MANIPAL UNIVERSITY JAIPUR

(University under Section 2(f) of the UGC Act)

B.TECH SECOND YEAR

ACADEMIC YEAR: 2020-2021

COURSE NAME: ENGINEERING MATHEMATICS-III

COURSE CODE : MA 2101

LECTURE SERIES NO : 37-38 (THIRTY SEVEN – THIRTY EIGHT)

CREDITS : 3

MODE OF DELIVERY : ONLINE (POWER POINT PRESENTATION)

FACULTY : DR. VIVEK SINGH

EMAIL-ID : vivek.singh@Jaipur.manipal.edu

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MANIPAL UNIVERSITY JAIPUR

VISION

Global Leadership in Higher Education and Human Development

MISSION

- Be the most preferred University for innovative and interdisciplinary learning
- Foster academic, research and professional excellence in all domains
- Transform young minds into competent professionals with good human values

VALUES

Integrity, Transparency, Quality,
Team Work, Execution with Passion, Humane Touch

SESSION OUTCOME

" TO UNDERSTAND THE CONCEPT OF ODE AND THEIR APPLICATIONS AND SOLVE THE PROBLEM"

ASSIGNMENT

QUIZ

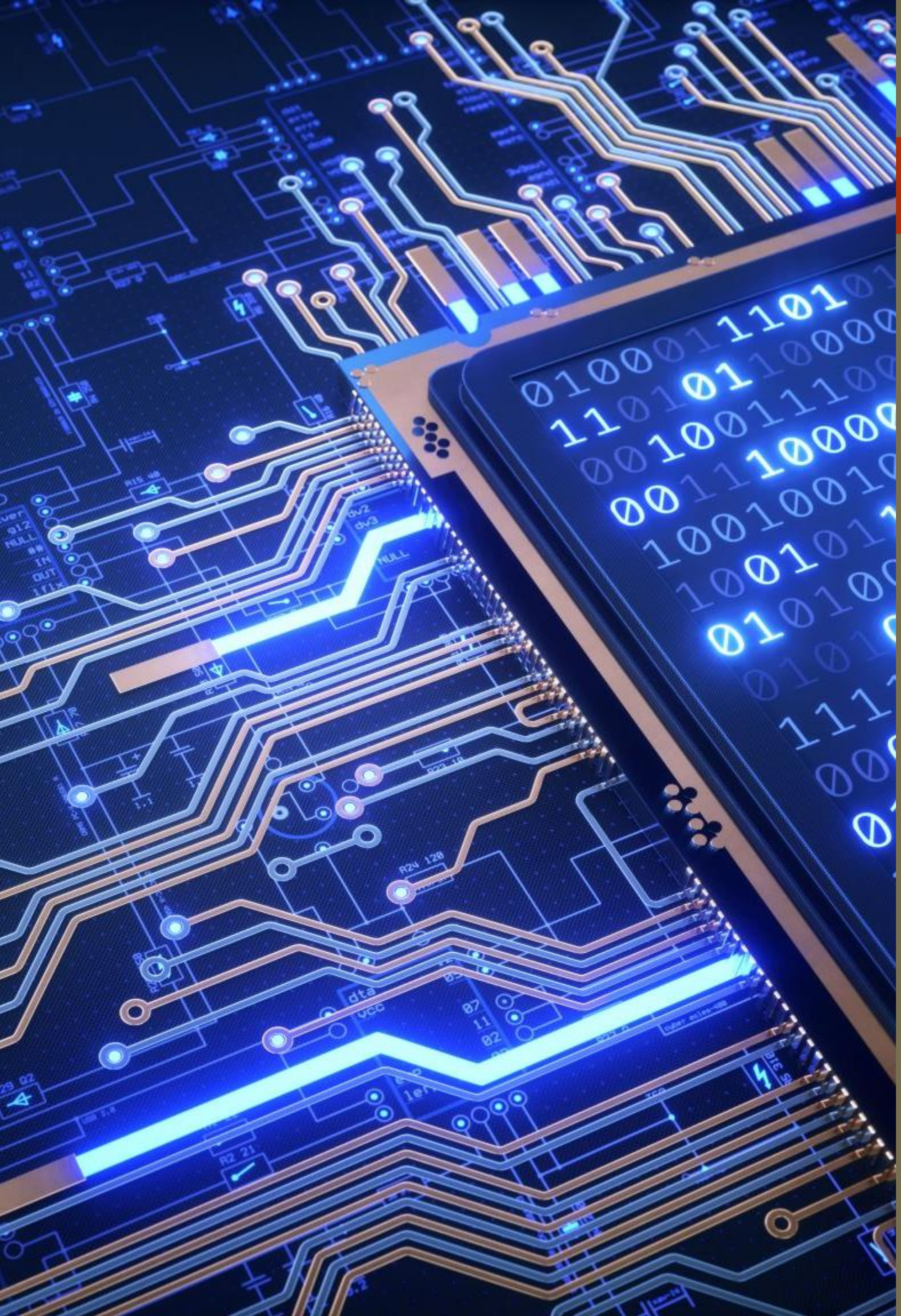
MID TERM EXAMINATION –I & II
END TERM EXAMINATION

ASSESSMENT CRITERIA'S

PROGRAM OUTCOMES MAPPING WITH CO1

[PO1]

ENGINEERING KNOWLEDGE: APPLY THE KNOWLEDGE OF MATHEMATICS, SCIENCE, ENGINEERING FUNDAMENTALS, AND AN ENGINEERING SPECIALIZATION TO THE SOLUTION OF COMPLEX ENGINEERING PROBLEMS.



Boolean Algebra

- Boolean algebra provides the operations and the rules for working with the set **{0, 1}.**
- These are the rules that underlie **electronic circuits**, and the methods we will discuss are fundamental to **VLSI design**.
- We are going to focus on three operations:
  - Boolean complementation,
  - Boolean sum and
  - Boolean product

Boolean Operations

The **complement** is denoted by a bar. It is defined by

0 = 1 and 1 = 0.

The **Boolean sum**, denoted by + or by OR, has the following values:

1 + 1 = 1,
1 + 0 = 1,
0 + 1 = 1, 0 + 0 = 0

The **Boolean product**, denoted by × or by AND, has the following values:

1 × 1 = 1,1 × 0 = 0,
0 × 1 = 0,
0 × 0 = 0

Examples:

1) Find the values of $1.0 + (0 + \overline{1}) + \overline{0}.0$
2) Show that $(1.1) + [(0 \,.\, \overline{1}) + 0] = 1$
3) Find the values of $(\overline{1} \,.\, \overline{0}) + (1 \,.\, \overline{0})$

Note:

- The complement, Boolean sum and Boolean product correspond to the logic operators ~ , ∨ and ∧ respectively, where 0 corresponds to F (False) and 1 corresponds to T (True)
- Equalities in Boolean algebra can be considered as equivalences of compound propositions.

Translate the following into logical equivalence:

1) $1.0 + (\overline{0 + 1}) = 0$

2) $(1.1) + [(\overline{0 \,.\, 1}) + 0] = 1$

Translate the logical equivalences into Boolean algebra:

1) $(T \wedge T) \vee [\sim(F \wedge T) \vee F] \equiv T$

2) $(T \vee F) \wedge (\sim F) \equiv F$

Boolean Expressions & Boolean Functions

- Let B={0,1}, then B^n= {(x_1, x_2, …, x_n) / $x_i \in$ B for I = 1 to n} is the set of all possible n-tuples of 0's and 1's.
- **Boolean variable:** The variable x is called a Boolean variable if it assumes values only from B. i.e. if its only possible values are 0 and 1.
- **Boolean function of degree n:** A function F: $B^n \to B$,
  i.e. F(x_1, x_2, …, x_n) = x, is called a Boolean function of degree n.

E.g.

1) F(x, y) = $x.\overline{y}$ from the set of ordered pairs of Boolean variables to the set {0, 1} is a Boolean function of degree 2 with given values in table:

x	y	$\overline{y}$	F
1	1	0	0
1	0	1	1
0	1	0	0
0	0	1	0

Examples of Boolean Functions

2) Boolean Function:

$$F = x + \overline{y}\,z$$

$\leftrightarrow$ Truth Table

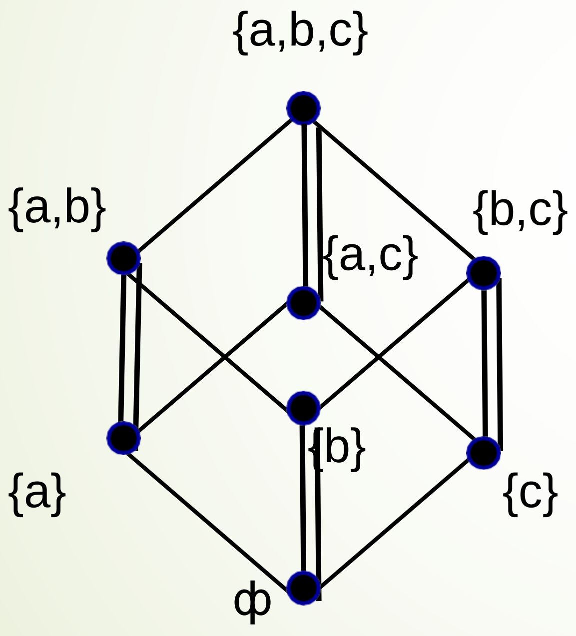
All possible combinations of input variables

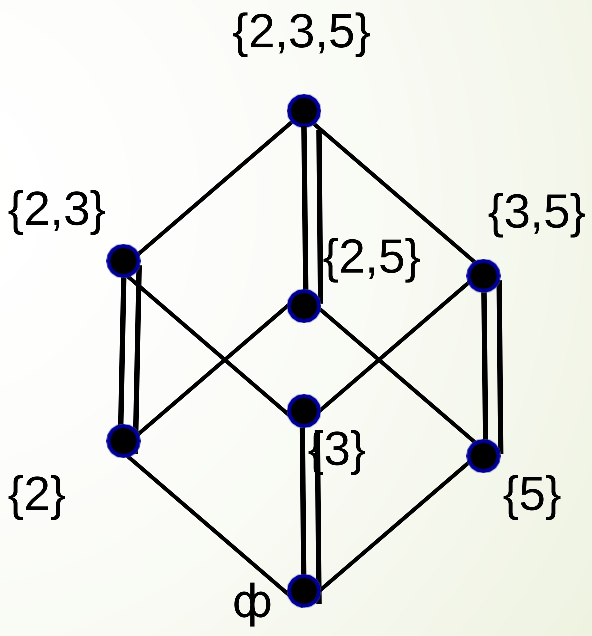
x	y	z	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Finite Boolean Algebra

Example:

S={a, b, c} and T={2,3,5}. consider the Hasse diagrams of the two lattices (P(S), ⊆) and (P(T), ⊆).





Note : the lattice depends only on the number of elements in set, not on the elements.

Finite Boolean Algebras

- $(P(S), \subseteq)$

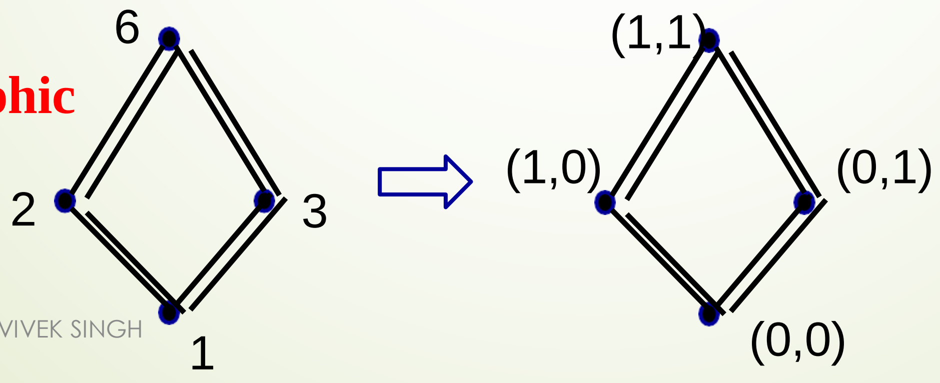
  Each x and y in B_n correspond to subsets A and B of S. Then $x \le y$, $x \wedge y$, $x \vee y$ and x' correspond to $A \subseteq B$, $A \cap B$, $A \cup B$ and A. Therefore,

  $(P(S), \subseteq)$ is isomorphic with Bn, where n=|S|

- Example

  Consider the lattice D_6 consisting of all positive integer divisors of 6 under the partial order of divisibility.

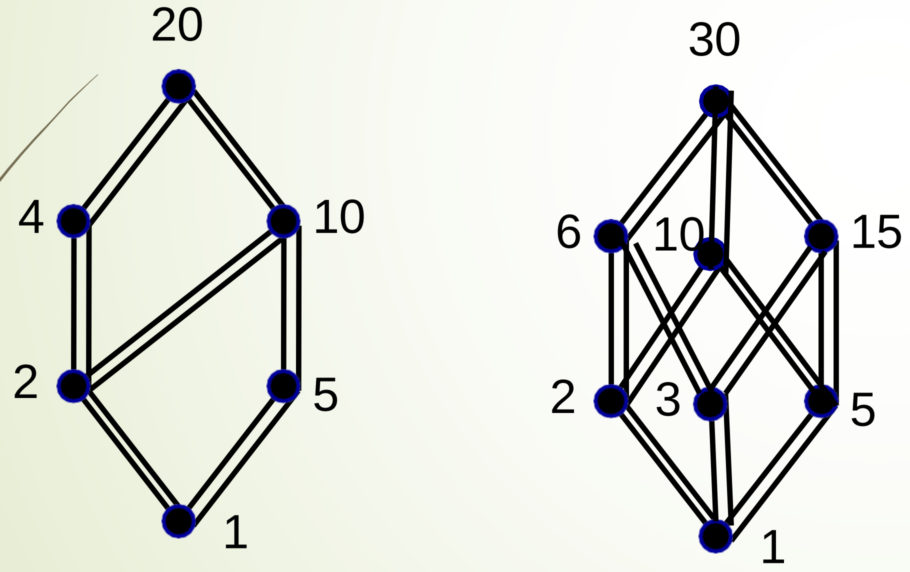
D_6 is isomorphic



Finite Boolean Algebras

♣ Example

Consider the lattices D_{20} and D_{30} of all positive integer divisors of 20 and 30, respectively.

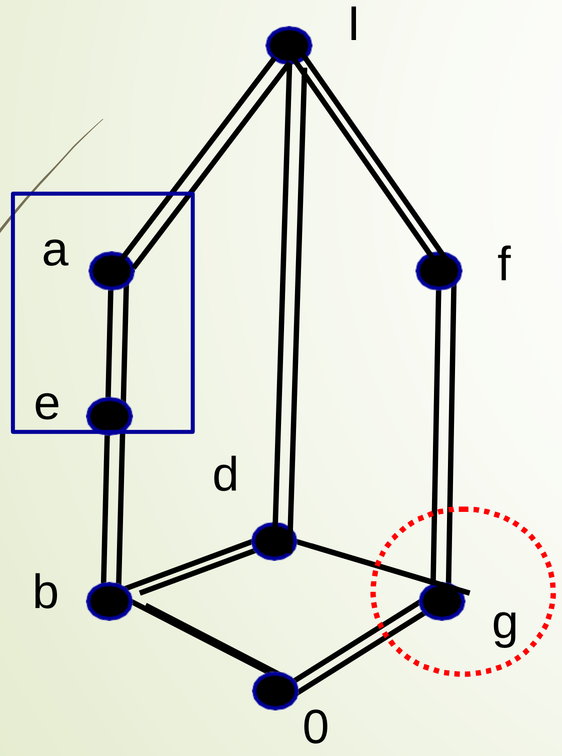


D_{20} is not a Boolean algebra (why? 6 is not 2^n)

D_{30} is a Boolean algebra, D_{30} ◊ B_3

Finite Boolean Algebras

Example: Show the lattice whose Hasse diagram shown below is not a Boolean algebra.



a and e are both gomplements of g

Theorem (e.g. properties 1~14) is usually used to show that a lattice L is not a Boolean algebra.

THANK YOU

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