

REVIEW QUESTIONS

16.1.1 Describe, using one simple diagram in each case, what happens when a narrow beam of electrons is passed through (a) a uniform electric field)b a uniform magnetic field. What do these results indicate about the charge on electron?

Ans. See Q No 2 & 3

16.2 Explain the working of different parts of oscilloscope.

16.3 Name some uses of oscilloscope.

16.4 Considering an oscilloscope explain.

(i) **How the filament is heated**

Ans: Filament is heated electrically by a battery (6V Supply).

(ii) **Why the filament is heated**

Ans: By heating filament a fine beam of electrons is obtained.

(iii) **Why the anode potential is positive with respect to the cathode potential.**

Ans: To accelerate the electrons emitted from heated filament positive potential of anode is used. In this way the electrons are focused into a fine beam as they pass through the anode.

(iv) **Why a large potential is applied between anode and cathode.**

Ans: After leaving the electron gun, electron beam passes between pair of horizontal. A large potential difference is applied between anode and cathode, due to this potential electrons are directed in specific direction. Higher voltage in short time produced and excellent displaying wave forms height voltage supply also heat the filament quickly and increased the rate of thermo ionic emission.

(v) **Why the tube evacuated?**

Ans: Ionization of gases present in tube occur due to height voltage applied across tube, so it must be evacuated. Due to ionization of gases a fine beam of electrons could not be produced and accelerate in specific direction.

16.5 **What is electron gun? Describe the process of the thermionic emission.**

Ans. See Q. No 2 & 3

16.6 What do you understand by digital and analog quantifies?

Ans. See Q. No 4

16.7 Differentiate between analog electronics and digital electronics. Write down names of five analogue and five digital devices that are commonly used in every day.

Ans. See Q. No 4

16.8 State and explain for each case whether the information given by the following devices is in analogue or a digital form.

Ans: (i) **A moving coil voltmeter measuring the e.m.f of a cell**

A moving coil voltmeter measuring the e.m.f of a cell provide information in the form of analogue form.

(ii) **A microphone generating an electric current.**

A microphone generating an electric voltage is also in the form of analogue form.

(iii) **A central heating thermostat controlling the water pump.**

Central heating thermostats controlling the water pump in the form of analogue signal.

(iv) **Automatic traffic lights controlling the flow of traffic.**

Automatic traffic lights also work on the basis of analogue quantities.

16.9 Write down some benefits of using digital electronics over analogue electronics.

Ans: The big advantage of digital electronics is quality.

There is no interference or loss of strength in digit signal traveling in an optical fibre. Digit technology in TV gives excellent view and allow you to be interactive.

Smart ID cards are being developed. A single card can be passport, national insurance card and driving license all in one. The card could also hold biometric data like an eye retina scene and voice scene for unique identification and security. All of this data would be held digitally in the tiny chip. Now, today everything is going digital like digital cameras are fast replacing traditional film equipment. You can download an image into a PC and edit the picture.

16.10 What are the three universal Logic Gates? Give their symbols and truth tables.

Ans. See Q. No. 13-14-15

CONCEPTUAL QUESTIONS

16.1 Name two factors which can enhance thermionic emission.

Ans: Rate of thermionic emission depends upon the nature of the metal used, temperature and surface area of the metal. By increasing the temperature and surface area of the cathode, rate of thermionic emission can be increased.

16.2 Give three reasons to support the evidence that cathode rays are negatively charged electrons.

Ans: IN the beginning, no one was sure about the nature of cathode-rays. It was J.J. Thomson who carried out many experiments and concluded that cathode-rays are negatively charged electrons. The three reasons to support this evidence are as follows.

- They are attracted towards positively charged plate.
- They are deflected in magnetic field opposite to the direction of positive charge.
- Their charge to mass ratio (e/m) is equal to e/m of electrons.

Q. 16.3 When electrons pass through two parallel plates having opposite charges they are deflected towards the positively charged plate. What important characteristics of the electron can be inferred from this?

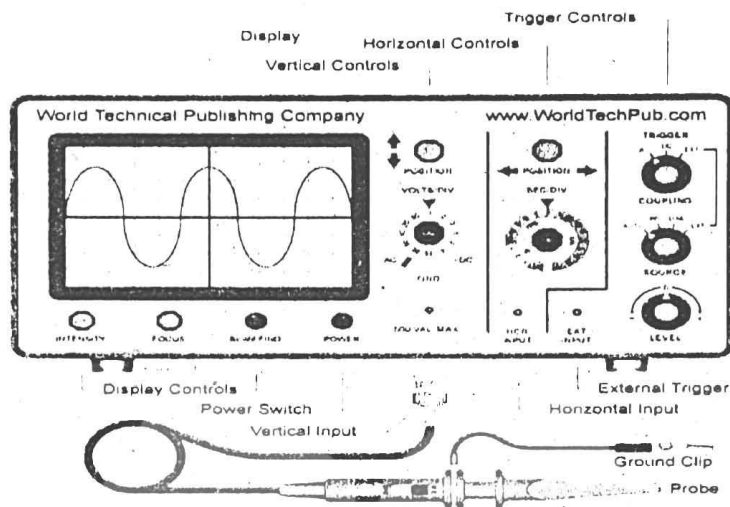
Ans: From the deflection of electrons towards the positively charged plate, we can easily conclude that electrons carry negative charge.

Q. 16.4 When a moving electron enters the magnetic field it is deflected from its straight path. Name two factors which can enhance electron deflection.

Ans: Two factors which enhance the deflection of electrons in a magnetic field are the strength of magnetic field and speed of electron.

16.5 In what ways is an oscilloscope a voltmeter?

In order to use oscilloscope as a voltmeter, switch OFF the time base and connect the voltage to be measured to the Y-input terminals. In this way the deflection of the spot would be vertically. The deflections is proportional to potential difference, which is to be measured. In this way the input of CRO (i.e. internal resistance between Y-inputs terminals) is very height, typically several million ohms. This makes an oscilloscope very nearly an ideal voltmeter.



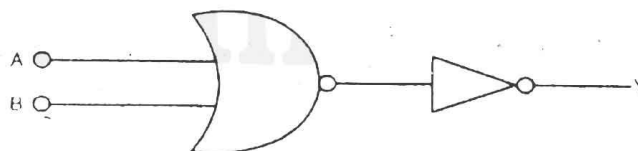
16.6 How can you compare the logic operation $X = A.B$ with usual operation of multiplication

Ans: From the truth table of AND operation it is clear that behave as multiplicative inverse. Each time result is zero when is multiplied with any Boolean variable. Hence logic operation $X = A.B$ behave as operation of multiplication

16.7 NAND gate is the reciprocal of AND gate. Discuss. .

Ans: In NAND gate the value of AND gate is inverted by NOT gate. From the sets of inputs and output given in truth table of NAND gate, it is clear that it is the reciprocal of AND gate i.e. every time the value of output of AND gate is

16.8 Show that the circuit given as below acts as OR gate.

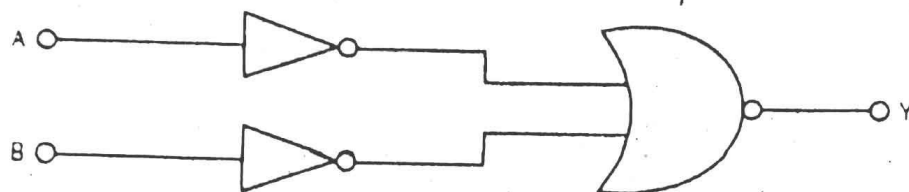


Ans: The electronic circuit which implements the OR operation is **known as OR gate**. It has two or more than two inputs and has only one output. The values of output of OR gate are always in accordance with the truth table of OR operation.. It means, the value of output of OR gate will be '1' when one of its inputs is at '1'. The output will be '0', when both inputs are at '0'.

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

Q. 16.9

Show that the circuit given as below acts as AND gate.



Ans: The circuit which implements the AND operation is known as AND gate. AND gate has two or more than two inputs and only one output. The value of output of NAND gate is always in accordance with the truth table of AND operation. It means output of AND gate will be '1' only when both of its inputs are at logic '1', for all other situations output of AND gate will be '0'.

A	B	$\bar{A}$	$\bar{B}$	$\bar{A} \cdot \bar{B}$	$\overline{\bar{A} \cdot \bar{B}}$
0	0	1	1	1	0
0	1	1	0	1	0
1	0	0	1	1	0
1	1	0	0	0	1

INFORMATION BASED QUESTIONS AND THEIR ANSWERS

Point to Ponder (Page 147)

Q.1 When a magnet is brought near to the screen of a television tube picture on the screen is distorted. Do you know why?

Ans. Electromagnets are used to deflect electrons to the desired positions of the screen of a television tube to produce clear picture. When a magnet is brought near to the screen of the television tube, the spot of the electrons beam on the screen is distorted.

Quick Quiz (Page 156)

Q.2 Assume you have an Or gate with two inputs, A and B. Determine the output C, for the following cases:

(a) $A = 1, B = 0$

(b) $A = 0, B = 1$

If either input is one, what is the output?

Ans. The value of the output of Or gate will '1' when either of its inputs is '1'. Thus, in this case, the output C will be '1'.

EXERCISE

MULTIPLE CHOICE QUESTIONS

- (1) The process by which electrons are emitted by a hot metal surface is known as
 (a) Boiling (b) Evaporation
 (c) Conduction ☒ (d) Thermionic emission
- (2) The particles emitted from a hot cathode surface are
 (a) Positive ions (b) Negative ions (c) Protons ☒ (d) Electrons
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graph LR
    A --- AND[AND Gate]
    B --- AND
    AND --- X
    
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- (3) The logical operation performed by this gate is
 (a) AND (b) NOR ☒ (c) NAND (d) OR
- (4) AND gate can be formed by using two
 (a) NOT gates (b) OR gates ☒ (c) NOR gates (d) OR gates
- (5) The output of a two-input NOR gate is 1 when
 (a) A is 1 and B is 0 (b) A is 0 and B is ☒ (c) Both A and B are 0 (d) Both A and B are 1
- (6) If $X = A \cdot B$, then X is 1 when:
☒ (a) A and B are 1 (b) A or B is 0 (c) A is 0 and B is 1 (d) A is 1 and B is 0
- (7) The output of a NAND gate is 0 when
 (a) Both of its inputs are 0 ☒ (b) Both of its inputs are 1
 (c) Any of its inputs is 0 (d) Any of its inputs is 1

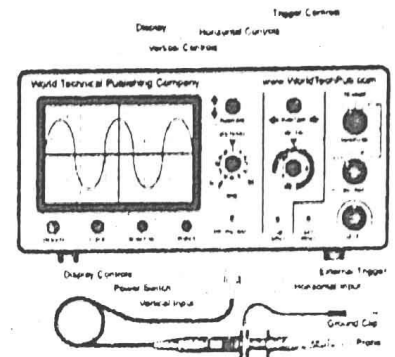
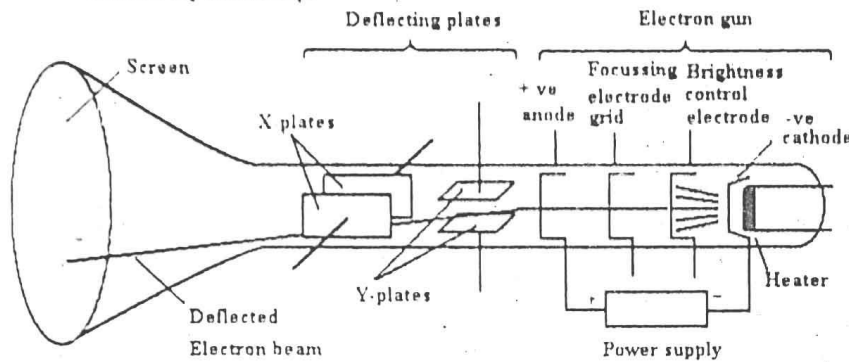
ANSWER KEY

1	2	3	4	5	6	7
d	d	c	c	c	a	b

BASIC ELECTRONICS

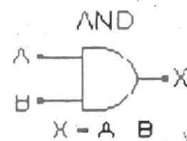
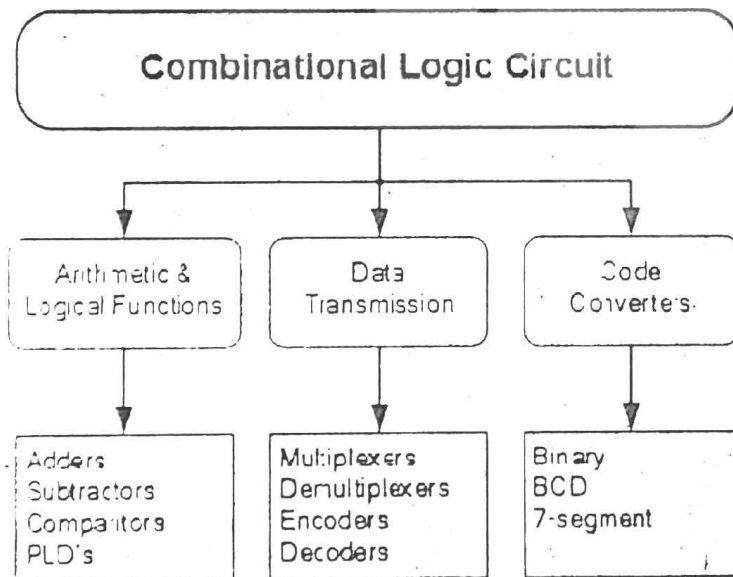
CATHODE RAY OSCILLOSCOPES

18.1.11 Cathode ray oscilloscope

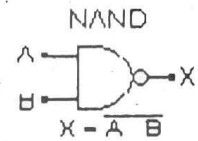


DIGITAL ELECTRONICS AND LOGIC GATES

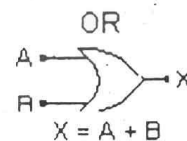
Combinational Logic Circuit



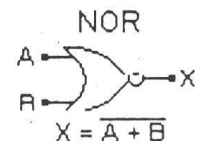
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1



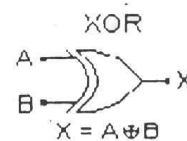
A	B	X
0	0	1
0	1	1
1	0	1
1	1	0



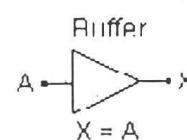
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1



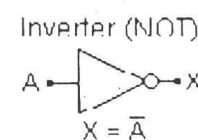
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0



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



A	X
0	0
1	1



A	X
0	1
1	0

MULTIPLE CHOICE QUESTIONS

16.1 Thermionic Emission

1.6.2 Investigating the properties of Electrons

16.3 Cathode-Ray Oscilloscope (C.R.O)

- (1) The branch of applied physics which deals with the behaviour of electrons using different devices for various useful purposes is
(a) light (b) mechanics (c) thermodynamics (d) electronics
- (2) Who observed the deflection of cathode rays by both electric and magnetic fields?
(a) Newton (b) J.J Thomson (c) Plank (d) Charles
- (3) Cathode rays contain negatively charged particles called:
(a) Neutrons (b) protons (c) electrons (d) positrons
- (4) The process of emission of electrons from the hot metal surface is called;
(a) dynamic emission (b) electronic emission
(c) thermionic emission (d) static emission
- (5) Metals contain large number of:
(a) free electrons (b) Free protons (c) free neutrons (d) bound electrons
- (6) For thermionic emission typical values of voltage and current used are:
(a) 3v, 0.4A (b) 6V, 0.3A (c) 5V, 0.3A (d) 6V, 0.1A
- (7) Electron gun is used to investigate the properties of;
(a) electron beam (b) nucleus (c) neutron (d) proton
- (8) The degree of deflection of electrons from their original direction is proportional to;
(a) the speed of electrons (b) the strength of the electric field applied
(c) the amount of current (d) the potential difference
- (9) A component of cathode-ray oscilloscope (C.R.O) is;
(a) the electron gun (b) the deflecting plates
(c) a fluorescent screen (d) all of given
- (10) Electron gun has an electrode for controlling the flow of electron in the beam;
(a) grid C (b) grid A (c) grid B (d) grid G
- (11) The screen of a cathode-ray tube consists of a thin layer of;
(a) aluminium (b) potassium (c) phosphor (d) sulphur
- (12) Cathode-ray oscilloscope (C.R.O) is used in many field of science for;
(a) displaying waveforms (b) measuring voltages
(c) range-finding (d) all given are true
- (13) To find the depth of sea-beds, C.R.O is used as:
(a) echo-sounding (b) displaying waveforms
(c) measuring voltage (d) range finding

16.4 Analogue and Digital Electronics

16.5 Basic Operations of Electronic-Logic Gates

- (14) Analogue quantities are;
(a) whose values vary continuously (b) whose values remain constant
(c) e.g. temperature of air (d) all of given are true
- (15) Time, pressure, distance are all:
(a) analogue quantities (b) variable quantities
(c) nominal quantities (d) digital quantities

- (16) Which is an analogue circuit which amplifies the signals without changing its shape to such an extent that it can operate a loudspeaker?
 (a) Galvanometer (b) Manometer (c) amplifier (d) Optical fiber
- (17) The quantities whose value vary in non –continuous manner are called;
 (a) analogue quantities (b) digital quantities
 (c) statistic quantities (d) continuous quantities
- (18) Those quantities whose value vary continuously or remain constant:
 (a) Analogue (b) Digital (c) Hybrid (d) All of them
- (19) Which of the following is an analogue device?
 (a) Electric fan (b) Electric iron (c) Radio receiver (d) All of them
- (20) Electronics which provides the data in the form of maximum and minimum voltage signals:
 (a) Analogue (b) Digital (c) Hybrid (d) All of them
- (21) Which of the following are digital devices?
 (a) Computer (b) Mobile phone (c) Digital camera (d) All of them
- (22) Circuits which convert the digital signal into analogue signals:
 (a) ADC (b) DAC (c) CAD (d) None of them
- (23) Circuits which convert the analogue signal into digital signal:
 (a) ADC (b) DAC (c) CAD (d) None of them
- (24) Digital electronics uses two digits.
 (a) 0,2 (b) 0,3 (c) 0,1 (d) 0,4
- (25) A switch has only possible states.
 (a) Two (b) Three (c) Four (d) Five
- (26) The states of binary variables are usually represented by the digits;
 (a) 1,2 (b) 0,2 (c) 0,3 (d) 0,1
- (27) George Boolean invented a special algebra known as algebra of logics or _____.
 (a) Boolean algebra (b) Geometry (c) Ratios (d) Trigonometry
- (28) Boolean algebra operates with two logic states represented by two distinct voltage level.
 (a) 0,2 (b) 0,3 (c) 1,0 (d) 1,1
- (29) The number of operations of Boolean algebra are:
 (a) 1 (b) 2 (c) 3 (d) 4
- (30) In Boolean Algebra zero represents:
 (a) Zero potential (b) Ground potential (c) Low potential (d) Both a & b
- (31) In Boolean Algebra 1 represents:
 (a) 5V (b) 1V (c) Both a & b (d) None of above

16.6 AND Operation

16.7 OR Operation

- (32) The logical operation, whose output will only be one if its all inputs are 1:
 (a) AND (b) OR (c) NOT (d) All of above
- (33) The logical operation, whose output will only be zero if its all inputs are zero:
 (a) AND (b) OR (c) NOT (d) All of above
- (34) AND operation is just like ----- combinations of resistors:
 (a) Series (b) Parallel (c) Both (d) None of above

- (35) **AND operations is represented by:**
 (a) Dot ($\bullet$) (b) Multiplication sign (c) Any sign (d) Both a & b
- (36) **OR operation is just like ----- combinations of resistors:**
 (a) Serial (b) Parallel (c) Both (d) None of above
- (37) **OR operations is represented by:**
 (a) Dot ($\bullet$) (b) Multiplication sign (c) '+' sign (d) Both a & b
- (38) **The various operations of Boolean variables are also called:**
 (a) Boolean constants (b) Algebraic operations (c) Logic operations (d) Both b & c
- (39) **The circuit which implements the AND operation is called:**
 (a) AND gate (b) AND circuit (c) OR gate (d) Both a & b
- (40) **The circuit which implements the OR operation is called:**
 (a) AND gate (b) OR circuit (c) OR gate (d) Both b & c
- (41) **The word "truth" that is used in Boolean algebra is borrowed from:**
 (a) Mathematics (b) Italian (c) Geometry (d) Subject of Logic
- (42) **If switches S_1 and S_2 both are open the lamp is:**
 (a) ON (b) OFF
 (c) sometime ON and sometime OFF (d) Neither ON nor OFF
- (43) **In case of OR operation the lamp is Off when:**
 (a) S_1 and S_2 are open (b) S_1 is open and S_2 is closed
 (c) S_1 is closed and S_2 is open (d) S_1 and S_2 are closed
- (44) **OR operation is represented by the symbol of (+) and Boolean expression for OR is:**
 (a) $x = A + B$ (b) $x = A - B$ (c) $x + A = A$ (d) $X = \overline{A+B}$

16.8 NOT Operation

16.9 NAND Gate

- (45) **NOT operation is represented by:**
 (a) line (b) bar over the symbol
 (c) both A & B (d) (.) dot
- (46) **Value of a Boolean variable 1 after NOT operation is;**
 (a) 0 (b) +1 (c) -1 (d) -2
- (47) **After NOT operation the value of Boolean variable 0 is;**
 (a) 0 (b) +1 (c) -1 (d) 1
- (48) **NOT gate is also called;**
 (a) converter (b) inverter (c) adder (d) subtractor
- (49) **NAND operation is simply an AND operation followed by a;**
 (a) NOR operation (b) OR operation (c) NOT operation (d) AND operation
- (50) **NOT operation is also known as:**
 (a) Gate (b) Inverter (c) Converse (d) All of above
- (51) **Number of input(s) of NOT operation are:**
 (a) 1 (b) 2 (c) 3 (d) 4
- (52) **The circuit which is used to implement NOT operation:**
 (a) AND gate (b) NOT gate (c) OR gate (d) Both a & b

- (53) NAND gate is the combination of:
 (a) AND & OR (b) AND & NOT (c) NOT & OR (d) None of them
- (54) A and B are two inputs of NAND gate. Its output would be zero when
 (a) A=0, B=0 (b) A=1, B=0 (c) A=0, B=1 (d) A=1, B=1
- (55) NOR gate is the combination of:
 (a) AND & OR (b) AND & NOT (c) NOT & OR (d) None of them
- (56) A and B are the two input of NOR gate. Its output would be 1 when:
 (a) A=0, B=0 (b) A=1, B=0 (c) A=0, B=1 (d) A=1, B=1
- (57) The output of the NAND is written as;
 (a) $x = A + B$ (b) $X = A - B$ (c) $x = A.B$ (d) $X = \overline{A.B}$
- 16.10 NOR Gate**
- 16.11 Uses Of Logic Gates**
- (58) The NOR operation is simply an OR operation followed by a;
 (a) NOT operation (b) AND operation (c) NAND operation (d) OR operation
- (59) The Boolean expression for NOR operation is;
 (a) $X = \overline{A+B}$ (b) $X = A - B$ (c) $X = A + B$ (d) $X = \overline{A.B}$
- (60) To make burglar alarm, we use:
 (a) NAND gate (b) OR gate (c) NOT gate (d) NOR gate

ANSWER KEY

Q.	Ans	Q.	Ans	Q.	Ans	Q.	Ans	Q.	Ans	Q.	Ans
1	d	11	c	21	d	31	a	41	d	51	a
2	b	12	d	22	b	32	a	42	a	52	b
3	c	13	a	23	a	33	b	43	a	53	b
4	c	14	d	24	c	34	a	44	a	54	d
5	a	15	a	25	a	35	a	45	b	55	c
6	b	16	c	26	d	36	b	46	a	56	a
7	a	17	b	27	a	37	c	47	d	57	d
8	b	18	a	28	c	38	c	48	b	58	a
9	d	19	d	29	c	39	a	49	c	59	a
10	d	20	b	30	d	40	c	50	b	60	a

SHORT QUESTIONS

16.1 Thermionic Emission

1.6.2 Investigating the properties of Electrons

16.3 Cathode-Ray Oscilloscope (C.R.O)

(1) Define electronics.

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

(2) What do you understand by thermionic emission?

Ans: Thermionic Emission

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

(3) What happens when a narrow beam of electrons is passed through a uniform electric field? What is its reason?

Ans: We can set up 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 two plates, it can be seen that the electrons are deflected towards the positive plate (Fig. 16.1). The reason for this is that electrons are attracted by the positive charges and repelled by the negative charges due to force $F = qE$. The degree of deflection of electrons from their original direction is proportional to the strength of the electric field applied.

(4) What is the function of electromagnetism in television?

Ans: Electromagnets are used to deflect electrons to the desired positions on the screen of a television tube.

(5) What happens when a narrow beam of electrons is passed through a uniform magnetic field.

Ans: Deflection of Electrons by Magnetic Field

We apply magnetic field at right angle to the beam of electrons by using a horse-shoe magnet as shown in fig. We will notice that the spot of the electrons beam on the screen is getting deflected from its original direction. Now change the direction of horse-shoe magnet. We will see that spot on the fluorescent screen is getting deflected in the opposite direction.

(6) When and who discovered electrons?

Ans: In the 1950's physicists started to examine the passage of electricity through a vacuum tube. Some kind of rays were emitted from the cathode or the negative electrode, the rays were called cathode rays. J.J Thomson in 1897 observed the deflection of cathode rays by both electric and magnetic field. From these deflection experiments he concluded that cathode rays must carry a negative charge. These negatively charged particles were given the name of electrons.

(7) What is meant by thermionic emission?

Ans: Definition:

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

(8) How thermionic emission is produced?

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

(9) What is Cathode – Rays Oscilloscope (C.R.O)?

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.

The information is displayed 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.

(10) Describe function of the electron gun

Ans: 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 from 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 connected 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.

(11) Write down uses of CRO

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.

(12) How glow is produced in the tube?

Ans: The glow in the tube is due to the circular motion of electrons in the magnetic field. The glow comes from the light emitted from the excitations of the gas atoms in the tube.

16.4 Analogue and Digital Electronics

16.5 Basic Operations of Electronic-Logic Gates

(13) Explain the difference between analogue and digital electronics.

Ans:

Analogue electronics	Digital electronics
The branch of electronics consisting of such circuits which process the analogue quantities (continuously vary) is called analogue electronics. Examples: • Amplifier • Electric iron • Refrigerator	The branch of electronics consisting of circuits which process the data being provided in the form of maximum and minimum voltage signals is known as digital electronics. Examples: • Computer • Digital camera • Mobile phone

(14) Name five analogue and five digital devices that are commonly used in everyday life.

Ans:

Analogue devices	Digital devices
(i) Electric iron (ii) Electric fan (iii) Radio receiver (iv) Refrigerator (v) Washing machine (vi) Microphone	(i) Computer (ii) Calculator (iii) Digital camera (iv) Mobile phone (v) Security system (vi) Fire alarm

(15) Name five analogue and five digital devices that are commonly used in everyday life?

Ans: **Analogue devices**

Analogue devices used in our everyday life are:

- Radio receiver
- Washing machine
- Public address system
- Electric lamp
- Refrigerator
- Electric motor

Digital devices

Digital devices used to everyday life are

- Burglar alarm
- Mobile phones
- Digital camera
- Radar
- Computer

(16) Write the brief importance of digital electronics?

Ans: Most of today's technologies fall under the classification of digital electronics. Digital electronics device store and process bits electrically which help user fastly.

(17) What is bit and byte?

Ans: A bit represents data using 1' and 0's.
8 bits is equal to 1 byte.

(18) What is digitization?

Ans: Digitization is the process of information into 1's and 0's.

(19) Define logic operation and logic gates

Logic operation

The various operations of Boolean variables are called as logic operations because the various variables used in subject of logic also possess two values. The word "truth" has also been borrowed from this subject.

Logic gates

In digital electronics, the 0 and 1 values of the variables are simulated by two different levels of the potential. Usually 0 is represented as zero or ground potential and 1 by 5 volts or by any other suitable voltage. Then such circuits have been designed which implement the various logic operations. These circuits are known as logic gates.

16.6 AND Operation

16.7 OR Operation

(20) Which of the following gates would have 1 as output.



Answer: a and d

(21) Define OR operation.

"OR operation to be that in which the output has a value 1 when at least one of its inputs is at 1. The output is 0 only when all the inputs are 0".

(22) Write down Truth table of OR gate

Truth table of OR operation

B	A	$X = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

(23) Define AND operation

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

(24) Write down Truth table of OR gate

Truth table of AND operation

Truth table shows all the values of the input variables and the value of output for each set of the values of the inputs. By using the sign of AND operation, the various lines of the truth table are shown in table.

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

16.8 NOT Operation

16.9 NAND Gate

(25) Define NOT Gate

"An operation after which the Boolean variable changes its state and acquires the second possible state is known as NOT operation".

(26) Write down Truth table of NAND gate

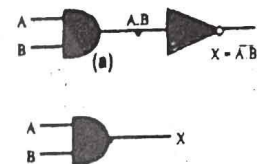
Truth table

Truth table of NOT operation is given in table.

A	$\bar{A}$
0	1
1	0

(27) Define NAND Gate

A NAND gate is formed by coupling a NOT gate with the output terminal of an AND gate. NAND gate is shown in Figure. The NOT gate inverts the output of the AND gate.



(28) Write down Truth table of NAND gate

Truth table of NAND gate

Table given is the truth table of NAND gate. In each line of this table, the value of the output has been obtained by inverting the value of the output of the AND gate corresponding to that line.

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

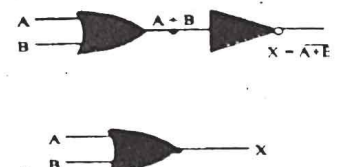
16.10 NOR Gate

16.11 Uses Of Logic Gates

(29) Define NOR Gate.

Ans:

A NOR gate is formed by coupling the output of OR gate with a NOT gate. NOR gate is shown in Figure. This NOT gate inverts the output $A+B$ of the OR gate.



(30) Write down Truth table of NOR gate

Truth table of NOR gate

Given table is the truth table of NOR gate. In this table, the value of output has been written by inverting the output of OR gate.

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

LONG QUESTIONS

Q.1 Define electronics.

Ans: Electronics

The branch of applied physics which deals with the behaviour of electrons using different device 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 fine beam of electrons. The whole setup is fitted in and evacuated glass tube.

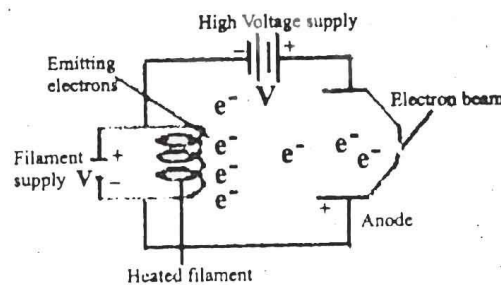
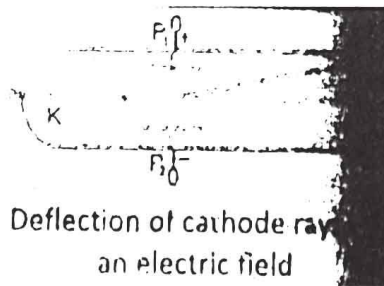


Fig. 16.1: Electron gun

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.



Reason

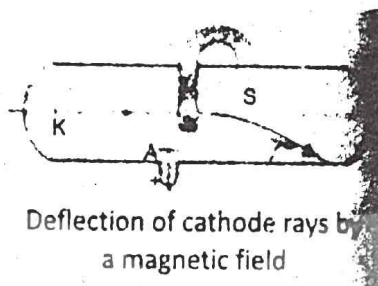
Deflection of electrons in electric field is due to the attraction of positive pole (Plate) and repulsion of negative plate. The electric force acting on the electron in electric field will be

$$F = qE$$

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.

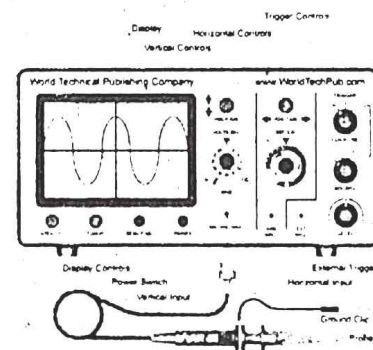
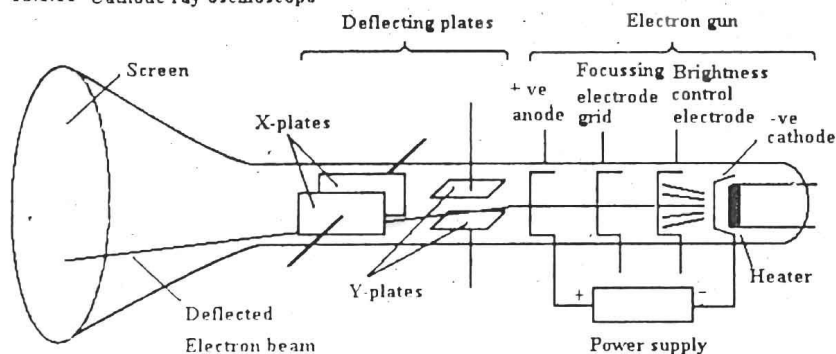


A spot of electron beam will be noticed on the screen due to the deflection of beam from its original path (direction). Now change the direction of the horse shoe magnet. We will see the spot on the fluorescent screen is getting deflected in the opposite direction.

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 from 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 connected 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 is a material that gives light as a result of bombardment by 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.

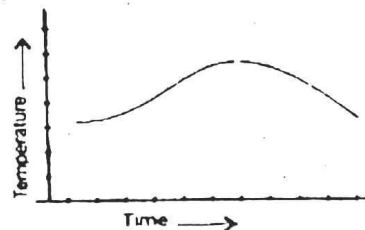


Fig. 19.1

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".

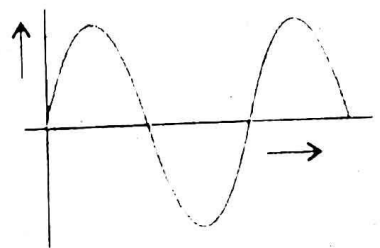
For this purpose digital electronics uses only two digits 0(zero) and 1 (one) and the whole data is provided in binary system due to which processing of data becomes easy.

Examples

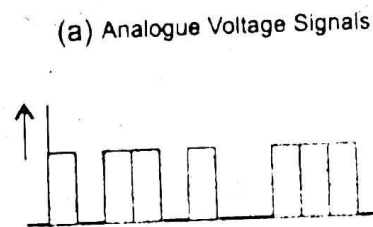
For quite a long period the use of digital electronics was limited to computers only but now-a-days its application is very wide spread Modern telephone system, radar system, naval and other systems of military importance, devices to control the operation of industrial machines, medical equipments and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



(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 (0) output is also Zero (0).

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 (0) 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 a 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 interprets the logical operators AND, OR and NOT.
- It develops 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 is either ON or OFF. Output voltage of the logic gate depends 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:

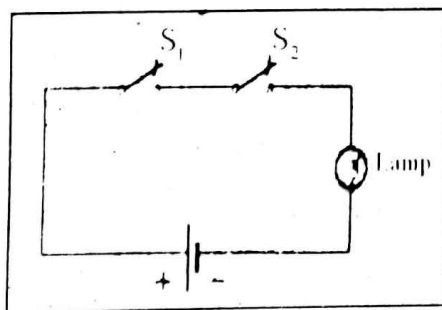
In order to understand the logic AND operation, we consider a circuit in which a lamp is connected to a battery using two switches S_1 and S_2 connected in series as shown in fig. These switches are considered as inputs and lamp is an output, this circuit is given as

Possible states

There are four possible states of two switches are given as

- When S_1 and S_2 are both open, the lamp is OFF.
- When S_1 is open and S_2 is closed, the lamp is OFF.
- When S_1 is closed and S_2 is open, the lamp is OFF.
- 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 form is called truth table".

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

These relationships are shown in table. Where 'X' represents the output. Hence AND operation may be represented by switches connected 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 closed i.e. the inputs of the AND operation are at logic '1', the output of AND operation will be at logic '1'.
- When two switches are open i.e. the inputs of AND operation are at logic '0', the output of AND operation will be at logic '0'.

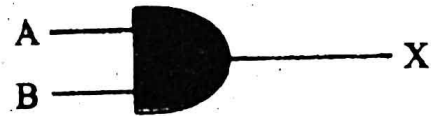
AND gate:

"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 of AND gate will be '0'.



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'."

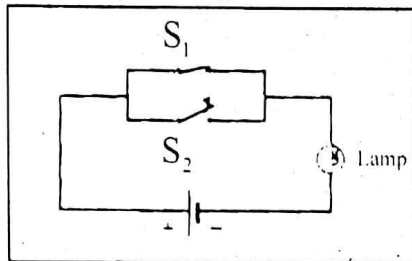
Explanation:

In order to understand 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 '0'. when both inputs are at '0'.



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 states.

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.

The states of NOT operation are shown in table.

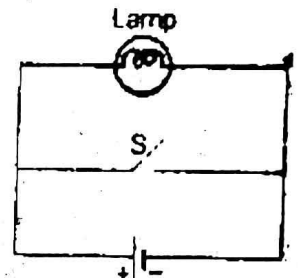


Fig 16.12

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. $\bar{A}$.

Expression:

Boolean expression for NOT operation is given as:

$$X = \bar{A}$$

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	$\bar{A}$
0	1
1	0

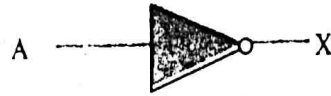
"Thus NOT operation inverts the state of Boolean variable".

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 '0' its output would be '1'. If its input is '1' the its output would be '0'. Not gate performs the basic logical function called inversion or complementation. Not gate is also called inverter.



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

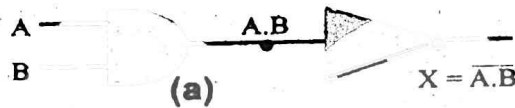
Ans: NAND gate:

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 operation, 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 from table that inverts the output of the NAND gate.

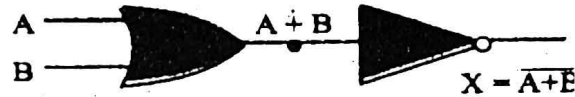
Q.17 What is NOR gate? Explain its symbol, expression and truth table?

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 of 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

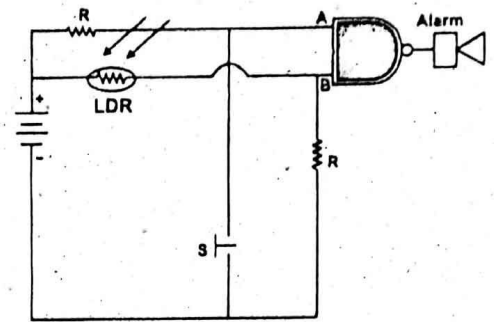
“A set of inputs and outputs in binary form is called truth table”.

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 high 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)