		off and saturation region. Explain them.			
	b)	Illustrate the applications of Zener diode.	L3	CO4	5 M
OR					
9	a)	Explain the operation of Zener diode and Draw its V-I Characteristics.	L3	CO4	5 M
	b)	Sketch V-I characteristics of a p – n junction diode in both forward and reverse bias configurations.	L3	CO4	5 M
UNIT-V					
10	a)	Explain the operation of a simple Zener voltage regulator. How does it maintain a constant output voltage across its terminals?	L3	CO4	5 M
	b)	Draw and label the block diagram of a typical DC power supply. Explain the function of each block in the diagram.	L3	CO4	5 M
OR					
11	a)	Draw a block diagram of a Public Address (PA) system and label its key components. Explain the role of each component in the system.	L3	CO4	5 M
	b)	Illustrate various applications and uses of PA system.	L3	CO4	5 M
UNIT-VI					
12	a)	Explain about the Gray code? Provide a comparison with binary code.	L3	CO4	5 M
	b)	Deduce JK flip-flop with the help of truth table.	L4	CO5	5 M
OR					
13	a)	Explain about functionality of Logic Gates along with truth tables.	L4	CO5	5 M
	b)	Determine the following decimal numbers to Excess-3 code i) 57 ii) 472 iii) 102	L3	CO4	5 M

Code: 23ES1103

I B.Tech - I Semester – Regular/Supplementary Examinations
DECEMBER 2024

BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common for CE, ME, IT, AIML, DS)

Duration: 3 hours — Max. Marks: 70

Note: 1. This question paper contains two Parts: Part-A and Part-B.
2. Each Part contains:
- 5 short answer questions. Each Question carries 1 Mark and
- 3 essay questions with an internal choice from each unit. Each question carries 10 marks.

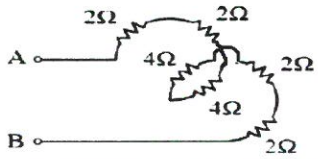
3. All parts of Question paper must be answered in one place.

BL – Blooms Level — CO – Course Outcome

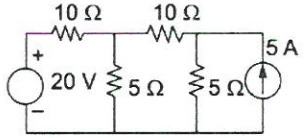
PART – A

		BL	CO
1.a)	Two resistors each of 2Ω connected in parallel. Calculate equivalent resistance.	L2	CO3
1.b)	Explain Form factor.	L2	CO1
1.c)	Explain the function of Commutator in DC Generator.	L3	CO2
1.d)	Illustrate the working principle of PMMC instrument.	L2	CO1
1.e)	Demonstrate the function of MCB.	L2	CO1

			BL	CO	Max. Marks
UNIT-I					
2	a)	Calculate the equivalent resistance between the terminals, AB in the following circuit.	L3	CO2	5 M



	b)	Illustrate the Kirchhoff's current law and Kirchhoff's Voltage law with an example of each.	L3	CO2	5 M
		OR			
3	a)	Calculate the power consumed by the each resistor in the circuit shown in Fig	L3	CO2	5 M



	b)	Describe the terms: Active power, Reactive power, Apparent power and Power factor for an AC circuit.	L2	CO2	5 M
		UNIT-II			
4	a)	Explain the construction of a DC machine with a neat diagram and required labeling.	L3	CO2	5 M
	b)	Explain the working of attraction type of moving iron instrument with a neat diagram.	L3	CO2	5 M
		OR			
5	a)	Draw the Wheatstone bridge circuit and estimate the relation for unknown resistance and known resistances.	L4	CO2	5 M
	b)	Outline the applications of i) Three Phase Induction Motor ii) Alternator.	L4	CO2	5 M
		UNIT-III			
6	a)	Illustrate the advantages of renewable energy sources than the conventional energy sources.	L3	CO2	5 M

	b)	Articulate the schematic diagram of wind power plant and explain it.	L3	CO2	5 M
		OR			
7	a)	Calculate the amount of electrical energy consumption for a month of 31 days in household of 220 V line with the following appliances being used per day: (i) Six 50W bulb for five hours. (ii) 1000W heater for 3 hours. (iii) 100W refrigerator for 24 hours. (iv) 1500W microwave oven for 4 hours. The cost of first 100 units is Rs.2.00 and next 200 units is Rs.3.90 per unit respectively.	L4	CO3	5 M
	b)	Explain what is earthing. Mention types of earthing. What are the safety precautions we should follow to avoid electric shock.	L4	CO3	5 M

PART – B

		BL	CO
1.f)	Describe various components of a Public Address system.	L2	CO4
1.g)	Demonstrate the function of Regulated Power Supply.	L3	CO4
1.h)	Construct the logic symbol and truth table for NAND gate.	L3	CO4
1.i)	Construct the block diagram of Full adder.	L3	CO4
1.j)	Mention any two applications of PN junction diode.	L2	CO4

			BL	CO	Max. Marks
		UNIT-IV			
8	a)	Construct the output characteristics of a p-n-p transistor in Common Emitter Configuration and indicate the active, cut-	L3	CO4	5 M

PVP23

Code: 23ES1103

I B.TECH – I SEM REGULAR/SUPPLEMENTARY EXAMINATIONS DEC 2024

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

(Common for CE, ME, IT, AIML, DS)

SCHEME OF VALUATION

Part - A

1 a)	Calculation of Equivalent resistance	1M
1 b)	Definition of form factor	1M
1c)	Function commutator in DC Generator	1M
1d)	Working Principle of PMMC	1M
1e)	Function of MCB	1M

2	(a)	Calculation of equivalent resistance	5M
	(b)	Statements of KVL & KCL	3M
		Explanation with example	2M
3	(a)	Calculation of currents flowing through each resistor (formulae + substitution + Result)	3M
		Calculation of power consumed by each resistor	2M
	(b)	Active Power	1M
		Reactive Power	1M
		Apparent Power	1M
		Power Factor	2M
4	(a)	Diagram and components of Construction of DC machine	3M
		Explanation	2M
	(b)	Diagram and components of Attraction type MI instrument	3M
		Explanation	2M
5	(a)	Wheatstone bridge circuit	3M
		Relation for unknown and known resistance expression	2M
	(b)	Applications of three phase induction motor (Any Three)	3M
		Applications of three phase induction alternator (Any Two)	2M
6	(a)	Advantages of renewable energy sources (Any five)	5M
	(b)	Diagram and components of wind power plant	3M
		Explanation	2M
7	(a)	Calculation of electrical energy	3M
		Calculation of amount	2M
	(b)	What is earthing	1M
		Types of earthing	1M
		Safety precautions to avoid shock (Any three)	3M

Part - B

1 f)	Components of a public address system	1M
1 g)	Function of regulated power supply	1M
1 h)	NAND gate symbol and truth table	1M
1 i)	Block diagram of Full adder	1M
1 j)	Two applications of PN junction diode	1M

8	(a)	PNP transistor in CE Configuration circuit Explanation Output characteristics	2M 1M 2M
	(b)	Applications of Zener diode (Any five)	5M
9	(a)	Diagram and operation of Zener diode V-I characteristics graph	3M 2M
	(b)	Diagram and operation of PN junction diode V-I characteristics graph	3M 2M
10	(a)	Circuit of a simple Zener voltage regulator Explanation	3M 2M
	(b)	Block diagram of a DC power supply and components Explanation	3M 2M
11	(a)	Block diagram of a PA system and components Explanation	3M 2M
	(b)	Applications and uses of PA system (Any five)	5M
12	(a)	Gray code explanation Comparison with binary code example	2M 3M
	(b)	JK flip-flop circuit Explanation Truth table	2M 1M 2M
13	(a)	Logic gates truth tables (Any four)	5M
	(b)	Decimal number to excess-3 code (i) 57 (ii) 472 (iii) 102	 1M 2M 2M

PART-A

1. a) $R_{eq} = (2*2)/(2+2) = 1\Omega$ 1M

b) Form Factor is the ratio of the RMS (root mean square) value to the average value. 1M

c) The commutator on the DC generator converts the AC into pulsating DC. Or bidirectional to unidirectional. 1M

d) When the current carrying coil is kept in the magnetic field, it experiences a force. 1M

e) The function of MCB is to protect an installation or appliance against sustained overloading and short-circuit faults. 1M

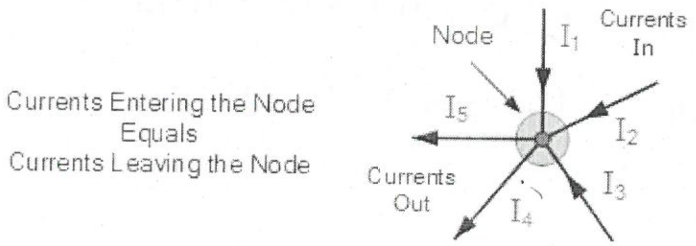
UNIT-I

2. a) All resistors are connected in series. 5M

Therefore $R_{eq}=2+2+4+4+2+2=16\Omega$

2. b) **KCL:** 3M

Kirchhoff's Current Law (KCL) states that "The algebraic sum of all currents entering and leaving a node is equal to zero."

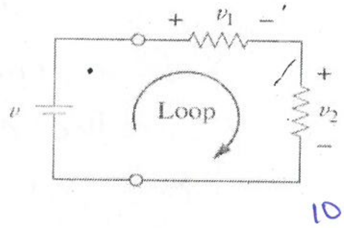


$$I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$$

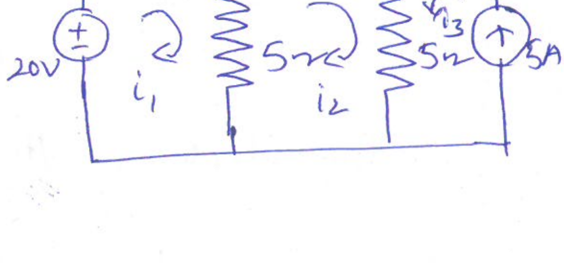
KVL: 2M

Kirchhoff's Voltage Law (KVL) states that the sum of all the voltages around a closed loop is equal to zero.

$v_1+v_2-v=0$



3. a) Applying mesh analysis 3M



KVL in mesh 1

$$20 - 10i_1 - 5(i_1 - i_2) = 0.$$

KVL in mesh 2

$$5(i_2 - i_1) + 10(i_2) + 5(i_2 + i_3) = 0.$$

In mesh 3, $i_3 = 5A$

$20 - 15i_1 + 5i_2 = 0 \rightarrow (1)$

$20i_2 - 5i_1 + 5i_3 = 0 \rightarrow (2)$

$15i_1 - 5i_2 = 20 \rightarrow (3)$

$5i_1 - 20i_2 = 25 \rightarrow (4)$

Solving (3) & (4).

$55i_2 = -55 \Rightarrow i_2 = -1A$.

substituting $i_2 = -1$ in eq (4)

$5i_1 + 20 = 25 \Rightarrow i_1 = 1A$.

$i_1 = 1A,\ i_2 = -1A\ i_3 = 5A$

Power absorbed in 10Ω = $i_1^2 R = (1)^2 \times 10 = 10\,W$. 2M

$5\Omega = (2)^2 \times 5 = 20\,W$

$10\Omega = i_2^2 R = (1)^2 \times 10 = 10\,W$

$5\Omega = (4)^2 \times 5 = 80\,W$.

3)
b) Active power :- Power consumed by resistive elements in the circuit 1M

$P = VI\cos\phi$.

Reactive power :- Power consumed by reactive elements (L & C) in the circuit 1M

$Q = VI\sin\phi$

Apparent power :- Total power consumed by the network. 1M

$S = VI^*$.

Powerfactor :- It is the cosine angle between voltage and current 2M

Powerfactor = $\cos\phi$.

4. a) Construction of a DC machine: 3M

A DC machine is a device that deals with the conversion of electrical energy to mechanical energy and vice versa and which consist of following essential parts.

1) Magnetic frame or YOKE

2) Pole cores and pole shoes

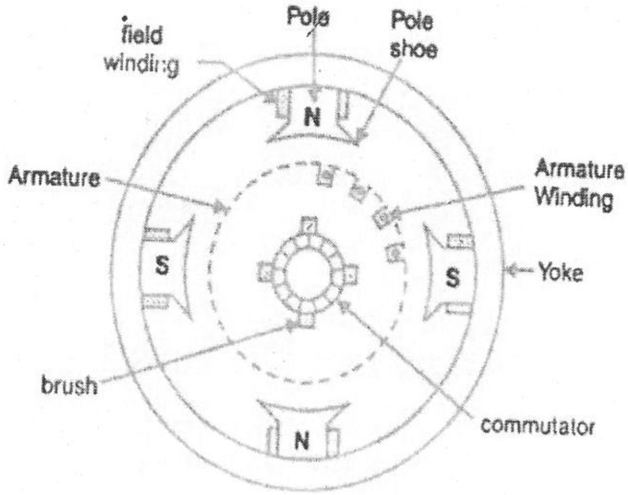
3) Field coils or pole coils or field winding

4) Armature core

5) Armature winding

6) Commutator

7) Brushes and bearings



Yoke:

1. The magnetic frame or the yoke of DC machine made up of cast iron or cast steel. 2M
2. Its main function is to form a protective covering over the inner sophisticated parts of the motor and provide support to the poles.

Pole cores and pole shoes:

1. The construction of magnetic poles basically comprises of two parts namely, the pole core and the pole shoe stacked together under hydraulic pressure and then attached to the yoke.
2. Field winding is placed on the pole core. The pole core function is to just hold the pole shoe over the yoke.

Field Winding:

1. The field winding of DC machine is made up of copper wire.
2. When the field current flows through these coils, they electro magnetize the poles which produce the necessary flux.

Armature core:

1. It houses the armature conductors or coils and causes them to rotate and hence cut the magnetic flux of the field magnets.
2. It consists of slotted soft-iron laminations that are stacked to form a cylindrical core.

Armature Winding:

1. The winding in which the EMF is induced is known as armature winding.
2. The slots of the armature core hold insulated conductors that are connected in a suitable manner. This is known as "Armature winding".

Commutator:

1. The Commutator of DC machine is a cylindrical structure made up of copper segments stacked together, but insulated from each other by mica.
2. Commutator reverses the current direction between the rotor and the external circuit.

Brushes of DC Machine:

1. The brushes of DC machine are made with carbon or graphite structures, making sliding contact over the rotating commutator.
2. The brushes are used to transfer the current from external circuit to the rotating commutator from where it flows into the armature winding.

4 b) Attraction type M.I. instrument

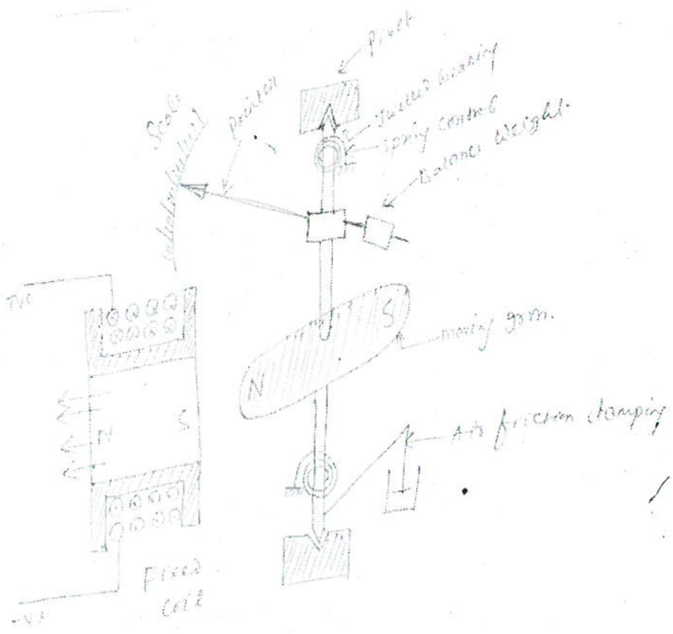
Construction:The moving iron fixed to the spindle is kept near the hollow fixed coil. The pointer and balance weight are attached to the spindle, which is supported with jeweled bearing. Here air friction damping is used.

2M

Principle of operation

The current to be measured is passed through the fixed coil. As the current is flow through the fixed coil, a magnetic field is produced. By magnetic induction the moving iron gets magnetized. The north pole of moving coil is attracted by the south pole of fixed coil. Thus the deflecting force is produced due to force of attraction. Since the moving iron is attached with the spindle, the spindle rotates and the pointer moves over the calibrated scale. But the force of attraction depends on the current flowing through the coil.

3M

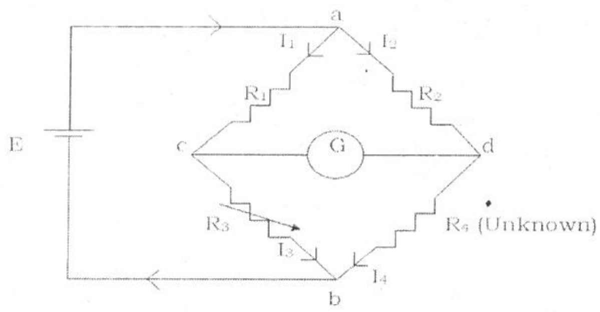


5 a) Wheat stone Bridge:

Wheatstone bridge is used to measure the unknown resistance of a resistor

The circuit diagram of Wheatstone Bridge is shown in figure. The four arms of the bridge ac, ad, cb and db contains the four resistors R1, R2, R3 and R4 respectively. G is a galvanometer or the null detector. E is the source of EMF.

3M



I_1, I_2, I_3 and I_4 are the currents through the resistors R_1, R_2, R_3 and R_4, respectively.

When the current through galvanometer is zero, at that time terminals c and d are said to be at same potential with respect to point „a" i.e.,

$$E_{ac} = E_{ad}$$

Hence the currents $I_1 = I_3$ and $I_2 = I_4$. This is called the balance of thebridge. And for this condition, we can write,

2M

$$I_1R_1 = I_2R_2$$

Where $I_1=I_3=E/(R_1+R_3)$ and $I_2=I_4=E/(R_2+R_4)$

Substituting the values of I_1 and I_2

We get $R_1R_4=R_2R_3$

The above equation is called the balance equation(condition) of the bridge. Here, if R4 is an unknown resistor, then its resistance R_X can be measured using the equation.

$$R_1R_X=R_2R_3$$

$$R_X = (R_2R_3)/R_1$$

5. b)

3M

Three phase Induction motors Applications:

Lifts, Cranes, Hoists, Large exhaust fans, Lathe machines, Crushers, Oil extracting mills, Textiles, Commercial electric, Hybrid vehicles, Jaw mills.

Alternators Applications:

2M

Automobiles, Electrical power generator plants, Marine applications, Diesel electrical multiple units, Radiofrequency transmission, Emergency communication and lightning, Backup power supply.

6. a) Advantages of renewable energy sources than the conventional energy sources. (Any five) 5M

i) Renewable sources of energy are abundantly available in nature.

ii) Renewable sources of energy are replenished continuously by natural process.

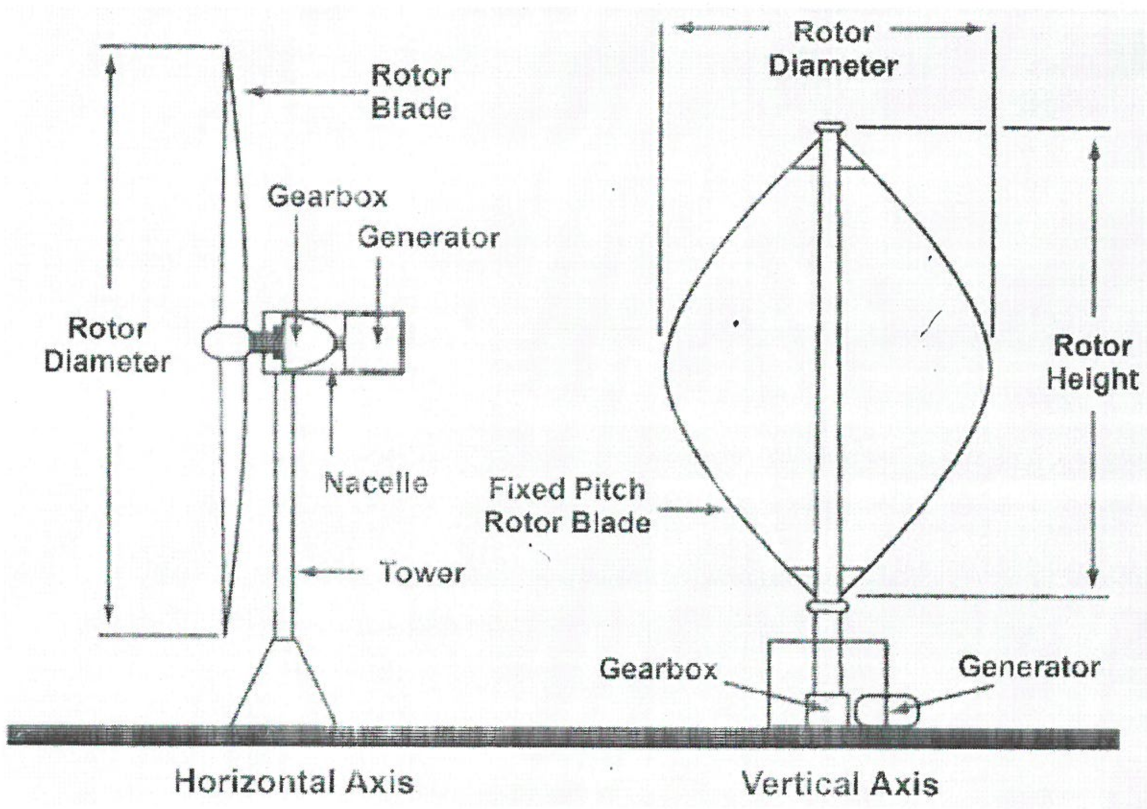
iii) Renewable energy sources cannot be exhausted completely.

iv) Renewable energy sources do-not pollute the environment.

v) Operating cost is less

Examples: Solar, Wind, Tidal, Geo-thermal etc.

6. b) 3M



Following are the different **parts of the wind turbine**:

1. Blades
2. The rotor
3. Nacelle
4. A gearbox and coupling (transmission system)
5. Aero turbine
6. Controller
7. Electrical generator
8. Supporting structure.

1. Blade 2M

Lifting-style wind turbine blades are used. These are designed most efficiently, especially to capture the energy of strong, fast winds.

2. The Rotor

The rotor is aerodynamically designed to occupy the maximum surface area of the wind to spin the most ergonomically.

3. Nacelle

A housing that contains all the components which are essential to operate the turbine efficiently is called a nacelle. Nacelle provides housing for:

1. Low-speed shaft
2. Brake
3. Gearbox
4. High-speed shaft
5. Generator
6. Anemometer
7. Wind vane.

4 Gearbox and Coupling (Transmission System)

A gearbox magnifies or amplifies the energy output of the rotor. The gearbox is located directly between the rotor and the generator. A rotor rotates the generator as directed by the tail vane.

5 Aero turbine

Aero turbine converts wind energy into rotary mechanical energy.

6 Controller

The controller realizes the wind direction wind speed output of the generator rotor and other required performance quantities of the system and initiates appropriate control signals to take appropriate corrective action.

7 Electrical Generator

This unit produces electricity from the rotation of the rotor. The generator comes in various sizes with respect to the output. This generator converts mechanical energy into electrical power. The output of the generator is coupled to the load or system grid.

8 Supporting Structure

This is the heavy structure set up with a proper foundation and carries all the components of the windmill. It should be properly designed with a proper factor of safety to withstand a dead load of all components and wind force.

Working of Wind Power Plant

The wind turbines or wind generators use the power of the wind which they turn into electricity. The speed of the wind turns the blades of a rotor (between 10 and 25 turns per minute), a source of mechanical energy. The rotor then turns on a generator that converts mechanical energy into electricity.

As the wind blows, a wind turbine converts the kinetic energy of the wind's motion into mechanical energy by the rotation of the rotor, and this mechanical energy is transmitted by the shaft to the generator through the gear train. The generator converts this mechanical energy into electrical energy, thereby generating electricity. A wind turbine is connected to the electricity network via a transformer located at the base of the structure.

7. a) 3M

(i) Electrical Energy Consumed by bulb = 6 X 50 X 5
= 1500 wh

(ii) Electrical Energy Consumed by heater = 1000 X 3
= 3000 wh

(iii) Electrical Energy Consumed by refrigerata = 100 X 24
= 2400 wh

(iv) Electrical Energy Consumed by Microwave Oven
$= 1500 \times 4 = 6000 \, wh$

Total Electrical Energy Consumption by the all appliance
$= 1500 + 3000 + 2400 + 6000$
$= 12900 \, wh$
$= 12.9 \, kwh/day$

Consumption for a month of 31 days =
$12.9 \times 31 = 399.9 \, kwh$
$= 399.9$ units

2M

Given the cost of first 100 unit is Rs. 2.00
∴ for first 100 units, amount $= 100 \times 2$
$= 200$ Rs

∴ for the Remaining units, amount $= 299.9 \times 3.90$
$= 1169.61$ Rs

Total Cost (or) amount of Electrical Energy
Consumption $= 200 + 1169.61$
$= 1369.61$ Rs

7. b) Earthing: 1M

Earthing is defined as "the process in which the instantaneous discharge of the electrical energy takes place by transferring charges directly to the earth through low resistance wire."

Types of Earthing 1M

There are three types of earthing, they are:

- Pipe earthing
- Plate earthing
- Strip earthing

Safety Precautions to avoid electric shock: 3M

1. Always turn off the power source before starting any electrical work. This includes turning off the circuit breaker or unplugging the device.
2. Wear personal protective equipment (PPE) such as safety glasses, rubber gloves, and non-conductive shoes.
3. Use tools that are specifically designed for electrical work and ensure they are in good condition.
4. Avoid working in wet or damp conditions or with wet hands.
5. Do not touch electrical parts or wires with bare hands, use tools or gloves instead.
6. Keep your work area clean and free from any flammable or combustible materials.
7. Always follow proper wiring procedures, and use proper insulation techniques.
8. Do not work on live circuits, even if you are experienced.
9. Make sure that any electrical work is done according to local codes and regulations.
10. If you are unsure of what to do, consult with a qualified electrician or seek professional advice.

PART-B

1. **f)** Components of Public Address System 1M

   i) Microphone

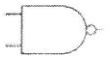
   ii) Amplifier

   iii) Loud Speaker

g) The Function of Regulated Power Supply is to convert unregulated alternating current into a stable direct current by using a rectifier. 1M

h) NAND gate: 1M

NAND



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

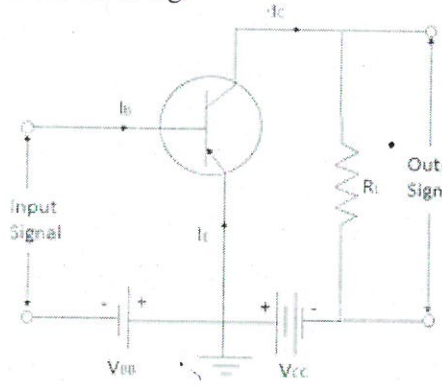
i) 1M

j) Applications of PN junction diode: Half wave rectifier, Full wave rectifier, Switch, Clippers and Clampers. 1M

UNIT-IV

8. a) In this configuration, the input is applied between the base and the emitter and the output is taken from the collector and the emitter. In this connection, the common emitter is common to both the input and the output circuits as shown in fig.

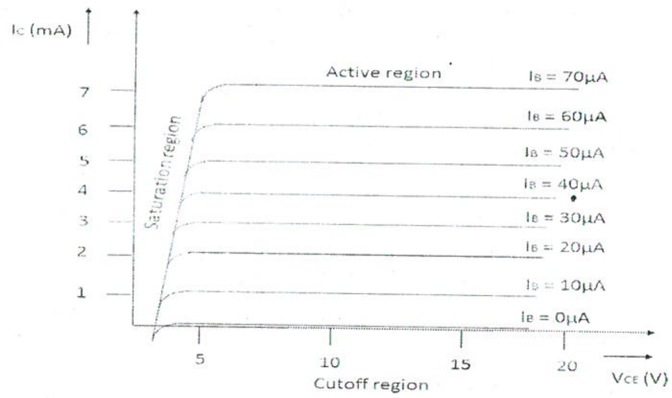
2M



PNP transistor

Output Characteristics:

2M



It is a curve that shows the relationship between the collector I_C and the collector-emitter voltage V_{CE}.

A suitable base current I_B is maintained. V_{CE} is increased in a number of steps from zero and the corresponding values of I_C are noted. It is repeated for different values of I_B then they are plotted as shownin the fig.

The output resistance is less than the common base configuration. It is equal to

$$\text{Output resistance, } r_o = \frac{\Delta V_{CE}}{\Delta I_C} \text{ at constant } I_B$$

The following points may be noted from the family of characteristic curves. 1M

1. The collector current I_C increases rapidly to a saturation level for fixed value of I_B but at the same time V_{CE} increases from zero.
2. A small amount of collector current flows even when $I_B = 0$. The current is called I_{CEO}. Now main collector current is zero and the transistor is cut-off.
3. The output characteristic may be divided into three regions.
   1. Active region
   2. Cut-off region
   3. Saturation region

Active region:

In this region the collector is reverse biased and the emitter is forward biased. The collector current I_c response is the most sensitive for changes in I_B. Only in this region, the emitter acts as a linear one.

Cut-off region:

The region below the curve for $I_B = 0$ is called cut-off region. In this region both junctions are reverse biased.

Saturation region:

The region curves to the left of line is called saturation region. In this region both the junctions are forward bias and incremental change in $I_B$do not produce corresponding large changes in I_C The ratio of $V_{CE}$to I_C at any point in this region is called saturation region.

8. b) Applications of Zener diode

Any five 5M

- **Voltage regulation and stabilization** in power supplies.
- **Overvoltage protection** and **surge protection**.
- **Voltage reference source** for accurate voltage measurement.
- **Clipping and clamping circuits** to limit voltage levels.
- **Current limiting** and **current regulation** in circuits.
- **Temperature sensing** and **compensation** in some specific applications.
- **Switching** and **voltage-dependent triggering** for electronic circuits.
- **Noise filtering** to suppress electrical spikes and disturbances.

9. a) Operation of Zener diode:

Zener diode Characteristics:

3M

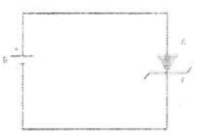
Zener diode is nothing but the heavily doped PN junction diode.

There are three biasing conditions for Zener junction diode and this is based on the voltage applied:

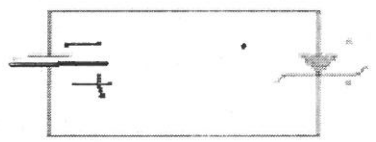
Zero bias: There is no external voltage applied to the Zener junction diode.

Forward bias: The positive terminal of the voltage potential is connected to the p-type while the negative terminal is connected to the n-type.

Reverse bias: The negative terminal of the voltage potential is connected to the p-type and the positive is connected to the n-type.



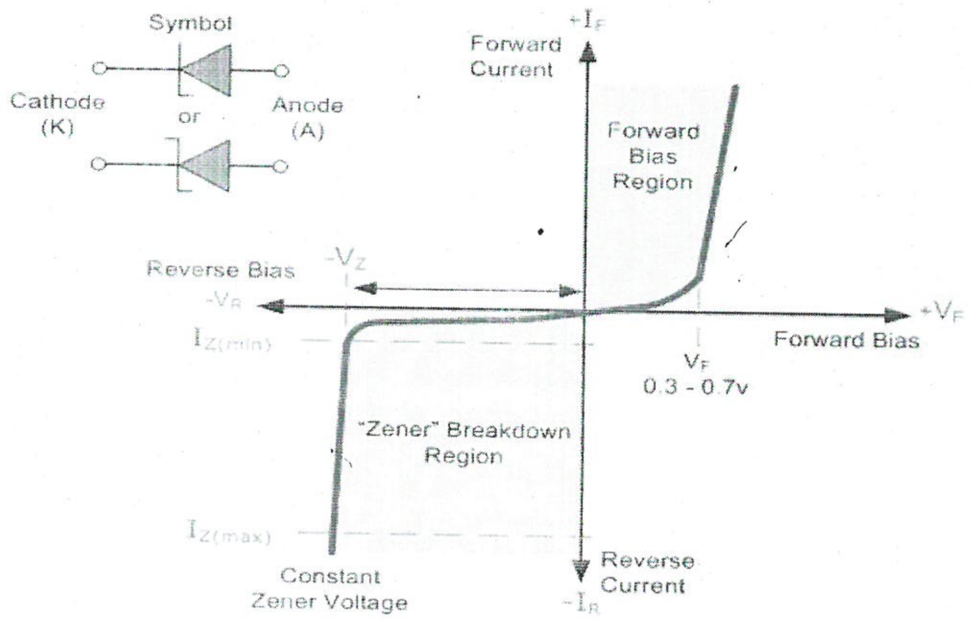
Forward bias of Zener Diode



Reverse biased zener diode

A graph of current through vs the voltage across the device is called the **characteristic of Zener diode**. The first quadrant is the forward biased region. Here the Zener diode acts like an ordinary diode. When a forward voltage is applied, current flows through it. But due to higher doping concentration, higher current flows through the Zener diode.

Zener Diode I-V Characteristics



In the third quadrant, the magic happens. The graph shows the current vs voltage curve when we apply a reverse bias to the diode. The Zener breakdown voltage is the reverse bias voltage after which a significant amount of current starts flowing through the Zener diode. Here in the diagram, V_Z refers to the Zener breakdown voltage. Until the voltage reaches Zener breakdown level, tiny amount of current flows through the diode.

Once the reverse bias voltage becomes more than the Zener breakdown voltage, a significant amount of current starts flowing through the diode due to Zener breakdown. The voltage remains at the Zener breakdown voltage value, but the current through the diode increases when the input voltage gets increased.

9. b) P-N Junction Diode:

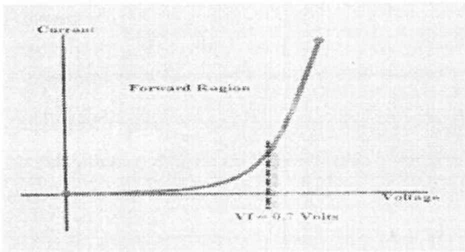
In a piece of a semiconductor, if one half of is doped by p-type and the other half is doped by n- type impurities, P-N junction (diode) is formed. The n- type has high concentration of free electrons. The p-type has high concentration of holes. At the junction diffusion takes place. There are three biasing conditions for p-n junction diode and this is based on the voltage applied:

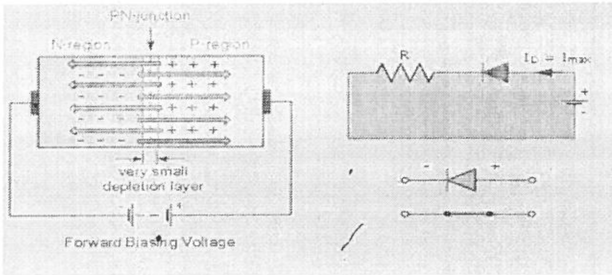
Zero bias: There is no external voltage applied to the p-n junction diode.

Forward bias: The positive terminal of the voltage potential is connected to the p-type while the negative terminal is connected to the n-type.

Reverse bias: The negative terminal of the voltage potential is connected to the p-type and the positive is connected to the n-type.

Forward Bias

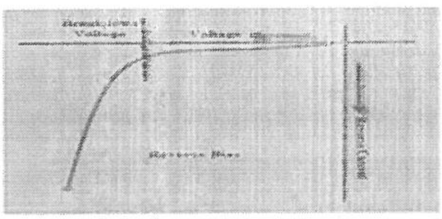


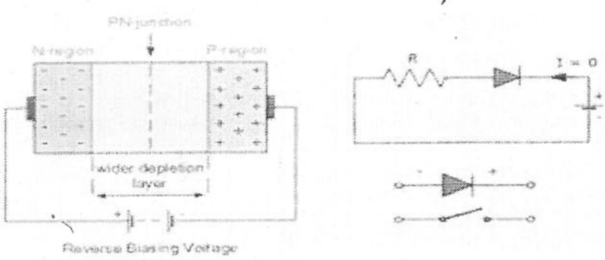


When a diode is connected in a **Forward Bias** condition, a negative voltage is applied to the N-type material and a positive voltage is applied to the P-type material. If this external voltage becomes greater than the value of the potential barrier, approx. 0.7 volts for silicon and 0.3 volts for germanium, the potential barriers opposition will be overcome and current will start to flow. This is because the negative voltage pushes or repels electrons towards the junction giving them the energy to cross over and combine with the holes being pushed in the opposite direction towards the junction by the positive voltage. This results in a characteristics curve of zero current flowing up to this voltage point, called the "knee" on the static curves and then a high current flow through the diode with little increase in the external voltage as shown above.

Reverse Bias:

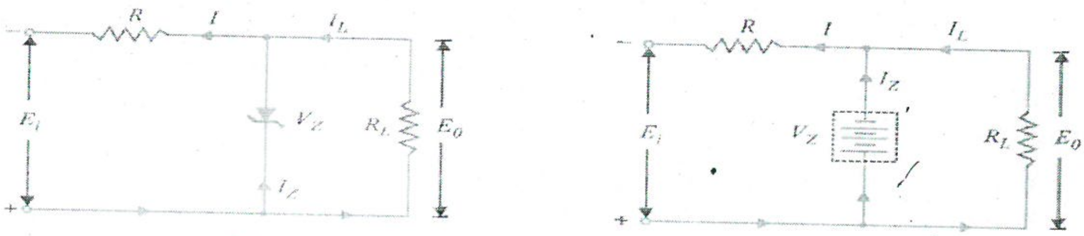
When a diode is connected in a **Reverse Bias** condition, a positive voltage is applied to the N-type material and a negative voltage is applied to the P-type material. The positive voltage applied to the N-type material attracts electrons towards the positive electrode and away from the junction, while the holes in the P-type end are also attracted away from the junction towards the negative electrode. The net result is that the depletion layer grows wider due to a lack of electrons and holes and presents a high impedance path, almost an insulator. The result is that a high potential barrier is created thus preventing current from flowing through the semiconductor material.





UNIT-V

10. a) Working of Zener diode as a voltage regulator: 3M



(i) (ii)

A Zener diode can be used as a voltage regulator to provide a constant voltage from a source whose voltage may vary over sufficient range. The circuit arrangement is as shown in figure (i). The Zener diode of Zener voltage V_z is reverse connected across the load R_L across which constant output is desired. The series resistance R absorbs the output voltage fluctuations so as to maintain constant voltage across the load. It may be noted that the Zener will maintain a constant voltage V_z (=E_O) across the load so long as the input voltage does not fall below V_z.

2M

When the circuit is properly designed, the load voltage E_O remains essentially constant even though the input voltage E_i and load resistance R_L may vary over a wide range.

(i) Suppose the input voltage increases. It is clear that output voltage remains constant at V_Z. The excess voltage is dropped across the series resistance R. This will cause increase in the value of total current I. The Zener will conduct the increase of current in I while the load current remains constant. Hence, output voltage E_O remains constant irrespective of the changes in the input voltage E_i.

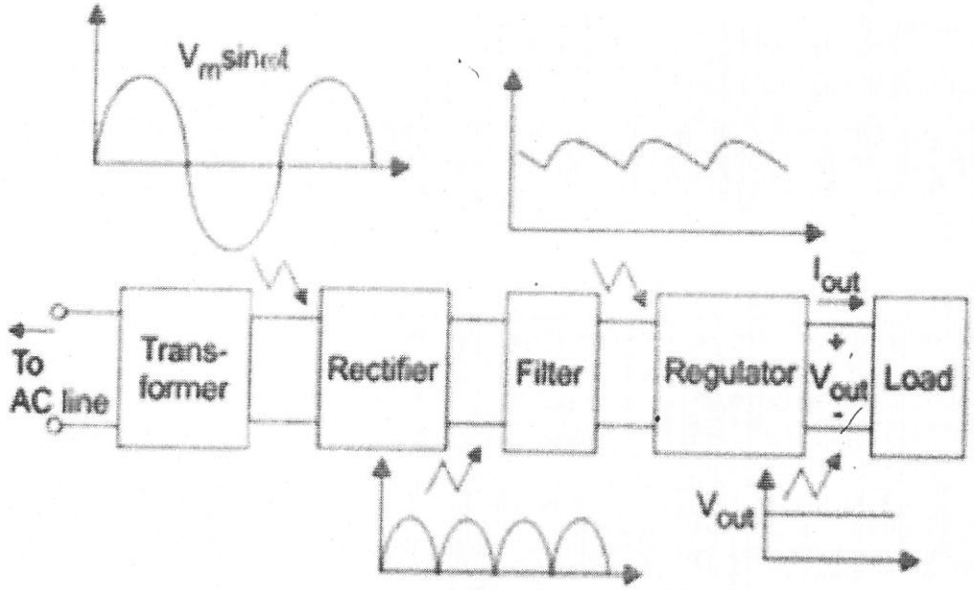
(ii) Now suppose that input voltage is constant (supply current I is constant) but the load resistance R_L decreases. This will cause an increase in load current. The additional current will come from a decrease in Zener current I_Z by maintain supply current I constant. Similarly, if load R_L increases then load current I_L will be decreases, absorbed by the Zener diode by increasing its Zener current I_Z by maintain supply current I constant. Consequently, the output voltage stays at constant value if load resistance varies.

10. b) Regulated power supply:

A regulated power supply can convert unregulated an AC (alternating current or voltage) to a constant DC (direct current or voltage). A regulated power supply is used to ensure that the output remains constant even if the input changes.

The regulated power supply will accept an AC input and give a constant DC output. Figure below shows the block diagram of a typical regulated DC power supply.

3M



Components of typical linear power supply

The basic building blocks of a regulated DC power supply are as follows:

1. A step down transformer
2. A rectifier
3. A DC filter
4. A regulator

Step Down Transformer 2M

A step down transformer will step down the voltage from the ac mains to the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit.

Rectification

Rectifier is an electronic circuit consisting of diodes which carries out the rectification process. Rectification is the process of converting an alternating voltage or current into corresponding direct (DC) quantity. The input to a rectifier is ac whereas its output is unidirectional pulsating DC.

DC Filtration

The rectified voltage from the rectifier is a pulsating DC voltage having very high ripple content. But this is not we want; we want a pure ripple free DC waveform. Hence a filter is used.

Regulation

This is the last block in a regulated DC power supply. The output voltage or current will change or fluctuate when there is change in the input from ac mains or due to change in load current at the output of the regulated power supply or due to other factors like temperature changes. This problem can be eliminated by using a regulator. A regulator will maintain the output constant even when changes at the input or any other changes occur.

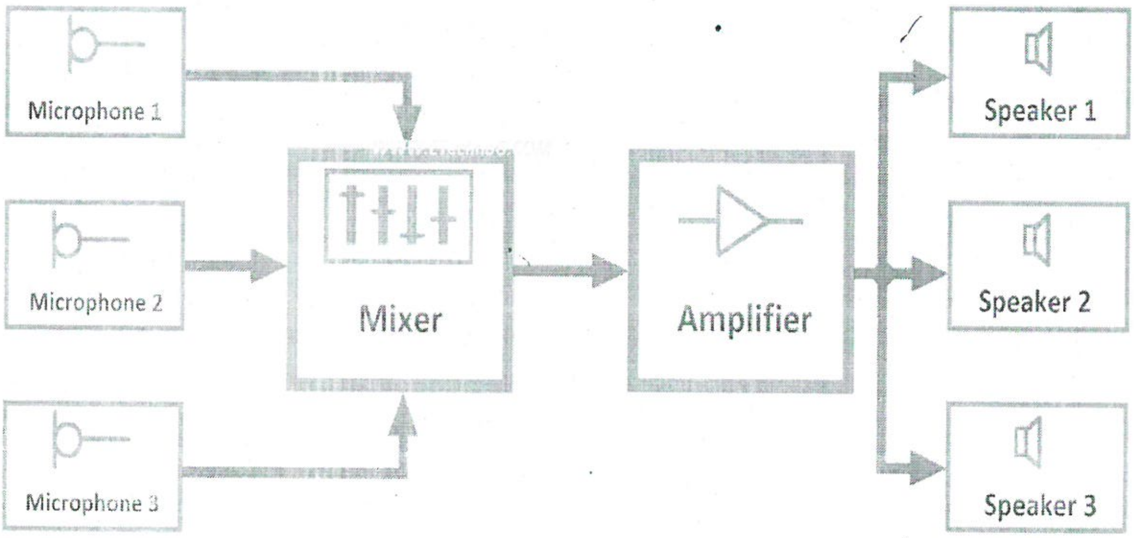
11. a) Public Address System:

3M

A public Address System or PA system is an electronic system that includes acoustic signal converting, mixing, amplifying, and playing. A PA system has microphones, amplifiers, and loudspeakers as its main components or equipment.

Basic Block Diagram of PA System

Here, you can see the public address system block diagram and its important blocks.



Components of a PA System

There are so many devices or components are used in PA system that depends upon their applications and other factors. But the main three components of any public address system are explained below.

1. Microphone

2M

The microphone is a very important part or component of a PA system. The microphone basically is a transducer that converts acoustic energy or sound energy into electrical energy. It continuously generates the pulsating electrical voltage according to the frequency of the sound energy applied to it. Various types of microphones are used in the PA system. The main basic two types of microphones are,

1. Handheld Microphone
2. Lapel Microphone

Other different types of microphones are,

- Wired Microphone
- Wireless Microphone

2. Amplifier

The amplifier is the second part of a PA system. The main function of the amplifier is to amplify or increase the volume level of the audio signal that can drive a loudspeaker. The requirement or size of the amplifier depends upon the number and size of the loudspeaker.

3. Loud Speaker

Loudspeakers play a very important role in the PA system. It converts electrical energy into acoustic energy or sound energy. The loudspeakers are generally connected to the amplifier and it generates sound according to the audio signal provided by the amplifier.

4. Mixer

A mixer is not a necessary part of a PA system. But if there are multiple audio sources or multiple microphones used in the PA system then a mixer is must require. The mixer is an electronic device that can control multiple sound sources simultaneously. It can mix all the sound sources together and play with a single loudspeaker with the help of an amplifier.

11. b) Applications and Uses of PA System Any five 5M

1. The PA system is used in group meetings, presentations, concerts, theaters, large halls, etc.

2. PA systems are also used in sports, stadiums, travel systems, security systems, conference systems, etc

12 (a) Gray code or cyclic Code:- 2M

The code which exhibits only a single bit change from one number to number is known as gray code or cyclic code.

Advantages:-

→ Better for reducing errors while converting analog to digital.
→ It can be used to reduce the size of the logic ckt.
→ useful in clock domain crossing

Comparision:- 3M

Decimal Code	BCD code	Gray code
0	0000	0000
1	0001	0001
2	0010	0011
3	0011	0010
4	0100	0110
5	0101	0111
6	0110	0101
7	0111	0100
8	1000	1100
9	1001	1101

→ Conversion from Binary to Gray:-

→ The most significant bit (MSB) of the Gray code is the same as the MSB of the binary number

→ Each subsequent bit in the Gray code is obtained by XORing the corresponding bit of the binary number with the previous bit of the binary number

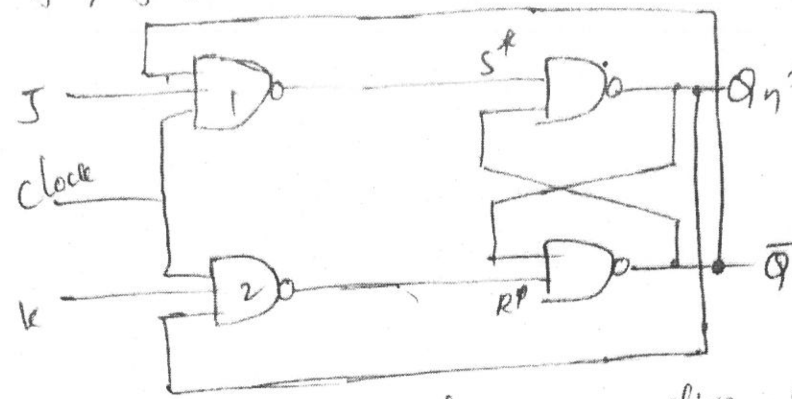
Ex:- Binary: 1→0→1→1

↓

Gray 1 1 1 0

12 (b) J-K flip-flop

2M



Case (i) :- when Clock is low irrespective of J & K 1M
$\Rightarrow S^*=1,\ R^*=1$ It act like memory

Case (ii) :- when Clock is high Clk = 1

(a) Clk=1, J=0, K=0
① & ② output of NAND are high $S^*=1, R^*=1$
$\Rightarrow$ it act like a memory

(b) Clk=1, J=0 & K=1 then $S^*=1, R^*=0$ (If $Q_n=0$
$\Rightarrow Q_{n+1}=0,\ \bar{Q}_{n+1}=1$

It acts as SR flip flop

(c) If clk=1, J=0, K=1 assume $Q_n=1 \Rightarrow \bar{Q}_n=0$
$S^*=1, R^*=0 \Rightarrow \bar{Q}_n=0, Q_n=1$

(d) If Clk=1, J=1, K=1 assume $Q_n=0 \Rightarrow \bar{Q}_n=1$
$S^*=0, R^*=1, \Rightarrow \bar{Q}_n=0, Q_n=1$

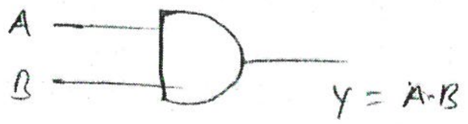
(d) If Clk=1, J=1, K=0, $R^*=1, S^*=0$ (assume $\bar{Q}_n=1$)
then $Q_{n+1}=1,\ \bar{Q}_{n+1}=0$

2M

Clock	J	K	Q_{n+1}	$\bar{Q}_{n+1}$	
Low	x	x	Q_n	$\bar{Q}_n$	→ Memory
high	0	0	Q_n	$\bar{Q}_n$	→ memory
	0	1	0	1	→ Reset
	1	0	1	0	→ set
	1	1	$\bar{Q}_n$	Q_n	→ Racing

13 (a) Logic Gates (Any four 5M)

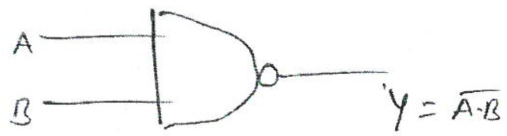
(i) AND Gate



Truth table

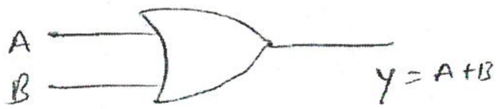
A	B	Y=A·B
0	0	0
0	1	0
1	0	0
1	1	1

(ii) NAND Gate



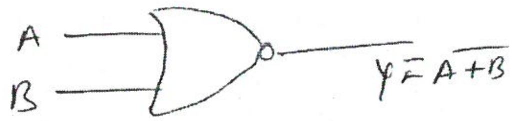
A	B	Y=$\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
0	0	0

(iii) OR Gate



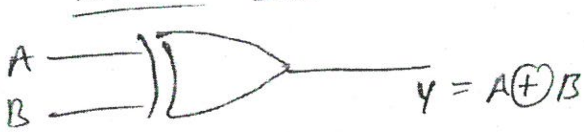
A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1.	1	1

(iv) NOR Gate



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

(v) EX-OR Gate



A	B	Y=A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

(vi) EX-NOR Gate

A	B	Y=A⊙B
0	0	1
0	1	0
1	0	0
1	1	1

(vii) NOT Gate

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

13 (b) Decimal numbers to Excess-3 Code:

(i) 5 7

+3 +3

8 10

$\Rightarrow$ (1000 1010)$_{Excess-3}$ 1M

(ii) 4 7 2

+3 +3 +3

$\Rightarrow$ (0111 1010 0101)$_{Excess-3}$ 2M

(iii) 1 0 2

+3 +3 +3

$\Rightarrow$ (0100 0011 0101)$_{Excess-3}$ 2M