OR					
9	a)	With a neat sketch outline the input and output characteristics of a transistor in common Emitter (CE) configuration.	L3	CO5	5 M
	b)	Briefly explain the operation of a small signal CE amplifier.	L2	CO4	5 M
UNIT-II					
10	a)	Draw the block diagram of Electronic Instrumentation System and explain the function of each block.	L3	CO4	5 M
	b)	Briefly explain the Working of Common Emitter (RC coupled) Amplifier with proper circuit and wave forms.	L2	CO5	5 M
OR					
11	a)	What is a Capacitor Filter? Analyze the importance of Capacitor Filter in a Full Wave Rectifier?	L4	CO4	5 M
	b)	Explain briefly about the following: i) A step down transformer ii) A rectifier iii) A DC filter iv) A regulator	L3	CO5	5 M
UNIT-III					
12	a)	Expand $A+B\overline{C}+AB\overline{D}+ABCD$ to min terms and max terms.	L4	CO5	5 M
	b)	Write the truth tables of SR, T and D-flip flop.	L2	CO5	5 M
OR					
13	a)	Realize half adder using 2 input EX-OR gate.	L4	CO5	5 M
	b)	Analyze EX-OR and EX-NOR logic gates functionality with truth tables.	L2	CO4	5 M

Code: 23ES1202

I B.Tech - II Semester – Regular / Supplementary Examinations
MAY 2025

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

(Common for EEE, ECE, CSE)

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.

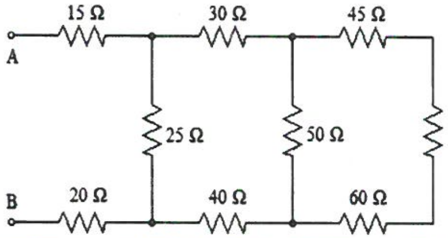
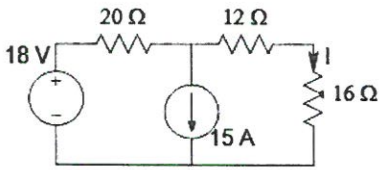
3. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	State ohm's law.	L1	CO1
1.b)	Explore the Significance of Measurement System.	L2	CO2
1.c)	Write any three applications of a DC Motor.	L1	CO2
1.d)	Define unit of Electrical Energy.	L2	CO3
1.e)	What is the function of Fuse?	L1	CO3

			BL	CO	Max. Marks
UNIT-I					
2	a)	Obtain the expression for equivalent resistance of 2 resistors connected in i) series and ii) parallel.	L3	CO2	5 M
	b)	For an AC Voltage of V = 300 Sin (314t) Volts, determine (i) Average Value (ii) RMS Value (iii) Peak Factor (iv) Form Factor (v) Frequency (vi) Time Period.	L3	CO2	5 M
OR					

3	a)	Find the equivalent Resistance between terminals A and B shown in Fig.  	L3	CO3	5 M
	b)	Find the current through 16Ω resistor using the superposition theorem for the circuit shown in the figure.  i. Write the statement of superposition theorem ii. Calculate the current through 16 Ω due to 18V source alone acting, with 15A current source not included. iii. Calculate the current through 16 Ω due to 15A source alone acting, with 18 V voltage source not included. iv. Find the total or actual current in the 16 Ω resistor when both 18 V and 15A sources acting.	L3	CO3	5 M
		UNIT-II			
4	a)	Describe the Construction and working principle of an Induction Motor with a neat sketch.	L3	CO2	5 M
	b)	With neat sketch, explain the measurement of unknown resistance using Wheatstone bridge.	L3	CO2	5 M

		OR			
5	a)	Explain the following parts of the Alternator with a neat sketch. (i) Stator (ii) Rotor	L3	CO2	5 M
	b)	Illustrate the construction and working principle of the Attraction Type MI Meter with a neat diagram.	L3	CO2	5 M
		UNIT-III			
6	a)	Explain Layout and operation of Wind power generating station.	L3	CO2	5 M
	b)	What are merits and de-merits of Miniature Circuit Breaker (MCB).	L3	CO3	5 M
		OR			
7	a)	Explain the need of earthing. List the types of earthing.	L2	CO3	5 M
	b)	What is an electric shock? How to prevent electric shock at home?	L3	CO3	5 M

PART – B

		BL	CO
1.f)	What is the difference between conductors and semiconductors?	L1	CO1
1.g)	Explain the operation of an NPN transistor.	L2	CO1
1.h)	State the function of an amplifier.	L1	CO5
1.i)	What are universal gates represent with symbols?	L1	CO4
1.j)	List any two basic properties of Boolean algebra.	L2	CO4

			BL	CO	Max. Marks
		UNIT-I			
8	a)	With a neat sketch outline the input and output characteristics of a transistor in common base (CB) configuration.	L3	CO5	5 M
	b)	With a neat sketch explain the characteristics of a PN Diode.	L2	CO4	5 M

PVP23

Code: 23ES1202

I B.TECH – II SEM REGULAR/SUPPLEMENTARY EXAMINATIONS MAY 2025

BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common for EEE, ECE, CSE)
SCHEME OF VALUATION

Duration :3 hours **Max.Marks:70**

Part - A

1 a)	State ohms law	1M
1 b)	Significance of Measurement System	1M
1c)	Any 3 applications of DC Motor	1M
1d)	Unit of Electrical Energy	1M
1e)	Function of Fuse	1M

2	(a)	Expression for equivalent resistance in series Expression for equivalent resistance in parallel	2.5M 2.5M
	(b)	Calculation of Average value Calculation of RMS Value Calculation of Peak Factor, Form Factor Calculation of Frequency Calculation of Time period	1M 1M 1M 1M 1M
3	(a)	Calculation of equivalent resistance for the given circuit	5M
	(b)	(i) Superposition Theorem statement (ii) Current calculation with only 18V source (iii) Current calculation with only 15A source (iv) Current calculation with both 18V & 15A sources	2M 1M 1M 1M
4	(a)	Construction of Induction Motor Working principle of Induction Motor	3M 2M
	(b)	Wheatstone bridge circuit Relation for unknown and known resistance expression	3M 2M
5	(a)	Sketch of Alternator construction Explanation of Stator in Alternator Explanation of Rotor in Alternator	1M 2M 2M
	(b)	Diagram and components of Attraction type MI instrument Explanation	3M 2M
6	(a)	Diagram and components of wind power plant Explanation	3M 2M
	(b)	Merits of MCB Demerits of MCB	3M 2M
7	(a)	Need of Earthing Types of Earthing	2M 3M
	(b)	Electric shock Safety precautions to avoid shock (Any 4)	1M 4M

Part - B

1 f)	Any1 difference between conductor and semiconductor	1M
1 g)	Operation of NPN transistor	1M
1 h)	Function of amplifier	1M
1 i)	Universal gates with symbols	1M
1 j)	Any 2 basic properties of Boolean Algebra	1M

8	(a)	PNP/NPN transistor in CB Configuration circuit Explanation Input & Output characteristics	2M 1M 2M
	(b)	Diagram and operation of PN diode V-I characteristics graph	3M 2M
9	(a)	PNP/NPN transistor in CE Configuration circuit Explanation Input & Output characteristics	2M 1M 2M
	(b)	Diagram of small signal amplifier Operation	3M 2M
10	(a)	Block diagram of Electronic Instrumentation system Explanation	3M 2M
	(b)	Diagram of Common Emitter RC coupled amplifier Operation Waveforms	2M 2M 1M
11	(a)	Capacitor Filter Diagram of capacitor filter in full wave rectifier Explanation of capacitor filter in full wave rectifier	1M 2M 2M
	(b)	i) Step down Transformer explanation ii)Rectifier explanation iii) DC Filter explanation iv)Regulator explanation	2M 1M 1M 1M
12	(a)	Min terms representation Max terms representation	2.5M 2.5M
	(b)	Truth table of SR flip-flop Truth table of D flip-flop Truth table of T flip-flop	2M 1.5M 1.5M
13	(a)	Half Adder Block diagram Truth Table of Half Adder Expressions for Sum, Carry Logic circuit using EX-OR gate	1M 1M 1M 2M
	(b)	EX-OR gate Truth table & functionality EX-NOR gate Truth table & functionality	2.5M 2.5M

PART-A

1. a) Ohms law states that at constant temperature the electrical current flowing through the conductor is directly proportional to voltage applied across it.

b) A measurement system is essential for collecting accurate and consistent data.

c) Fans, mixers, vacuum cleaners

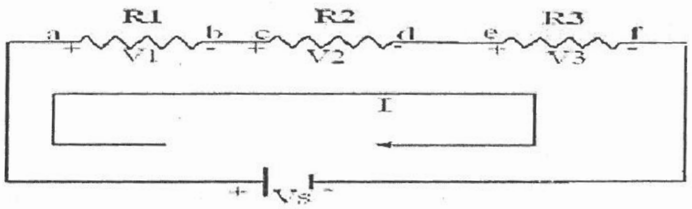
d) The unit of electrical energy is the kilowatt-hour (kWh) in practical usage, and the joule (J) in the SI.

e) The function of Fuse is to interrupt the flow of excessive current in an Electric circuit

UNIT I

2. a) Resistances in Series:

The circuits in which resistances are connected end to end so that the same current flows through all the resistances is called a series circuit as shown in the figure.



According to the KVL in the above circuit

$$Vs = V_1+V_2+ V_3$$

$$V_1 = IR_1 \quad V_2 = IR_2 \quad V_3 = IR_3$$

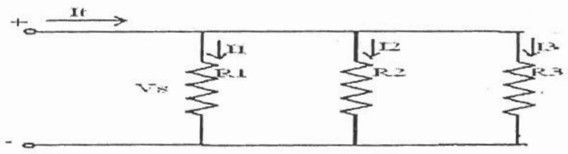
$$V_s = IR_1 + IR_2 + IR_3 = (R_1 + R_2 + R_3)$$

$$V_s = IR_{eq}$$

$$R_{eq} = R_1 + R_2 + R_3$$

Resistances in parallel:

When one end of each resistance is joined to a common point and the other end of each resistance is joined to another common point so that there are many paths for current flow as the number of resistances, it is called a parallel circuit.



$$I_t = I_1+I_2+I_3$$

The same voltage is applied across each resistor. By applying ohm"s law the current in each branch is given by

$$I_1 = V_s/R_1,\ I_2 = Vs/R_2,\ I_3 = V_s/R_3$$

accordingly to Kirchhoff"s current law

$$I_t = I_1+I_2+I_3$$

$$\frac{V_s}{R_{eq}} = \frac{V_s}{R_1} + \frac{V_s}{R_2} + \frac{V_s}{R_3}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

UNIT-I

2.b) Given the Ac voltage: $V = 300 \sin(314t)$ Volts.

$V = V_{peak} \sin \omega t$

Peak (maximum) voltage $V_{peak} = 300V$

(i) Average value

For full cycle, the average value of a sine wave is zero.

Average value of positive half cycle is:

$$V_{avg} = \frac{2}{\pi} \cdot V_{peak} = \frac{2}{\pi} \cdot 300 = 190.99V.$$

(ii) RMS value

$$V_{rms} = \frac{V_{peak}}{\sqrt{2}} = \frac{300}{\sqrt{2}} = 212.13V.$$

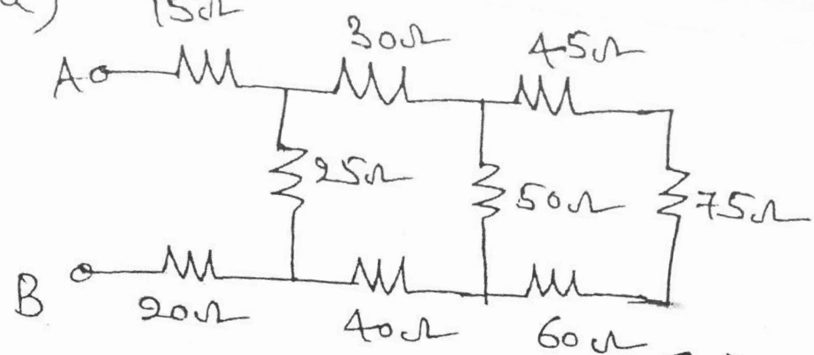
(iii) Peak Factor $= \frac{V_{peak}}{V_{rms}} = \frac{300}{212.13} = 1.414$

(iv) Form Factor $= \frac{V_{rms}}{V_{avg}} = \frac{212.13}{190.99} = 1.111$

(v) Frequency, $\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi} = \frac{314}{2\pi} = 50Hz$

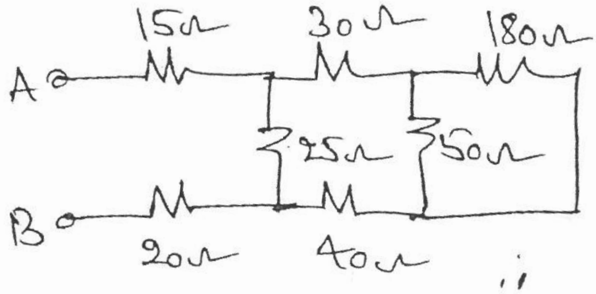
(vi) Time period $T = \frac{1}{f} = \frac{1}{50} = 0.02S = 20mS.$

3. a)



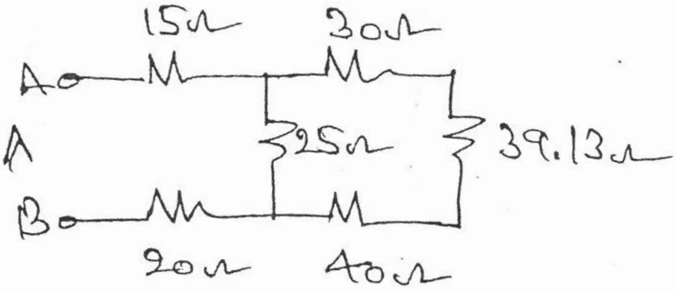
Series

$45+75+60 = 180\Omega$



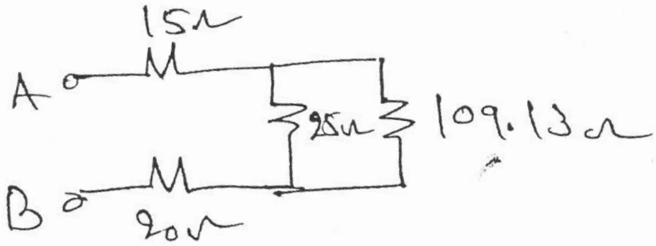
Parallel.

$$\frac{180\times 50}{180+50} = 39.13\Omega$$



Series

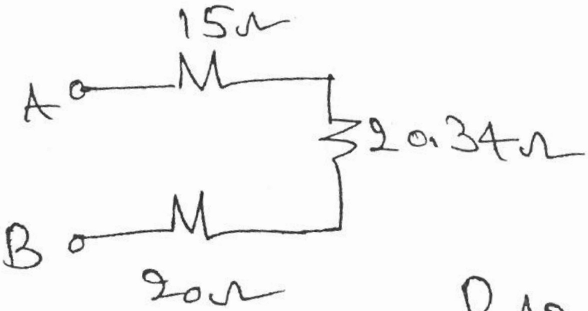
$30+39.13+40 = 109.13\Omega$



Parallel

$$\frac{109.13\times 25}{109.13+25} = \frac{2728.25}{134.13}$$

$$= 20.34\Omega$$

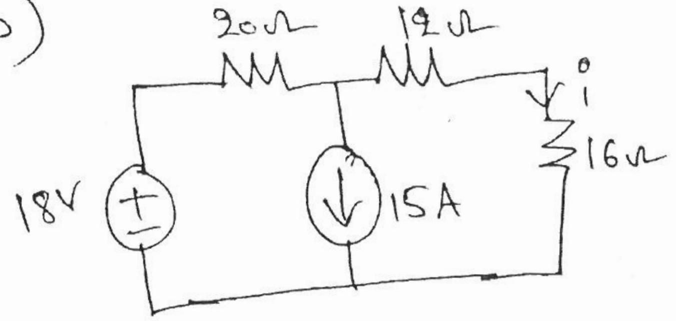


Series.

$R_{AB} = 15+20.34+20$

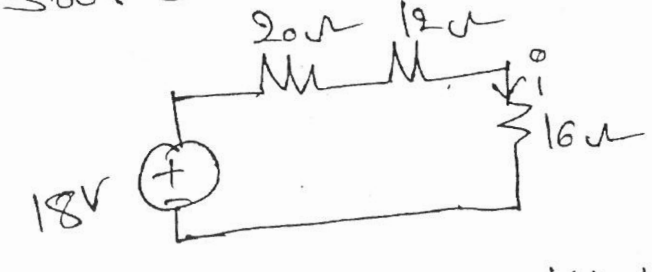
$= 55.34\Omega$

3.b)



i) Superposition theorem: It states that in any linear, bilateral network where more than one source is present, the response across any element in the circuit is the sum of the responses obtained from each source considered separately while all other sources are replaced by their internal resistance.

ii) Current through 16Ω due to 18V source alone (15A current source open circuited),



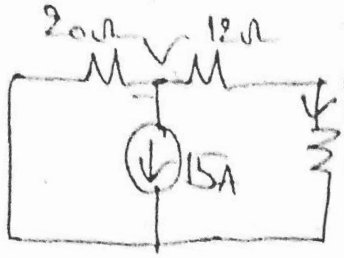
$R_{total} = 20 + 12 + 16 = 48\Omega$

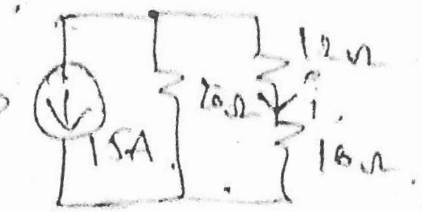
$\therefore i = \frac{18}{48} = 0.375 A$

All are in series, so, same current flows through all resistors.

$i_{16\Omega} = 0.375 A$

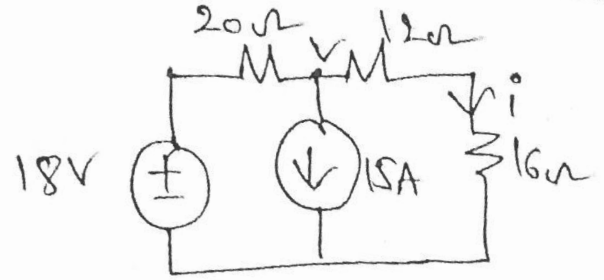
iii) Current through 16Ω due to 15A Current Source alone (18V source shorted)





$$i_{16\Omega} = -15 \times \frac{20}{20+28} = -6.25\,A$$

iv) Total current or actual current when both 18V & 15A sources acting.



By node analysis, $\frac{V-18}{20} + 15 + \frac{V}{28} =$

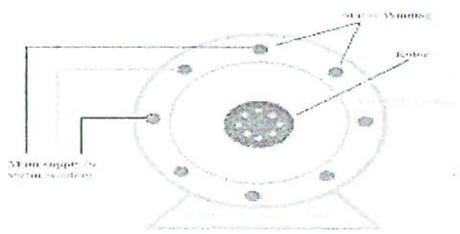
$$V = -164.5$$

$$\therefore i_{16\Omega} = \frac{-164.5}{28} = -5.875\,A.$$

UNIT II

4.a) Construction of 3 phase Induction motor

A 3-phase induction motor has two main parts (i) stator and (ii) rotor. The rotor is separated from the stator by a small air-gap which ranges from 0.4 mm to 4 mm, depending on the power of the motor.



INDUCTION MOTOR

1. Stator

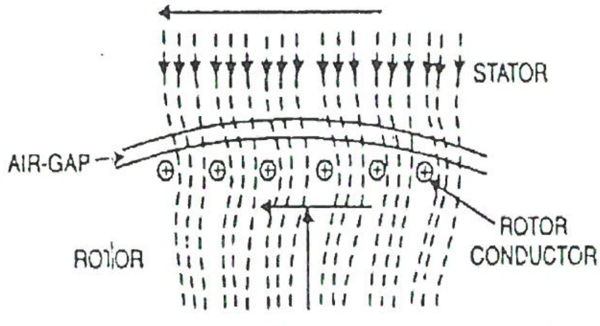
It consists of a steel frame which encloses a hollow, cylindrical core made up of thin laminations of silicon steel to reduce hysteresis and eddy current losses. A number of evenly spaced slots are provided on the inner periphery of the laminations. The insulated connected to form a balanced 3-phase star or delta connected circuit. The 3-phase stator winding is wound for a definite number of poles as per requirement of speed.

2. Rotor

The rotor, mounted on a shaft, is a hollow laminated core having slots on its outer periphery. The winding placed in these slots (called rotor winding) may be one of the following two types:

(i) Squirrel cage type (ii) Wound type

Working Principle of Three Phase Induction Motor



Consider a portion of 3-phase induction motor as shown in Figure. The operation of the motor can be explained as under:

When 3-phase stator winding is energized from a 3-phase supply, a rotating magnetic field is set up which rotates round the stator at synchronous speed N_S (= 120 f/P).

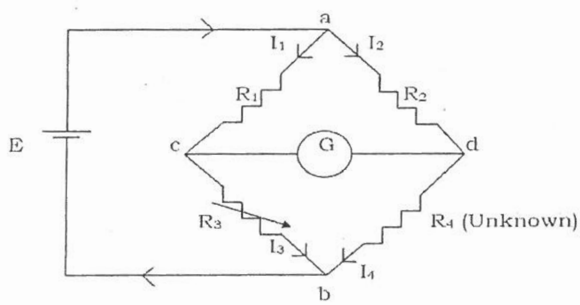
The rotating field passes through the air gap and cuts the rotor conductors, which as yet, are stationary. Due to the relative speed between the rotating flux and the stationary rotor e.m.f.'s is induced in the rotor conductors. Since the rotor circuit is short-circuited, currents start flowing in the rotor conductors.

The current-carrying rotor conductors are placed in the magnetic field produced by the stator. Consequently, mechanical force acts on the rotor conductors. The sum of the mechanical forces on all the rotor conductors produces a torque which tends to move the rotor in the same direction as the rotating field.

4 b) **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.



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 the bridge. And for this condition, we can write, $I_1R_1 = I_2R_2$

Where $I_1 = I_3 = \frac{E}{R_1+R_3}$ and $I_2 = I_4 = \frac{E}{R_2+R_4}$

Substituting the values of I_1 and I_2

$$\frac{E}{R_1+R_3}R_1=\frac{E}{R_2+R_4}R_2$$

$$\frac{R_1}{R_1+R_3}=\frac{R_2}{R_2+R_4}$$

$$R_1(R_2+R_4)=R_2(R_1+R_3)$$

$$R_1R_4=R_2R_3$$

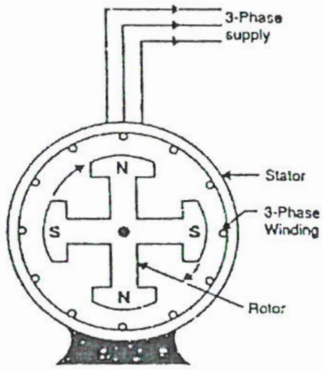
The above equation is called the balance equation(condition) of the bridge.Here, if R4 is an unknown resistor, then its resistance Rx can be measured using the equation

$$R_1R_x=R_2R_3$$

$$R_x=\frac{R_2R_3}{R_1}$$

Here resistor R3 is called the standard arm, whereas R2 and R1 are called the ratio arms.

5. a) Stator



It is the stationary part of the machine and is built up of sheet-steel laminations having slots on its inner periphery. A 3-phase winding is placed in these slots and serves as the armature winding of the alternator. The armature winding is always connected in star and the neutral is connected to ground.

Rotor

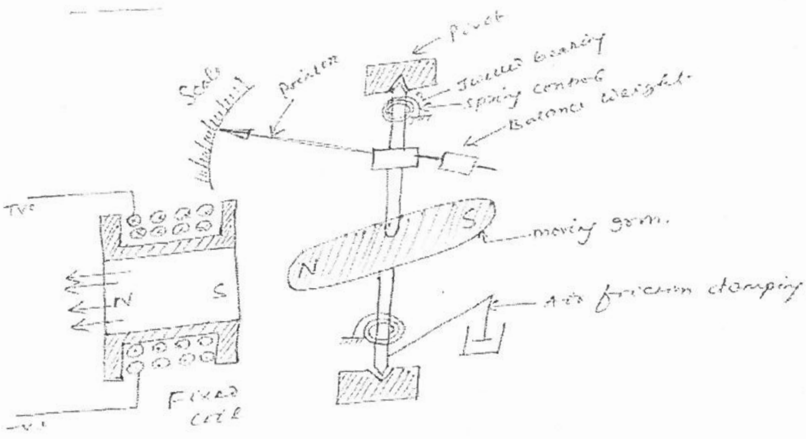
The rotor carries a field winding which is supplied with direct current through two slip rings by a separate d.c. source.This d.c. source (called exciter) is generally a small d.c. shunt or compound generator mounted on the shaft of the alternator.

5. 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.

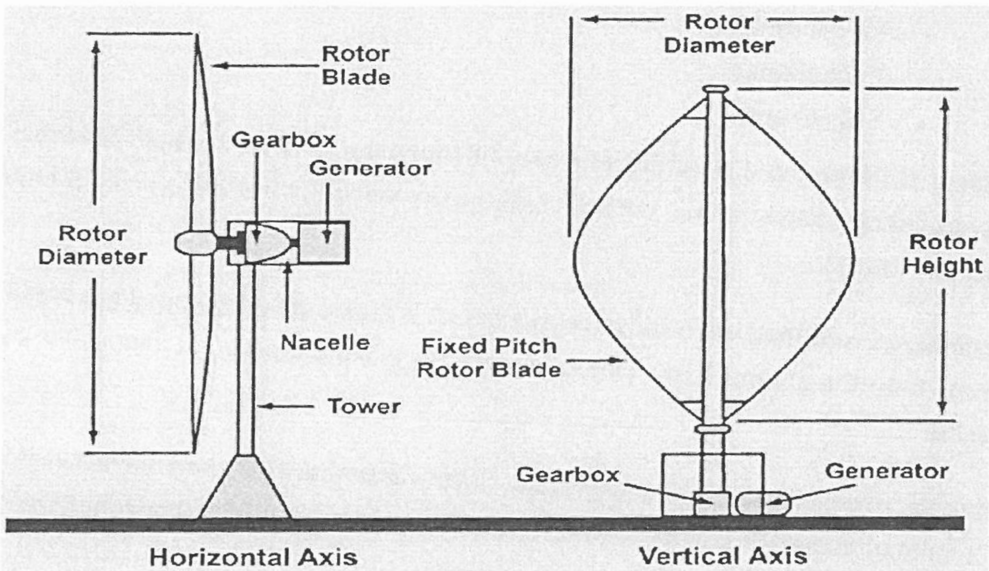
Principle of operation

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.



UNIT III

6. a) Wind energy is a renewable source of energy and available all around the globe in abundance. So to harness this natural resource in the best possible way wind turbines are designed.. The wind power plants are used for the generation of electricity in high wind area with the help of wind turbines



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.

6. b) **MCB**

Merits

1. Handling of an MCB is safer.
2. Restoration of power supply quickly is possible with MCBs.
3. During abnormal conditions such as overload and fault conditions, automatically
4. Switches off the electrical circuit
5. Power restoration can be done quickly.
6. It is easier to identify when they have tripped.

Demerits

1. Slow tripping
2. Aging and wear
3. Vulnerability to heat
4. They are more expensive than fused switches.
5. Cannot protect against earth faults.

7. a) 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: There are three types of earthing, they are

- Pipe earthing
- Plate earthing
- Strip earthing

Pipe earthing is the best and most efficient way of earthing and is also easily affordable. Pipe earthing uses 38mm diametre and 2 metres length pipe vertically embedded in the ground to work as earth electrodes.

In plate earthing, an earthing plate made of copper or G.I. is buried into the ground at a depth more than 3 metres from the ground level. This earthing plate is embedded in an alternative layer of coke and salts.

Strip earthing is used in transmission processes. Strip electrodes of cross section not less than 25mm X 1.6mm of copper or 25 mm X 4mm of G.I. or steel are buried in horizontal trenches of a minimum depth of 0.5m.

7. b) Our bodies conduct electricity. If any part of your body meets live electricity an electric current flows through the tissues, which causes an electric shock.

To prevent electric shock at home, safety measures are:

a. Always turn off the power source before starting any electrical work. This includes turning off the circuit breaker or unplugging the device.
b. Wear personal protective equipment (PPE) such as safety glasses, rubber gloves, and non-conductive shoes.
c. Use tools that are specifically designed for electrical work and ensure they are in good condition.
d. Avoid working in wet or damp conditions or with wet hands.
e. Do not touch electrical parts or wires with bare hands, use tools or gloves instead.
f. Keep your work area clean and free from any flammable or combustible materials.
g. Always follow proper wiring procedures, and use proper insulation techniques.

h. Do not work on live circuits, even if you are experienced.
i. Make sure that any electrical work is done according to local codes and regulations.
j. If you are unsure of what to do, consult with a qualified electrician or seek professional advice.

NOTE: Consider any 4

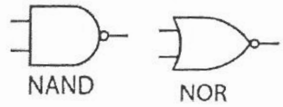
PART-B

1.f) Conductors easily allow electric current to flow. Semiconductors can behave like conductors or insulators depending on conditions (like temperature or doping), making them ideal for electronics.

1.g) A small value battery B_1 forward biases the emitter-base junction of a NPN and the collector–base junction is reverse biased by a high value battery V_{CB}. The negative terminal of the battery V_{EB} repels the electrons in the N-region on the left. This electron in the N-Type emitter to flow towards the base. This constitutes the emitter current I_E.

1.h) The function of an amplifier is to increase the strength (amplitude) of a signal without changing its original content.

1.i) **Universal gates** are logic gates that can be used to construct all other logic gates. NAND,NOR gates are universal gates.



1.j) **Any 2 properties may be considered.**

1. Commutative Property

- For OR:
  $A + B = B + A$
- For AND:
  $A \cdot B = B \cdot A$

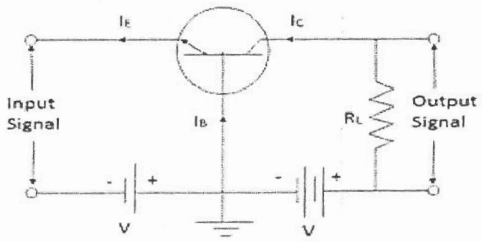
2. Identity Property

- For OR: $A + 0 = A$
- For AND: $A \cdot 1 = A$

UNIT-I

8.a) Common base characteristics:

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

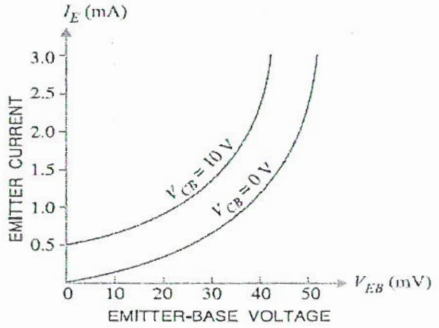


In a common base configuration, the input current is the emitter current I_E and the collector current I_C. The ratio of change in collector current to the change in emitter current at constant collector-base voltage is called current amplification factor.

$$\alpha = \frac{\Delta I_C}{\Delta I_E} \text{ at constant } V_{CB}$$

In a transistor V_{EB}, I_E,I_C,V_{CB} are parameters. In the above connection voltmeters and ammeters are connected to measure input and output voltages and currents as shown in figure below.

The circuit arrangement for determining the characteristics of a common base NPN transistor is shown in fig. In this circuit, the collector to base voltage (V_{CB}), emitter to base voltage (V_{BE}) can be varied using V_{CC} and V_{EE} values The DC voltmeters and DC milli ammeters are connected in the emitter and collector circuits to measure the voltages and currents.



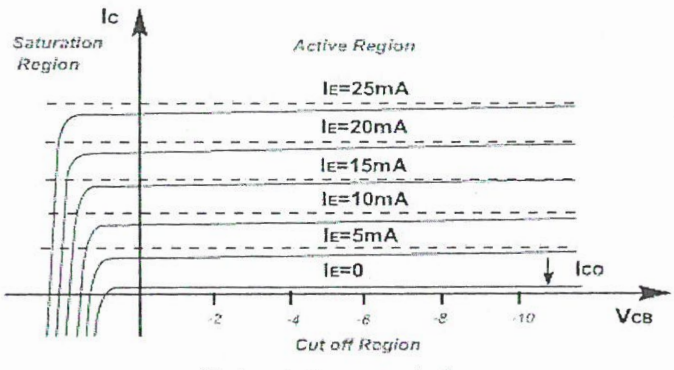
Input characteristics:

The curve plotted between the emitter current (I_E) and the emitter to base voltage (V_{BE}) at constant collector to base voltage (V_{CB}) are known as input characteristics of a transistor in common base configuration.

(i) The emitter current I_E increases rapidly with small increase in emitter-base voltage V_{EB}. It means that input resistance is very small.

$$\text{Input resistance, } r_i = \frac{\Delta V_{BE}}{\Delta I_E} \text{ at constant } V_{CB}$$

(ii) The emitter current is almost independent of collector-base voltage V_{CB}. This leads to the conclusion that emitter current (and hence collector current) is almost independent of collector voltage.



Output characteristics

The emitter current I_E is held constant at each of several fixed levels. For each fixed level of I_E, the output voltage V_{CB} is adjusted in convenient steps, and the corresponding levels of collector current I_C are recorded. In this way a table of values is obtained from which a family of output characteristics may be plotted. In the figure the corresponding I_C and V_{CB} values obtained when I_E was held constant are plotted

8.b) P-N Junction Diode characteristics

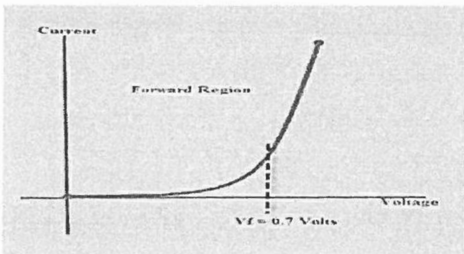
In a piece of a semiconductor, if one half of is doped by p-type and the other half is doped by n- type impurities, P-N junction (diode) is formed. There are three biasing conditions for p-n junction diode and this is based on the voltage applied:

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

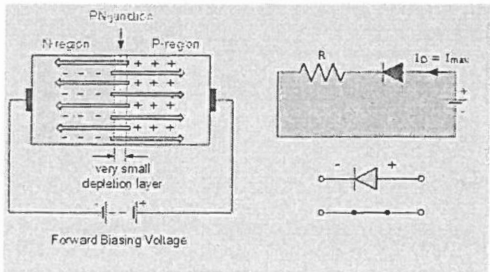
Forward bias: The positive terminal of the voltage potential is connected to the p-type while the negative terminal is connected to the n-type.

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



Forward bias V-I Characteristics

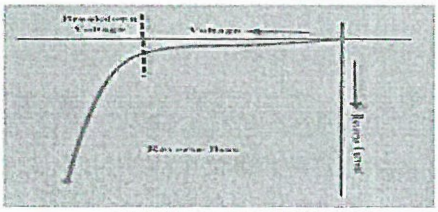
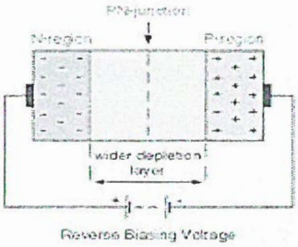


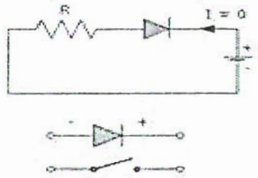
Forward Bias Condition

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:

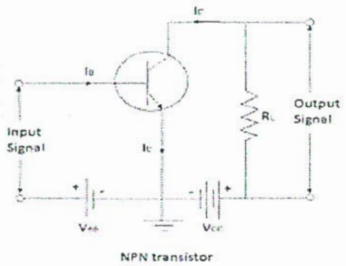
When a diode is connected in a **Reverse Bias** condition, a positive voltage is applied to the N-type material and a negative voltage is applied to the P-type material. The positive voltage applied to the N-type material attracts electrons towards the positive electrode and away from the junction, while 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.



9.a) Common Emitter Characteristics:

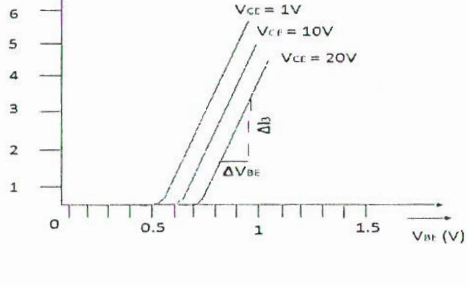
Fig. shows the circuit employed for determining transistor common emitter characteristics.



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. In the common emitter configuration, the input current is the base current I_B and the output current is the collector current I_C. The ratio of change in collector current to the change in base current at constant collector-emitter voltage is called current amplification factor (β).

$$\beta = \frac{\Delta I_C}{\Delta I_B} \text{ at constant } V_{CE}$$

Input Characteristics: It is a curve, which shows the relationship between the base current I_B and the emitter-base voltage, V_{BE} at constant V_{CE}. The method of determining the characteristic is as follows.



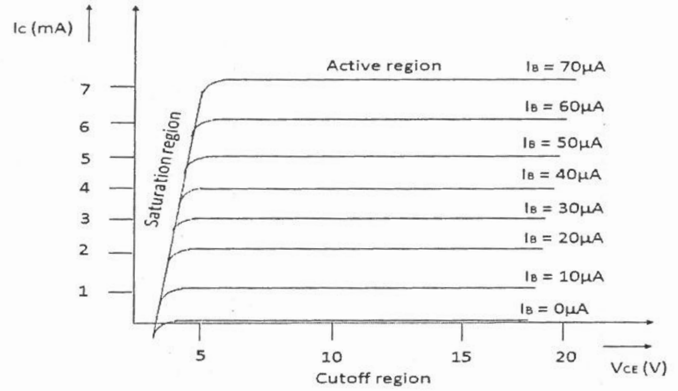
First, voltage is applied from Vcc. Next, voltage V_{BE} is increased in number of steps and corresponding values of I_B are noted. The figure shows the input characteristic for common emitter configuration. The following points may be noted from the characteristic.

1. The input resistance of the transistor is equal to the reciprocal of the slope of the inputcharacteristic curve

$$\text{Input resistance, } r_i = \frac{\Delta V_{BE}}{\Delta I_B} \text{ at constant } V_{CE}$$

2. The initial portion of the curve is not linear
3. The input resistance varies considerable from a value of 4-Kilo ohm to a value of 600 ohms

Output Characteristics:

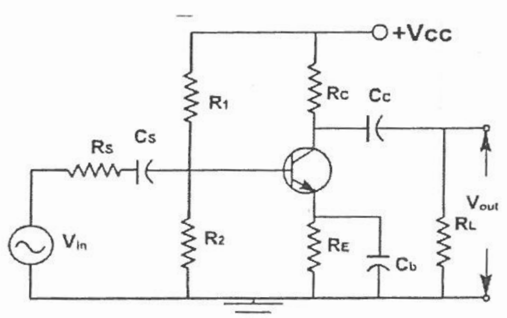


It is a curve that shows the relationship between the collector I_C and the collector-emitter voltage V_{CE}.A suitable base current I_B is maintained. V_{CE} is increased in a number of steps from zero and the corresponding values of I_C are noted. It is repeated for different values of I_B then they are plotted as shown in the fig.The output resistance is less than the common base configuration.

9.b) Small Signal CE Amplifier:

CE amplifiers are very popular to amplify the small signal ac. After a transistor has been biased with a Q point near the middle of a dc load line, ac source can be coupled to the base. This produces fluctuations in the base current and hence in the collector current of the same shape and frequency. The output will be enlarged sine wave of same frequency.

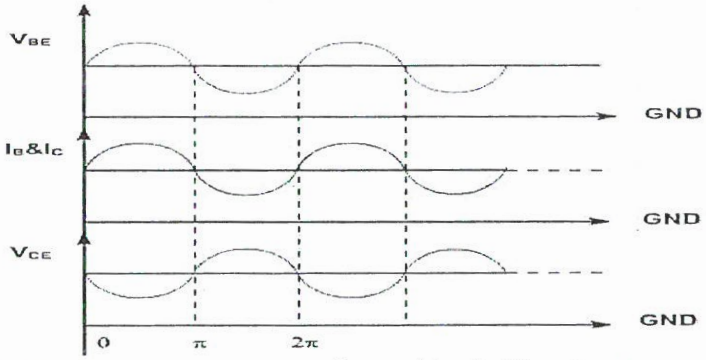
The amplifier is called linear if it does not change the wave shape of the signal. As long as the input signal is small, the transistor will use only a small part of the load line and the operation will be linear. On the other hand, if the input signal is too large.



The fluctuations along the load line will drive the transistor into either saturation or cut off. This clips the peaks of the input and the amplifier is no longer linear.

Because of the fluctuation in base current; collector current and collector voltage also swings above and below the quiescent voltage. The ac output voltage is inverted with respect to the ac input voltage, meaning it is 180o out of phase with input.

During the positive half cycle base current increase, causing the collector current to increase. This produces a large voltage drop across the collector resistor; therefore, the voltage output decreases and negative half cycle of output voltage is obtained. Conversely, on the negative half cycle of input voltage less collector current flows and the voltage drop across the collector resistor decreases, and hence

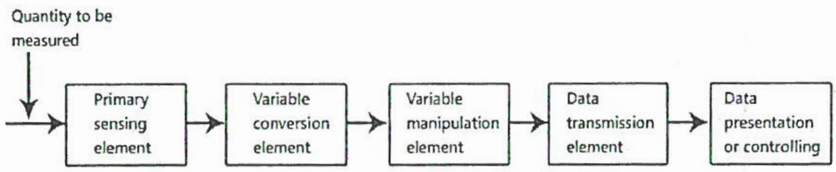


collector voltage increases we get the positive half cycle of output voltage.

UNIT II

10.a) **Block diagram of Electronic Instrumentation System:**

It is branch of engineering which deals with various types of instrument to record, monitor, indicate and control various physical parameters such as pressure, temperature, etc.



Block diagram of instrumentation system

The block diagram shown above is of basic instrumentation system. It consist of primary sensing element, variable manipulation element, data transmission element and data presentation element.

Primary sensing element

The primary sensing element is also known as sensor. Basically transducers are used as a primary sensing element. Here, the physical quantity (such as temperature, pressure etc.) are sensed and then converted into analogues signal.

Variable conversion element

It converts the output of primary sensing element into suitable form without changing information. Basically these are secondary transducers.

Variable manipulation element

The output of transducer may be electrical signal i.e. voltage, current or other electrical parameter. Here, manipulation means change in numerical value of signal. This element is used to convert the signal into suitable range.

Data transmission element

Sometimes it is not possible to give direct read out of the quality at a particular place (Example – Measurement of temperature in the furnace). In such a case, the data should transfer from one place to another place through channel which is known as data transmission element. Typically transmission path are pneumatic pipe, electrical cable and radio links. When radio link is used, the electronic instrumentation system is called as telemetry system.

Data presentation or controlling element

Finally the output is recorded or given to the controller to perform action. It performs different functions like indicating, recording or controlling.

10.b) RC Coupled Amplifier:

A Resistance Capacitance (RC) Coupled Amplifier is basically a multi-stage amplifier circuit extensively used in electronic circuits. Here the individual stages of the amplifier are connected together using a resistor–capacitor combination due to which it bears its name as RC Coupled.

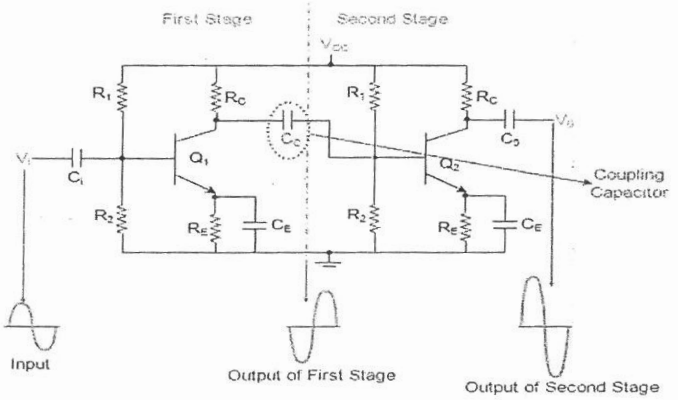


Figure 1 **Two-Stage RC Coupled Amplifier**

The AC component of this signal is coupled to the second stage of the RC coupled amplifier through the coupling capacitor CC and thus appears as an input at the base of the second transistor Q2. This is further amplified and is passed-on as an output of the second stage and is available at the collector terminal of Q2 after being shift by 180 degrees in its phase.

This means that the output of the second stage will be 360 degree out-of-phase with respect to the input, which inturn indicates that the phase of the input signal and the phase of the output signal obtained at stage II will be identical.

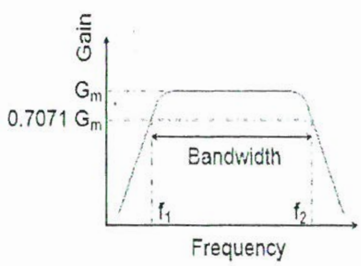
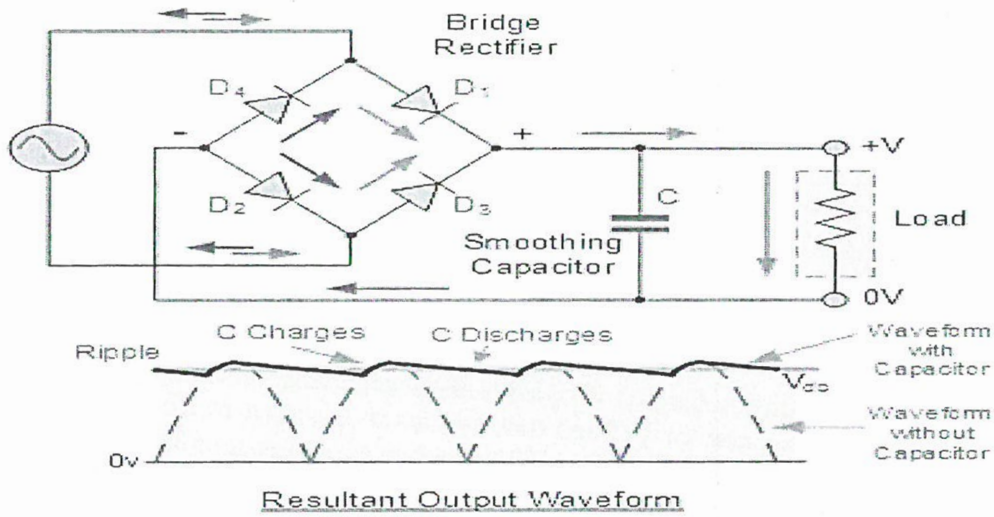


Figure 2 **Frequency Response Curve of a RC Coupled Amplifier**

The frequency response of a **RC coupled amplifier** (a curve of amplifier's gain v/s frequency), shown by Figure 2, indicates that the gain of the amplifier is constant over a wide range of mid-frequencies while it decreases considerably both at low and high frequencies.

This is because, at low frequencies, reactance of coupling capacitor C_C is high which causes a small part of the signal to couple from one stage to the other. Moreover for the same case, even the reactance of the emitter capacitor C_E will be high due to which it fails to shunt the emitter resistor R_E effectively which in turn reduces the voltage gain. On the other hand, at high frequencies, the reactance of C_C will be low which causes it to behave like a short circuit. This results in an increase in the loading effect of the next stage and thus reduces the voltage gain. In addition to this, for this case, the capacitive reactance of the base-emitter junction will be low.

11.a) **A** capacitor filter uses a capacitor to remove or reduce the ripple from a rectified DC voltage, making it smoother and more constant in a full wave rectifier.



During the positive quarter cycle of the ac input signal, the diodes D_1 ,D_2 are forward biased, the capacitor C gets charges through forward bias diodes D_1 ,D_2 to the peak value of input voltage V_m.

In the next quarter cycle from $\pi/2$ to π the capacitor starts discharging through load resistance R_L , because once capacitor gets maximum value diodes D_1 ,D_2 will be reverse biased and stops conducting, so during this period from $\pi/2$ to π capacitor C supplies load current.

In the next quarter cycle from π to $3\pi/2$ of the rectified output voltage, if the input voltage exceeds the capacitor voltage, making diodes D_3, D4 forward biased, this charges the capacitor back to V_m. In In the next quarter cycle that is from $3\pi/2$ to 2, the diodes D_3, D4 gets reverse biased and the capacitor supplies load current. Next again diodes D_1, D2 are forward biased and the cycle of capacitor charging and discharging continuous, hence load current becomes continuous in nature.

11.b)

i) **Step Down Transformer**: 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.

ii) **Rectifier**: 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. Usually a full wave rectifier or a bridge rectifier is used to rectify both the half cycles of the ac supply (full wave rectification).

iii) **DC Filter**: 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. Different types of filters are used such as capacitor filter, LC filter, Choke input filter, π type filter

iv) **Regulator**: 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. Transistor series regulator, Fixed and variable IC regulators or a Zener diode operated in the zener region can be used depending on their applications. IC's like 78XX and 79XX are used to obtained fixed values of voltages at the output.

UNIT-III

12. a) Given Boolean expression is:

$A + B\bar{C} + AB\bar{D} + ABCD$.

Expand to minterms

$A \rightarrow$ possible Combinations (A=1)

From A : $ABCD$, $ABC\bar{D}$, $AB\bar{C}D$, $ABC\bar{D}$, $A\bar{B}CD$,
$A\bar{B}C\bar{D}$, $A\bar{B}\bar{C}D$, $A\bar{B}\bar{C}\bar{D}$ — 8 minterms. (m8 to m15)

$B\bar{C} \rightarrow$ possible Combinations (A-0/1, D-0/1)

From $B\bar{C}$: $\bar{A}B\bar{C}\bar{D}$, $\bar{A}B\bar{C}D$, $AB\bar{C}\bar{D}$, $AB\bar{C}D$ - 4 terms (m4, m6, m13,

$AB\bar{D} \rightarrow$ possible Combinations (C-0/1) m14)

From $AB\bar{D}$: $AB\bar{C}\bar{D}$, $ABC\bar{D}$ — 2 terms (m12, m13).

From $ABCD \rightarrow$ full term m15

Unique minterms — m4, m6, m8, m9, m10, m11, m12, m13, m14, m15

Expand to maxterms

maxterms = Complement of minterms (or) Not in minterm list.

Unique Maxterms $\rightarrow$ M0, M1, M2, M3, M5, M7

$\therefore$ Sum of Minterms $= \sum m(4, 6, 8, 9, 10, 11, 12, 13, 14, 15)$

Product of Maxterms $= \prod M(0, 1, 2, 3, 5, 7)$.

12.b)

CP	S	R	Qn	Qn+1	State
↑ ↑	0 0	0 0	0 1	0 1	No Change(NC)
↑ ↑	0 0	1 1	0 1	0 0	Reset
↑ ↑	1 1	0 0	0 1	1 1	Set
↑ ↑	1 1	1 1	0 1	X X	Indeterminate
0 0	X X	X X	0 1	0 1	No Change(NC)

SR Flipflop Truth table

CP	D	Qn	Qn+1	State
↑ ↑	0 0	0 1	0 0	Reset
↑ ↑	1 1	0 1	1 1	Set
0 0	- -	0 1	0 1	No Change(NC)

D Flipflop Truth table

CP	T	Qn	Qn+1	State
↑ ↑	0 0	0 1	0 1	No Change(NC)
0 0	X X	0 1	0 1	No Change(NC)
↑ ↑	1 1	0 1	1 0	Toggle

T Flipflop Truth table

13. a) Half-Adder: A half adder is a combinational logic circuit that performs binary addition of two single-bit inputs, A and B, producing two outputs: SUM and CARRY

(a) Block diagram

Inputs		Outputs	
x	y	Sum(S)	Carry (C)
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

(b) Truth table

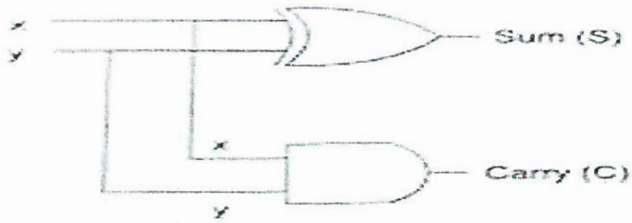
From the truth table, it is noted that the sum output is equivalent to the output of two input Ex-OR gate.

the sum output can be written as follows:

$$Sum(S) = x \oplus y$$
$$Sum(S) = x\,\bar{y} + y\,\bar{x}$$

the carry output is equivalent to the output of the two input 'AND' gate.

$$Carry\ (C) = xy$$



Half adder using XOR gate

13.b) **EX-OR (Exclusive OR) Gate: Symbol: ⊕**

Boolean Expression:

Y=A⊕B

Functionality: Outputs **1 only when inputs are different. "Either A or B is true, but not both".**

Truth Table:

A	B	A⊕B
0	0	0
0	1	1
1	0	1

1	1	0

2. **EX-NOR (Exclusive NOR) Gate:Symbol: ⊙**

Boolean Expression:

$$Y = \overline{A \oplus B}$$

Functionality: Outputs **1 only when inputs are the same,** Often called the **"Equality Gate"**

Truth Table:

A	B	A⊙B
0	0	1
0	1	0
1	0	0
1	1	1