construct a circuit for a full subtractor using AND gates, OR gates, and inverters. A full subtractor has two bits and a borrow as input and produces as output a difference bit and a borrow.

(b) Define a Lattice. Determine whether $(P(S), \subseteq)$ is a lattice where S is a set {1, 2, 3, 4}. Also Show that every totally ordered set is a lattice.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) Explain various Rules of Inference for Propositional Logic.

(b) Show that the premises "It is not sunny this afternoon and it is colder than yesterday," "We will go swimming only if it is sunny," "If we do not go swimming, then we will take a canoe trip," and "If we take a canoe trip, then we will be home by sunset" lead to the conclusion "We will be home by sunset."

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Construct the binary tree using following in-order and post-order traversal.
In-order : DBMINEAFCJGK
Post-order : ABDEIMNCFGJK
Also Find the Pre-order of the constructed Binary Tree.

(b) How many positive integers between 1000 and 9999 both inclusive
i) are divisible by 9?
ii) are not divisible by either 5 or 7?
iii) have distinct digits?
iv) are divisible by 5 but not by 7?
v) are divisible by 5 or 7?

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