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M. C. A. (First Semester) Examination, April-May 2019

(New Scheme)

(Computer Applications Branch)

MATHEMATICAL FOUNDATIONS of COMPUTER SCIENCE

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 40

Note : *Attempt any* ***two*** *parts from each units and it carries 10 marks each.*

Unit-I

1. Define Logical Equivalence. Short that 10

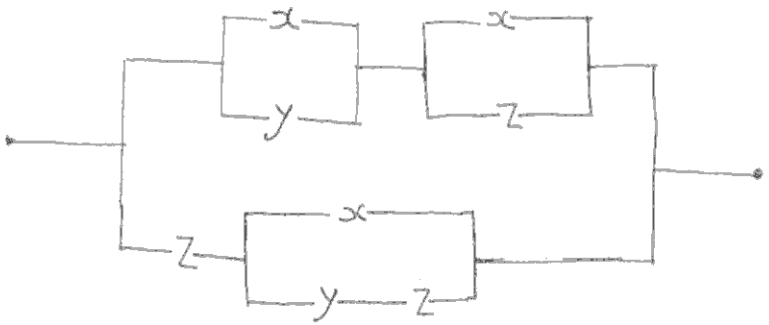
$$p \Leftrightarrow q \equiv (p \Rightarrow q) \wedge (q \Rightarrow p)$$

(b) Prove that in a Boolean algebra B, for any $a \in B$: 10

(i) $(a+b)' = a' \cdot b'$

(ii) $(a \cdot b)' = a' + b'$

(c) Replace the following switching circuit by a simpler one. 10



Unit-II

2. (a) If I is the set of integers and the relation $xRy \Rightarrow x - y$ is an even integer, then prove that R is an equivalence relation, where $x, y \in I$. 10

(b) Define the following with examples : 10

(i) Tuples

(ii) Lists

(iii) strings

(iv) Language

(v) Partial Order Relation

(c) Show that the function $f : R \to R_1$ defined by $f(x) = 3x + 5$ is one-one onto, where R is the set of real numbers. 10

Unit-III

3. (a) Prove that 10

$$A \times (B \cap C) = (A \times B) \cap (A \times C)$$

(b) Consider a requrcive function G from Z^+ to Z for all integrcrs $n \geq 1$. 10

$$g(n) = \begin{cases} 1 & \text{if } n \text{ is } 1 \\ 1 + g\left(\frac{n}{2}\right) & \text{if } n \text{ is even} \\ g(3n-1) & \text{if } n \text{ is odd and } n > 1 \end{cases}$$

Is g well defined? Justify.

(c) Generate the language

$L(G) = \{a^n b a^m / n, m \geq 1\}$ by the following grammar :

$G = (\{S, A, B, C\}, \{a, b\}, S, \phi)$ where,

ϕ is the set of productions.

$\{s \to a', s \to aB, B \to bC, C \to ac, c \to a\}$

Unit-IV

4. (a) Define the following graphs : 10

(i) Undirected and directed graph

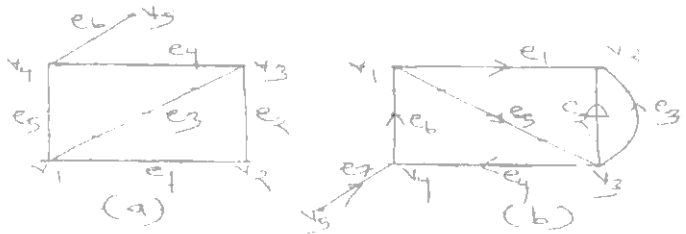
(ii) Paths and circuits

(ii) Isomorphic Graph

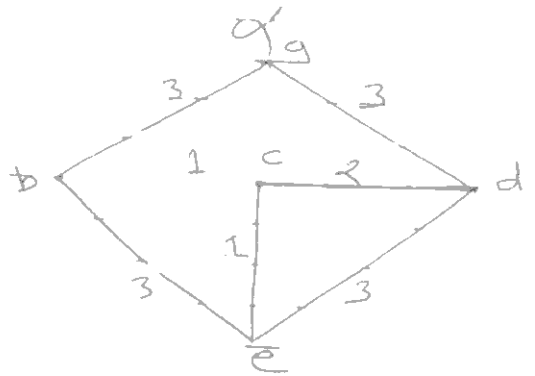
(iv) Bipartite Graph

(v) Complete Graph

(b) Find the incidence matrix of each of the following graphs.



(c) Find a minimal sanning tree of the following grapli :



Unit-V

5. (a) Prove that the cube root of unity is an abelian groop with respect to multiplicative binary operation. 10

(b) State and prove Lagrange's Theorem. 10

(c) Define the following terms : 10

(i) Homomorphism

(ii) Isomorphism

(iii) Group codes

(iv) Hamming Matrices

(v) Cosets