ECE 213

DIGITAL ELECTRONICS

Course Instructor
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Assistant Professor and Head

Course details

[LTP 3-1-0]

[3 lectures + 1 Tutorial] /week

- **Text Book**

1. DIGITAL DESIGN PRINCIPLES AND PRACTICES by JOHN F. WAKERLY

- **Reference Book**

1. DIGITAL FUNDAMENTALS by THOMAS L. FLOYD , R. P JAIN, PEARSON
2. DIGITAL LOGIC DESIGN by MORRIS MANO, PRENTICE HALL OF INDIA, 5th Edition, (2001)
3. DIGITAL ELECTRONICS LOGIC AND DESIGN by CHERRY BHARGAVA, BS PUBLICATIONS, 1st Edition, (2018)

Course Assessment Module

Marks Breakup

Attendance	**5**
CA	**30***
MTT	**25**
ETT	**40**

3 Assignment (Online Mode)

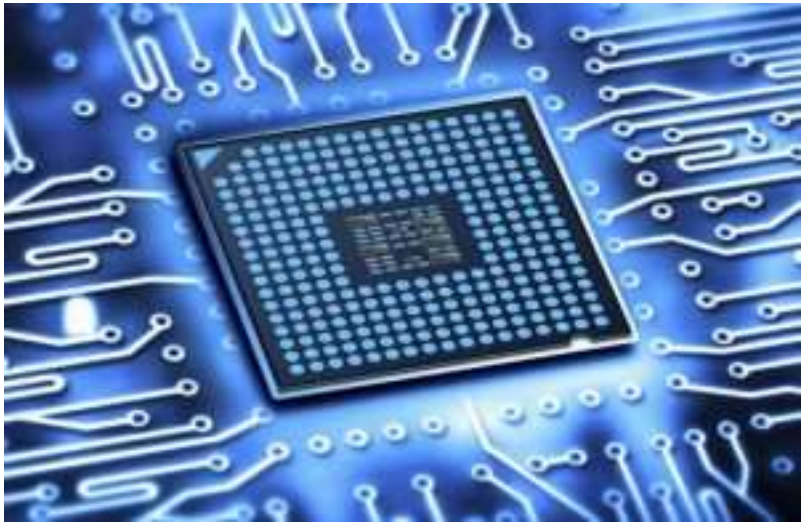
*CA Category A0203 Best 2 Out of 3 CA

Submission and Allocation over UMS

Minimum 1 week time

What is Digital Electronics

- Electronics Vs Electrical Engg.
- Digital Electronics is that branch of electronics which deals with the digital signals to perform various tasks and meet various requirements !
- It is based upon the digital design methodologies and consists of digital circuits, IC's and logic gates.
- It uses only binary digits, '0' or '1'



Why digital electronics needed

- Most analog systems were less accurate, and were slow in computation and performance.
- Digital system have the ability to work faster than analog equivalents, and can operate on very high frequencies too ! ! !
- It was much economical than analog methodologies as the performance was faster !

Digital Systems : The 21st Era

- Basically, the 21st era systems uses Silicon wafers, IC's, CMOS etc. in the VLSI technology to build up the large scale electronic devices & machines.
- The most commonly used devices are the Data servers, GPS systems, Security systems, market products like Bar Code Readers etc. !
- All these devices are precise and reliable except the user makes his own mistake, i.e. in these devices, system errors are least possible.
- The Cost : Performance ratio is high, hence these are economically beneficial too !

Analog vs Digital

Analog signal are time varying

Analog devices accepts value across a continuous range

Digital signal is modeled as accepting only one of two discrete value. High ‘1’ or Low ‘0’

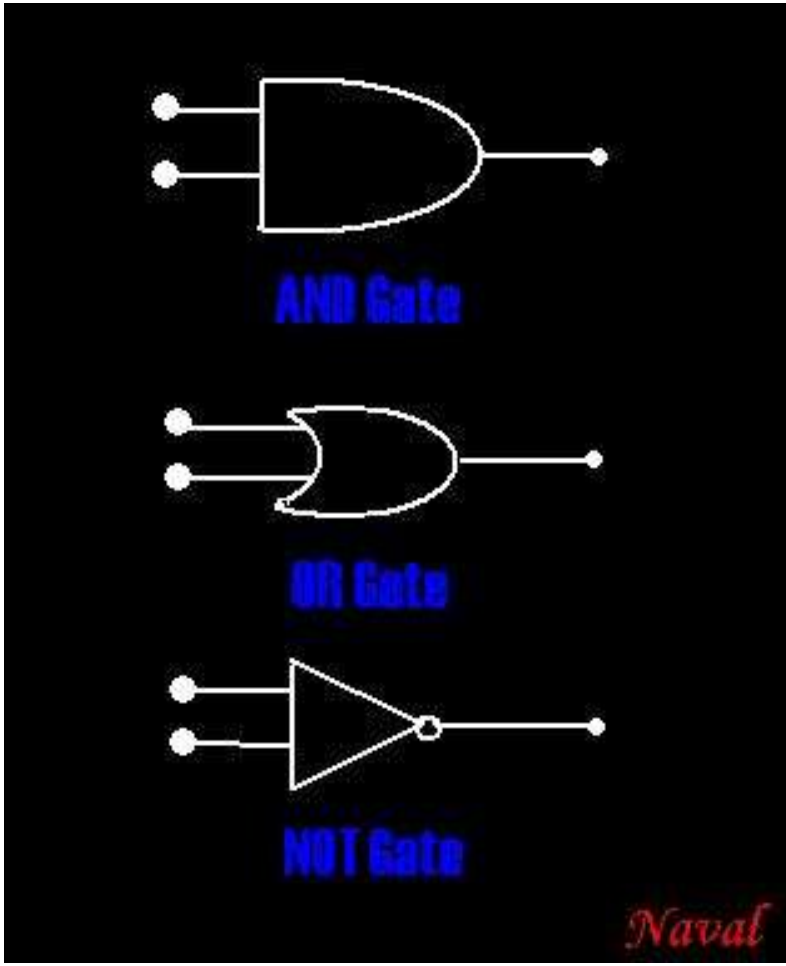
Digital devices preferred over Analog

- Reproducibility of result
- Ease of design
- Flexibility
- Programmability
- Processing speed
- Economy
- Steadily advanced technology

Most common digital devices are **Logic gate, Flip Flop**

Logic Gates

- Logic gates are the basic blocks of the digital circuits.
- There are basic gates of three types viz. AND, OR & NOT.
- Two universal gates are made of these 3 basic gates, which are NAND gate & NOR gate.
- These gates are the basic functional blocks of digital circuits which work upon making combinations of 0's and 1's !
- These are the sub-components of the IC's !



Digital Systems over Analog Systems

- The most common present time example is the speedometers used in vehicles.
- In analog meters, there is an error chance of misreading the speed, while in the digital seven-segment display of a digital speedometer, there is no chances left for a misreading error, hence increasing the accuracy !
- Even in the digital meters, there is a ‘HOLD’ button to hold the display value on screen.

Course Objectives

CO1 :: recall the basics of digital electronic logics and circuits.

CO2 :: apply boolean algebra in minimize the complex boolean expression

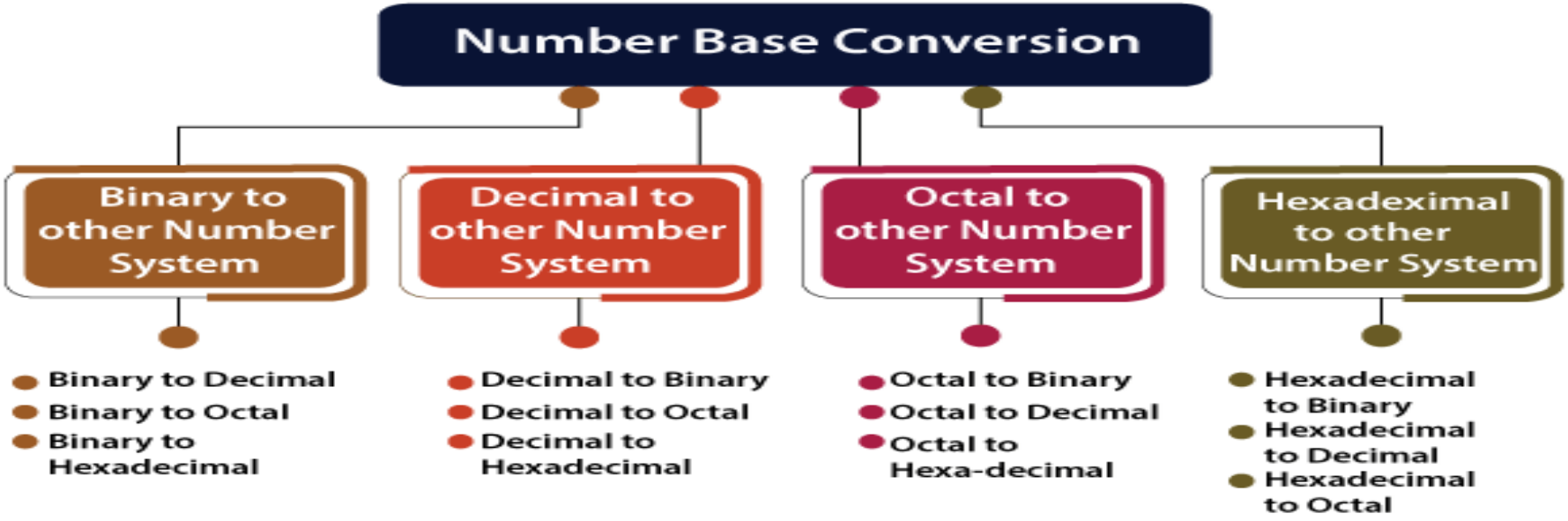
CO3 :: distinguish between combinational logic system and sequential logic system

CO4 :: analyze the basic techniques in designing and implementing digital systems.

What do we need to know?

Unit 1

- Binary Number Systems,
- Codes- Positional number system
- Methods of base conversions, Binary arithmetic
- Octal arithmetic, Hexadecimal arithmetic
- Error detection code and correction code



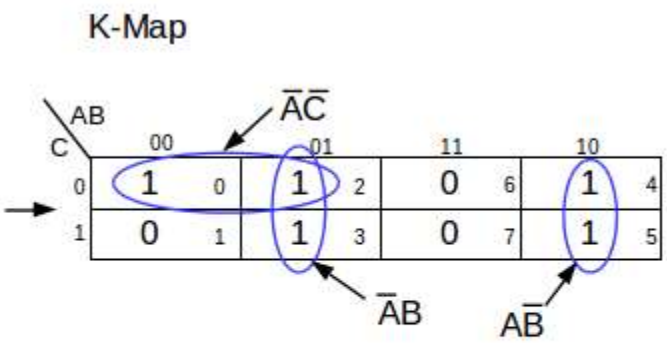
What do we need to know?

Unit 2

- Combinational Logic System
- Truth table, Basic logic operation
- Boolean Algebra, Basic postulates
- Standard representation of logic functions -SOP forms
- Simplification of switching functions - K-map, Quine-McCluskey tabular methods

3 Variable Truth Table

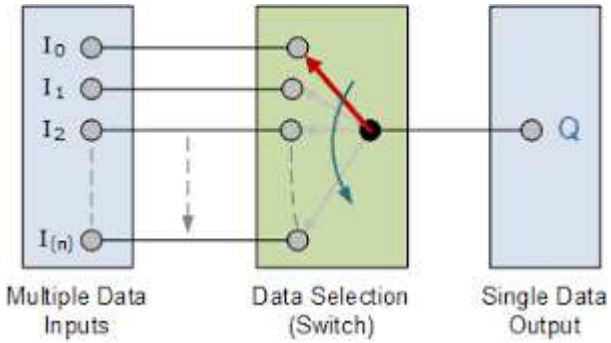
	A	B	C	F
0	0	0	0	1
1	0	0	1	0
2	0	1	0	1
3	0	1	1	1
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

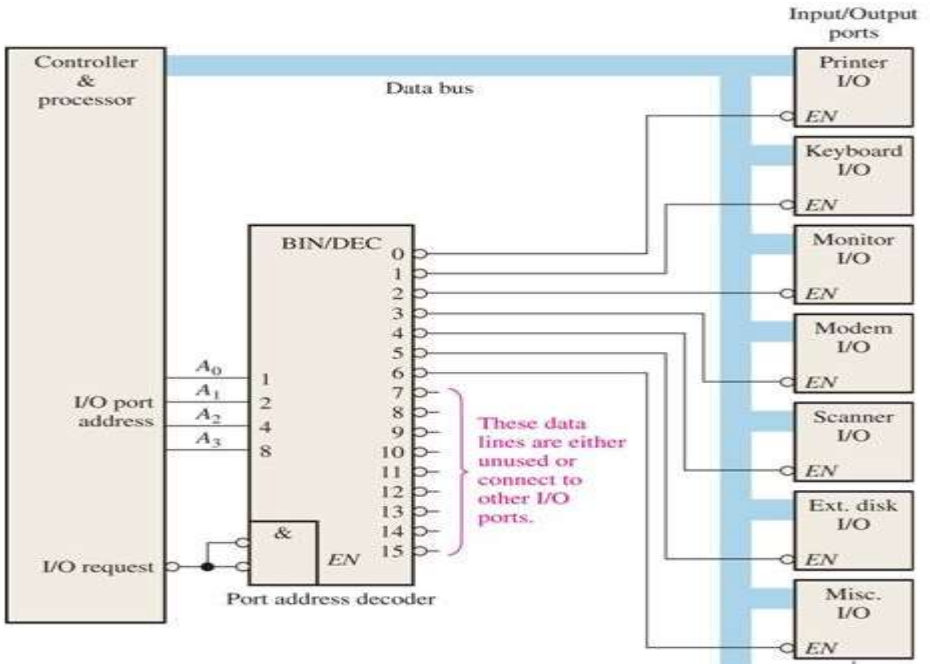


What do we need to know?

Unit 3

- Design of combinational circuits and logic families
- Decoder and encoder operation and function implementation
- Multiplexer and demultiplexer operation
- introduction to logic families, Comparison of parameters like fanout, noise margin ,delay and power dissipation

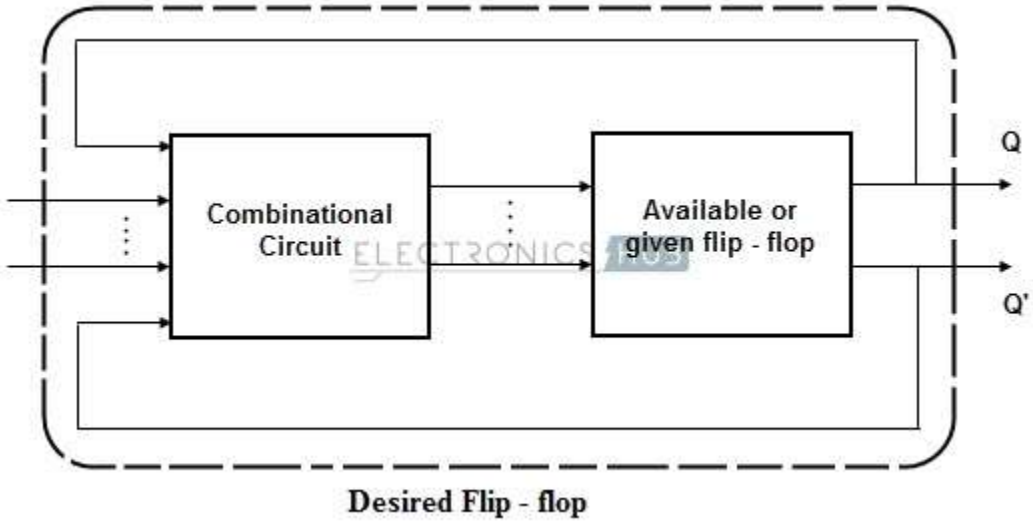




What do we need to know?

Unit 4

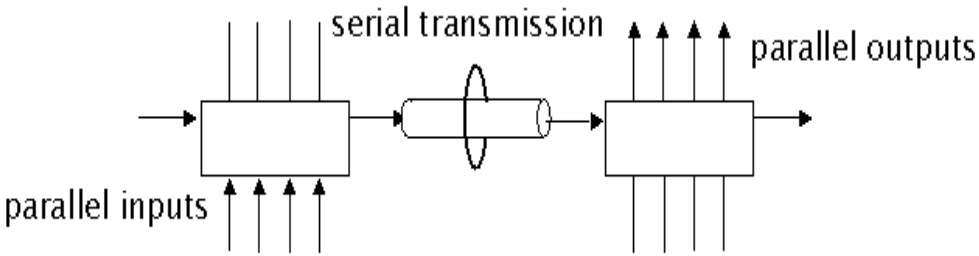
- Sequential Logic systems
- Basic sequential circuits
- SR-latch, D-latch, D flip-flop, JK flipflop, T flip-flop
- Timing hazards and races
- Analysis of state machines



What do we need to know?

Unit 5

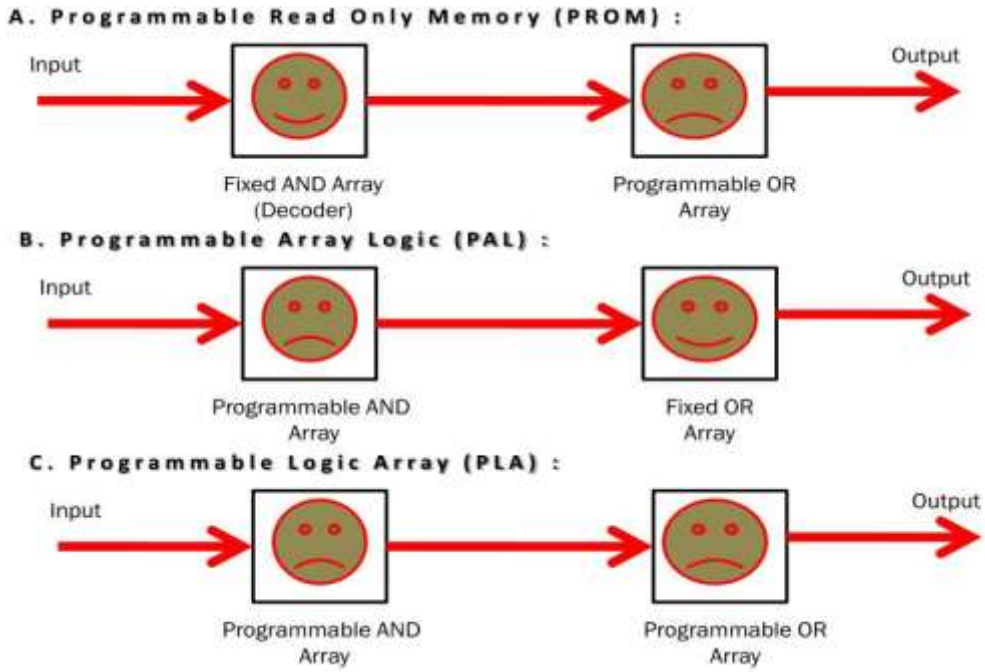
- Sequential logic Application
- Multi-bit latches, Registers
- Counters
- Shift register



What do we need to know?

Unit 6

- Memory and digital instruments
- Introduction to ROM and RAM
- PLA and its application, PAL and its application
- Introduction to digital instruments, Voltage measurement using successive approximation technique

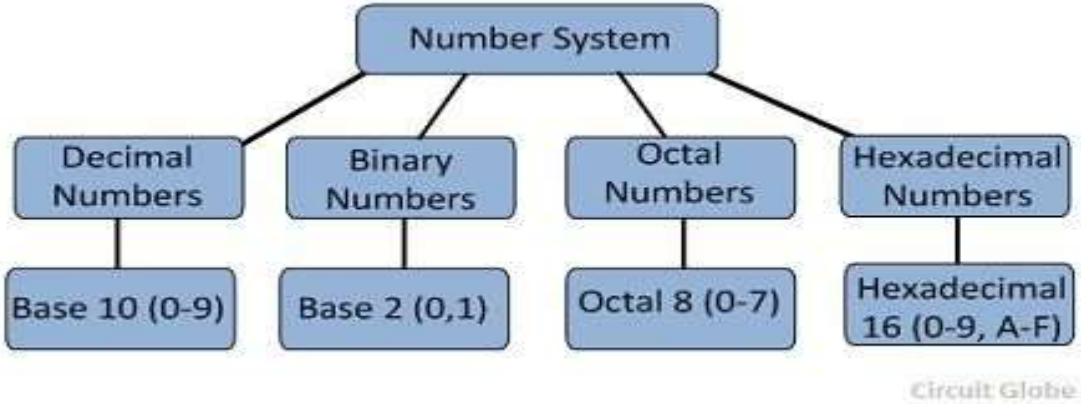


Number System and Code

Digital system process binary digits 0 and 1

4 types of number system are

- Decimal Number System
- Binary Number System
- Octal Number System
- Hexadecimal Number System



Binary	Decimal	Octal	3-Bit String	Hexadecimal	4-Bit String
0	0	0	000	0	0000
1	1	1	001	1	0001
10	2	2	010	2	0010
11	3	3	011	3	0011
100	4	4	100	4	0100
101	5	5	101	5	0101
110	6	6	110	6	0110
111	7	7	111	7	0111
1000	8	10	—	8	1000
1001	9	11	—	9	1001
1010	10	12	—	A	1010
1011	11	13	—	B	1011
1100	12	14	—	C	1100
1101	13	15	—	D	1101
1110	14	16	—	E	1110
1111	15	17	—	F	1111

Positional Number System

Digital system can understand positional number system

Value of a number is determined with help of **digit, position of the digit in the number and base of the number system**

Decimal positional number

$$(1234)_{10} = 1000 + 200 + 30 + 4$$
$$= (1\times1000) + (2\times100) + (3\times10) + (4\times1)$$
$$= (1\times10^3) + (2\times10^2) + (3\times10^1) + (4\times10^0)$$

Each weight is a power of 10.

Decimal point allow negative as well as positive power of 10

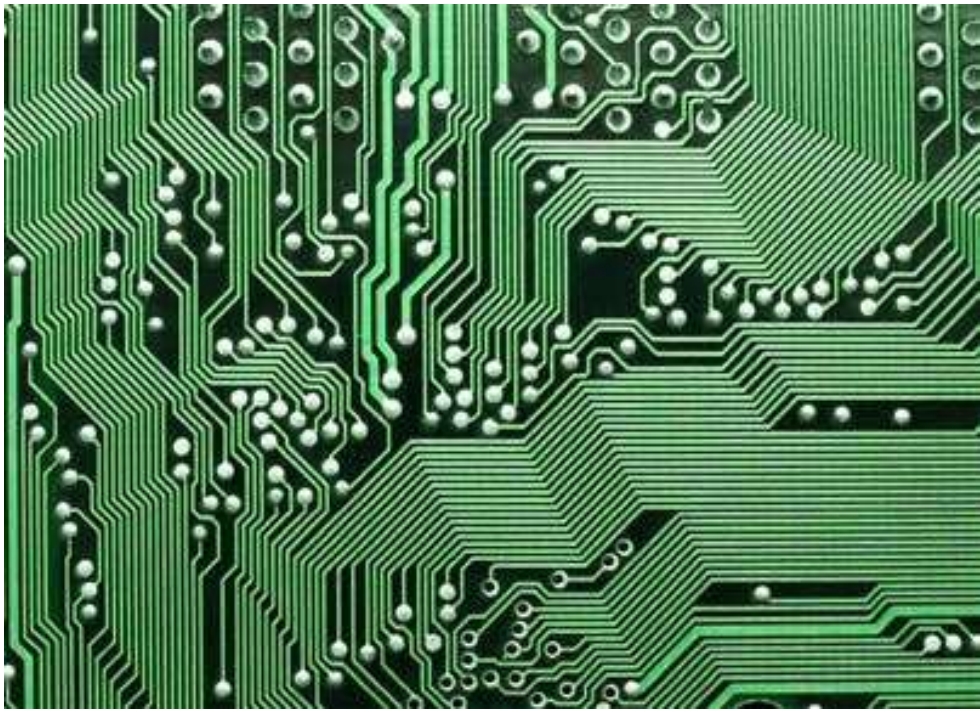
$$(5185.68)_{10} = (5\times1000) + (1\times100) + (8\times10) + (5\times1) + (6\div10) + (8\div100)$$
$$= (5\times10^3) + (1\times10^2) + (8\times10^1) + (5\times10^0) + (6\times10^{-1}) + (8\times10^{-2})$$

In general

$$D = \ldots\ldots + d_1\times10^1 + d_0\times10^0 + d_{-1}\times10^{-1} + d_2\times10^{-2} + \ldots\ldots$$

Future Scopes & Possibilities

- The digital electronics uses VLSI technology, which has considerably decreased the size and area of the circuit boards, and has enhanced the accuracy and performance of the systems.
- Moreover, digital systems have the advantage of data encryption for the communication purposes
- The data transmission is safe and secure.
- All these factors clearly show that the digital electronics stream has wide future scope in the modern era !



Get Set Go!!!

Gear up
Fasten your seat belts

Explore your hardware designing abilities

Build futuristic solutions…