UNIT-I

NUMBER SYSTEM

Points to be covered in this topic

- INTRODUCTION
- BINARY NUMBER SYSTEM
- DECIMAL NUMBER SYSTEM
- OCTAL NUMBER SYSTEM
- HEXADECIMAL NUMBER SYSTEM
- CONVERSIONS
- BINARY ADDITION
- BINARY SUBTRACTION
- BINARY MULTIPLICATION
- BINARY DIVISION

NUMBER SYSTEM

❑ INTRODUCTION

- When we type **some letters or words, the computer translates them in numbers** as computers can understand only numbers.
- A computer can understand **positional number system** where there are only a **few symbols called digits** and these symbols represent **different values depending on the position they occupy in the number.**
- A value of each digit in a number can be determined using
  1. **The digit**
  2. **The position of the digit in the number**
  3. **The base of the number system** (where base is defined as the total number of digits available in the number system).
- A set of values used to represent different quantities For example, a number student can be used to represent the number of students in the class Digital computer represent all kinds of data and information in binary numbers.
- Includes audio, graphics, video, text and numbers.
- **Total number of digits used in the number system is called its base or radix.**

❑ BINARY NUMBER SYSTEM

- Characteristics of binary number system are as follows:
- Uses two digits, **0 and 1**.
- Also called **base 2 number system**
- Each position in a binary number represents **a 0 power of the base (2).** - Example 2^0
- Last position in a binary number represents a x power of the base (2).
- Example 2^x where x represents the last position - 1.

- Example Binary Number: 101012

❑ DECIMAL NUMBER SYSTEM

- The number system that we use in **our day-to-day life** is the decimal number system.
- Decimal number system has **base 10 as it uses 10 digits** from 0 to 9.
- In decimal number system, the successive positions to the left of the decimal point represent **units, tens, hundreds, thousands and so on.**
- Each position represents a specific **power of the base (10).**
- For example, the decimal number 1234 consists of the digit 4 in the units position, 3 in the tens position, 2 in the hundreds position, and 1 in the thousands position, and its value can be written as

$$(1x1000) + (2x100)+(3x10)+(4xl)$$

$$(1x10^3)+(2x10^2)+(3x10^1)+ (4x10^\circ)$$

$$1000+200+30 +4$$

$$1234$$

❑ OCTAL NUMBER SYSTEM

Characteristics of octal number system are as follows:

- Uses eight digits, **0,1,2,3,4,5,6,7.**
- Also called **base 8 number system.**
- Each position in an octal number represents a **0 power of the base (8).**
- **Example 8^0**
- Last position in an octal number **represents a x power of the base (8).**
- Example 8^X where x represents the last position - 1.
- Example Octal Number: 12570_8

❑ HEXADECIMAL NUMBER SYSTEM

Characteristics of hexadecimal number system are as follows:

- **Uses 10 digits and 6 letters, 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.**

- Letters represents numbers starting from 10. **A = 10. B = 11, C = 12, D = 13, E = 14, F = 15.**
- Also called base **16 number system**
- Each position in a hexadecimal number represents a **0 power of the base (16). Example 16^0**
- Last position in a hexadecimal number represents a x power of the base (16). Example 16^x where x represents the last position - 1.

Number system	Base(Radix)	Used digits	Example
Binary	2	0,1	$(11110000)_2$
Octal	8	0,1,2,3,4,5,6,7	$(360)_8$
Decimal	10	0,1,2,3,4,5,6,7,8,9	$(240)_{10}$
Hexadecimal	16	0,1,2,3,4,5,6,7,8,9, A,B,C,D,E,F	$(F0)_{16}$

❑ CONVERSIONS

❖ DECIMAL TO BINARY

Decimal Number System to Other Base:

A) Divide the Number (Decimal Number) by the base of target base system (in which you want to convert the number: Binary (2), octal (8) and Hexadecimal (16)).

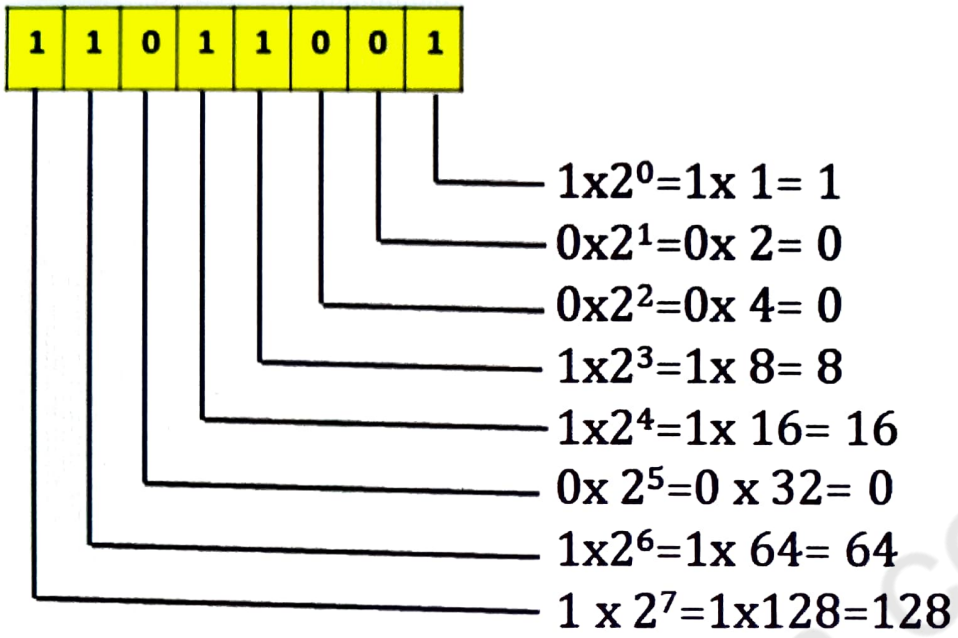
B) Write the remainder from step 1 as a Least Signification Bit (LSB) To Step last as a Most Significant Bit (MSB).

2	12345	1 **LSB**
2	6172	0
2	3086	0
2	1543	1
2	771	1
2	385	1
2	192	0
2	96	0
2	48	0
2	24	0
2	12	0
2	6	0
2	3	1
	1	1 **MSB**

Binary Number is $(1100000111001)_2$

❖ BINARY TO DECIMAL

A) Multiply the digit with 2(with place value exponent). Eventually add all the multiplication becomes the Decimal number.



1+8+16+64 +128=217

❖ OCTAL TO BINARY

Converting from octal to binary is as easy as converting from binary to octal. Simply look up each octal digit to obtain the equivalent group of three binary digits.

Octal:	0	1	2	3	4	5	6	7
Binary:	000	001	010	011	100	101	110	111

Octal:	3	4	5	
Binary:	011	100	101	= 011100101 binary

❑ BINARY ADDITION

- Binary addition technique is similar to the **normal addition of decimal numbers** excluding that as an **alternative value of 10 digits**, it carries on a 2 value.
- For example, as **we compute 7+9 manually**, then the **answer is 16.**
- So we know that the result has to write like **two digits 1 and 6.**
- The main reason to write down the result like 1 6 is, **the addition of 7 + 9 is greater than the single digit.**
- So the **result cannot be denoted through a single digit** because the largest single digit is '9'.
- Similarly, whenever we would like to sum **two binary numbers, only we will have a carry if the product is bigger than 1 because, in binary numbers, 1 is the highest number.**
- The binary addition rules are given in the following truth table of subtraction.

A	B	A+B	CARRY
0	0	0	0
0	1	1	0
1	0	1	0
1	1	10	1

- In the above tabular form, the initial three equations are the same for the binary digit number. The addition of binary numbers step by step is explained in detail. For binary addition take an example of 11011 & 10101.

1 1 1 1 (Carry)
1 1 0 1 1 (27)
1 0 1 0 1 (21)
- - - - - - - - - - -
1 1 0 0 0 0 (48)

Here the step by step binary addition rules is explained below

1 + 1 => 1 0, so 0 with a carry 1

1 + 1 + 0 => 1 0. So 0 with carry 1

1+0+1 => 10 => 0. So 0 with carry 1

1+1+0 => 10 => 10 = 0 with carry 1

1+1+1=> 10+1 => 11= 1 with carry 1

1 +1 +1 = 11

Carefully note that 10 + 1 => 11 and this is equal to 2 + 1= 3. Therefore the necessary outcome is 111000.

Examples

❑ BINARY SUBTRACTION

❖ First Method

- In subtraction, this is the **primary technique**. In this method, ensure that the subtracting number must be **from a larger number to smaller**, or else this technique won't work appropriately.

If the **minuend is smaller than the subtrahend, then this method is used by just switch their positions** and memorize that the effect will be a -ve number. The binary subtraction rules are given in the following truth table of subtraction.

A	B	A-B	BORROW
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

- For example, in the binary subtraction, subtract the subtrahend from minuend. Take an example of subtrahend (110112) and minuend (11011012).

- For subtraction, **arrange these two like the subtrahend should be below the minuend.**
- To get the same number of digits in subtrahend, add zeros where it requires.

```
  1101101
- 0011011
---------
  1010010
```

- In the above binary subtraction example, the **subtraction was achieved from the right side to the left side with the help of tabular form** which is shown in the above.
- Here the step by step binary subtraction rules is explained below.

If the input 1 1 = 0, then borrow to the next step is 0.

If the input 0 1 = 1 & borrow is 0. So 1 0 = 1 then borrow to the next step is 1.

If the input 1 0 = 0 & borrow is. So 1 1 = 0 then borrow to the next step is 0.

If the input 1 1 = 0 & borrow is 0. So 0 0 = 0 then borrow to the next step is 0.

If the input 0 1 = 1 & borrow is 0. So 1 0 = 1 then borrow to the next step is 1.

If the input 1 0 =1 & borrow is 1. So 1 1 = 0, then borrow to the next step is 0.

Final step, If the input 1 0 = 0 & borrow is 0. So 10 = 1, then borrow to the next step is 0.

So the final result will be 1010010

❖ Second Method: one's Complement

- Subtraction of binary numbers using the 1's complement method allows subtraction only by addition.

Example : Subtract 1010 from 1111 using 1's complement theory.

$$1010 \xrightarrow{\text{1's complement}} 0101$$

```
  1111
(+)0101
------
  0100
(+) 0001
------
  0101
```

❖ Second Method: Two's Complement

- First, confirm that the **digits in the subtrahend and minuends should be equal.**
- In the above example, the digits in the minuends have 7 whereas in subtrahend the digits are 5.
- So we need to **extend the digits in subtrahend by adding zeros.**
- A 2's complement of a number can be achieved by **complementing each digit of the number like zero's to ones and ones to zeros.**
- Finally, **add one to one's complement.**
- An example of this two's complement is shown below.

0011011

- 1's complement can be achieved by **converting 0's to 1's and 1's to 0's.** So the result will be like the following.

0011011 - - - -> 1100100 (1's complement)

- 2's complement can be achieved by **adding 1 to 1's complement.** So the result will be like the following.

1100100

+ 0000001

= 1100101

- Now add the subtrahend's 2's complement & minuend.

1101101 (subtrahend)

+ 1100101 (2's complement)

(MSB) (1)1010010

- In the above result, ignore the MSB (most significant bit) of the outcome. **If there is no additional bit, you did a mistake while adding the digits.**

- The **binary subtraction examples** are shown in the following figure.

1011011 − 10010 = 1001001:

$$\begin{array}{r} 1\ 0\ 1\ 1\ 0\ 1\ 1 \\ -\quad\ 1\ 0\ 0\ 1\ 0 \\ \hline 1\ 0\ 0\ 1\ 0\ 0\ 1 \end{array}$$

100010110 − 1111010 = 10011100:

$$\begin{array}{r} {\scriptstyle 0\ \ 1\ \ 1\ \ 1\ \ 1} \\ 1\ \ 0\ \ 0\ \ 0\ \ 1\ \ 0\ \ 1\ \ 1\ \ 0 \\ -\quad\ 1\ \ 1\ \ 1\ \ 1\ \ 0\ \ 1\ \ 0 \\ \hline 1\ \ 0\ \ 0\ \ 1\ \ 1\ \ 1\ \ 0\ \ 0 \end{array}$$

❑ BINARY MULTIPLICATION

- The binary multiplication operation is actually a **process of addition and shifting operation.**
- This process has to be continued **until all the multiplier is done, and finally, the addition operation is made.**
- Similar to the decimal system, the multiplication of the binary numbers is done by **multiplying the multiplicand with the multiplier.**
- It is noted that the multiplication **by zero makes all the bits zero,** and this step may be ignored in the intermediate steps.
- The multiplication **by 1 makes all the multiplicand value unchanged.**

Rules of Binary Multiplication

- ✓ **0 x 0 = 0**
- ✓ **0 x 1 = 0**
- ✓ **1 x 0 = 0**
- ✓ **1 x 1 = 1,**

and no carry or borrow bits

Example 1: Solve 1010 × 101
Solution:
1010 × 101
1010
(×) 101
————————
1010
0000
————————
01010 ..... First Intermediate Sum
1010
————————
110010

❑ BINARY DIVISION

Binary Division Rules

- ✓ $1 \div 1 = 1$
- ✓ $1 \div 0$ = Meaningless
- ✓ $0 \div 1 = 0$
- ✓ $0 \div 0$ = Meaningless

Example 1.

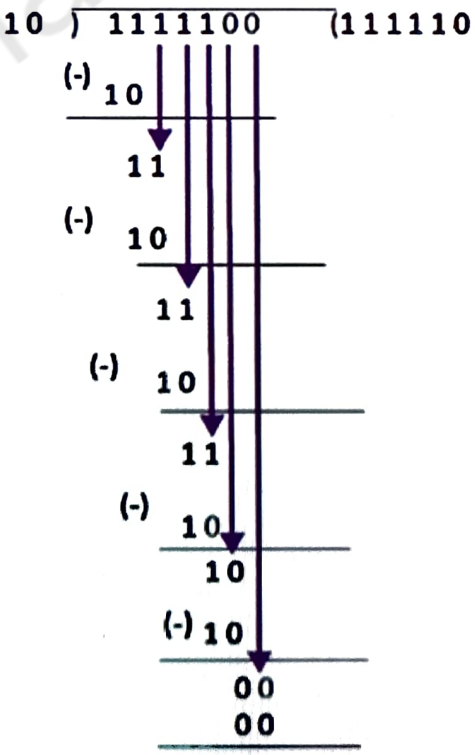
Question: Solve 01111100 ÷ 0010

Solution:

Given

01111100 ÷ 0010

- Here the dividend is 01111100, and the divisor is 0010
- **Remove the zero's in the Most Significant Bit in both the dividend and divisor,** that doesn't change the value of the number.
- So the **dividend becomes 1111100, and the divisor becomes 10.**
- Now, use the long division method.



- **Step 1:** First, look at the first two numbers in the dividend and compare with the divisor. Add the number 1 in the quotient place. Then subtract the value, you get 1 as remainder.
- **Step 2:** Then bring down the next number from the dividend portion and do the step 1 process again
- **Step 3:** Repeat the process until the remainder becomes zero by comparing the dividend and the divisor value.
- **Step 4:** Now, in this case, after you get the remainder value as 0, you have zero left in the dividend portion, so bring that zero to the quotient portion.

Therefore, the resultant value is quotient value which is equal to 111110

So, 01111100 ÷ 0010 = 111110

UNIT-I

CONCEPT OF INFORMATION SYSTEM AND SOFTWARE

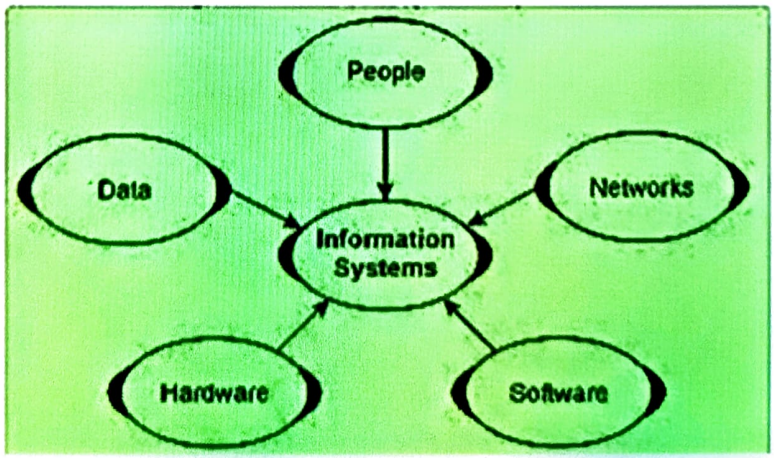
Points to be covered in this topic

- ❑ INTRODUCTION
- ❑ INFORMATION GATHERING
- ❑ REQUIREMENT AND FEASIBILITY ANALYSIS
- ❑ DATA FLOW DIAGRAM
- ❑ PROCESS SPECIFICATIONS
- ❑ INPUT/OUTPUT DESIGN
- ❑ PROCESS LIFE CYCLE
- ❑ PLANNING AND MANAGING THE PROJECT

CONCEPT OF INFORMATION SYSTEM AND SOFTWARE

❑ INTRODUCTION

- An information system is a system that **provides collection, storage and retrieval of information** in an organized manner.
- An information system can also be referred to as a **software or system that helps us to organize data and use it in a systematic manner** as and when required.
- It helps to **convert raw data into useful information** that can be analyzed at various levels in different organizations.
- The information system can be of two types - **general and specialized.**
- **General Information System** - These information systems are used widely for **basic analysis of data in any organization**. These are not specific to any department or industry. For e.g. **DBMS i.e. database management system (DBMS)** is a type of software that is used to store and organize large amount of data for further analysis.
- **Specialized Information System** - These systems are specifically designed to **suit the requirements of a particular organization or category**. For e.g. **GIS i.e. Geographic Information System** is used to access geographical data for various regions.



❑ INFORMATION GATHERING

- Information gathering refers to **collection of information from various sources and then compiling that data** in the required format.
- This data is further **analyzed to solve a particular problem** or situation.
- However, in specialized industries like air force, military etc., information gathering is a special skill that requires training and education involved.

❖ Sources used in information gathering

➢ **Existing Sources** - It refers to those sources of information that can be **found on internet or some other social media** and thus information can be easily retrieved and used.

➢ **Natural Sources** - It refers to those sources of information which exist in the market but one has to do a **lot of research to compile this information**. Eg. Information regarding some product, people who have already tried that product, their experiences, feedback etc.

❖ Purpose of information gathering -

Researchers are keen to gather information on various topics for the following reasons-

- Enhance knowledge related to a particular subject.
- Develop various skills for problem solving.

❖ Requirements gathering techniques

➢ **Brainstorming Technique**

- Idea generation
- Idea reduction and voting

➢ **Mind Mapping Technique**

- Use emphasis
- Use association
- Be clear
- Layout

➢ **Use Case Workshop Technique**

- Most popular
- Collect requirements in step-by-step manner
- Helps understanding the details
- Easy to document and written in natural language

❖ Techniques of information gathering –

- Analysis is done to **understand business functions and requirements.**
- Model of the existing system **is created and changes are suggested** as per requirements.
- **Logical explanations and discussions** are carried out to implement suggested changes.
- **Balance is maintained** between current system and required new system.

❑ REQUIREMENT AND FEASIBILITY ANALYSIS

❖ **Requirements Analysis** refers to process of **analyzing various requirements of a particular user** and then design a product or a software. The following points are considered for this analysis

- Actual usage or requirement of a product
- Specifications to be met
- Expected outcomes

- Requirements analysis is important for the **success or failure of a particular project.**

- These requirements are well **documented and measured before initiating any project** and then finally tested before launching that product in the market.
- This can be a long and tiring process **that involves many changes** before finalization.
- This is because, **requirements of a particular user keeps on changing** while the project is still in process.

➢ **Feasibility Analysis** refers to a **detailed analysis which is conducted prior to start of a proposed project.**

- The major points to be considered in it are –
  - ✓ Whether the project is technically feasible or not?
  - ✓ Whether it can be completed within estimated cost or not?
  - ✓ Whether it will be a profitable project or not?
- Such analysis is conducted when **large amount of investment is involved** by major corporations of this world.
- Such organizations prefer **conducting feasibility analysis before the start of any project**, in order to make sure that they are going to invest in a profitable business and are availing the right opportunity.
- Thus, feasibility analysis **ensures that upcoming project would be a great success** as it was strategically planned and executed.
- This kind of analysis is used to **assess all the strengths and weaknesses of a proposed project** and hence, one is able to **bring in meaningful changes** in order to achieve desired results.

❑ DATA FLOW DIAGRAM

- Data flow diagram refers to **graphical representation of flow of data** through an information system.

- It is the first step followed in order to create an overview of any information system.

- These diagrams are used for visualization of processing of data in various systems.
- Data flow diagram shows how the information will be entered into a system, how it will be processed and where it will be stored.

Data Flow Diagram

❖ Data flow diagrams symbols

There are two types of symbols used in DFDs.

- **Yourdon & Coad** - It is mainly used for system analysis and depicted as circles.
- **Gane & Sarson** - It is mainly used for visualizing information systems and is depicted as rounded corners.

❖ Components of DFD

1. **Process** - It is used to describe how data input will be transformed into data output.
2. **Flow** - It is used to describe the movement of data within any information system.
3. **Store**-It refers to the storehouse of data where all the data storage takes place.
4. **Terminator** - It refers to the final entity with which a system communicates and provides required information. It can be a person, group of persons, organization, department etc.

❖ Types of DFDS

➢ **Physical DFD** - A physical DFD represents how various functions are performed in a system.

➢ **Logical DFD** - A logical DFD is mainly related to business and its activities.

In short, we can say that, logical DFD provides "What" information on a system and physical DFD provides "How" information on a system.

❑ PROCESS SPECIFICATIONS

❖ **Process Specification** refers to **specifying a particular process** which describes **how to use input data strategically in order to transform it into required output**. It shows what should be done to utilize the available information as input and generate an output.

- In other words, we can say that process specification refers to a method of **documenting. analyzing and explaining the process** used to create an output in an information system.

➢ **Requirements of Process Specification**

- Each process specification should contain **detailed requirement of functionality.**
- Each set of process specification must **specify all the rules governing transformation of data flow** within an information system.
- Each set of process specification must specify all the **underlying policies governing transformation of data**. However, it is not necessary to describe the method used to transform that data.

➢ **Process Specification Format Information**

a. Number - as used on the DFD

b. Name - as used in the process symbol on the DFD

c. Description - Description of what the process accomplishes

❑ INPUT/OUTPUT DESIGN

❖ **Input Design** is the process of **converting data into a computer based system.** This design is necessary to **get correct interpretation of the data** that has been fed into the computer. It is a **link between information and the user.**

✓ It is required to **convert entered data into a usable form.**

➢ **Requirements of Input Design**

- It should be simple and easy to use.
- It should avoid extra steps involved in analysis of data.
- It should avoid delay in interpretation of data.
- It should be error-free.
- It should keep the process simple and controlled.

➢ **Considerations of Input Design**

- What kind of data needs to be entered in the computer system?
- How much data needs to be entered?
- How the data should be coded or interpreted?
- How to make it user friendly and guide the user for its appropriate use?
- Prepare proper input validations.
- Follow pre-decided steps in case of an error.

❖ **Output Design** is the process of **getting required output from the entered data,** what the system must produce to **meet business requirements of its users.**

➢ **Objectives of Output Design**

✓ The right amount of output should be **delivered at the right time and right place.**

➢ **Output Media**

✓ Paper

- ✓ Screen
- ✓ Video/Audio Aids
- ✓ CDROM, DVD
- ✓ Other electronic media

❑ PROCESS LIFE CYCLE

❖ **Process Lifecycle** is the method of understanding **initial, intermediate and final stages of growth and development** in any process.

- A process can be defined as the basic unit of work in any system
- its complete cycle **including model, implementation, execution, monitoring and optimization is termed as process life cycle.**

➢ **Steps of process life cycle**

1. Planning, 2. Implementation, 3. Monitoring, 4. Changes, 5. Evaluation

○ **Planning –**

- The initial stages of process life cycle includes **modeling phase in which when we gather all the details related to that process.**
- Eg. What does the process demands, why it is required, what will be the steps, who will participate in it, how it will be executed, from where it should begin and how will it end?
- With all this information in hand, a **flow diagram** is constructed to visualize the whole process.

○ **Implementation & Monitoring –**

- After planning, the process is **implemented as per plan and is closely monitored for desired output** or results.

○ **Changes or Adjustments –**

- If a given process is generating desired output, then it is allowed to continue as implemented.

- Otherwise, a **list of changes or required adjustments is made** and suggestions are taken for betterment of the process.

- **Evaluation –**

- As the name suggests, it is the last step in process life cycle where **each and every step is carefully evaluated for desired results.**

❑ PLANNING AND MANAGING THE PROJECT

- Planning and Managing the Project involves various methodologies that are required for **proper implementation and successful running of any project.**
- The various steps involved in planning and management of a project are as follows-

➢ Planning the Project

- In order to plan the project, it should be **divided into manageable components** so that each component can be deeply analyzed and managed.
- After breaking them into variable components, we should **identify their dependent entities** like the factors responsible for successful running of the project.
- Next step is to **provide an estimated time line for completion of project** so that every component and factor can be taken care of properly.
- Before implantation, we should **carefully analyze the resource requirement in detail in order to minimize the chances of alterations** during later stages.
- The **risk factors involved in a project should also be considered** well in advance so that they can be avoided in final stages of development.

➢ Tracking and Managing the Project

- Tracking project's progress is essential in order to **fulfill the time line that has been estimated** in initial stages of planning.
- Project tracking is also important to **keep a check on emerging problems** that can arise anytime during the implementation of a project.
- If such problems are **diagnosed in initial stages**, it becomes easier to deal with them before they become big issues and put a hold to any process.

➢ Project Management Metrics

- **Schedule** - It involves providing an estimated time period.
- **Cost**-It calculates the estimated budget for a particular project.
- **Resource** - It defines how much resource and how many persons are