LONG QUESTIONS

Q.1 Define electronics.

Ans: Electronics

The branch of applied physics which deals with the behaviour of electrons using different devise for various useful purposes is known as electronics

Q.2 What is meant by thermionic emission? How thermionic emission is produced?

Ans: **Definition:**

"The process of emission of electrons from the hot metal surfaces is called thermionic emission."

How thermionic emission is produced?

Metals contain a large number of free electron. At room temperature electrons cannot escape the metal surface due to attractive forces of atomic nucleus. When the metal is heated to a height temperature. Some of the free electrons may gain sufficient energy to escape the metal surface.

Thermionic emission from tungsten filament:

Thermionic emission can be produced by electrically heating a fine tungsten filament. Typical values of the voltage and current used are 6V and 0.3 A respectively.

Q.3 How electron beam is obtained? Explain the effect of electric and magnetic field on electron beam.

Ans: **Electron beam:**

Electrons are produced by the thermionic emission from a tungsten filament heated by 6V supply. A fine filament is fitted in electron gun as shown in fig.

A high positive potential is applied to a cylindrical anode (+). The electrons are accelerated to a high speed and pass through the hole of the anode in the form of a find beam of electrons. The whole setup is fitted in and evacuated glass tube.

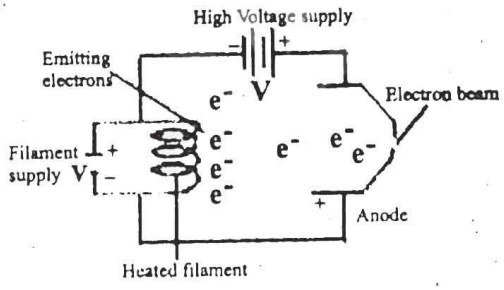
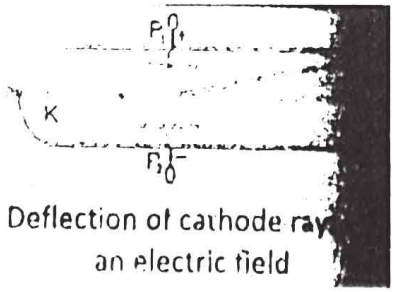


Fig. 16.1: Electron gun

Deflection of electrons by electric field

We can setup electric field by applying a potential difference across two parallel metal plates placed horizontally separated with some distance. When an electron beam passes between the plates, it can be seen that the electrons are deflected toward the positive plate as shown in fig.



Deflection of cathode ray
an electric field

Reason

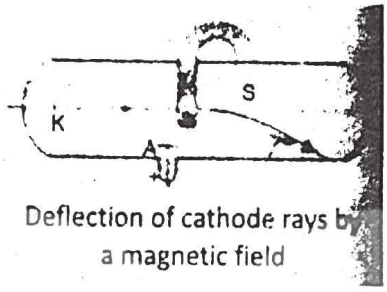
Deflection of electrons in electric filed is due to the attraction of positive pole (Plate) and repulsion of negative plate. The electric force acting on the electron in electric field will be

$$F = qE$$

Where 'q' the charge of electron and 'E' is the electric field intensity due to plates. The degree of deflection of electrons from their original direction is proportional to the strength of the electric field applied.

Deflection of electrons by magnetic field

Magnetic field is applied at right angle to the beam of electrons by using horse shoe magnet as shown in fig.



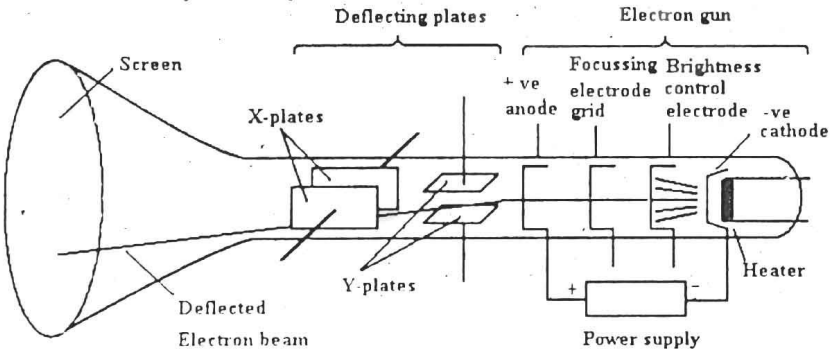
Deflection of cathode rays by a magnetic field

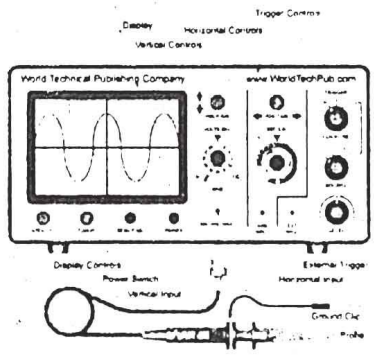
A spot of electron beam will be noticed on the screen due to the deflection of beam from its original path (direction). Now change the direction of the horse shoe magnet. We will see the spot on the fluorescent screen is getting deflected in the opposite direction.

Q.4 What is Cathode – Rays Oscilloscope (C.R.O)? Explain the working of different parts of oscilloscope?

Ans: The Cathode – ray oscilloscope is an instrument which is used to display the magnitudes of changing electric currents or potentials as shown in fig.

28.1.11 Cathode ray oscilloscope





The information is displaced on the screen of a "cathode ray tube." This screen appears a circular or rectangular window usually with a centimeter graph.

Examples:

Picture tube in our TV set and the display terminal for most computers are cathode ray tubes.

Construction and Working:

The cathode-ray oscilloscope (C.R.O) consists of the following components:

1. The electron gun
2. The deflecting plates
3. A fluorescent screen

The electron gun:

The electron gun consists of an electron source which is an electrically heated cathode that ejects electrons.

Flow of the electrons in the beam is controlled by an electrode called grid 'G'. The grid is connected to the negative potential. The more negative this potential. The more electrons will be repelled form the grid and hence fewer electrons will reach the anode and the screen. The number of the electrons reaching the screen determines. The brightness on the screen light. Hence the negative potential of the grid can be used as a brightness control.

The anode is connoted to the positive potential and hence is used to accelerate the electrons. The electrons are focused into a fine beam as they pass through the anode.

2. **The deflecting plates**

After leaving electron gun, the electron beam passes between a pair of horizontal plates. A potential difference applied between these plates deflects the beam in a vertical plane. This pair of plates provides the Y-axis or vertical movement of the spot on the screen. A pair of vertical plates provides the x-axis or horizontal movement of the spot on the screen.

3. **The fluorescent screen**

The screen of cathode – ray tube consists of a thin layer of phosphor, which a material that gives light as a result of bombardment b y fast moving electrons.

Uses of C.R.O

The CRO is used in many fields of science, some uses are given below:.

i. Displaying wave forms.

ii. Measuring voltages.

iii. Range finding (as in radar)

iv. Echo – sounding (to find the depth of sea – beds).

v. To display heart beats.

Q;4 Write a note on analogue and digital electronics.

Ans: **Analogue quantities**

Those quantities whose values vary continuously or remain constant are known as analogue quantities.

Example

The temperature of air varies continuously during 24 hours of a day. If we plot a graph between time and temperature recorded at different times, we get a graph as shown in Figure.

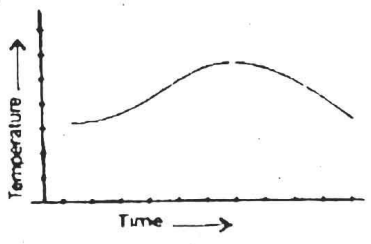


Fig. 19 1

This graph shows that the temperature varies continuously with time. Therefore temperature is an analogue quantity. Similarly time, pressure, distance etc., are analogue quantities.

Analogue Electronics

The part of electronics consisting of such circuits which processes analogue quantities is called analogue electronics.

Example

For example the public address system is an analogue system in which the microphone converts sound into a continuously varying electric potential. This potential is an analogue signal which is fed into an amplifier. Amplifier is an analogue circuit which amplifies the signal without changing its shape to such an extent that it can operate a loudspeaker. In this way loud sound is produced out of the speaker.

Digital Electronics

"The part of electronics which processes the data provided in the form of digits is known as digital electronics".

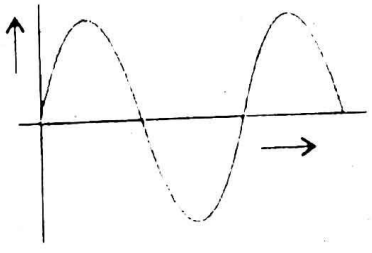
For this purpose digital electronics uses only two digits 0(zero) and 1 (one) and the whole data is provided in binary system due to which processing of data becomes easy.

Examples

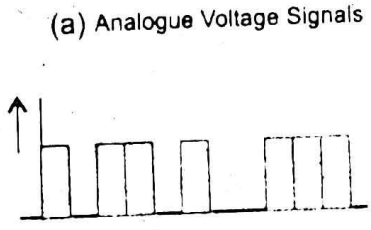
For quite a long period the use of digital electronics was limited to computers only but now-a-days its application is very wide spread Modern telephone system, radar system, naval and other systems of military importance, devices to control the operation of industrial machines, medical equipments and many household appliances are all using digital technology

Representation of analogue and digital signals

Figure given below shows an analogue and digital signals. It can be seen that digital signal provides the data by a maximum and minimum voltage level. In it the changes are not continuous.



(a) Analogue Voltage Signals



(a) Analogue Voltage Signals

(b) Digital Voltage Signals

Fig. 19.3

Analogue to Digital converter (ADC)

"A circuit has been designed which converts the analogue signal into a digital one in the form of digits. This circuit is known as analogue to digital converter, i.e., ADC".

When we get an analogue signal in the form of digits, we can process it with digital circuit, the output of which is also in digital form.

Digital to Analogue converter (DAC)

"A circuit that is designed to convert digital output into analogue form by a circuit known as digital to analogue converter (DAC)".

As the output of DAC is an analogue signal, it can be readily sensed by us. Thus electronic systems used at present consist of both analogue and digital type circuits

Q.9 What is use of ADC and DAC? Briefly explain?

Ans: In our daily life the quantities that we perceive by our senses are usually analogue quantities which can not be processed by digital circuits. To resolve this difficulty different circuits has been designed which convert analogue quantities into digital quantities and digital quantities into analogue quantities are per required. There circuits are known as ADC and DAC.

i. Analogue Digital Converter (ADC)

A circuit which is designed to convert analogue signal into a digital one in the form of digits is known as analogue to digital converter. (ADC).

ii. Digital Analogue Converter (DAC)

When we get an analogue signal in the form of digits we can process it with digital circuit the output of which is also in digital form. This digital output is converted into analogue circuit known as digital to analogue converter i.e DAC.

As the output of DAC is an analogue signal it can readily be sensed by us. Thus electronic system used at present consists of both analogue and digital type circuits.

Q.10 What is meant by binary (Boolean) variables? Explain with example.

"The variables which have only two possible states are knows as binary variables".

Ans: **Explanation:**

There are many things which have two possible sates e.g.

i. A switch could be either open or closed.

ii. A circuit may be either ON or OFF.

iii. A statement would be either true or false.

iv. The answer of a question could be right .

All three things which have only two possible states are called binary (Boolean) variables.

Representation of Binary variables

The state of binary variables are usually represented by the digits '0' and '1'.

Example:

Suppose we form a circuit by connecting a lamp to battery using a switch 'S' as shown in fig. We call the state of switch as input and state of current or lamp as output.

Switch and lamp are binary variables

When the switch is open no current passes through the circuit and lamp is OFF. In other words when input is Zero (O) output is also Zero (O).

When the switch is closed current passes through the circuit and the lamp is ON. Both switch and lamp have value '1'. Hence switch and lamp (Current) both have two possible states Zero (O) and one 1. therefore they are considered as binary variables. This is also explain in table given in front.

S	Lamp
Open	Off
Closed	On

Q.11 What is meant by Boolean Algebra? Explain its importance.

Ans: "The algebra used to describe logic operations by symbols is called Boolean Algebra'.

Importance:

"George Boolean invented Boolean Algebra".

By using Boolean algebra the values of output variables are determined when the values of input variables of ca circuit or system are known. Boolean Algebra is a branch of mathematics which deals with the relationship of logic variables. Boolean Algebra handles variables that represent two types of logic propositions.

Importance:

Boolean algebra has become the main cornerstone of digital electronic.

- It operates with two logic states '1' and '0'.
- It interpret the logical operators AND, OR and NOT.
- It develop a systematic complex digital systems.
- Simple logic gates perform the simple mathematical as well as intricate logical operations.
- Logic operations are considered as combination of switches.

Q.12 What do you mean by logic gate?

Ans: Logic gate is a switch (digital circuit), its outputs can have only one of the two possible states, i.e either a higher voltage (1) or a low voltage (0) – it the either ON or OFF. Output voltage of the logic gate depend upon the condition of its input. It may be high (1) or low (0) according to the condition of input.

Q.13 What is AND operation? Explain in possible states. Write its symbol, Expression and gate?

Ans: **AND operation**

"AND operation is such a logic operation that its output is 1 only when all the values of its inputs are 1".

Explanation:

In order to understand the logic AND operation, we consider a circuit in which a lamp is connected to a battery using two switches S_1 an S_2 connected in series as shown in fig. These switches are considered as inputs and lamp is an output, this circuit is given as

Possible states

There are four possible states of two switches are given as

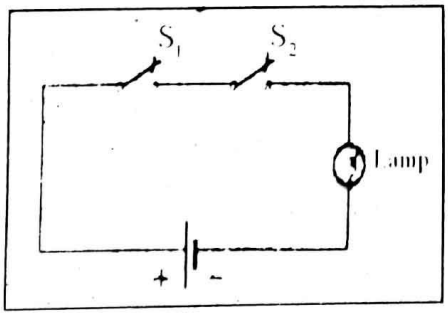
i) When S_1 and S_2 are both open, the lamp is OFF.

ii) When S_1 is open and S_2 is closed, the lamp is OFF.

iii) When S_1 is closed and S_2 is open, the lamp is ON.

iv) When both S_1 and S_2 are closed, the lamp is On.

These states of switches and lamp are shown in table. It is clear from table that when either of the switches (S_1 and S_2) or both are open, the lamp is OFF. When both switches are closed, the lamp is ON.



S_1	S_2	Lamp
Open	Open	Off
Open	Closed	Off
Closed	Open	Off
Closed	Closed	ON

Symbol and AND operation:

Symbol for AND operation is dot (.)

Expression:

Boolean expression of AND operation is

$X = A.B$

This expression is read as

"X equals to A AND B

Truth table:

"Set of inputs and outputs in binary from is called truth table".

In binary language, when either of the inputs or both the inputs are low (0,, the output is slow (0). When both the inputs are high (1), the output is high (1).

These relationship are shown in table. Where 'X' represent the output. Hence AND operation may be represented by switches concede in series and each switch represents an input.

B	A	X = A.B
0	0	0
0	1	0
1	0	0
1	1	1

Important results:

- When two switches are close i.e. the inputs of the AND operation are at logic '1', The output and AND operation will be at logic '1'.
- When two switches are open i.e. the in puts of AND operation are at logic 'O', the output of AND operation will be at logic 'O'.

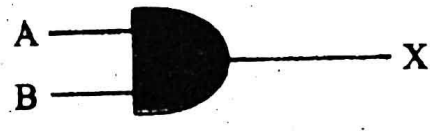
AND gate:

"The circuit which implements the AND operation is known as AND gate".

Symbol and AND gate:

Symbol of AND operation is given as

AND gate has two or more than two inputs and only one output. The value of output of AND gate will be '1' only when both of its inputs are at logic '1' and for all other situations output and AND gate will be 'O'.



Q.14 What is OR operation? Explain its possible states. Write its symbol, expression and gate?

Ans: OR operation

"The logical operation in which the value of output variable is equal to '1' when any one of the both input variables have value equal to '1'.

Explanation:

In order to under the logic OR operation we consider a circuit in which a lamp is connected to a battery using two switches, S_1 and S_2 connected in parallel considered as two inputs.

Possible states

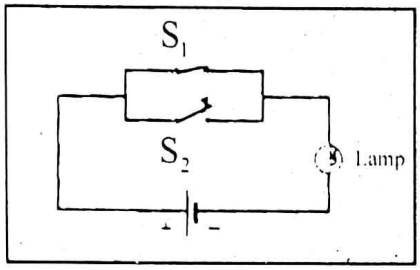
There are four possible states which are given as:

i) When S_1 and S_2 are open the lamp is OFF.

ii) When S_1 is open and S_2 closed the lamp is ON.

iii) When S_1 is closed and S_2 open the lamp is On.

iv) When both S_1 and S_2 are closed the lamp ON.



S_1	S_2	Lamp
Open	Open	OFF
Open	Closed	ON
Closed	Open	ON
Closed	Closed	ON

All possible states of the lamp and switches are shown on the table given below.

It is clear from table that the lamp will glow if at least one of the switch i.e. S_1 and S_2 is closed (at logic '1')

Symbol of OR operation

OR operation is represented by the symbol of plus (+).

Expression:

Boolean expression for OR operation is given as

$$X = A + B$$

This expression is read as:

"X equals to A OR B"

Truth Table:

"Set of inputs and outputs in binary form is called truth table".

Truth table of OR operation is shown as:

Hence OR operation may be represented by switches connected in parallel, since only one of these parallel switches need to turn on in order to flow current in the circuit.

B	A	X
0	0	0
0	1	1
1	0	1
1	1	1

OR gate

The electronic circuits which implements the OR operation is known as OR gate".

Symbol of OR gate:

Symbol of 'OR' gate is given in fig

OR gate has two or more than two inputs and has only one output. The values of output of OR gate are always in accordance with the truth table of OR operation. It means value of output of OR gate will be '1' when one of its inputs is at '1' the value of output will be 'O', when both inputs are at 'O'.

Q.15 What is meant by NOT operation? Explain its possible states, write its symbol, Expression and gate.

Ans: NOT operation

"A logical operation which changes the state of binary (Boolean) variable".

OR

"Not operation inverts the value of Boolean variable".

Explanation:

In order to understand NOT operation, we consider a circuit in which a lamp is connected to a battery with a switch 'S in parallel way.

Possible states

NOT operation has only one input and only one output.

There are two possible sates.

i) When the switch "S' is open , the current will pass through the lamp and it will glow.

ii) When the switch is closed, no current will pass through the lamp due to large resistance of its filament and it will not glow.

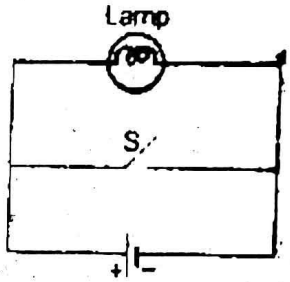


Fig 16.12

The states of NOT operation are shown in table.

S	LAMP
OFF	ON
ON	OFF

Symbol of NOT operation

NOT operation is represented by a line or bar over the Boolean variable i.e . $\overline{A}$.

Expression:

Boolean expression for NOT operation is given as:

$$X = \overline{A}$$

This is read as:

"*X equals A NOT*".

Truth Table

"A set of inputs and outputs in binary form is called truth table". Truth table of NOT operation is shown in table given below: Hence, it is clear from the table. If the Boolean variable is '0', then after NOT operation its value before NOT operation is '1', then after NOT operation it would change to '0'.

A	$\overline{A}$
0	1
1	0

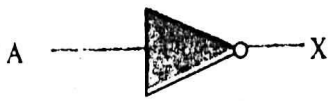
"Thus NOT operation inverts the state of Boolean variable".

NOT gate

The electronic circuit which implements NOT operation is known as NOT gate.

Symbol of NOT gate

The symbol of NOT gate is given as NOT gate has only one input and one output terminal NOT gate works in such a way that if its input is 'O' is output would be '1'. It its input is '1' the nits output would be 'O'. Not gate performs the basic logical function called inversion of complementation. Not gate is also called inverter.



Q.16 What is NAND gate? Explain its symbol. Express and Truth table?

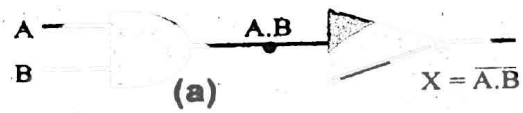
Ans: NAND gate:

NAND operation is simply AND operation followed by a NOT operation. "the NAND gate is obtained by coupling a NOT gate with the output terminal of the AND gate".

Symbol of NAND gate

Symbol of NAND gate is given as:

The NOT gate inverts the output of the AND gate.



Short symbol of NAND gate

In this symbol the NOT gate has been replaced with a small circle. this small Circle attached to a the output of NAND gate shows NOT o eration, its fig is given below:

Expression:

Boolean expression for NAND operation is described as:

The output of the NAND gate equals A.B and is written as:

$$X = \overline{A.B}$$

It is read as

"X equals A AND B NOT".

Truth Table

B	A	X = $\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Hence it is clear form table that inverts the output of the NAND gate.

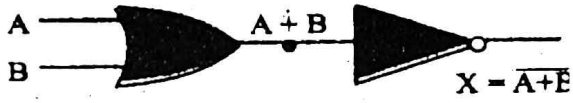
Q.17 What is NOR gate? Explain its symbol, expression and truth table?

Ans: NOR gate:

The NOR operation is simply an OR operation followed by a Not operation. " The NOR gate is obtained by coupling the output of the OR gate with NOT gate".

Symbol of NOR gate

The symbol of NOR gate is given as: For the same combination of inputs, the output of a NOR gate will be opposite to that of an OR gate.



Short symbol of NOR gate:

In this symbol the NOT gate has been replaced with a small circle. In the symbol If NOR gate, this small circle attached at the output of OR gate shows NOT operation, its fig is given as

Expression:

Boolean expression for NOR operation is describes as:

$$X = \overline{A + B}$$

It is read as:

"X equals A OR B NOT".

Truth Table

B	A	$X = \overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

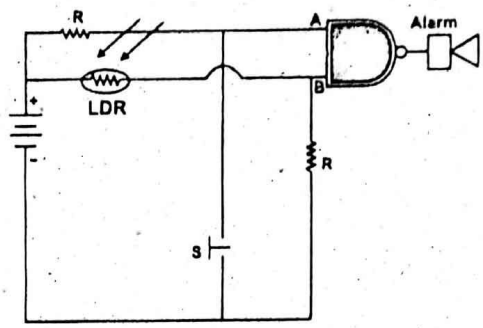
" A set of inputs and outputs in binary form is called truth table".

Q.18 What is the use of logic gates? Explain with one example.

Ans: We can use logic gates in electronic circuits to do useful tasks. These circuits usually use light depending resistors (LDRs) to keep inputs low. An LDR can act as a switch that is closed when illuminated by light and open in the dark.

House safety Alarm

We can use single NAND gate to make burglar alarm. This can be done by using NAND gate, an LDR, a push – button switch S and an alarm. Connect LDR between NAND gate input B and the positive terminal of the battery. the LDR will cause a height level input (1) at B when in light because of its low resistance. The LDR will cause a low level input (0) at B when light is interrupted and causes high resistance in LDR. A low level signal is also caused at A when burglar steps on switch S. So this burglar alarm sounds when either burglar interrupts light falling on LDR or steps on switch S.



(Burglar alarm schematic circuit)