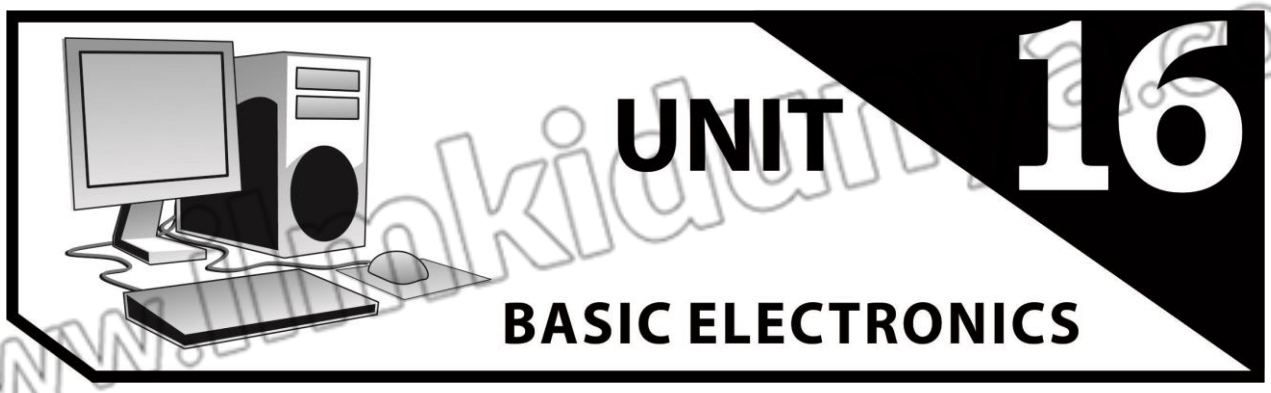


UNIT 16

BASIC ELECTRONICS

16.1 THERMIONIC EMISSION
16.2 INVESTIGATING THE PROPERTIES OF ELECTRONS
16.3 CATHODE-RAY OSCILLOSCOPE (C.R.O)

LONG QUESTION

16.1 Q.1 What is meant by thermionic emission? How thermionic emission is produced? *(K.B)*

(GRW 2017) (Review Ex. 16.5)

Ans: **THERMIONIC EMISSION**

Definition:

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

Production of Thermionic Emission:

Metals contain a large number of free electron. At room temperature, electrons cannot escape the metal surface due to attraction forces of atomic nucleus. If the metal is heated to a high temperature, some of the free electrons may gain sufficient energy to escape the metal surface.

Tungsten Filament:

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

16.2 Q.1 How electron beam is obtained? Explain the effect of electric and magnetic field on electron beam. *(K.B+U.B+A.B)* **(RWP 2017)**

OR Write a note on electron gun. **(DGK 2017), (Review Ex. 16.5)**

OR Discuses deflection of electrons by electric field. **(SGD 2016, 2017)**

OR 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?

(Review Ex. 16.1)

Ans: **PRODUCTION AND PROPERTIES OF ELECTRON**

Electron Beam:

Electrons are produced by the thermionic emission from a tungsten filament heated by 6V supply.

A high positive potential is applied several thousand 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 an evacuated glass tube.

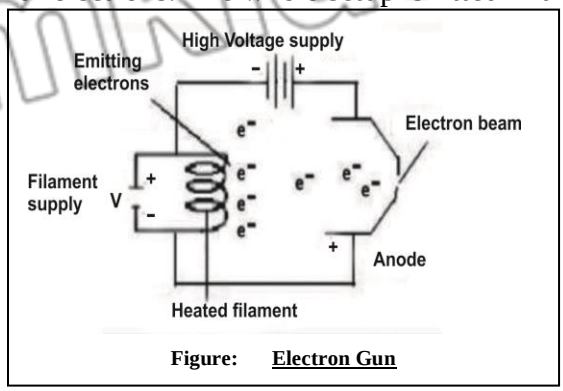


Figure: Electron Gun

Deflection of Electrons by Electric Field:

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

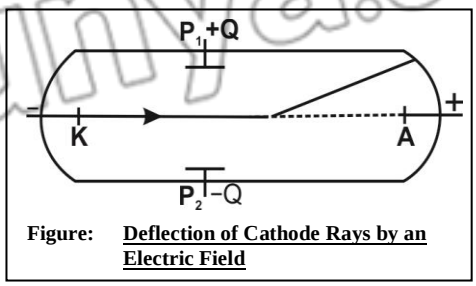


Figure: Deflection of Cathode Rays by an Electric Field

Reason:

The reason for this is that electrons are attracted by positive charges and are repelled by negative charges due to the force

$$F = qE$$

Where 'q' is the charge of electron and 'E' is the electric field 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 horseshoe magnet.

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

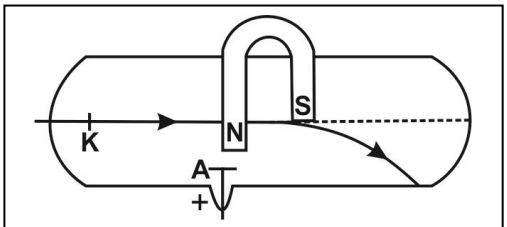


Figure: Deflection of Cathode Rays by a Magnetic Field

16.3 Q.1 What is cathode – rays oscilloscope (C.R.O)? Explain the working of different parts of oscilloscope? *(K.B+U.B+A.B)* **(Review Ex. 16.2)**

(LHR 2014, 2016, 2017, GRW 2015, 2017, SGD 2016, 2017, SHW 2017, FSD 2017, MTN 2017)

Ans: **CATHODE – RAYS OSCILLOSCOPE**

The cathode – ray oscilloscope is an instrument which is used to display the magnitudes of changing electric currents or potentials.

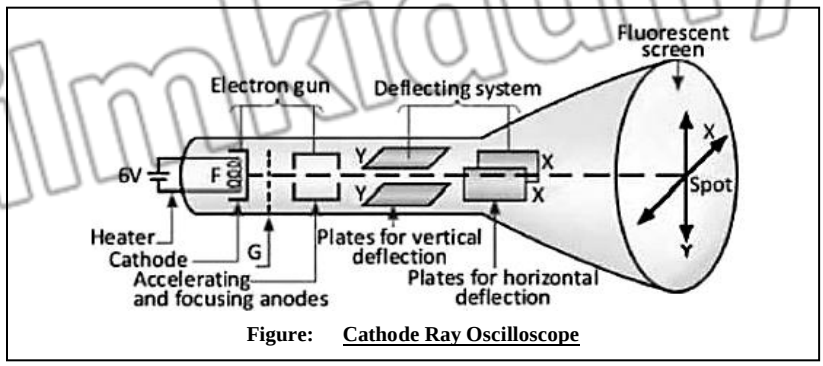


Figure: Cathode Ray Oscilloscope

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 superimposed on it.

Examples:

- Picture tube in our TV set
- Display terminal of most computers are cathode ray tubes

Construction:

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

- The electron gun with control grid
- The deflecting plates
- A fluorescent screen

Working of Electron Gun: **(LHR 2015)**

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

Electron gun also has an electrode called grid G for controlling the flow of electrons in the beam. The grid is connected to a 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 of the screen. 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.

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.

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:

- Displaying wave forms
- Measuring voltages
- Range finding (as in radar)
- Echo – sounding (to find the depth of sea – beds)
- To display heart beats

16.1, 16.2, 16.3 SHORT QUESTIONS

Q.1 Define electronics. ***(K.B)*** **(SHW 2017, LHR 2015, 2017, GRW 2017)**

Ans: *Electronics is that branch of applied physics which deals with the controlled motion of electrons using different devices.*

Q.2 What do you understand by thermionic emission? ***(K.B)***

(LHR 2014, 2017, GRW 2016, 2017), BWP 2017, MTN 2017)

Ans: ***Given on Page # 312***

Q.3 What happens when a narrow beam of electrons is passed through a uniform electric field? ***(K.B+U.B)***

Ans: ***Given on Page # 313***

Q.4 What is the function of electromagnet in television? ***(K.B)*** **(Do you know Pg. # 142)**

Ans: **FUNCTION OF ELECTROMAGNET**

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

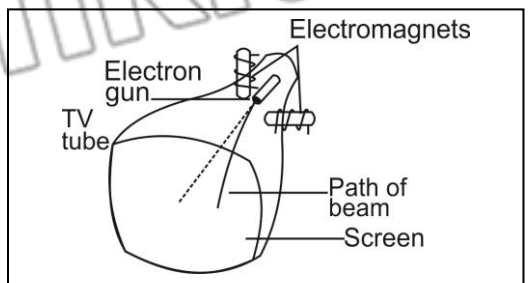


Figure: CRO in Television

Q.5 What happens when a narrow beam of electrons is passed through a uniform magnetic field? ***(K.B+U.B)*** **(LHR 2015, GRW 2014)**

Ans: ***Given on Page # 313***

Q.6 When and who discovered electrons? ***(K.B)***

Ans: **DISCOVERY OF ELECTRONS**

1n the 1850's physicists stared to examine the passage of electricity through vacuum by putting two electrodes in a sealed vacuum tube. They discovered that some kind of rays were emitted from the cathode or the negative electrode, these 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.

Q.7 How thermionic emission is produced? ***(K.B)***

Ans: **PRODUCTION OF THERMIONIC EMISSION**

Metals contain a large number of free elections. At room temperature electrons cannot escape the metal surface due to attraction forces of atomic nucleus. If the metal is heated to a high temperature some of the free electrons may gain sufficient energy to escape the metal surface.

Q.8 What is cathode – rays oscilloscope (C.R.O)? ***(K.B+A.B)*** **(DGK 2017)**

Ans: ***Given on Page # 313***

Q.9 Describe functions of the electron gun. ***(K.B+A.B)*** **(LHR 2014)**

Ans: ***Given on Page # 314***

Q.10 Write down uses of CRO. ***(A.B)*** **(SGD 2017)(Review Ex. 16.3)**

Ans: ***Given on Page # 314***

Q.11 What are the components of CRO? ***(K.B)*** **(SGD 2017, DGK 2017, SHW 2017)**

Ans: ***Given on Page # 314***

Q.12 How glow is produced in the tube? ***(K.B)*** **(Do you know Pg. # 143)**

Ans: **PRODUCTION OF GLOW IN THE TUBE**

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.

Figure: Glow in the Tube

Q.13 What are the functions of deflecting plates in CRO? ***(K.B+A.B)*** **(LHR 2015)**

Ans: **FUNCTIONS OF DEFLECTING PLATES**

The functions of deflecting plates in CRO are given below:

- 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.

Q.14 What is fluorescent screen? ***(K.B)*** **(FSD 2017, BWP 2017)**

Ans: ***Given on Page # 314***

Q.15 Why beam of electron is called cathode ray? ***(K.B)*** **(Do you know Pg. # 143)**

Ans: **CATHODE RAY**

The beam of electrons was called a cathode ray, because the electron had not yet been discovered. The old terminology survives in electronic engineering where a cathode-ray tube is any tube constructed along Thomson's lines whether in a computer, monitor, a television, or an oscilloscope.

Q.16 How we came to know about the cathode rays? ***(K.B)*** **(For your information Pg. # 140)**

Ans: **EVIDENCE OF CATHODE RAYS**

In a cathode-rays tube, a greenish glow is formed on the inner surface of the glass opposite the cathode, which itself is glowing orange. The shadow cast by the cross at the centre of the tube gives evidence that rays of some kind are passing through the tube.

Q.17 How we can say that cathode rays move in a straight line? ***(K.B)*** **(Physics Insight Pg. # 140)**

Ans: **STRAIGHT LINE MOTION OF CATHODE RAYS**

When an opaque object like a metal cross is placed in the path of cathode rays in a cathode ray tube, a shadow of the metal cross is formed at the end opposite to the cathode. This is an evidence that rays of some kind are passing straight through the tube.

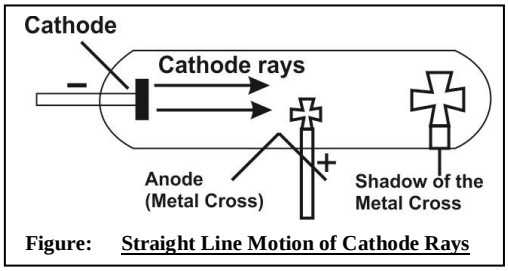


Figure: Straight Line Motion of Cathode Rays

Q.18 In what ways an oscilloscope acts as a voltmeter? ***(K.B+U.B)***

Ans: **OSCILLOSCOPE AS 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.

Q.19 When a magnet is brought near to the screen of a television tube picture on the screen is distorted. Do you know why? ***(K.B+U.B)*** **(Point to ponder Pg. # 142)**

Ans. **DISTORTION OF TV SCREEN**

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.

Q.20 How cathode ray will deflect when it is under the inference of magnetic field. ***(K.B+U.B)***

Ans. **DEFLECTION OF CATHODE RAYS**

A Cathode ray will deflect as shown when it is under the influence of an external magnetic field.

Figure: **Deflection of Cathode Ray in Magnetic Field**

Q.21 Is it possible for us to pass electric current through vacuum? ***(Conceptual Base)***

Ans. Current can flow through vacuum when charge carriers, electrons or ions, are transported across it. A good example are electronic vacuum tubes where electrons are emitted from a heated cathode filament and transported through vacuum by an applied electric field to a positively charged anode. The current is often controlled by applying a voltage to a grid in the path of this electron flow.

Q.22 How the pattern of electric current is produce on the fluorescent screen of CRO? ***(Conceptual Base)***

Ans. The pattern of electric current is produce on the fluorescent screen of CRO when the electron produce from electron gun strike on thin layer of phosphor of fluorescent screen it produce light and draw a pattern of electric current.

Q.23 Why the negative charge on the grid is not keep minimum for a long time? ***(Conceptual Base)***

Ans. The grid in CRO is used to control the brightness of CRO screen. If the negative charge on grid is minimum the number of electron striking on the screen is maximum and the brightness of screen is maximum. So when the brightness of screen is maximum for a long time it will destroy the screen.

16.1,16.2,16.3 MULTIPLE CHOICE QUESTIONS

1. The branch of applied physics which deals with the behaviour of electrons using different devices for various useful purposes is: ***(K.B)***

(A) Light (B) Mechanics
(C) Thermodynamics (D) Electronics

2. Who observed the deflection of cathode rays by both electric and magnetic fields? ***(K.B)***

(A) Newton (B) J.J Thomson
(C) Plank (D) Charles

3. Cathode rays contain negatively charged particles called: ***(K.B)***

(A) Neutrons (B) Protons
(C) Electrons (D) Positrons

4. The process of emission of electrons from the hot metal surface is called: ***(K.B)*** **(GRW 2014)**

(A) Dynamic emission (B) Electronic emission
(C) Thermionic emission (D) Static emission

5. Metals contain large number of: ***(K.B)***

(A) Free electrons (B) Free protons
(C) Free neutrons (D) Bound electrons

6. For thermionic emission typical values of voltage and current used are: ***(K.B)***

(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: ***(K.B)***

(A) Electron beam (B) Nucleus
(C) Neutron (D) Proton

8. The degree of deflection of electrons from their original direction is proportional to: ***(K.B+U.B)***

(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: ***(K.B)***

(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: ***(K.B)***

(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: ***(K.B)***

(A) Aluminium (B) Potassium
(C) Phosphor (D) Sulphur

12. Cathode-ray oscilloscope (C.R.O) is used in many field of science for: ***(A.B)***

(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.B)***

(A) Echo-sounding (B) Displaying waveforms
(C) Measuring voltage (D) Range finding

14. Deflecting plate is a component of _____. **(BWP 2017)**

(A) Computer (B) C.R.O
(C) Radio (D) Fluorescent tube

15. When we heat a metal at high temperature they emit ____. *(K.B)*

(A) Hole (B) Neutron
(C) Proton (D) Electron

16. C.R.O consists of ____ main parts. *(K.B)*

(A) Five (B) Four
(C) Three (D) Two

16.4 ANALOGUE AND DIGITAL ELECTRONICS
16.5 BASIC OPERATIONS OF ELECTRONIC-LOGIC GATES

LONG QUESTION

16.4 Q.1 Write a note on analogue and digital electronics. *(A.B+K.B)* **(LHR 2015, 2017) (Review Ex. 16.6)**

Ans: **ANALOGUE AND DIGITAL ELECTRONICS**

Analogue quantities:

Those quantities whose values vary continuously are known as analogue quantities.

Example:

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

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 branch of electronics consisting of circuits which processes analogue quantities is called analogue electronics.

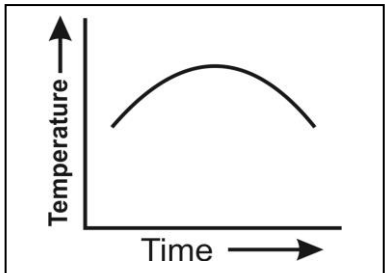


Figure: Temperature Time Graph

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 by the speaker.

Other examples of analog electronics are:

- Radio
- Television
- Telephone

Digital Quantities:

The quantities whose values vary in discrete steps are called digital quantities.

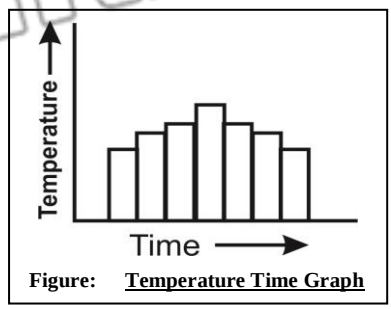


Figure: Temperature Time Graph

Digital quantities are expressed in the form of digits or numbers.

Digital Electronics:

"The branch of electrons which deals with the digital quantities is called 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
- Household appliances

Analogue Signal:

A continuously varying signal is called an analogue signal.

Example:

An alternating voltage varying between the maximum value of +5V and the minimum value of -5V is an analogue signal.

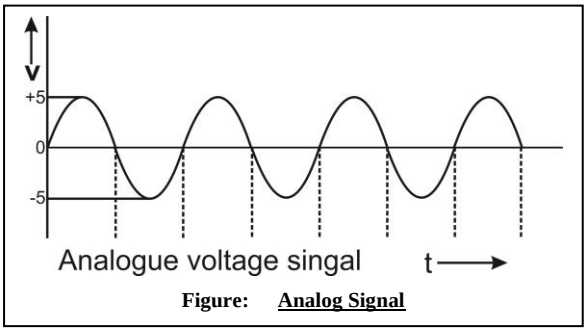


Figure: Analog Signal

Digital Signal:

A signal can have only two discrete values is called a digital signal.

Example:

A voltage with square waveform is a digital signal. This signal has only two values +5V and 0V. The high voltage is +5V and the low voltage is 0V.

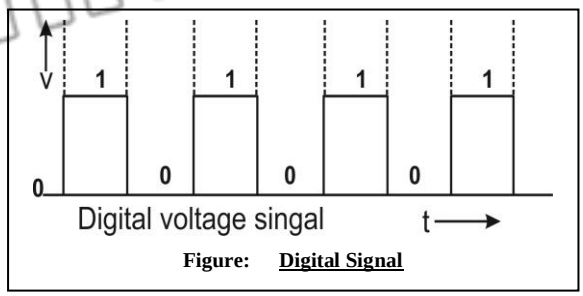


Figure: Digital Signal

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.

S	Lamp
Open	Off
Closed	On

16.4 Q.2 What is use of ADC and DAC? Briefly explain? ***(K.B+A.B+U.B)***

Ans:

ADC AND DAC

In our daily life the quantities that we perceive by our senses are usually analogue quantities which cannot be processed by digital circuits. To overcome this problem 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.

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.

16.5 Q.1 What is meant by binary (Boolean) variables? Explain with example. ***(K.B+U.B+A.B)***

Ans:

BOOLEAN VARIABLES

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

Explanation:

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

- A switch could be either open or closed.
- A circuit may be either ON or OFF.
- A statement would be either true or false.
- The answer of a question could be right or wrong.

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

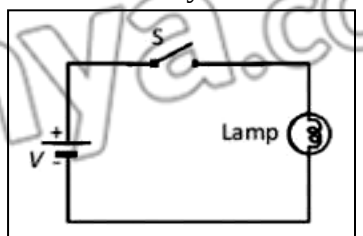


Figure: Circuit Diagram

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'. 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 output is also zero.

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. These states are called logic states and logic variables.

16.5 Q.2 What is meant by Boolean Algebra? Explain its importance. ***(K.B+A.B)***

Ans: **BOOLEAN ALGEBRA**

George Boole invented Boolean Algebra. It is also known as algebra of logics.

Definition:

"It is the branch of mathematics that deals with the relationship of logic variables**''**.

Application:

By using Boolean algebra the values of output variables are determined when the values of input variables of circuit or system are known. Boolean Algebra handles variables that represent two types of logic propositions! 'true and false'.

Importance:

Boolean algebra has become the foundation of digital electronic.

- It operates with two logic states '1' and '0' represented by two distinct voltage levels.
- 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.

16.4, 16.5 SHORT QUESTIONS

Q.1 Define digital and analogue electronics. ***(K.B)***

(MTN 2017, SGD 2017, RWP 2017, FSD 2017, LHR 2015, 2016, GRW 2014)

OR Explain the difference between analogue and digital electronics. **(Review Ex. 16.7)**

Ans: *Given on Page # 319*

Q.2 Name five analogue and five digital devices that are commonly used in everyday life. ***(K.B+A.B)*** **(Review Ex. 16.7)**

Ans: **NAMES OF ANALOGUE AND DIGITAL DEVICES**

The names of analogue and digital devices are as follows:

Analogue Devices:

- Electric iron
- Electric fan
- Radio receiver
- Refrigerator
- Washing machine

Digital Devices:

- Computer
- Calculator
- Digital camera
- Mobile phone
- Security system

Q.3 Write the importance of digital electronics? ***(K.B+A.B)*** **(For your information Pg. # 145)**

Ans: **IMPORTANCE OF DIGITAL ELECTRONICS**

Digital technology has entered every part of our lives. Digital TV gives excellent view and allows us to be interactive. Digital cameras are faster replacing traditional film equipment. We can download an image into a PC and crop, enhance, airbrush and edit the picture. Smart ID cards are being developed. A single card can be a passport, national insurance card and driving license all in one. The card could also hold biometric data like an eye retina scan and voice scan for unique identification and security. All of this data would be held digitally in the tiny chip.

Q.4 What is meant by logic operation? *(K.B)*

Ans: **LOGIC OPERATION**

Digital circuits perform the binary arithmetic operation with binary digits '1' and '0'. These operations are called logic function or logic operations.

Q.5 What do you meant by logic gate? *(K.B)*

Ans: **LOGIC GATES**

Logic gate is a switch (digital circuit), its outputs can have only one of the two possible states. Such circuits have been designed which implement the various logic operations. These circuits are known as logic gates.

Q.6 What are basic operations of digital electronics? *(K.B)* **(FSD 2017)**

Ans: **BASIC OPERATIONS OF DIGITAL ELECTRONICS**

Basic operations of digital electronics are:

- AND operation
- OR operation
- NOT operation

Q.7 Briefly introduce Boolean algebra. *(K.B)* **(Intro. to Boolean algebra Pg. # 146)**

Ans: **INTRODUCTION OF BOOLEAN ALGEBRA**

The algebra used to describe logic operations by symbols is called Boolean Algebra. Like ordinary algebra, English alphabets (A, B, C, etc.) and used to represent the Boolean variables. However, Boolean variable can have only two values; 0 and 1.

Q.8 Why TV and telephone signals has been transformed from analogue to digital? *(K.B)*

(Do you know Pg. # 146)

Ans: **TRANSFORMATION OF ANALOGUE SIGNALS TO DIGITAL SIGNALS**

TV and telephone signals once travelled as analogue signals. Electric signals in copper wire would interfere with each other and give poor quality of sound and vision. Today, everything is going digital. The big advantage of digital is quality. There is no interference or loss of strength in digital signals travelling in an optical fiber.

Q.9 Show analogue signal of microphone. *(K.B)* **(Do you know Pg. # 144)**

Ans: Microphone creates an analogue signal, shown by the voltage versus time graph.

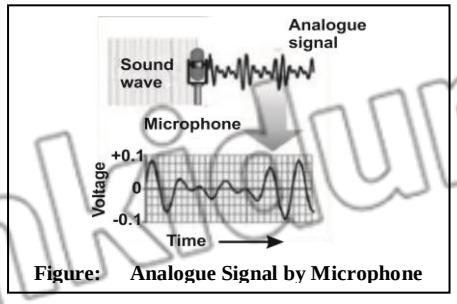


Figure: Analogue Signal by Microphone

16.4, 16.5 MULTIPLE CHOICE QUESTIONS

1. Analogue quantities are: *(K.B)*

(A) Whose values vary continuously (B) Whose values remain constant
(C) Temperature of air (D) All of given are true

2. Time , pressure, distance are all: *(K.B)*

(A) Analogue quantities (B) Variable quantiites
(C) Nominal quantities (D) Digital quantities

3. Which is an analogue circuit which amplifies the signals without changing its shape to such an extent that it can operate a loudspeaker? ***(K.B)***
(A) Galvanometer (B) Manometer
(C) amplifier (D) Optical fiber

4. The quantities whose value vary in non – continuous manner are called: ***(K.B)***
(A) Analogue quantities (B) Digital quantities
(C) Statistic quantities (D) Continuous quantiies

5. Those quantities whose value vary continuously or remain constant: ***(K.B)***
(A) Analogue (B) Digital
(C) Hybrid (D) All of them

6. Which of the following is an analogue device? ***(K.B)***
(A) Electric fan (B) Electric iron
(C) Radio receiver (D) All of them

7. Electronics which provides the data in the form of maximum and minimum voltage signals: ***(K.B)***
(A) Analogue (B) Digital
(C) Hybrid (D) All of them

8. Which of the following are digital devices? ***(K.B)***
(A) Computer (B) Mobile phone
(C) Digital camera (D) All of them

9. Circuits which convert the digital signal into analogue signals: ***(K.B)***
(A) ADC (B) DAC
(C) CAD (D) None of them

10. Circuits which convert the analogue signal into digital signal: ***(K.B)***
(A) ADC (B) DAC
(C) CAD (D) None of them

11. Digital electronics uses two digits. ***(K.B)***
(A) 0,2 (B) 0,3
(C) 0,1 (D) 0,4

12. A switch has only possible states. ***(K.B)***
(A) Two (B) Three
(C) Four (D) Five

13. The states of binary variables are usually represented by the digits: ***(K.B)***
(A) 1,2 (B) 0,2
(C) 0,3 (D) 0,1

14. George Boolean invented a special algebra known as algebra of logics or _____.*(K.B)*
(A) Boolean algebra (B) Geometry
(C) Ratios (D) Trigonometry

15. Boolean algebra operates with two logic states represented by two distinct voltage level. ***(K.B)***
(A) 0,2 (B) 0,3
(C) 1,0 (D) 1,1

16. The number of operations of Boolean algebra are: ***(K.B)***
(A) 1 (B) 2
(C) 3 (D) 4

17. In Boolean algebra zero represents: ***(K.B)***
(A) Zero potential (B) Ground potential
(C) Low potential (D) Both a & b

18. In Boolean algebra 1 represents: ***(K.B)***
(A) 5V (B) 1V
(C) Both a & b (D) None of above

16.6 AND OPERATION
16.7 OR OPERATION

LONG QUESTION

16.6 Q.1 What is AND operation? Explain in possible states. Write its symbol, Expression and gate? *(K.B+A.B+U.B)*

(LHR 2015, 2017, GRW 2014, 2016, DGK 2017, MTN 2017, SHW 2017)(Review Ex. 16.10)

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. 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 OFF.

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

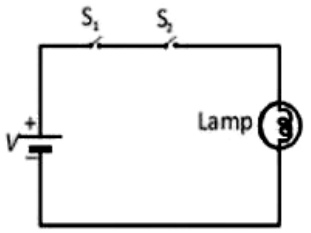


Figure: **Circuit Diagram of AND Operation**

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.

A	B	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 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:

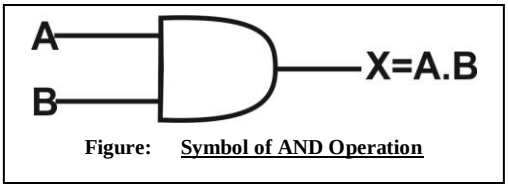


Figure: Symbol of AND Operation

AND gate has two or more than two inputs and only one output. The value of output of AND gate is always in accordance with the truth table of AND operation. It means output of AND gate will be '1' only when all are of its input at logic '1'and for all other situations output of AND gate will be '0'.

16.7 Q.1 What is OR operation? Explain its possible states. Write its symbol, expression and gate? *(K.B+A.B+U.B)*

(GRW 2014, 2016, 2017, FSD 2017, BWP 2017)(Review Question 16.10)

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

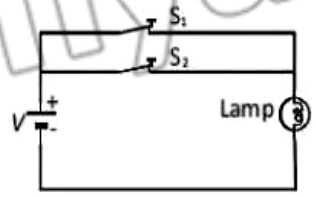


Figure: **Circuit Diagram of OR Operation**

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:

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

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.

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 below.

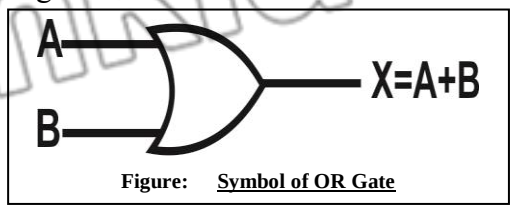
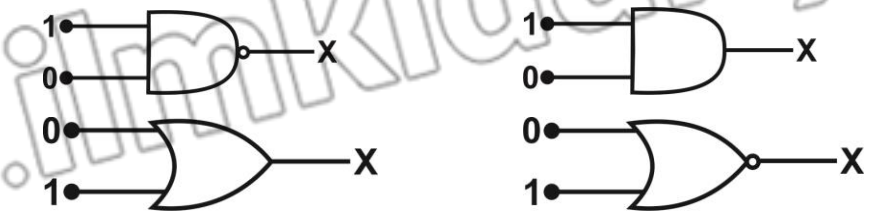


Figure: **Symbol of OR Gate**

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 anyone of its inputs is at '1' the value of output will be '0'. when both inputs are at '0'.

16.6, 16.7 SHORT QUESTIONS

Q.1 Which of the following gates would have 1 as output. ***(K.B+U.B)***



Ans: a and d gates would have 1 as output.

Q.2 Define OR operation. ***(K.B)*** **(LHR 2017, MTN 2017)**

Ans: ***Given on Page # 326***

Q.3 Write down Truth table of OR gate ***(K.B+U.B)***

Ans: **TRUTH TABLE OF OR OPERATION**

The truth table of OR gate is given below:

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

Q.4 Define AND operation. ***(K.B)*** **(RWP 2017)**

Ans: ***Given on Page # 325***

Q.5 Write down Truth table of AND gate. ***(K.B+U.B)*** **(LHR 2017, GRW 2016)**

Ans: **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.

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

Q.6 Define Truth table. ***(K.B)***

Ans: **TRUTH TABLE**

Definition:

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

16.6, 16.7 MULTIPLE CHOICE QUESTIONS

1. The logical operation, whose output will only be one if its all inputs are 1: ***(K.B)***

(A) AND (B) OR
(C) NOT (D) All of above

2. The logical operation, whose output will only be zero if its all inputs are zero: ***(K.B)***

(A) AND (B) OR
(C) NOT (D) All of above

3. AND operation is just like _____ combinations of resistors. ***(K.B)***

(A) Series (B) Parallel
(C) Both (D) None of above

4. AND operations is represented by: ***(K.B)***
(A) Dot (•) (B) Multiplication sign
(C) Any sign (D) Both a & b

5. OR operation is just like _____ combinations of resistors. ***(K.B)***
(A) Serial (B) Parallel
(C) Both (D) None of above

6. OR operations is represented by: ***(K.B)***
(A) Dot (•) (B) Multiplication sign
(C) '+' sign (D) Both a & b

7. The various operations of Boolean variables are also called: ***(K.B)***
(A) Boolean constants (B) Algebraic operations
(C) Logic operations (D) Both b & c

8. The circuit which implements the AND operation is called: ***(K.B)***
(A) AND gate (B) AND circuit
(C) OR gate (D) Both a & b

9. The circuit which implements the OR operation is called: ***(K.B)***
(A) AND gate (B) OR circuit
(C) OR gate (D) Both b & c

10. In case of OR operation the lamp is Off when: ***(K.B)***
(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

11. OR operation is represented by the symbol of (+) and Boolean expression for OR is: ***(K.B)***
(A) x = A + B (B) x = A - B
(C) x +A = A (D) $X = \overline{A+B}$

12. The output of OR operation is 0 when: ***(K.B)***
(A) A = 0, B = 0 (B) A = 1, B = 1
(C) A = 0, B = 1 (D) A = 1, B = 0

16.8 NOT OPERATION
16.9 NAND GATE

LONG QUESTIONS

16.8 Q.1 What is meant by NOT operation? Explain its possible states, write its symbol, Expression and gate. ***(K.B+U.B+A.B)*** **(LHR 2015)(Review Question 16.10)**

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.

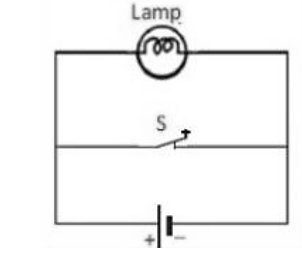


Figure: Circuit Diagram of NOT Gate

- When the switch "S' is open , the current will pass through the lamp and it will glow.
- When the switch is closed, no current will pass through the lamp due to large resistance of its filament and it will not glow.

S	LAMP
OFF	ON
ON	OFF

Symbol of NOT operation:

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

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". If the value of Boolean variable is 1, then after NOT operation it values would change to 0. Similarly, if it values before NOT operation, then after NOT operation it would change to '1'.

A	$X = \overline{A}$
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 '0' is output would be '1'. It its input is '1' the nits output would be '0'. Not gate performs the basic logical function called inversion of complementation. Not gate is also called inverter.

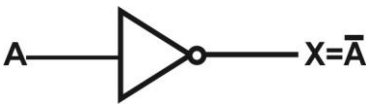


Figure: Symbol of NOT Gate

Purpose of Gate:

The purpose of this gate is to convert one logic to opposite logic level into the opposite logic level. When a high level is applied to an inverter, a low level appears on its output in vice versa.

16.9 Q.1 What is NAND gate? Explain its symbol. Express and Truth table? *(K.B+U.B+A.B)*

(LHR 2017, GRW 2014)

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".

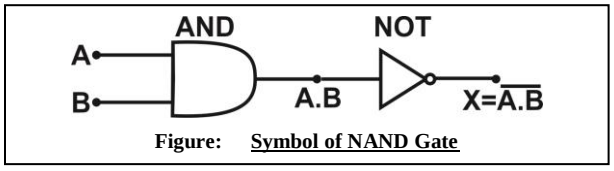


Figure: Symbol of NAND Gate

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.

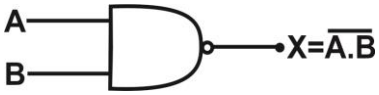


Figure: Short Symbol of NAND Gate

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.

16.8, 16.9 SHORT QUESTIONS

Q.1 Which gate perform logic complementations? ***(K.B)*** **(SHW 2017)**

OR Define NOT Gate. **(RWP 2017)**

Ans: **NOT GATE**

Definition:

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

NOT gate performs logic complementation.

Q.2 Write down Truth table of NOT gate. ***(U.B+K.B)***

Ans: ***Given on Page # 330***

Q.3 Define NAND Gate. ***(K.B)*** **(BWP 2017)**

Ans: ***Given on Page # 330***

Q.4 Write down Truth table of NAND gate. ***(U.B+K.B)*** **(BWP 2017)**

Ans: ***Given on Page # 331***

Q.5 Write down the purpose of NOT Gate? ***(K.B+A.B)***

Ans: **PURPOSE OF NOT GATE**

The purpose of NOT gate is as follows:

The purpose of this gate is to convert one logic to opposite logic level into the opposite logic level. And a high level is applied to an inverter, a low level appears on its output in vice versa.

16.8, 16.9 MULTIPLE CHOICE QUESTIONS

1. NOT operation is represented by: ***(K.B)***

(A) line (B) bar over the symbol
(C) both A & B (D) (.) dot

2. Value of a Boolean variable 1 after NOT operation is: ***(K.B+U.B)***

(A) 0 (B) +1
(C) -1 (D) -2

3. After NOT operation the value of Boolean variable 0 is: ***(K.B+U.B)***

(A) 0 (B) +1
(C) -1 (D) 1

4. NOT gate is also called: ***(K.B)***

(A) converter (B) inverter
(C) adder (D) subs tractor

5. NAND operation is simply an AND operation followed by a: ***(K.B)***

(A) NOR operation (B) OR operation
(C) NOT operation (D) AND operation

6. NOT operation is also known as: ***(K.B)***

(A) Gate (B) Inverter
(C) Converse (D) All of above

7. Number of input(s) of NOT operation are: ***(K.B)***

(A) 1 (B) 2
(C) 3 (D) 4

8. The circuit which is used to implement NOT operation: ***(K.B)***

(A) AND gate (B) NOT gate
(C) OR gate (D) Both a & b

9. NAND gate is the combination of: ***(K.B)***

(A) AND & OR (B) AND & NOT
(C) NOT & OR (D) None of them

10. A and B are two inputs of NAND gate. Its output would be zero when: ***(K.B)***

(A) A=0, B=0 (B) A=1, B=0
(C) A=0, B=1 (D) A=1, B=1

11. The equation of NOT operation is _____.*(K.B)* **(GRW 2016)**

(A) X = A. B (B) X = A + B
(C) X = A – B (D) $X = \overline{A}$

12. The output of NAND gate is 0 when _____ . ***(K.B)*** **(RWP 2017)**

(A) A=0, B=0 (B) A=1, B=1
(C) A=0, B=1 (D) A=1, B=0

16.10 NOR GATE
16.11 USES OF LOGIC GATES

LONG QUESTIONS

16.10 Q.1 What is NOR gate? Explain its symbol, expression and truth table? *(K.B+A.B+U.B)*

(LHR 2014, GRW 2014)

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.

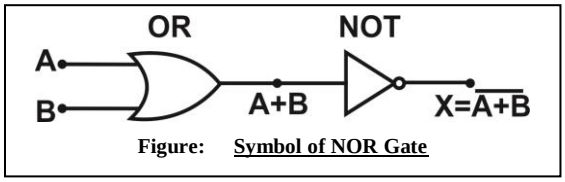


Figure: Symbol of NOR Gate

Short Symbol of NOR Gate:

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

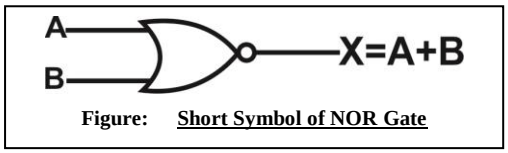


Figure: Short Symbol of NOR Gate

Expression: **(BWP 2017)**

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".

16.11 Q.1 What is the use of logic gates? Explain with one example. *(K.B+U.B+A.B)*
(GRW 2014)

Ans: **USES OF LOGIC GATES**

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.

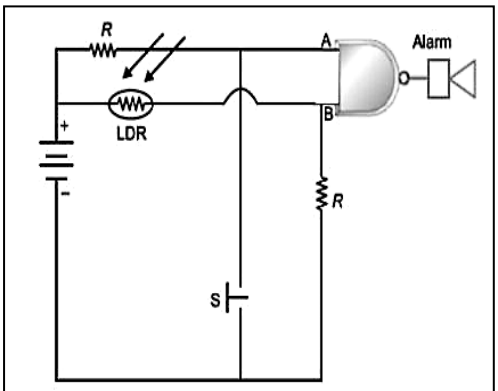


Figure: Burglar Alarm Schematic Circuit

16.10, 16.11 SHORT QUESTIONS

Q.1 Define NOR Gate. ***(K.B)***

Ans: ***Given on Page # 333***

Q.2 Write down Truth table of NOR gate. ***(K.B+U.B)*** **(LHR 2014, 2015)**

Ans: ***Given on Page # 333***

Q.3 What is bit and byte? ***(K.B)*** **(For your information Pg. # 151)**

Ans:

BIT AND BYTE

A bit represents data using 1' and 0's.

Eight bits is equal to 1 byte.

Q.4 What is digitization? ***(K.B)*** **(For your information Pg. # 151)**

Ans:

DIGITIZATION

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

Q.5 Assume you have an OR gate with two inputs, A and B. Determine the output C, for the following cases: ***(U.B)*** **(Quick Quiz Pg. # 151)**

(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'.

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

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

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

Here double line indicates double NOT operation.

Q.6 How we can obtain NOT gate from NAND or NOR gate explain with the help of truth table? ***(K.B+U.B)*** **(For your information Pg. # 150)**

Ans:

FORMATION OF NOT GATE

Formation of NOT gate from NAND and NOR gates with the resultant truth table.

A	Output	A	Output
0	1	0	1
1	0	1	0

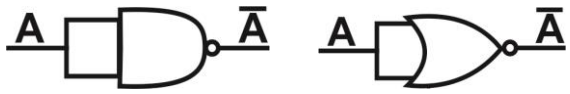


Figure: Formation of NOT gate from NAND and NOR gates with the resultant truth tables

16.10, 16.11 MULTIPLE CHOICE QUESTIONS

1. The NOR operation is simply an OR operation followed by a: ***(K.B)***

(A) NOT operation (B) AND operation

(C) NAND operation (D) OR operation

2. The Boolean expression for NOR operation is: ***(K.B)***

(A) $X = \overline{A+B}$ (B) $X = A - B$

(C) $X = A + B$ (D) $X = \overline{A.B}$

3. To make burglar alarm, we use: ***(A.B)***

(A) NAND gate (B) OR gate

(C) NOT gate (D) NOR gate

4. NOR gate is the combination of: ***(K.B)***

(A) AND & OR (B) AND & NOT

(C) NOT & OR (D) None of them

5. A and B are the two input of NOR gate. Its output would be 1 when: ***(U.B)***

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

(C) A=0, B=1 (D) A=1, B=1

MCQ'S ANSWER KEY (TOPIC WISE)

16.1 THERMIONIC EMISSION

16.2 INESTIGATING THE PROPERTIES OF ELECTRONS

16.3 CATHODE RAY OSCILLOSCOPE (C.R.O)

1	2	3	4	5	6	7	8	9	10	11	12
D	B	C	C	A	B	A	B	D	D	C	B

13	14	15	16
A	B	D	C

16.4 ANALOGUE AND DIGITAL ELECTRONICS

16.5 BASIC OPERATIONS OF ELECTRONIC-LOGIC GATES

1	2	3	4	5	6	7	8	9	10	11	12
D	A	C	B	A	D	B	D	B	A	C	A

13	14	15	16	17	18
D	A	C	B	D	A

16.6 AND OPERATION

16.7 OR OPERATION

1	2	3	4	5	6	7	8	9	10	11	12
A	B	A	A	B	C	C	A	A	A	A	A

16.8 NOT OPERATION

16.9 NAND GATE

1	2	3	4	5	6	7	8	9	10	11	12
B	A	B	B	C	B	B	B	B	D	D	B

16.10 NOR GATE

16.11 USES OF LOGIC GATES

1	2	3	4	5
A	A	C	C	A

TEXT BOOK EXERCISE

MULTIPLE CHOICE QUESTIONS

Choose the correct answer from the following choices:

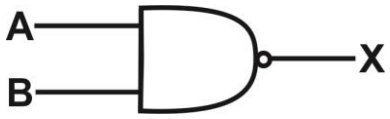
i. The process by which electrons are emitted by a hot metal surface is known as: ***(K.B)*** **(LHR 2015)**

(a) boiling (b) evaporation
(c) conduction (d) thermionic emission

ii. The particles emitted from a hot cathode surface are ***(K.B)*** **(GRW 2014, 2015, LHR 2017)**

(a) positive ions (b) negative ions
(c) protons (d) electrons

iii. The logical operation performed by this gate is: ***(K.B)***



(a) AND (b) NOR
(c) NAND (d) OR

iv. AND gate can be formed by using two: ***(K.B)*** **(GRW 2015, SGD 2017)**

(a) NOT gates (b) OR gates
(c) NOR gates (d) NAND gates

v. The output of a two-input NOR gate is 1 when: ***(K.B)***

(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

vi. If X = A. B, then X is 1 when: ***(K.B+U.B)*** **(GRW 2014, 2016, LHR 2016)**

(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

vii. The output of a NAND gate is 0 when: ***(K.B+U.B)***

(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

i	ii	iii	iv	v	vi	vii
D	D	C	D	C	A	B

REVIEW QUESTIONS

16.1 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? ***(K.B+U.B)***

Ans. (See Topic 16.1, 16.2 & 16.3, Long Question-2)

16.2 Explain the working of different parts of oscilloscope. ***(K.B+U.B+A.B)***

Ans: (See Topic 16.1, 16.2 & 16.3, Long Question-3)

16.3 Name some uses of oscilloscope. ***(A.B)***

Ans:

USES OF CRO

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

- Displaying wave forms
- Measuring voltages
- Range finding (as in radar)
- Echo – sounding (to find the depth of sea – beds)
- To display heart beats

16.4 Considering an oscilloscope explain.

(i) How the filament is heated? ***(K.B)***

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

(ii) Why the filament is heated? ***(K.B)***

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

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

Ans: To accelerate the electrons emitted form 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. ***(K.B+U.B)***

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? ***(K.B)***

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 cold not be produced and accelerate in specific direction.

16.5 What is electron gun? Describe the process of the thermionic emission. ***(K.B+A.B+U.B)***

Ans. (See Topic 16.1,16.2 & 16.3 Long Question-1 & 2)

16.6 What do you understand by digital and analog quantities? ***(K.B)***

Ans. (See Topic 16.4, Long Question-1)

16.7 Differentiate between analog electronics and digital electrons. Write down names of five analogue and five digital devices that are commonly used in every day. ***(K.B+A.B)***

Ans:

DIFFERENTIATION

The differences between analogue and digital electronics are given below:

Analogue Electronics	Digital Electronics
Definition	
• The branch of electronics consisting of such circuits which process the analogue quantities (continuously vary) is called analogue electronics.	• The branch of electronics which deal with the digital quantities is called digital electronics.

Examples	
• Amplifier • Electric iron • Refrigerator	• Computer • Digital camera • Mobile phone

NAMES OF ANALOGUE AND DIGITAL DEVICES

The names of analogue and digital devices are as follows:

Analogue Devices:
- Electric iron
- Electric fan
- Radio receiver
- Refrigerator
- Washing machine

Digital Devices:
- Computer
- Calculator
- Digital camera
- Mobile phone
- Security system

16.8 State and explain for each case whether the information given by the following devices is in analogue or a digital form. ***(K.B+U.B)***

(a) A moving coil voltmeter measuring the e.m.f of a cell

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

(b) A microphone generating an electric current.

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

(c) A central heating thermostat controlling the water pump.

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

(d) 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. ***(A.B)*** **(BWP 2017)**

Ans:

ADVANTAGES OF DIGITAL ELECTRONICS

The benefits of using digital electronics over analogue electronics is given below:

- The big advantage of digital electronics is quality.
- There is no interference or loss of strength in digit signal traveling in an optical fibre.
- Digital technology in TV gives excellent view and alloy 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. ***(K.B+U.B+A.B)***

Ans. (See Topic 16.6 & 16.7, Long Question-1 & 2)
(See Topic 16.8 & 16.9, Long Question-1)

CONCEPTUAL QUESTIONS

16.1 Name two factors which can enhance thermionic emission.

Ans: **FACTORS ENHANCING THERMIONIC EMISSION**

The factors which enhance thermionic emission are as follows:

- 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: **NEGATIVE CHARGE ON ELECTRONS**

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.

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 form this?

Ans: **PROPERTY OF ELECTRON**

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

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: **FACTORS ENHANCING ELECTRON DEFLECTION**

The factors which enhance electron deflection are as follows:

- Strength of magnetic field
- Speed of electron.

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

Ans: **COMPARISON**

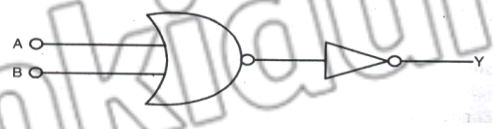
From the truth table of AND operation it is clear that behave as multiplicative inverse. Each time result is zero when is multiplied with any Boolean variable. Hence logic operation X = A.B behave as operation of multiplication.

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

Ans: **REFCIPROCAL OF AND GATE**

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, its is clear that it is the reciprocal of AND gate i.e. every time the value of output of AND gate is

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

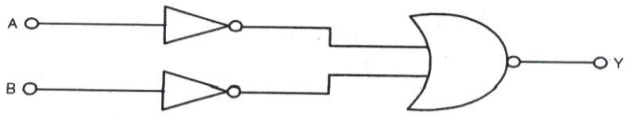


Ans: **OR GATE**

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 'l' when one of its inputs is at 'l'. 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
0	1	1	0	1
1	0	1	0	1
1	1	1	0	1

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



Ans: **AND GATE**

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 'l' only when both of its inputs are at logic 'l', for all other situations output of AND gate will be '0'.

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

16.9 What is LDR?

Ans. The light-dependent resistor or photoresistor is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photoresistor decreases with increase in incident intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light sensitive detector circuits and light activated and dark-activated switching circuits acting as a resistance semiconductor.

SELF TEST

Time: 40 min. **Marks: 25**

Q.1 Four possible answers (A), (B), (C) & (D) to each question are given, mark the correct answer. (6×1=6)

1. NAND operation is simply an AND operation followed by a:

(A) NOR operation (B) OR operation

(C) NOT operation (D) AND operation

2. 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

3. The various operations of Boolean variables are also called:

(A) Boolean constants (B) Algebraic operations

(C) Logic operations (D) Both b & c

4. Digital electronics uses two digits.

(A) '0' and '2' (B) '0' and '3'

(C) '0' and '1' (D) '0' and '4'

5. The main components of C.R.O are:

(A) Five (B) Four

(C) Three (D) Two

6. Typical value of the voltage and current used for thermionic emission are:

(A) 3v and 0.4A (B) 6V and 0.3A

(C) 5V and 0.3A (D) 6V and 0.1A

Q.2 Give short answers to following questions. (5×2=10)

i. Define thermionic emission.

ii. Differentiate between digital and analogue quantities.

iii. What are the uses of C.R.O?

iv. Define AND operation. Also draw its circuit diagram.

v. What are the uses of logic gates?

Q.3 Answer the following questions in detail. (4+5=9)

a) Write a note on C.R.O.

b) What is OR operation? Draw its circuit diagram and truth table.

Note:

Parents or guardians can conduct this test in their supervision in order to check the skill of students.