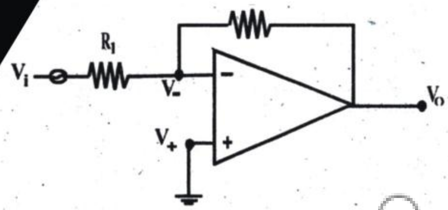


Chapter 18

ELECTRONICS

KEY POINTS

P-N Junction and Its Characteristics:

A p-n junction is formed when a crystal of germanium or silicon is grown in such a way that if one half is doped with a trivalent impurity and the other half with Pentavalent impurity

Depletion Region:

A region around the p-n junction which contains only fixed positive and negative ions is called depletion region. This region is formed due to diffusion of free electrons from n region top region, annihilation the hole.

Potential Barrier:

Potential difference develops across the depletion region due to the positive and negative ions is called potential barrier.

Its value for silicon diode is 0.7 volt and for germanium is 0.3 volt.

Forward Biased P-N Junction:

- When an external potential difference is applied across a p-n junction such that p-side is positive and n-side is negative.
- The resistance offered by diode in forward biasing is very small, of the order of few ohms.
- The width of the depletion region also become very small.

Reverse Biased P-N Junction:

When the external source of voltage is applied across a p-n junction such that its positive terminal is connected to n-region and its negative terminal to p-region

- In reverse biased situation no current flows due to the majority charge carriers. However a very small current, of the order of few micro amperes, flows a cross the junction due to flow of minority charge carriers, know as reverse current or leakage current
- At a certain high voltage the reverse current increases sharply. This voltage is called break down voltage.

Rectification:

Conversion of alternating current into direct current is called rectification.

There are two very common types of rectification.

- Half-wave rectification
- Full wave Rectification

Bridge Rectifier:

- Four diodes are used.
- Two diodes remains ON (Forward Biased) in each half of the input cycle while other two remains OFF (Reverse Biased) in the same half o the cycle.

Specially Designed P-N Junctions:

- Light Emitting Diode
- Light emitting diodes (LED) are made from special semi-conductors such as gallium arsenide and gallium arsenide phosphide.
- When an electron combines with a hole during forward bias conduction, a photon of visible light is emitted.
- They convert Electric energy into light.

Photo Diode:

- Photo diode is used for detection of light.
- A photo diode can turn its current **ON** and **OFF** in nano seconds.
- These diodes work under reverse biased condition.

Uses:

(i) Detection of both visible and invisible spectrums
(ii) Automatic switching.
(iii) Logic circuits.
(iv) Optical communication equipment. etc

Photovoltaic Cell:

- Such cells are p-n junction in which potential barrier between p and n regions is used to drive a current through external circuit when light is incident on junction.
- The current is directly proportional to the intensity of light.

Transistor:

Transistor is a semiconductor device consisting of three electrodes, namely emitter, base and collector and two junctions emitter-base junction and collector-base junction. For normal operation, the base-emitter junction is forward biased whereas the collector-base junction is reversed biased.

Types of Transistors:

n-p-n transistor

A transistor in which p-type material is sandwiched between two n-type materials is known as n-p-n transistor.

p-n-p transistor

A transistor in which n-type material is sandwiched between two p-type materials is known as p-n-p transistor.

Current Flow in N-P-N Transistor:

- Emitter injects a large number of electrons in base region.
- $I_E = I_C + I_B$, $I_B < I_c$

Transistor gain of current $\beta = \frac{I_C}{I_B}$

Transistor as an Amplifier:

- A junction transistor in the common emitter mode can act as a voltage amplifier, if a suitable resistor, called a load is connected in the collector circuit.
- Voltage gain amplifier , $\frac{V_o}{V_{in}}$, is given as

$$\frac{V_o}{V_{in}} = \beta\left(\frac{R_c}{r_{ie}}\right)$$

Where, r_{ie} = internal resistance of transistor between base and emitter terminals.

- Out put voltage obtained at Load resistance is out of the phase of input voltage.

Transistor as a switch:

- Transistors are used as switch in many important electronic circuits such as in computer circuits.
- The collector C and emitter E behaves as the terminals of switch.
- The base B and emitter E act as control terminals.
- When the switch is on, a large I_c flows in the CE circuit, resistance and potential drop between C and E becomes very small.
- When the switch is off, $I_B = 0$, so $I_c = \beta I_B = 0$. Thus resistance between C and E becomes infinity.

Operational amplifier:

- An integrated circuit having a small silicon chip enclosed in a capsule with eight pins attached to it, serving as working terminals, is called operational amplifier.
- It has two input terminals. One is known as inverting input (-) and the other non-inverting input (+). The inverting input terminal shifts the phase of input signal by 180^o.

Characteristics of operational amplifier High input resistance:

It is resistance between the (+) and (–) inputs of the amplifier. Its value is very high – of the order of several mega ohms.

Output Resistance:

It is the resistance between the output terminal and ground.
Its value is only few ohms

Open Loop Gain:

Open loop gain denoted by A_{OL}

$$A_{OL} = \frac{V_o}{V_+ - V_-} \qquad \text{OR} \qquad A_{OL} = \frac{V_o}{V_i}$$

The open loop gain for amplifier is very high ~10^5.

OP-AMP As Inverting Amplifier:

- The non-inverting terminal (+) is grounded; its potential is zero
- $I_1 = V_{in}/R_1$ & $I_2 = -V_o/R_2$
- Input signal is applied at inverting terminal (–).
- Gain is defined as the ratio of output voltage to input voltage.

$$G = -\frac{R_2}{R_1}$$

OP-AMP as Non-Inverting Amplifiers:

- In this case the input signal V_i is applied at the non-inverting terminal (+).

$$\text{Gain} = \frac{V_o}{V_{in}} = 1 + \frac{R_2}{R_1}$$

OP-AMP as a Comparator:

- OP-AMP usually requires two power supplies of equal voltage, but of opposite polarity.

Comparator as a Night Switch:

- When intensity of light falls below a certain level, the streetlight is automatically switched on. This can be accomplished by using OP-AMP as a comparator.
- $V_R = \frac{R_2}{R_1 + R_2} \times V_{CC.}$ $\qquad V' = \frac{R_3}{R_L + R_3} \times V_{CC}$
- LDR is light dependent resistance.

Digital Systems:

A digital system deals with quantities or variables, which have only two discrete values or states.

- In describing functions of digital systems, a closed switch will be shown as 1 and an open switch will be shown as **0**.

Logic Gates:

The electronic circuits that implement the various logic operations are known as logic gates.

Fundamental Logic Gates:

OR gate

It has two or more inputs and single output X.

The X will be zero when both inputs are zero. $X = A + B$

AND gate

It has two or more inputs and a single output.

Its output X will be 1 when both inputs A and B are 1.

Output X will be zero when both inputs are zero. $X = A \cdot B$

NOT gate

It performs the operation of inversion or complementation so, it is also known as inverter.

It changes 1 to 0 and 0 to 1. $X = \overline{A}$

Other Logic Gates:

NOR gate

In NOR gate the output of OR gate is inverted. $X = \overline{A + B}$

NAND gate

In NAND gate the out put of an AND gate is inverted.

The bubble in the symbol of NAND gate shows that the output of AND gate is inverted.

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

Exclusive OR Gate (XOR):

A logic circuit whose output signal is 1 when inputs are different is known as exclusive OR gate.

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

Exclusive-NOR gate (XNOR):

Its Boolean expression is

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

TOPICAL MULTIPLE CHOICE QUESTIONS

Topic 18.1:

Brief Review of p-n Junction and its Characteristics

(1) The branch of physics which deals with the electrons and their flow through devices is called
(a) electronics **(b)** electrostatics
(c) electricity **(d)** electro magnetism

(2) The most commonly used semi-conductor is
(a) germanium **(b)** silicon
(c) gallium **(d)**aluminium

(3) Silicon is the basic material from which sophisticated integrated circuits are made known as
(a) resistors **(b)** transistors
(c) chips **(d)** transformers

(4) In electronic devices the chips are described in the form of
(a) white boxes **(b)** black boxes.
(c) silver boxes **(d)** golden boxes

(5) The majority carriers in n-type substances are
(a) protons **(b)** holes
(c) positrons **(d)** electrons

(6) The number of valence electrons in silicon
(a) 2 **(b)** 3
(c) 4 **(d)** 6

(7) Which term refers to the region, where the two regions of the semiconductor meet
(a) anti-node **(b)** junction.
(c) loop **(d)** depletion region

(8) The region in p-n junction where charge carriers are not present is called
(a) diffused region **(b)** depletion region
(c) p-region **(d)** n-region

(9) By which process the depletion region is formed around the junction
(a) diffusion. **(b)** fusion
(c) emission **(d)** fission

(10) The potential difference develops across the depletion region is called
(a) potential barrier. **(b)** absolute potential
(c) potential carrier **(d)** inverse potential

(11) Depletion region in p-n junction is
(a) positively charged **(b)** negatively charged
(c) neutral **(d)** either a or b

(12) In case of germanium, the value of potential barrier develops across the depletion region is
(a) 0V **(b)** 0.9V
(c) 0.7V **(d)** 0.3V

(13) When an external potential difference is applied across p-n junction then n-side has
(a) negative charge **(b)** positive charge
(c) neutral charge **(d)** none of these

(14) In which case 0.7V of potential difference develops across the depletion region
(a) silicon **(b)** germanium
(c) boron **(d)** iridium

(15) Mathematically the forward resistance of the p-n junction is given by
(a) $r_f = \frac{\Delta I_f}{\Delta V_f}$ **(b)** $r_f = \frac{\Delta V_f}{\Delta I_f}$
(c) $r_f = \Delta V_f \times \Delta I_f$ **(d)** $r_f = \frac{1}{\Delta I_f \times \Delta V_f}$

(16) In forward biased, a p-n junction offers
(a) low resistance. **(b)** high resistance
(c) zero resistance **(d)** infinite resistance

(17) Which one of the following is not an acceptor impurity
(a) aluminium **(b)** iridium
(c) boron **(d)** gallium

(18) What type of material is formed when Pentavalent material is added to pure germanium
(a) p-type **(b)** n-type
(c) both a & b **(d)** none of these

(19) When the external source of voltage is applied across p-n junction such that its positive terminal is connected to n-region and its negative terminal to p-region, then p-n junction is
(a) reverse biased. **(b)** inverse biased
(c) forward biased **(d)** neutral biased

(20) In reverse biased state, a very small current flows across the p-n junction is of order of
(a) few amperes **(b)** pico amperes
(c) few milli amperes **(d)** few micro amperes

(21) In reverse biased state the current flows across the junction due to flow of
(a) majority charge carriers **(b)** minority charge carriers.
(c) electrons **(d)** none of these

(22) Under the reversed biased condition there is
(a) large amount of current through the diode
(b) very small amount of current through diode
(c) no current through the diode
(d) none of these

(23) In reverse biased the resistance offered by the diode is of the order of
(a) several mega ohms **(b)** few ohms
(c) moderate **(d)** zero

(24) As the reverse voltage is increased, the K.E of the minority charge carriers with which they cross depletion region is
(a) decreased **(b)** increased
(c) remain same **(d)** zero

(25) A diode characteristic graph is plot between
(a) current and voltage . **(b)** current and resistance
(c) voltage and resistance **(d)** resistance and potential difference

(26) p-n junction is also known as

(a) diode **(b)** transistor
(c) resistor **(d)** anode

(27) In semi-conductor diode, the n-region is considered as

(a) anode **(b)** cathode
(c) diode **(d)** neutral

(28) In symbolic representation of diode the head known as

(a) anode **(b)** cathode
(c) diode **(d)** neutral

Topic No. 18.2:

Rectification

(29) The process in which A.C is converted into D.C is

(a) amplification **(b)** sterilization
(c) rectification. **(d)** magnification

(30) The types of rectifications are

(a) 3 **(b)** 4
(c) 5 **(d)** 2

(31) The method by which only one half of A.C cycle is converted into direct current is called

(a) half wave amplification **(b)** full wave rectification
(c) half wave rectification. **(d)** full wave amplification

(32) During the interval $0 \rightarrow \frac{T}{2}$ the forward biased diode offers

(a) very small resistance. **(b)** very high resistance
(c) very small current flow through it **(d)** zero resistance

(33) The voltage which appears across load resistance R is called

(a) input voltage **(b)** output voltage
(c) reverse voltage **(d)** zero voltage

(34) The output voltage of a rectifier is

(a) smooth **(b)** pulsating
(c) straight **(d)** parabolic

(35) Rectification is possible by

(a) transistor **(b)** diode
(c) amplifier **(d)** capacitor

(36) The pulsating current can be made smooth by using a circuit known as

(a) filter **(b)** conductor
(c) radiator **(d)** inductor

(37) In full wave rectification by bridge circuit the number of diodes required are

(a) 3 **(b)** 5
(c) 2 **(d)** 4

(38) In the process of rectification the current received across the load resistance is

(a) A.C **(b)** D.C
(c) both a & b **(d)** none of these

Topic 18.3:

Specially Designed p-n Junctions

(39) The application of photo diode is
- **(a)** logic circuits
- **(b)** detection of radiation
- **(c)** automatic switching
- **(d)** all of these

(40) Light emitting diodes are made from special
- **(a)** conductors
- **(b)** insulator
- **(c)** semi-conductors
- **(d)** none of these

(41) Photo diode is used for the
- **(a)** detection of voltage
- **(b)** detection of current
- **(c)** detection of resistance
- **(d)** detection of light

(42) The photo diode is operated in the
- **(a)** reverse biased state
- **(b)** forward biased state
- **(c)** inverse biased state
- **(d)** converse biased state

(43) When no light is incident on the junction then
- **(a)** reverse current is maximum
- **(b)** reverse current is negligible.
- **(c)** forward current is minimum
- **(d)** reverse voltage is almost negligible

(44) A photo diode can turn its current ON and OFF in
- **(a)** micro seconds
- **(b)** pico seconds
- **(c)** nano seconds
- **(d)** milli seconds

(45) An ideal diode is that which offers zero resistance when it is
- **(a)** reverse biased
- **(b)**forward biased
- **(c)** inverse biased
- **(d)** converse biased

(46) When ideal diode is reverse biased then the it offers
- **(a)** zero resistance
- **(b)** maximum resistance
- **(c)** minimum resistance
- **(d)** infinite resistance

(47) Photo voltaic cell consists of
- **(a)** thin p-region and thick n-region.
- **(b)** thick p-region and thin n-region
- **(c)** thick p-region and n-region
- **(d)** thin p-region and n-region

(48) The photo voltaic cell converts
- **(a)** mechanical energy into light energy
- **(b)** light energy into mechanical energy
- **(c)** light energy into electrical energy
- **(d)** electric energy into mechanical energy

(49) The photo voltaic cell is made of
- **(a)** germanium
- **(b)** silicon
- **(c)** arsenic
- **(d)** antimony

Topic 18.4:

Transistors

(50) A transistor consists of
- **(a)** single crystal of germanium or silicon
- **(b)** double crystal of silicon or germanium
- **(c)** single crystal of arsenic
- **(d)** single crystal of boron

(51) The number of regions in transistor is/are
- **(a)** 2
- **(b)** 3
- **(c)** 4
- **(d)** 1

(52) If the central region of transistor is p-type then the transistor is said to be
- **(a)** p-n-p transistor
- **(b)** n-p- n transistor
- **(c)** p-n-n transistor
- **(d)** p-p-n transistor

(53) The central region of the transistor is called
(a) base **(b)** emitter
(c) receiver **(d)** collector

(54) The base of the transistor is of the order of
(a) 10^{-5}m **(b)** 10^{-6}m
(c) 10^{-9}m **(d)** 10^{-3}m

(55) The collector is comparatively
(a) smaller than base **(b)** larger than emitter.
(c) smaller than emitter **(d)** equal in size as emitter

(56) If the central region of transistor is n-type then the transistor is said to be
(a) p-n-p transistor. **(b)** n-p-n transistor
(c) p-n-n transistor **(d)** p-p-n transistor

(57) The emitter and collector have ___________ as compare to base
(a) smaller concentration of impurity **(b)** zero concentration of impurity
(c) greater concentration of impurity **(d)** none of these

(58) The concentration of impurity of collector is
(a) less than base **(b)** less than emitter.
(c) greater than base **(d)** both b and c

(59) For normal operation of transistor, the collector base junction is always
(a) reverse biased. **(b)** forward biased
(c) converse biased **(d)** none of these

(60) The direction of flow of current in p-n-p transistor is from
(a) emitter to collector **(b)** emitter to base.
(c) base to collector **(d)** base to emitter

(61) For normal operation of transistor, the battery
(a) V_{CC} is much smaller than V_{BB} **(b)** V_{CC} is much greater than V_{BB}
(c) both a & b **(d)** V_{CC} equal to V_{BB}

(62) Generally used transistor for actual practice is
(a) p-n-p transistor **(b)** n-p-n transistor
(c) p-n-n transistor **(d)** p-p-n transistor

(63) The basic relation for the transistor
(a) $I_E = I_C - I_B$ **(b)** $I_E = I_C + I_B$
(c) $I_C = I_E + I_B$ **(d)** $I_B = I_C - I_E$

(64) The current gain of transistor is
(a) ratio of I_C to the I_B. **(b)** ratio of I_B to the I_E
(c) ratio of I_C to the I_E **(d)** ratio of I_B to the I_C

(65) The general unit of current gain of a transistor
(a) ampere **(b)** milli ampere
(c) micro ampere **(d)** no unit

(66) The value of current gain of n-p-n transistor is of the order of
(a) tens **(b)** hundreds
(c) millions **(d)** thousands

(67) In a certain circuit, the transistor has a collector current of 10 mA and a base current of 40 μA. What is the current gain of the transistor
(a) 0.25 **(b)** 400
(c) 250 **(d)** 100

Topic 18.5:

Transistor As an Amplifier

(68) The most common building block of any complex electronic circuit is
(a) rectifier **(b)** amplifier
(c) resistor **(d)** thermistor

(69) In majority of electronic circuits, which devices are basically used as amplifiers
(a) resistors **(b)** transistors
(c) rectifiers **(d)** capacitors

(70) The output voltage($V_o = V_{CE}$) in transistors is determined by
(a) KVL rule **(b)** KCL rule
(c) KIL rule **(d)** KTL rule

(71) Conversion of low A.C voltage into high A.C voltage is called
(a) magnification **(b)** rectification
(c) amplification **(d)** induction

(72) The voltage gain of the common emitter n-p-n transistor as an amplifier
(a) $\beta \frac{r_{ie}}{R_C}$ **(b)** $\beta \frac{r_{ic}}{R_C}$
(c) $\beta \frac{R_C}{r_{ie}}$ **(d)** $\beta \frac{V_C}{R_C}$.

(73) The output voltage of common emitter amplifier is
(a) in phase with input voltage **(b)** in 180° phase shift with input voltage
(c) in any phase with input voltage **(d)** in 90° phase shift with input voltage

Topic 18.6:

Transistor As a Switch

(74) In transistor as a switch, the output terminals are
(a) collector and emitter **(b)** collector and base
(c) emitter and base **(d)** none of these

(75) The transistors with various combinations are widely used as switch in
(a) rectifier **(b)** computers
(c) generators **(d)** transformers

(76) The control terminals which decide the state of switch are
(a) emitter and base. **(b)** collectors only
(c) collector and base **(d)** emitter and collector

Topic 18.7:

Operational Amplifier

(77) The whole amplifier is integrated on a small silicon chip enclosed in a capsule is
(a) oscillator **(b)** rectifiers
(c) operational amplifier **(d)** invertors

(78) The number of inputs of Op-Amp are
(a) 2 **(b)** 3
(c) 5 **(d)** 4

(79) A signal that is applied at the inverting (-) input, appears after amplification, at the output terminal with a phase shift of
(a) 90° **(b)** 0°
(c) 270° **(d)** 180°

(80) The voltage gain of amplifier is expressed as

(a) $\frac{V_o}{V_i}$ **(b)** $\frac{V_i}{V_o}$

(c) $\frac{V_o}{V_+ - V_-}$ **(d)** both a and c

(81) An op-amp can be used as

(a) comparator **(b)** night switch

(c) inverting and non inverting amplifier **(d)** all of these

(82) When a signal is applied at the (+) terminal then after amplification, it appears at the output with a phase shift of

(a) 90° **(b)** 0°

(c) 360° **(d)** 180°

(83) In amplifier the resistance between the (+) and (-) inputs is of the order of

(a) few ohms **(b)** several mega ohms

(c) few milli ohms **(d)** few micro ohms

(84) The integrated amplifier which performs mathematical operations electronically is called

(a) filters **(b)** rectifiers

(c) op-amp **(d)** oscillators

(85) The whole amplifier is integrated on a

(a) small aluminium chips **(b)** small silicon chips

(c) very large silicon chips **(d)** very large germanium chips

(86) In amplifier the resistance between the output terminal and ground has the value of

(a) few ohms (b) mega ohms

(c) kilo ohms **(d)** none of these

(87) The open loop gain of op-amp is expressed as

(a) $A_{OL} = V_o + V_i$ **(b)** $A_{OL} = \frac{V_o + V_i}{2}$

(c) $A_{OL} = \frac{V_o}{V_+ - V_-}$ **(d)** $A_{OL} = \frac{V_+ - V_-}{V_o}$

(88) The open loop gain loop is of the order of

(a) 10^4 **(b)** 10^5

(c) 10^9 **(d)** 10^6

Topic 18.8 & 18.9:

Op-Amp as inverting and non inverting Amplifier

(89) Which of the following terminal is grounded while using op-amp as inverting amplifier

(a) (+) non inverting **(b)** (-) inverting

(c) both a and b **(d)** none of these

(90) The expression for gain of an inverting amplifier is

(a) $G = \frac{R_1}{R_2}$ **(b)** $G = -\frac{R_2}{R_1}$

(c) $G = 1 + \frac{R_2}{R_1}$ **(d)** $G = 1 - \frac{R_2}{R_1}$

(91) **If R_1= 10kΩ and R_2 = 100kΩ then gain of inverting amplifier is**
(a) 10 **(b)** 100
(c) -10 **(d)** 110

(92) **The expression for gain of an non-inverting amplifier is**
(a) $G = \frac{R_1}{R_2}$ **(b)** $G = \frac{R_2}{R_1}$
(c) $G = 1 + \frac{R_2}{R_1}$ **(d)** $G = 1 - \frac{R_2}{R_1}$

(93) **If $R_1 = \infty$ and R_2 = 0 then gain of non-inverting amplifier is**
(a) 0 **(b)** 1
(c) infinity **(d)**10

(94) **In op-amp as inverting amplifier, the potential of non-inverting terminal(+) is**
(a) 0 **(b)** 1
(c) infinity **(d)** maximum

(95) **In relation $G = -\frac{R_2}{R_1}$, the negative sign shows the output signal is**
(a) 180° out of phase with input signal **(b)** 90° out of phase
(c) 180° in phase with input signal **(d)** no phase change

(96) **The gain (G) of op-amp depends upon the**
(a) two internally connected resistances **(b)** two externally connected resistances
(c) three internally connected resistances **(d)** 1 internally connected resistances

Topic 18.10 & 18.11:

Op-Amp as a Comparator & Comparator as a Night Switch

(97) **Op-amp usually requires two power supplies of**
(a) unequal voltage and but of opposite polarity
(b) unequal voltage and but of same polarity
(c) equal voltage and but of same polarity
(d) equal voltage and but of opposite polarity

(98) **Most of the op-amp operate with _________ supply**
(a) $V_{CC} = \pm 1.5V$ **(b)** $V_{CC} = \pm 3.5V$
(c) $V_{CC} = \pm 12V$ **(d)** $V_{CC} = \pm 9V$

(99) **Automatic functioning of street lights can be done by the**
(a) capacitor **(b)** rectifier
(c) comparator **(d)** inductor

(100) **The value of LDR depends upon the**
(a) intensity of heat **(b)** intensity of sound
(c) intensity of light **(d)** intensity of voltage applied

(101) **When we are using op-amp as comparator and $V_- < V_+$ then**
(a) $V_o = +V_{CC}$ **(b)** $V_o < -V_{CC}$
(c) $V_o = -V_{CC}$ **(d)** $V_o > -V_{CC}$

Topic 18.12 to 18.15

Digital Systems, Fundamental Logic Gates, Other Logic Gates & Applictions of Gates in control system

(102) For the manipulation of the quantities which have values 1 and 0, special algebra used is called
(a) simple algebra (b) Newton algebra
(c) Boolean algebra (d) Libnitz algebra

(103) The electronic circuits which implement the various logic operations are known as
(a) logic gates (b) digital gates
(c) electronic gate (d) all of these

(104) In digital systems the ON bulb will be described as
(a) 0 (b) 1
(c) may a or b (d) none of these

(105) Which of the following is called fundamental gates
(a) NOR (b) OR
(c) XOR (d) NAND

(106) NOR gate is used to invert the output of
(a) OR gate (b) AND gate
(c) XOR gate (d) NAND gate

(107) The outputs of two inputs OR gate is 0 when its
(a) both inputs are 1 (b) both inputs are 0
(c) both inputs is 1 (d) either input is zero

(108) The mathematical relation for NOR operation
(a) $X = A\bar{B} + \bar{A}B$ (b) $X = \overline{A+B}$
(c) $X = \bar{A}.\bar{B}$ (d) both b and c

(109) A sensor of light is
(a) diode (b) LED
(c) LDR (d) all of these

(110) The mathematical relation for XOR operation
(a) $X = A\bar{B} + \bar{A}B$ (b) $X = A + B$
(c) $X = A.B$ (d) $X = \overline{A.B}$

(111) Which of the following is sound sensor
(a) diode (b) microphone
(c) rectifier (d) LDR

(112) The mathematical relation for XNOR operation
(a) $X = A\bar{B} + \bar{A}B$ (b) $X = \overline{A+B}$
(c) $X = \overline{A\bar{B} + \bar{A}B}$ (d) $X = \overline{A.B}$

(113) The mathematical relation for OR operation
(a) $X = \bar{A} + B$ (b) $X = A + B$
(c) $X = A.B$ (d) $X = \overline{A.B}$

(114) The output of OR gate will be 1 if
(a) all inputs are zero (b) all inputs are 1
(c) at least one input is 1 (d) none of these

(115) The output of AND gate will be 0 if

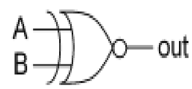
(a) all inputs are zero
(b) all inputs are 1
(c) at least one input is 0
(d) both a and c

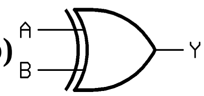
(116) The output of two inputs of XOR gate is 1 if
(a) all inputs are zero
(b) all inputs are 1
(c) at least one input is 1
(d) both a and c

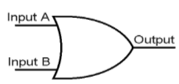
(117) The minimum number of input requires to perform the NOT operation
(a) are 3
(b) is 1
(c) are 2
(d) all of these

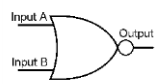
(118) NAND gate inverts the output of
(a) OR gate
(b) AND gate
(c) XAND gate
(d) NOT gate

(119) The OR gate is symbolically represented by

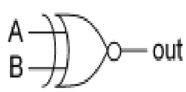
(a) 

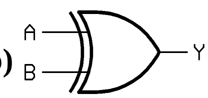
(b) 

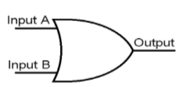
(c) 

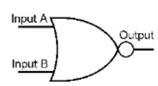
(d) 

(120) The NOR gate is symbolically represented by

(a) 

(b) 

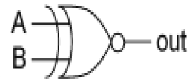
(c) 

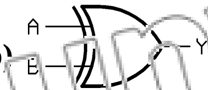
(d) 

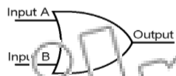
(121) In level sensor, we use the logic gate.
(a) OR gate
(b) NOR gate
(c) AND gate
(d) NAND gate

KIPS EXERCISE

(1) The XOR gate is symbolically represented by

(a) 

(b) 

(c) 

(d) 

(2) In p-type substances, majority charge carriers are:
(a) electrons **(b)** protons
(c) positron **(d)** holes

(3) In reverse biasing a p-n junction offers:
(a) low resistance **(b)** infinite resistance
(c) zero resistance **(d)** several mega ohms

(4) A diode cannot be used as:
(a) an amplifier **(b)** a detector
(c) a rectifier **(d)** a modulator

(5) LED works on the basis of:
(a) emission of energy in the form of photons
(b) Faraday's law
(c) Einstein's theory of relativity
(d) photoelectric effect

(6) Light emitting diodes (LED) are made form special semi-conductors such as
(a) gallium arsenide **(b)** gallium arsenide phosphide
(c) gallium phosphide **(d)** both a and b

(7) Photodiodes can be used:
(a) for detecting of light
(b) automating switching
(c) logic circuits and optical communication devices
(d) all of these

(8) Transistors are made from:
(a) plastics **(b)** metals
(c) insulators **(d)** doped semi-conductors

(9) The SI unit of voltage gain is:
(a) ampere **(b)** volt
(c) coulomb **(d)** no unit

(10) The output of AND gate will be one when:
(a) both the inputs are at one **(b)** both the inputs are at zero
(c) any of its input is at one **(d)** none of these

(11) Mathematical notation for NAND operation is:
(a) $X = \overline{A+B}$ **(b)** $X = \overline{A} + \overline{B}$
(c) $X = \overline{A}.\overline{B}$ **(d)** both b and c

(12) In the symbol of NOT gate the symbol of inversion is
(a) rectangle **(b)** bubble
(c) triangle **(d)** ellipse

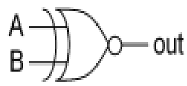
(13) The truth table shown below for the gate

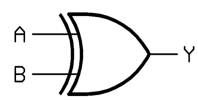
A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

(a) AND **(b)** OR
(c) XOR **(d)** XNOR

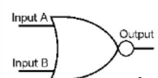
(14) Digital system deals with the variables which has only
(a) two discrete value **(b)** one discrete value
(c) four discrete value **(d)** three discrete values

(15) The XNOR gate is symbolically represented by

(a) 

(b) 

(c) 

(d) 

(16) When comparator uses as a night switch then potential across R_2 provides the reference voltage V_R to the (+) input of the op-amp expressed as

(a) $V_R = \frac{R_1}{R_1 + R_2} \times V_{CC}$ **(b)** $V_R = \frac{R_2}{R_1 + R_2} \times V_{CC}$

(c) $V_R = \frac{R_1 + R_2}{R_2} \times V_{CC}$ **(d)** $V_R = \frac{R_1 - R_2}{R_2} \times V_{CC}$

(17) Due to the high input resistance of R_{in}, practically ____________ flows between the two input terminals
(a) large current of several amperes **(b)** current of few amperes
(c) no current **(d)** none of these

(18) A transistor is a combination of
(a) three back to back p-n junction **(b)**four back to back p-n junction
(c) one back to back p-n junction **(d)** two back to back p-n junction

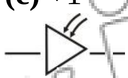
(19) During the period of $\frac{T}{2} \to T$ the diode is
(a) reverse biased. **(b)** forward biased
(c) inverse biased **(d)** converse diode

(20) When energy is sufficient to overcome the potential barrier a current begin to flow across the p-n junction is of order of
(a) few amperes **(b)** pico amperes
(c) few mili amperes **(d)** few micro amperes

MULTIPLE CHOICE QUESTIONS

(From Past Papers 2012-2021)
(Lahore + Gujranwala Boards)

(1) For non-inverting amplifier if $R_1 = \infty$ ohm and $R_2 = 0$ ohm, then gain of amplifier is: (LHR-2012)
(a) −1 (b) zero
(c) +1 (d) Infinite

(2)  **is the electrical symbol for (GRW-2012)**
(a) diode (b) photodiode
(c) photocell (d) LED

(3) A potential barrier of 0.7 volt exists across p-n junction made from: (LHR-2013)
(a) silicon (b) germanium
(c) indium (d) gallium

(4) Conversion of A.C into D.C. is called (LHR-2013)
(a) modulation (b) amplification
(c) oscillation (d) rectification

(5) When a p-n junction is reverse biased, the depletion region is (LHR- 2013)
(a) widened (b) narrowed
(c) normal (d) no change

(6) The central region of a transistor is called (LHR- 2013)
(a) base (b) emitter
(c) collector (d) neutral

(7) Base of the transistor is very thin of the order of (GRW- 2013)
(a) 10^{-2} m (b) 10^{-4} m
(c) 10^{-6} m (d) 10^{-8} m

(8) Universal gate is the gate which can perform the function of (GRW- 2013)
(a) buffer gate (b) any logic gate
(c) any basic gate (d) any exclusive gate

(9) The output voltage of a rectifier is: (GRW- 2013)
(a) smooth (b) pulsating
(c) perfectly direct (d) alternating

(10) A light emitting diode (LED) emits light only when: (GRW- 2013)
(a) reverse biased (b) forward biased
(c) unbiased (d) none of these

(11) Which factor does not affect the conductivity of p-n junction diode:- (GRW- 2013)
(a) doping (b) temperature
(c) voltage (d) pressure

(12) The device which is used as amplifier and works with the negative feedback is (LHR- 2014)
(a) operational amplifier (b) n-p-n transistor
(c) p-n-p transistor (d) transistor

(13) Which is not a basic logic operation (LHR- 2014)
(a) NOT (b) AND
(c) OR (d) NAND

(14) The reverse current gain of transistor is given by (LHR- 2014)

(a) majority charge carriers **(b)** minority charge carriers
(c) both (a) and (b) **(d)** none of these

(15) An expression for current gain of transistor is given by **(GRW- 2014)**
(a) $\beta = I_B / I_c$ **(b)** $\beta = I_B + I_c$
(c) $\beta = I_c - I_B$ **(d)** $\beta = I_c / I_B$

(16) Potential difference across two terminal of silicon diode at 300 K is: **(LHR- 2015)**
(a) 0.3 V **(b)** 0.7 V
(c) 0.9 V **(d)** 1.2 V

(17) The open loop gain of the amplifier is order of: **LHR- 2015 (G-II)**
(a) 10^2 **(b)** 10^8
(c) 10^5 **(d)** 10^{12}

(18) A diode characteristic curve is plotted between: **LHR-2016 (G-I)**
(a) current and time **(b)** voltage and time
(c) voltage and current **(d)** forward voltage and reverse voltage

(19) Transistor are made from: **LHR-2016 (G-I)**
(a) plastic **(b)** metal
(c) insulator **(d)** doped semiconductor

(20) A p-n junction cannot be used as: **LHR-2016 (G-II)**
(a) rectifier **(b)** amplifier
(c) detector **(d)** LED

(21) For rectification we use **GRW-2016 (G-I)**
(a) transformer **(b)** diode
(c) choke **(d)** generator

(22) SI unit of current gain is **GRW-2016 (G-I)**
(a) ampere **(b)** volt
(c) coulomb **(d)** no unit

(23) The Boolean equation for exclusive NOR gate is given by: **GRW-2019 (G-I)**
(a) X = A.B +B.A **(b)** $X = \overline{A.\overline{B} + \overline{B}.A}$
(c) $X = \overline{A.\overline{B} + \overline{A}.B}$ **(d)** $X = A.\overline{B} + \overline{B}.A$

(24) The output resistance of an operational amplifier is **GRW-2019 (G-II)**
(a) high **(b)** low
(c) zero **(d)** equal to input resistance

(25) The Boolean expression of NAND gate is: **LHR-2019 (G-I)**
(a) X=A.B **(b)** X= $\overline{A}$
(c) X= $\overline{A.B}$ **(d)** X=A+B

(26) The current gain β of the transistor given by: **LHR-2021 (G-I)**
(a) $\beta = \frac{I_B}{I_C}$ **(b)** $\beta = I_B + I_C$
(c) $\beta = I_B - I_C$ **(d)** $\beta = \frac{I_C}{I_B}$

(27) **The input resistance of an operational amplifier is:** **LHR-2021 (G-I)**
(a) Zero **(b)** Low
(c) High **(d)** Equal to output resistance

(28) **If R_1 = 10 KΩ and R_2 = 100 KΩ then gain of inverting amplifier is: LHR-2021 (G-II)**
(a) –11 **(b)** –10
(c) 10 **(d)** 11

(29) **Automatic functioning of street light can be done by the use of:** **LHR-2021 (G-II)**
(a) Inductor **(b)** Capacitor
(c) Comparator **(d)** Thermistor

(30) **Forward resistance of the p-n junction is.** **GRW-2022 (G-I)**
(a) Very large **(b)** Of the order of kΩ
(c) A few ohms **(d)** In mega ohms

(31) **In a transistor greater concentration impurity is added in.** **GRW-2022 (G-I)**
(a) Emitter **(b)** Collector
(c) Both emitter and collector **(d)** Based

(32) **Automatic function of street lights can be done by____.** **GRW-2022 (G-II)**
(a) Inductor **(b)** Comparator
(c) Transistor **(d)** Capacitor

(33) **A two input NAND gate with input 'A' and 'B' has output zero if_________.** **GRW-2022 (G-II)**
(a) B is zero **(b)** A is zero
(c) Both 'A' and 'B' inputs are zero **(d)** Both inputs 'A' and 'B' are 1

MULTIPLE CHOICE QUESTIONS

(From Past Papers 2012-2019)
(Faisalabad + Sargodha + Rawalpindi + Mirpur (AJK) Boards)

(1) **The electric circuit which gives the inversion** **(FSD- 2013)**
(a) XNOR gate **(b)** OR gate
(c) AND gate **(d)** NOT gate

(2) **The potential barrier for Ge at room temperature is** **FSD-2013, 2014, RWP-2013**
(a) 0.7 volt **(b)** 1 volt
(c) 0.6 volt **(d)** 0.3 volt

(3) **Pulsating DC can be made smooth by using a circuit known as:** **(FSD- 2013)**
(a) filter **(b)** tank
(c) acceptor **(d)** all of these

(4) **The automatic working of streets light is due to** **(SGD- 2013)**
(a) inductor **(b)** capacitor
(c) comparator **(d)** rectifier

(5) **Gain of inverting op-amp in the $R_1 = \infty$ and $R_2 = 0$** **(SGD- 2013)**
(a) ∞ **(b)** 1
(c) 0 **(d)** -1

(6) **A NAND gate with two inputs A and B has an output 0, if** **(SGD- 2013)**
(a) A is 0 **(b)** B is 0
(c) Both A and B are 0 **(d)** Both A and B are 1

(7) **The open loop gain of an operational amplifier is of the order of.** **(SGD- 2013)**
(a) 10^8 **(b)** 10^5
(c) 10^2 **(d)** 10^{-3}

(8) A diode characteristics curve is a graph plotted between **(SGD- 2012)**
(a) current and time **(b)** voltage and time
(c) voltage and current **(d)** forward voltage and reverse current

(9) The out put of "AND" gate will be one (1), when **(SGD- 2012)**
(a) both inputs are at zero **(b)** either one input is at one (1)
(c) both input are at one (1) **(d)** none of them

(10) The voltage gain of an inverting amplifier is: **(RWP- 2012)**
(a) $-\frac{R_1}{R_2}$ **(b)** $\frac{R_2}{R_1}$
(c) $-\frac{R_2}{R_1}$ **(d)** $1+\frac{R_2}{R_1}$

(11) Photo diode can turn its current on and off in: **(RWP- 2013)**
(a) micro- sec **(b)** nano-sec
(c) pico-sec **(d)** femto-sec

(12) Pulsating output of full wave rectifier can be made smooth by using circuit called: **(RWP- 2014)**
(a) filter **(b)** amplifier
(c) resistor **(d)** transistor

(13) Minimum number of semi-conductor diodes required for full wave rectification are: **(FSD- 2015)**
(a) 1 **(b)** 2
(c) 3 **(d)** 4

(14) The gain of non-inverting amplifier is: **(RWP- 2015)**
(a) $1+\frac{R_2}{R_1}$ **(b)** $1+\frac{R_1}{R_2}$
(c) $-\frac{R_2}{R_1}$ **(d)** $-\frac{R_2}{R_1}$

(15) The common emitter current amplification factor β is given by: **(RWP- 2015)**
(a) $\frac{I_B}{I_E}$ **(b)** $\frac{I_E}{I_B}$
(c) $\frac{I_C}{I_E}$ **(d)** $\frac{I_C}{I_B}$

(16) In forward biasing, the value of resistance is: **(SGD- 2015)**
(a) large **(b)** very large
(c) small **(d)** very small

(17) During negative half cycle of A.C then p–n junction offers **MIRPUR (AJK)- 2015**
(a) high resistance **(b)** low resistance
(c) no resistance **(d)** all of these

(18) The input resistance of an op amplifier is **FSD-2016 (G-I)**
(a) zero **(b)** low
(c) high **(d)** equal to output resistance

(19) AC can be converted in to DC by **FSD-2016 (G-I)**
(a) transformer **(b)** rectifier

(c) motor (d) capacitor

(20) Out put resistance of an op-amp is **SGD-2016 (G-I)**

(a) high (b) zero

(c) low (d) equal to input resistance

(21) A device which converts low voltage or current to high voltage or current is called **SGD-2016 (G-II)**

(a) transformer (b) AC-generator

(c) rectifier (d) amplifier

(22) $X = \overline{A+B}$ **is the mathematical notation for** **SGD-2016 (G-II)**

(a) OR gate (b) NOR gate

(c) NAND gate (d) AND gate

(23) The gain of transistor amplifier depends upon: **RWP-2016 (G-I)**

(a) resistance connected with collector (b) resistance connected at base

(c) input voltage (d) output voltage

(24) In bridge rectifier, number of diodes required are equal to; **MIRPUR (AJK) 2017**

(a) 1 (b) 2

(c) 3 (d) 4

(25) For normal operation of a transistor, the E – B junction is always; **MIRPUR (AJK) 2017**

(a) forward biased (b) reverse biased

(c) not biased (d) no effect of biasing

(26) The central region of transistor is known as **SGD-2017 (G-I)**

(a) emitter (b) base

(c) collector (d) depletion region

(27) A transistor consist of **SGD-2017 (G-II)**

(a) three electrodes (b) two electrodes

(c) one electrode (d) five electrodes

(28) The SI unit of current gain **SGD-2017 (G-II)**

(a) ampere (b) volt

(c) coulomb (d) no unit

(29) In a comparator circuit, when intensity of light decrease, then resistance of LDR: **FSD-2019 (G-I)**

(a) R_L increases (b) R_L decreases

(c) V_R decreases (d) V_R increases

(30) $X = \overline{A.B}$ **is the mathematical notation for:** **FSD-2019 (G-I)**

(a) NAND gate (b) OR gate

(c) NOR gate (d) AND gate

(31) Colour of light emitted by LED depends upon: **RWP-2019 (G-I)**

(a) its forward biasing (b) its reverse biasing

(c) type of material (d) forward current

(32) The magnitude of voltage gain of an amplifier having $r_{ie} = 1\Omega$, $\beta = 100$ and $R_c = 200\Omega$ is: **SGD-2022 (G-I)**

(a) 2000 (b) 1000

(c) 500 (d) 5

(33) Which one is used as temperature sensor in electrical circuit? **SGD-2022 (G-I)**

(a) capacitor (b) diode

(c) LDR (d) thermistor

(34) **The size of base in a transistor is.** SGD-2022 (G-II)
(a) 10^{-6}m **(b)** 10^{-8}m
(c) 10^{-7}m **(d)** 10m

(35) **_______ is the building block of every circuit** SGD-2022 (G-II)
(a) resistor **(b)** capacitor
(c) amplifier **(d)** diode

MULTIPLE CHOICE QUESTIONS

(From Past Papers 2012-2019)

(D.G Khan + Bahawalpur + Multan + Sahiwal Boards)

(1) **Logic gates can control some physical parameters like** (MTN-2012)
(a) temperature, pressure **(b)** current, voltage
(c) resistance, inductance **(d)** capacitance, impedance

(2) **In n – p – n transistor current does not flow in the direction from:-** (MTN-2013)
(a) emitter to collector **(b)** emitting base
(c) base to collector **(d)** collector to emitter

(3) **The potential difference across the depletion region of Germanium is** (MTN-2014)
(a) 0.3 V **(b)** 0.5 V
(c) 0.7 V **(d)** 0.8 V

(4) **Voltage gain of the transistor as an amplifier is negative because of** (DGK-2012)
(a) input voltage is amplified **(b)** phase shift of 180^o
(c) output voltage is amplified **(d)** phase shift is 0^o

(5) **The open loop gain of the op-amplifier is of the order of** (DGk-2013)
(a) 10^7 **(b)** 10^5
(c) 10^3 **(d)** 10^6

(6) **The device which is used as amplifier and work with the negative feed back is** (DGK-2014)
(a) operational amplifier **(b)** n p n transistor
(c) p n p transistor **(d)** Transistor

(7) **Which is not a basic logic operation** (DGK-2014)
(a) NOT **(b)** AND
(c) OR **(d)** NAND

(8) **The term Invertor is used for:** (BWP 2012)
(a) NOR gate **(b)** NAND gate
(c) XNOR gate **(d)** NOT gate

(9) **The potential difference across the depletion region of silicon is** (BWP 2013)
(a) 0.5 V **(b)** 0.7 V
(c) 0.8 V **(d)** 0.11 V

(10) **A sensor of light is** (BWP 2014)
(a) transistor **(b)** LED
(c) diode **(d)** light dependent resistance

(11) **When a pn-junction is reverse biased the depletion region is** (BWP 2014)
(a) widened **(b)** narrowed
(c) normal **(d)** none of these

(12) **The characteristics curve of p-n junction is between** (SWL 2013)
(a) voltage and current **(b)** voltage and time

(c) current and time | (d) power and current

(13) The p-n junction on forward biasing acts as **(SWL 2013)**
(a) capacitor (b) high resistor
(c) inductor (d) low resistor

(14) The use of LDR is in the circuit of: **(SWL 2015)**
(a) night switch (b) logic gate
(c) rectifier (d) oscillator

(15) The size of base in a transistor is: **(MTN 2015)**
(a) 10^{-9} m (b) 10^{-7} m
(c) 10^{-8} m (d) 10^{-6} m

(16) Greater concentration of impurity is added in: **MTN 2015 (G-II)**
(a) base (b) emitter
(c) collector (d) LED

(17) The ratio β in transistor is called: **MTN 2015 (G-II)**
(a) current gain (b) voltage gain
(c) nuclear gain (d) emitter gain

(18) Reverse current flows due to: **(DGK 2015)**
(a) majority charge carriers (b) minority charge carries
(c) electrons (d) holes

(19) Open loop gain OP – Amp is of the order of: **(DGK 2015)**
(a) 10^5 (b) 10^6
(c) 10^7 (d) 10^8

(20) For rectification we use: **DGK 2015 (G-II)**
(a) transformer (b) diode
(c) choke (d) generator

(21) The gain of amplifier is given as: **BWP 2015 (G-II)**
(a) $-\beta R_C / r_{ie}$ (b) $\beta r_{ie} / R_C$
(c) $\frac{-R_2}{R_1}$ (d) $1+\frac{R_2}{R_1}$

(22) The potential barrier for germanium at room temperature is **SWL-2016**
(a) 0.3 volts (b) 0.5 volts
(c) 0.7 volts (d) 0.9 volts

(23) The color of light emitted by a LED depends on **SWL-2016**
(a) its forward biasing (b) the type of semi-conductor material used
(c) the amount of forward current (d) its reverse biasing

(24) The Boolean expression of NAND Gate is: **MTN-2016 (G-II)**
(a) $X = A.B$ (b) $X = \overline{A}$
(c) $X = \overline{A.B}$ (d) $X = A + B$

(25) A two inputs NAND gate with inputs A and B has an output 0, if **BWP-2016 (G-I)**
(a) B is zero (b) A is zero
(c) both A and B are 1 (d) both A and B are 0

(26) Truth table of logic function: **BWP-2016 (G-I)**
(a) summarizes its output values only (b) tabulates all its input conditions only
(c) display all its input and output possibilities (d) is not base on logic algebra

(27) The Boolean equation for exclusive OR–gate is given by **SWL-2017**
(a) $X = A.B + B.A$ (b) $X = A.\overline{B} + \overline{A}.B$

(c) $\bar{A}.\bar{B}+A.B$ (d) $X=\overline{A.B+A.B}$

(28) The devices which are required to convert various physical quantities into electric voltage are called **SWL-2017**
(a) filters (b) rectifiers
(c) amplifiers (d) sensors

(29) Automatic functioning of street light can be done by **DGK-2017 (G-I)**
(a) inductors (b) capacitors
(c) transistors (d) comparators

(30) Which diode works at reverse biasing? **DGK-2017 (G-I)**
(a) LED (b) photovoltaic cell
(c) photodiode (d) silicon diode

(31) An expression for current gain of a transistor is given by **DGK-2017 (G-II)**
(a) $\beta = I_B / I_C$ (b) $\beta = I_B + I_C$
(c) $\beta = I_C - I_B$ (d) $\beta = I_C / I_B$

(32) Potential difference across depletion region in case of silicon diode at room temperature is: **BWP-2017 (G-I)**
(a) 0.3 V (b) 0.9 V
(c) 0.7 V (d) zero volts

(33) A Sensor of Light is: **BWP-2019 (G-II)**
(a) Transistor (b) LED
(c) Diode (d) LDR

(34) A two inputs NAND gate with inputs A and B has an output 'O' if: **MTN-2019 (G-I)**
(a) A is 0 (b) B is 0
(c) Both A and B are 0 (d) Both A and B are 1

(35) The operation of complementation is performed by: **MTN-2019 (G-II)**
(a) AND Gate (b) OR Gate
(c) XOR GATE (d) NOT Gate

(36) In op-amp, the input resistance is of the order of: **MTN-2019 (G-II)**
(a) Several Mega Ohms (b) Several Kilo Ohms
(c) Few Ohms (d) Hundred Ohms

(37) The size of base of transistor is of the order of. **MTN-2022 (G-I)**
(a) 10^{-6}m (b) 10^{-5}m
(c) 10^{-1}m (d) 10^{-3}m

(38) Two inputs NAND Gate with input A and B has output "o" if, **MTN-2022 (G-I, II)**
(a) A is 0 (b) B is 0
(c) both A and B are 0 (d) both A and B are 1

(39) The colour of light emitted by LED depends on. **MTN-2022 (G-II)**
(a) the reverse bias (b) the amount of forward current
(c) type of semiconductor material (d) the forward bias

ANSWER KEY
(Topical Multiple Choice Questions)

1	a	21	b	41	d	61	b	81	d	101	a	121	b
2	b	22	b	42	a	62	b	82	b	102	c		
3	c	23	a	43	b	63	b	83	b	103	a		
4	b	24	b	44	c	64	a	84	c	104	b		
5	d	25	a	45	b	65	d	85	b	105	b		

6	c	26	a	46	d	66	c	86	a	106	a
7	b	27	b	47	a	67	c	87	c	107	b
8	b	28	a	48	c	68	b	88	b	108	b
9	a	29	c	49	b	69	b	89	a	109	c
10	a	30	d	50	a	70	a	90	b	110	a
11	c	31	c	51	b	71	c	91	c	111	b
12	d	32	a	52	b	72	c	92	c	112	c
13	a	33	b	53	a	73	b	93	b	113	b
14	a	34	b	54	b	74	a	94	b	114	c
15	b	35	b	55	b	75	b	95	a	115	c
16	a	36	a	56	a	76	a	96	b	116	c
17	b	37	d	57	c	77	c	97	d	117	b
18	b	38	b	58	d	78	a	98	c	118	b
19	a	39	d	59	a	79	d	99	c	119	c
20	d	40	c	60	b	80	d	100	c	120	d

(KIPS Exercise)

1	b	4	a	7	d	10	a	13	a	16	b	19	a
2	d	5	a	8	d	11	c	14	a	17	c	20	c
3	d	6	d	9	d	12	b	15	a	18	d		

(From Past Papers 2012-2021)
(Lahore + Gujranwala Board)

1	c	4	d	7	c	10	b	13	d	16	b	19	d	22	d	25	c	28	b	31	a
2	b	5	a	8	b	11	d	14	b	17	c	20	b	23	c	26	d	29	c	32	c
3	a	6	a	9	b	12	a	15	d	18	c	21	b	24	b	27	c	30	c	33	c

(From Past Papers 2012-2019)
(Faisalabad + Sargodha + Rawalpindi + Mirpur (AJK) Boards)

1	d	6	d	11	b	16	d	21	d	26	b	31	c
2	d	7	b	12	a	17	a	22	b	27	a	32	a
3	a	8	c	13	d	18	c	23	a	28	d	33	d
4	c	9	c	14	a	19	b	24	d	29	a	34	a
5	b	10	c	15	d	20	c	25	a	30	a	35	c

(From Past Papers 2012-2019)
(DGK + Bahawalpur + Multan Board)

1	a	8	d	15	d	22	a	29	d	36	a
2	c	9	b	16	b	23	b	30	c	37	a
3	a	10	d	17	a	24	c	31	d	38	d
4	b	11	a	18	b	25	c	32	c	39	c
5	b	12	a	19	a	26	c	33	d		
6	a	13	d	20	b	27	b	34	d		
7	d	14	a	21	a	28	d	35	d		

SHORT QUESTIONS

(From Textbook Exercise)

18.1 How does the motion of an electron in a n-type substance differ from the motion of holes in a p – type substance?

LHR-13(G-I), DGK-15(G-II), GRW-16 (G-I), LHR-16 (G-I), DGK-17 (G-II), GRW-19 (G-I), LHR-19 (G-II), MTN-19 (G-I)

Ans:

Motion of Electrons	Motion of Holes
• Electrons flow from negative terminal towards the positive terminal of the battery. • Motion of electrons give rise to the electronic current. • Electrons move along $-\vec{E}$.	• Holes moves form positive terminal to the negative terminal to the battery. • Motion of holes give rise to the conventional current. • Holes move along $\vec{E}$.

18.2 What is the net charge of a n-type or a p – type substance?

BWP-13, SWL-14(G-I), RWP-14, MTN-15(G-I)&(G-II), SGD-15(G-I), GRW-15(G-I), DGK-16 (G-I), RWP-16 (G-I), LHR-16 (G-II), DGK-17 (G-I), MIRPUR (AJK)-17, LHR-17 (G-I), GRW-19 (G-II), MTN-19 (G-II)

Ans: Both n – type and p – type substances are neutral and net charge is equal to zero. Because each atom in n – type and p – type substance is neutral. As no electron is added or removed from n – type or p – type so, both are neutral.

18.3 The anode of diode is 0.2 V positive with respect to its cathode. Is it forward biased?

SGD-14(G-I)&(G-II), RWP-14, DGK-15(G-I), FSD-15(G-I), MIRPUR (AJK) 15, SWL-16, RWP-16 (G-I), SWL-19

Ans: A diode is said to be forward biased if p – type is connected to positive terminal of battery and n – type to the negative terminal of battery. In this case anode of diode that is p – type is 0.2 volt positive with respect to cathode (n-type). Therefore, diode is said to be forward biased. But since the value of this potential (0.2V) is less than the potential barrier of silicon (0.7V) or germanium (0.3 V), thus very small current would flow through the circuit.

18.4 Why charge carriers are not present in the depletion region?

LHR-13(G-II), GRW-13(G-I), MTN-14, FSD-14(G-I), DGK-15(G-II), SGD-15(G-II), MTN-16 (G-I, II), SGD-16(G-I, II), GRW-16 (G-I), SGD-17 (G-I), LHR-17 (G-I), FSD-19 (G-I), BWP-19 (G-II)

Ans: An n-region contains free electrons as majority charge carriers and p – region contains holes as majority charge carriers. Thus, after the formation of the junction, the free electrons in the n – region because of their random motion, diffuse into the p – region. As a result of their diffusion, a charge less region is formed around the junction in which charge carriers are not present.

18.5 What is the effect of forward and reverse biasing of a diode on the width of depletion region?

LHR-12, GRW-12, GRW-13(G-I), MTN-14, RWP-14, BWP-15(G-II), RWP-15(G-I), LHR-15(G-II), SWL-17, BWP-17 (G-I), MTN-19 (G-I & II)

Ans: **Forward Biased State**

When a diode is forward biased then width of depletion region decreases because the electrons and holes are pushed towards depletion region therefore, conductivity increase.

Reverse Biased

When diode is reverse biased then width of depletion region increases because electrons and holes move away from depletion region therefore, conductivity decreases.

18.6 Why ordinary silicon diodes do not emit light?

SGD-15(G-I), FSD-15(G-I), MIRPUR (AJK) 15, MTN-16 (G-I, II), DGK-16 (G-I), FSD-16 (G-I), LHR-16 (G-II), FSD-19 (G-I), GRW-19 (G-II), BWP-19 (G-II)

Ans: Forbidden energy gap between conduction band and valance band in silicon is very small, of the order of few electron volts. Thus, when electron jumps form conduction band to valence band, it emits radiation of very large wavelength lying in the infrared region. Thus, no visible light is emitted by silicon diode.

18.7 Why a photo diode is operated in reverse biased state?

LHR-12, DGK-13, GRW-14(G-I)&(G-II), BWP-14(G-I), DGK-14(G-I)&(G-II), SGD-15(G-II), MTN-15(G-II), LHR-15(G-II), SWL-16, MTN-16 (G-I), BWP-16 (G-I), SGD-16 (G-II), LHR-16 (G-II), SGD-17 (G-I), DGK-17 (G-II), SWL-19, RWP-19 (G-I)

Ans: Photo diode is used for detection of light. It can turn its current on and off in nano second. It is operated in reverse biased state. When light falls on it then electrons holes pairs are created in the depletion region and reverse current starts flowing. It conducts only when light falls on it. If it is operated in forward biased it will conduct weather light falls on it or not.

18.8 Why is the base current in a transistor very small?

GRW-12, LHR-13(G-II), DGK-13, LHR-14(G-I), GRW-14(G-I), SGD-15(G-II), MTN-15(G-I), FSD-15(G-I), RWP-15(G-I), GRW-15(G-I), LHR-15(G-I), SGD-16 (G-I), LHR-16 (G-I), DGK-17 (G-I), SGD-17 (G-II), MIRPUR (AJK)-17, GRW-19 (G-I)

Ans: The base of transistor is very thin of the order 10^{-6} m and lightly doped. On the normal operation charge carriers enter from emitter and a very few of them combine with the charge carriers present in base but majority of the charge carriers move towards collector region. That's why the base current is very small. As we know that

$I_E = I_B + I_C$

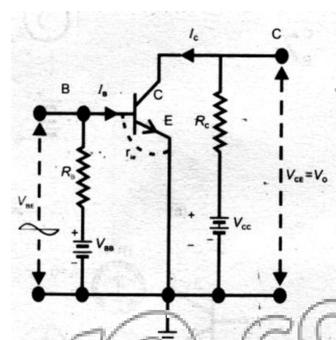
$I_B = I_E - I_C$

$I_C < I_E$

$\therefore \quad I_B$ is very small.

18.9 What is the biasing requirement of the junctions of a transistor for its normal operation? Explain how these requirements are met in a common emitter amplifier?

LHR-12, LHR-13(G-I), MTN-16 (G-II), GRW-16 (G-I)



Ans: For normal operation of a transistor emitter base junction is forward biased and base collector junction is reverse biased. In a common emitter amplifier V_{BB} is connected across base and emitter for forward biasing and V_{CC} is connected across collector and emitter for reverse biasing.

18.10 What is the principle of virtual ground? Apply it to find the gain of an inverting amplifier.

LHR-14(G-II), SGD-14(G-II), DGK-15(G-I), SGD-16 (G-I), LHR-19 (G-II)

Ans: The open loop gain of operational amplifier is very high i.e.,

$A_{OL} = \dfrac{V_o}{V_+ - V_-}$

As A_{OL} is high then,

$V_+ - V_- \approx 0$

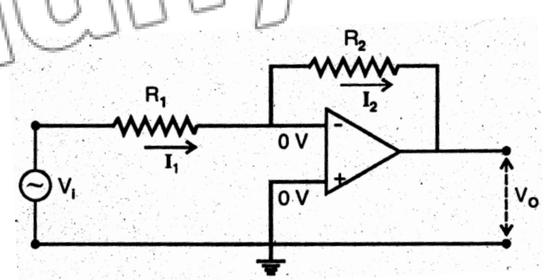
$V_+ \approx V_-$

Since V_+ is at ground.

So $\quad V_- \approx 0$

This is called principle of virtual ground.

From figure:



$$I_1 = \frac{V_i - V_-}{R_1} = \frac{V_i - 0}{R_1} = \frac{V_i}{R_1}$$

and $$I_2 = \frac{V_- - V_o}{R_2} = \frac{0 - V_o}{R_2} = \frac{-V_o}{R_2}$$

Applying Kirchhoff's 1st rule

$$I_1 = I_2$$

$$\frac{V_i}{R_1} = -\frac{V_o}{R_2}$$

$$\Rightarrow \quad \frac{V_o}{V_i} = \frac{-R_2}{R_1}$$

$$\therefore \quad \boxed{\text{Gain} = \frac{-R_2}{R_1}}$$

18.11 The inputs of a gate are 1 and 0. Identify the gate if its output is (a) 0 (b) 1.

MIRPUR (AJK) 15

Ans: **(a)** If

A	B	OUT PUT
1	0	0

This may be either AND gate i.e. X=A.B

Or it is NOR Gate i.e. $X=\overline{A+B}$ or XNOR gate. i.e $X=\overline{A\overline{B}+\overline{A}B}$

(b) If

A	B	OUT PUT
1	0	1

This is OR Gate i.e. X = A+B

It is NAND gate i.e $X=\overline{A.B}$, Exclusive OR gate $X=A\overline{B}+\overline{A}B$

KIPS TOPICAL SHORT QUESTIONS

18.1 BRIEF REVIEW OF P-N JUNCTION AND ITS CHARACTERISTICS

(1) What is meant by hole in a semi-conductor? How it is produced?

Ans: At room temperature, the covalent bonds in semi-conductors are broken to thermal vibration of electrons. Hence, electrons are free, an electron vacancy is known as hole.

(2) How is p-n junction formed? **DGK-2017 (G-II)**

Ans: A p-n junction is formed when a crystal of germanium or silicon is grown in such a way that its one half is doped with a trivalent impurity and the other half is doped with Pentavalent impurity.

(3) What is meant by forward and reverse biasing of a semi-conductor diode?

Ans: **Forward Biasing**

When P-N junction is connect to the battery in such a way that p-type is connected with positive terminal and N type with negative terminal, then P-N junction conducts and known as diode. This process is known is forward biasing.

Reverse Biasing

When P-N junction is connected to the battery such that p-type is connected with –ive terminal and N-type with +ive terminal, there is no current that flows through the junction. It is known as reverse biasing.

(4) Give some properties of a semi conductor?

Ans: $\Rightarrow$ At 0K, semi conductor behaves like insulator.

⇒ Its resistivity value is between conductors and insulators
⇒ Its Resistance decreases with increase in temperature

(5) What is meant by potential barrier?

Ans: A potential difference is established in the depletion region due to formation of ions. It is known as potential barrier or hill. Its value offer Si is 0.7 V and for Ge is 0.3 V.

(6) What is meant by depletion region?

Ans: After the formation of the P-N junction, a charge less region between P-type and N-type substance is called depletion region. It contains fixed ions.

18.2 RECTIFICATION

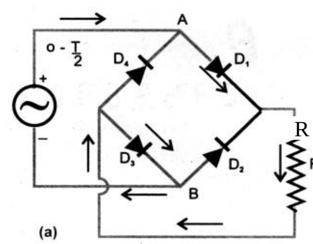
(7) What is meant by rectification?

Ans: Conversion of A.C into D.C is called rectification. The device used for this purpose is known as rectifier. It is of two types:
(i) Half wave rectification
(ii) Full wave rectification

(8) Draw circuit diagram used for full wave rectification. Show direction of current in the circuit when positive half of input A.C cycle passes through it.

DGK-2012, SWL-2013

Ans: For period $0 \rightarrow \frac{T}{2}$

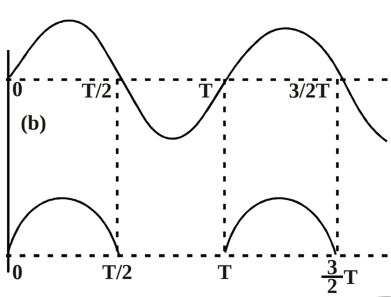


During the positive half cycle i.e during the time $0 \rightarrow \frac{T}{2}$, the terminal A of the bridge is positive with respect to its other terminal B. Now the diodes D_1 & D_3 become forward biased & conduct current as in fig 'a'.

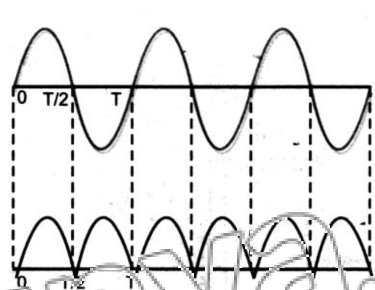
(9) Draw the input and output waveforms of half wave and full wave rectifier. BWP-2014

Ans:

Half wave rectification



Full wave rectification



18.3 SPECIALLY DESIGNED P-N JUNCTION

(10) Why is a photo diode operated in reverse biased state?

Ans: In a photodiode, current flows due to minority charge carriers called reverse current. Since minority charge carriers move under reverse biased condition, thus photodiode is operated in reverse state. It is used for the detection of light.

(11) What do LED and LASER stand for?

Ans: **(i) LED**: LED stands for Light Emitting Diodes.

Definition:- Light emitting diode is basically a p-n junction diode made from the semi-conductor gallium arsenide phosphide. When electric current passes through such a circuit, energy is released in the form of light (photons). It is called a light emitting diode (LED).

(ii) Laser: Laser stands for Light Amplification by Stimulated Emission of Radiation.

Definition:- A laser is a device which produces very narrow intense beam of light having the following properties.

(i) It is monochromatic (of one frequency or one wavelength)

(ii) It is coherent (crest and troughs of beam are in phase)

(iii) It is unidirectional (radiations of beam travel in the same direction)

The light emitted by an ordinary light source is not only incoherent but also emitted in all directions. So laser light is different from the ordinary light.

(12) What is solar cell (or photovoltaic cell)? Give its uses.

Ans: **Solar Cell:-** A photo voltaic cell (solar cell) is a device which converts light energy into electrical energy.

When light is made to fall on this cell, the voltage across its terminals increases. The value of voltage increases with the increase of intensity of incident light. Current is directly proportional to the intensity of light

The photo-voltaic cell is basically a junction device. The cells are made of semi-conductor materials. It is generally made from either silicon or Selenium.

Uses:- Photo cells are used in satellites and space vehicles to convert solar energy into electrical energy which can be used to operate the other electronic equipments.

(13) What is photo diode? What are the applications of photo diode?

Ans: Photo diode is used for the detection of light. A photo diode can turn its current **ON** and **OFF** in nano seconds. These diodes work under reverse biased condition.

Applications of photo – diodes

(i) Detection of both visible & invisible radiation.

(ii) Automatic switching

(iii) Logic circuits

(iv) Optical communication equipment etc.

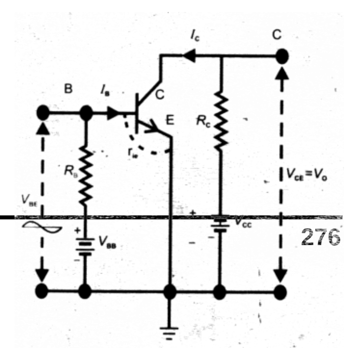
18.4 to 18.6 TRANSISTORS, TRANSISTOR AS AN AMPLIFIER AND TRANSISTOR AS A SWITCH

(14) Draw the circuit symbols for (a) npn and (b) pnp transistor.

Ans:

(a) npn transistor **(b)** pnp transistor

(15) What is a transistor? How n-p-n transistor circuit is drawn in a common emitter configuration.



Ans: **Definition:** A transistor is a combination of two words 'transfer' and 'resistor', transfer means to flow the charge and resistor means to resist the flow of charge.
Transistor is a semi-conductor diode device consisting of two p-n junctions and three regions, namely emitter, base and collector.
In a common emitter configuration emitter base junction is forward biased and collector base junction is reverse biased.

(16) What is meant by current gain of transistor?

Ans: The ratio of collector current I_C to that of base current I_B is known as current gain of a transistor. It is a constant quantity.

Mathematically $\beta = \frac{I_C}{I_B}$ = constant

It has no Unit

(17) Find the current gain of a transistor whose collector current is 100 mA and base current is 100 μA.

Ans: The current gain of transistor is given by;

$$\beta = \frac{I_C}{I_B} = \frac{100\times10^{-3}A}{100\times10^{-6}A}$$

$$\beta = 1000$$

(18) A transistor has I_E = 10 mA and I_B = 40 μA. Calculate current gain of transistor. **BWP-2012**

Ans: As we know that;

$$I_E = I_B + I_C$$

$$I_C = I_E - I_B = 10mA - 40\mu A$$

$$= 10mA - 0.04\,\text{mA}$$

$$= 9.96mA$$

$$\beta = \frac{I_C}{I_B}$$

$$= \frac{9.96mA}{0.04mA} = 249$$

18.7 OPERATIONAL AMPLIFIER

(19) Write briefly about operational amplifier. **BWP 2019 (G-II)**

Ans: An integrated circuit having a small silicon chip enclosed in a capsule with eight pins attached to it, serving as working terminals, is called operational amplifier. It has two input terminals. One is known as inverting input (-) and the other non-inverting input (+). The inverting input terminal shifts the phase of input signal by 180°.

(20) What is mean by Open loop?

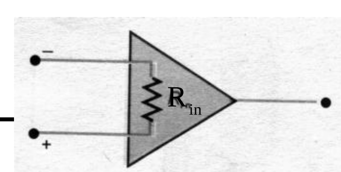
Ans: **Open loop**
When an operational amplifier is operated without connecting any resistance or capacitor from its output to any one of its input terminal, it is said to be in open loop condition. In other words open loop condition means no feed back is taken.

(21) Briefly explain, what is meant by saturation in op-Amplifier?

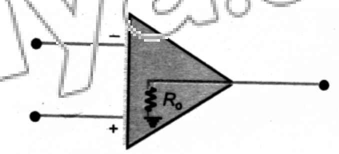
Ans: A condition when inverting and non-inverting input voltage becomes equal is called saturation.

(22) Write down the characteristics of operational amplifier.

Ans: **(i) Input Resistance**



It is the resistance between the (+) & (-) inputs of the amplifier. Its value is very high, of the order of several mega ohms. Due to high input resistance R_{in}, practically no current flows between the two input terminals. It is very important feature of the op – amp.

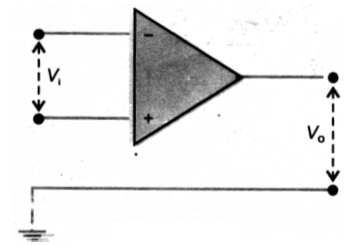


(ii) Output Resistance

It is resistance between the output terminal & ground. Its value is only a few ohms.

(iii) Open Loop Gain

It is the ratio of output voltage V_0 to the voltage difference between non – inverting & inverting (-) inputs when there is no external connection between the output & the inputs i.e



$$A_{OL} = \frac{V_o}{V_+ - V_-} = \frac{V_0}{V_{in}}$$

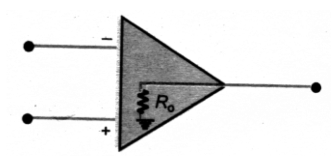
Open loop gain of the amplifier is very high, of the order of 10^5.

(23) Define input resistance and output resistance of an operational amplifier?

RWP-2013

Ans: **(i) Input Resistance**

It is the resistance between the (+) & (-) inputs of the amplifier. Its value is very high, of the order of several mega ohms. Due to high input resistance R_{in}, practically no current flows between the two input terminals. It is very important feature of the op – amp.



(ii) Output Resistance

It is resistance between the output terminal & ground. Its value is only a few ohms.

(24) Write some important uses of operational amplifier. **FSD-2014**

Ans: The following are the uses of operational amplifier:

(i) The operational amplifier as inverting amplifier.

(ii) The operational amplifier as non-inverting amplifier.

(iii) The operational amplifier as a comparator.

18.8 OP-AMP AS INVERTING AMPLIFIER

(25) If R_1 = 10kohm and R_2 = 100kohm. Find the gain of an inverting amplifier.

FSD-2013

Ans: The gain of an inverting amplifier is given by;

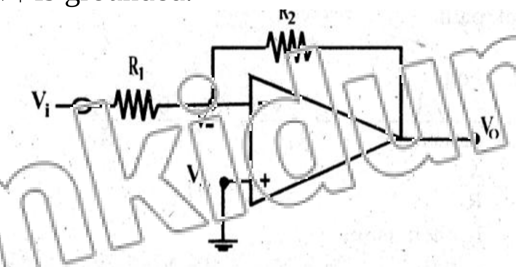
$$G = -\frac{R_2}{R_1} = -\frac{100k\Omega}{10k\Omega} = -10$$

18.9 OP-AMP AS NON-INVERTING AMPLIFIER

(26) What is meant by virtual ground?

Ans: **Virtual Ground**

Virtual ground behaviour of inverting terminal means to have V = 0 even particularly V is not grounded but V_+ is grounded.



Proof: Consider an operational amplifier with V_+ as grounded

So $V_+ \approx 0$,

Also using

$$A_{OL} = \frac{V_o}{V_+ - V_-} \quad \Rightarrow \quad V_+ - V_- = \frac{V_o}{A_{OL}}$$

$$V_+ - V_- = \frac{V_o}{10^5} = \frac{V_o}{\text{very high value}} \approx 0$$

$$V_+ - V_- \approx 0$$
$$V_+ \approx V_- \quad or \quad V_- \approx V_+$$

So V_+ is particularly grounded and

V_- is virtually grounded because of its equality with V_+

18.10, 18.11 OP-AM AS A COMPARATOR AND COMPARATOR AS A NIGHT SWITCH

(27) What is meant by comparator, describe the function of operational amplifier as comparator?

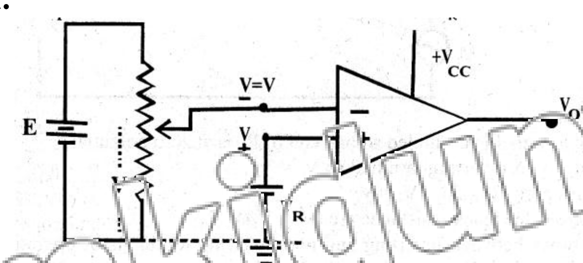
Ans: A circuit or device which is capable to compare the two potentials is called comparators.

Operational Amplifier as Comparator:

Circuit diagram of operational amplifier comparator consists of

(i) Operational amplifier **(ii)** Potential divider V_R

Circuit Diagram:



i. Inverting terminal is connected to variable source having potential V at any instant which can be varied by varying sliding terminal.

ii. V_R is applied at non – inverting terminal, V_R is constant.

iii. $+V_{CC}$ is biased with operational amplifier which makes output voltage.

$V_o = +$ if $V_+ > V_-$ $\Rightarrow$ $V_R > V$

$V_o = -$ if $V_- > V_+$ $\Rightarrow$ $V > V_R$

Comparison:

(i) If V_o = positive , $V_R > V$

(ii) If V_o = negative , $V_R < V$
(iii) If V_o =0 , $V_R = V$

18.12 DIGITAL SYSTEMS

(28) What is Boolean algebra?

Ans: Two basic mathematical operations, i.e., addition and subtraction for the mathematical manipulation of ordinary quantities which can possess all continuous values, a special algebra is require that is called Boolean algebra.
The Boolean algebra is based on three basic operations:
(i) AND
(ii) OR
(iii) NOT
It includes addition and subtraction of ordinary math operations.

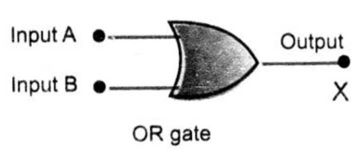
18.13 FUNDAMENTAL LOGIC GATES

(29) Define the term logic gate. Write names of fundamental gates. SGD-2017 (G-II)

Ans: The electronic circuits which implement the various logic operations are known as logic gates. In these gates, the high voltage level is shown by 1 & low voltage level is shown by 0.
The fundamental logic gates are:
(i) OR-gate
(ii) AND-gate
(iii) NOT-gate

(30) Write down the truth tables of OR gate and AND gate DGK-2013

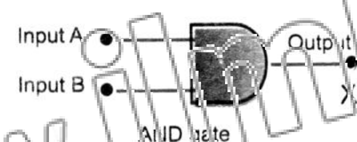
Ans: **OR GATE: X = A + B**
OR gate, as shown in fig, implements the logic of OR operation. It has two or more inputs & a single output X. Output has a value 1, When at least one of its inputs A & B is at 1. Thus X will be zero only when both the inputs are 0. Truth table shows the fact X = A + B.



OR gate

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

AND GATE: X = A.B
The fig shows AND gate. It has two inputs and a single output X. The output is 1 only when both of the inputs A & B are at 1. For all other combination of the values of A & B, X is zero. Mathematically X = A.B



AND gate

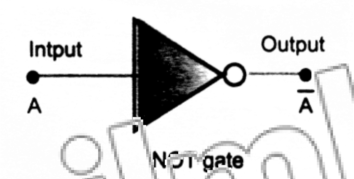
A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

(31) Draw the symbolic diagram of NOT gate and also write its truth table.
SGD-2017 (G-I)

Ans: **NOT GATE: X =** $\overline{A}$
The fig shows the NOT Gate. It performs the operation of inversion or complementation, so NOT gate is also called inverter. It changes the logic level to its opposite level, shown

in truth table. $\bar{1} = 0$ & $\bar{0} = 1$. In figure "bubble" (o) indicates operation of inversion. Mathematically

$$X = \bar{A}$$

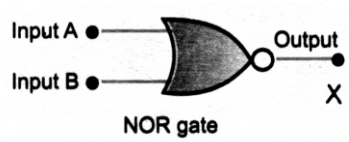


A	Output
0	1
1	0

18.14 OTHER LOGIC GATES

(32) Draw the symbol and truth table of NOR gate. **FSD-2016 (G-I)**

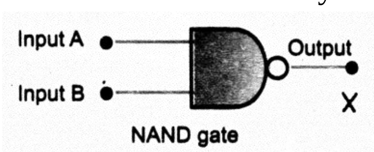
Ans: In NOR Gate, the output of OR gate is inverted as in truth table. Mathematically $X = \overline{A + B}$



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

(33) Write down the logic table and expression of NAND gate. **SGD-2015**

Ans: In NAND gate, the output of AND gate is inverted, operated by "bubble" (o), shown in truth table. Mathematically $X = \overline{A.B}$



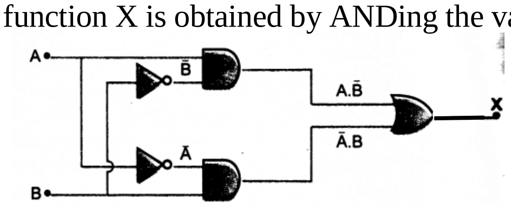
A	B	Output
0	0	1
0	1	0
1	0	0
1	1	1

(34) Give the circuit diagram and truth table of Exclusive – OR gate. **SGD-2012**

Ans: **EXCLUSIVE OR GATE (XOR):** $X = A\bar{B} + \bar{A}B$

Consider a Boolean function X of two variables A & B such that $X = A\bar{B} + \bar{A}B$

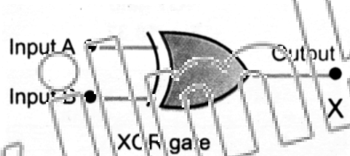
(i) The first term of the function X is obtained by ANDing the variable A with NOT of B.



(ii) The second term is NOT of A and ANDing with B.

(iii) The function X is obtained by ORing these two terms, obtained by the circuit arrangement of fig (a). The truth table gives the function X.

(iv) The value of X is 0 when the two inputs have same values. X is 1 when the inputs have different values.

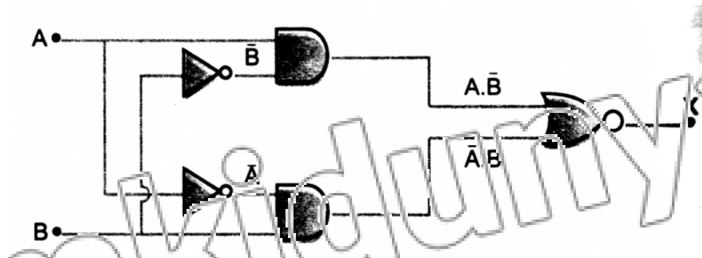


A	B	Output
0	0	0
1	0	1
0	1	1
1	1	0

(35) Write down symbol and truth table of exclusive-NOR gate. **GRW-2015**

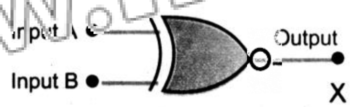
Ans: **EXCLUSIVE – NOR GATE (XNOR):** $X = \overline{A\bar{B} + \bar{A}B}$

The exclusive NOR gate is obtained by inverting the output of a XOR gate, represented by bubble (O) at output.



(i) The output of XNOR is 1 when its two inputs are identical.

(ii) The output of XNOR is 0 when two inputs are different.



XOR gate

Table 18.8

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

18.15 APPLICATIONS OF GATES IN CONTROL SYSTEM

(36) How Gates are used in controlling systems? **GRW-2019 (G-II)**

Ans: Gates are used in controlling the functions of the system by monitoring some physical parameters. The parameters are such that temperature, pressure or some other physical quantity of the system.

Gates operate with electrical voltages only. For this voltage, some devices are used for converting various physical quantities into electrical voltage. These devices are called sensors.

(37) Give two applications of gates in control system. **SWL-2017**

Ans: The application of gates in control system are:

(i) In Night switch, the LDR light dependent resistance is a sensor. LDR converts the intensity of light into electrical voltage.

(ii) A Thermistor is a sensor for temperature.

(iii) A microphone is a sound sensor.

(iv) Level sensors which give an electrical signal when the level of liquid in a vessel attains a certain limit.

SHORT QUESTIONS

(Past Papers 2012-2021)

(Gujranwala + Lahore Boards)

(1) What is the principle of virtual ground? Apply it to find the gain of an inverting amplifier. **LHR-2014**

(2) What is the effect of forward biasing on the width of depletion region? **GRW-2012, 2013, LHR-2012**

(3) What is the biasing requirement of the junctions of a transistor for its normal operation? Explain how these requirements are met in a common emitter amplifier? **LHR-2012, 2013**

(4) Draw the figure showing electrical conduction by holes in semi-conductors? **LHR-2013, 2014**

(5) Draw the symbol of XOR Gate and write its truth table. **LHR-2013, 2014**

(6) Write two characteristics of op amplifier. **(LHR 2015)**

(7) Write down the truth table of exclusive-OR gate. **LHR 2015(G-II)**

(8) Write down symbol and truth table of exclusive-NOR gate. **(GRW 2015)**

(9) What is photo diode? Write its two applications (or uses). **GRW-2012, LHR-2013, 2014, 2015, 2016 (G-I)**

(10) What is meant by rectification? **LHR-2016 (G-I)**

(11) Why ordinary silicon diodes do not emit light? **LHR-2016 (G-II)**

(12) Why a photodiode is operated in reverse biased state? **GRW-2014, LHR-2012, 2016 (G-II)**

(13) How does the motion of an electron in an n type substance differ from the motion of holes in a p type substance? **LHR-2013, 2016 (G-II), GRW-2016 (G-I)**

(14) Why is the base current in a transistor very small? **LHR 2013, 2014, 2016 (G-I), GRW-2012, 2014, 2016 (G-I)**

(15) Write down the characteristics of operational amplifier. **GRW-2014, LHR-2017 (G-I)**

(16) What is the net charge on an n-type or a p-type substance? **GRW-2013, LHR-2016 (G-I), 2017 (G-I)**

(17) Why charge carriers are not present in the depletion region? **GRW-2013, 2016 (G-I), LHR-2013, 2017 (G-I)**

(18) What is depletion region? Explain briefly. **LHR-2019 (G-II)**

(19) What is meant by current gain of a transistor? Write its formula **GRW-2019 (G-I)**

(20) How Gates are used in controlling systems? **GRW-2019 (G-II)**

(21) What is the principle of virtual ground? Apply it to find the gain of an inverting amplifier. **LHR-2021 (G-I)**

(22) What is the potential barrier of silicon and germanium? **LHR-2021 (G-I)**

(23) Why ordinary silicon diodes do not emit light? **LHR-2021 (G-II)**

(24) Why a photodiode is operated in reverse biased state? **LHR-2021 (G-II)**

(25) What is the working principle of a light emitting diode? **LHR-2021 (G-II)**

SHORT QUESTIONS

(From Past Papers 2012-2019)

(Faisalabad + Sargodha + Rawalpindi + Mirpur (AJK) Boards)

(1) What is the effect of forward biasing and reverse biasing on depletion region in a semiconductor diode? **(FSD 2012, 2013 + SGD- 2013 + RWP- 2013, 2014)**

(2) If R_1 = 10kohm and R_2 = 100kohm. Find the gain of an inverting amplifier **(FSD 2013)**

(3) What is the mathematical expression of AND gate? Write its truth table. **(FSD 2014)**
(4) Write some important uses of operational amplifier. **(FSD 2014)**
(5) Give the circuit diagram and truth table of Exclusive – OR gate. **(SGD 2012)**
(6) What is current gain of a transistor? **(SGD 2013)**
(7) Find the current gain of a transistor whose collector current is 100 mA and base current is 100 μA.
(8) How operational amplifier acts as comparator? **(RWP 2012)**
(9) Define input resistance and output resistance of an operational amplifier? **(RWP 2013)**
(10) Write down the logic table and expression of NAND gate. **(SGD 2015)**
(11) What is photo diode? Why it is operated in reverse biased? **SGD 2015(G-II)**
(12) The inputs of a gate are 1 and 0. Identify the gate if its output is (a) 0, (b) 1 **FSD-2012, MIRPUR (AJK) 2015**
(13) Why ordinary silicon diodes do not emit visible light? **SGD-2013, RWP-2013, MIRPUR (AJK) 2015, FSD-2012, 2016 (G-I)**
(14) Write any two characteristics of operational amplifier. **FSD-2016 (G-I)**
(15) Draw the symbol and truth table of NOR gate. **FSD-2016 (G-I)**
(16) What is the principle of virtual ground of operational amplifier? **SGD-2016 (G-I)**
(17) Draw symbols of two types of transistors. **SGD-2016 (G-II)**
(18) The anode of a diode is 0.2V positive with respect to its cathode. Is it forward biased? **MIRPUR (AJK) 2015, RWP-2014, 2016 (G-I)**
(19) Why charge carriers are not present in the depletion region? **FSD-2014, SGD-2013, 2016(G-II), 2017 (G-I)**
(20) Why a photo-diode is operated in reverse biased? Comment. **SGD-2012, 2013, 2016 (G-II), 2017 (G-I)**
(21) Draw the symbolic diagram of NOT gate and also write its truth table. **SGD-2017 (G-I)**
(22) Define the term logic gate. Write names of fundamental gates. **SGD-2017 (G-II)**
(23) Name three basic characteristics of op-Amp. Also give their approximate values. **SGD-2017 (G-II)**
(24) What is net charge on a n-type or a p-type substance? **FSD-2013, SGD-2015, MIRPUR (AJK) 2017**
(25) Why is the base current in a transistor very small? **RWP-2012, MIRPUR (AJK) 2017, SGD-2016 (G-II), 2017 (G-II)**
(26) Write the mathematical notation and symbol for XNOR gate. **MIRPUR (AJK) 2017**
(27) What is solar cell? Give its uses. **FSD-2019 (G-I)**
(28) Write four application of photo diodes. **RWP-2019 (G-I)**

SHORT QUESTIONS

(From Past Papers 2012-2019)

(D.G Khan + Bahawalpur + Multan + Sahiwal Boards)

(1) Draw the symbolic diagram of OR Gate and write its truth table. **(MTN 2013)**
(2) What is the effect of forward and reverse biasing of a diode on the width of depletion region? **(DGK 2012)**
(3) What is an op-amplifier? Explain briefly. **(MTN 2014)**

(4) Draw circuit diagram used for full wave rectification. Show direction of current in the circuit when positive half of input A.C cycle passes through it.
DGK-2012, SWL-2013, MTN-2012, 2014

(5) Write down the truth tables of OR gate and AND gate. **DGK-2013**

(6) A transistor has I_E = 10 mA and I_B = 40 mA. Calculate current gain of transistor.
BWP-2012

(7) What is current gain of transistor? **BWP-2013**

(8) Define depletion region and potential barrier. **BWP-2014**

(9) Draw the input and output waveforms of half wave and full wave rectifier. **BWP-2014**

(10) Write down the logic expression and table for Exclusive OR Gate.
DGK 2015, MTN 2015 (G-II)

(11) What is the principle of virtual ground?

(12) Define "β" for Transistor. Also write its fundamental current equation. **BWP 2015 (G-II)**

(13) The anode of a diode is 0.2 V positive with respect to its cathodes. Is it forward biased?
MTN-2013, SWL-2016

(14) What is photodiode? Write down its any two applications. **SWL-2016**

(15) Why charge carriers are not present in the depletion region?
BWP-2014, MTN-2016 (G-I & II)

(16) What is the biasing requirement of the junctions of a transistor for its normal operation?
MTN-2016 (G-II)

(17) What is the net charge on a n-type and a p-type substance?
SWL-2013, BWP-2013, 2015, DGK-2016 (G-I), 2017 (G-I)

(18) Why ordinary silicon diode do not emit light? Explain briefly
BWP-2012, 2013, SWL-2013, DGK-2016 (G-I), MTN-2012, 2016 (G-I & II)

(19) What is OR gate? Write its truth table. **DGK-2016 (G-I)**

(20) What do you know about photo-voltaic cell? **BWP-2016 (G-I)**

(21) Give two applications of gates in control system. **SWL-2017**

(22) Draw the symbols of pnp and npn transistors. **SWL-2017**

(23) What is the net charge on a n-type or a p-type substance? **DGK-2017 (G-I)**

(24) Why is the base current in a transistor very small?
BWP-2012, 2016, DGK-2013, 2014, 2017 (G-I)

(25) How is p-n junction formed? **DGK-2017 (G-II)**

(26) Why a photodiode is operated in reversed biased state?
SWL-2016, BWP-2016 (G-I), 2017 (G-I), MTN-2016 (G-I), 2019, DGK-2017 (G-II)

(27) Why does the motion of an electron in a n-type substance differ from the motion of holes in a p-type substance? **DGK-2017 (G-II)**

(28) What do you mean by the term rectifier and rectification? **SWL-2019**

(29) Write briefly about operational amplifier. **BWP-2019 (G-II)**

(30) Write two characteristics of OP-amplifier. **DGK-2015 (G-II), MTN-2019 (G-I)**

(31) What is potential barrier? What is the value of potential barrier of silicon and Germanium? **MTN-2019 (G-II)**