PVP 23

Code: 23ES1103

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

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

Duration: 3 hours Max. Marks: 70

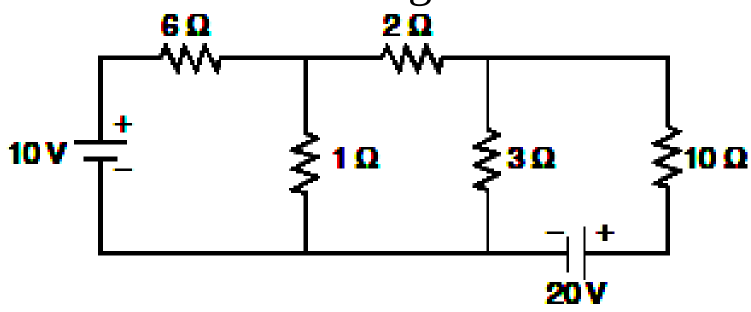
Note: 1. This question paper contains two Parts: Part-A and Part-B.
2. Each Part contains:
- 5 short answer questions. Each Question carries 1 Mark and
- 3 essay questions with an internal choice from each unit. Each question carries 10 marks.

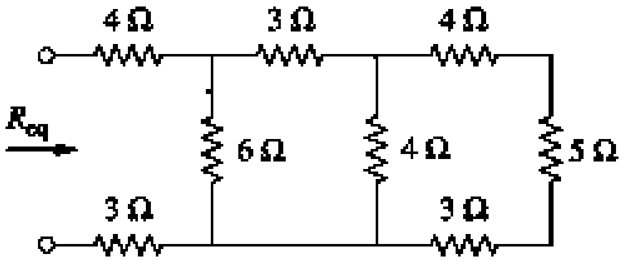
3. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	Omit the equivalent inductance for two inductors (L1& L2) connected in series and parallel.	L1	CO1
1.b)	Define form factor.	L1	CO1
1.c)	List any two applications of Fuse.	L1	CO1
1.d)	Define Superposition theorem.	L1	CO1
1.e)	Define open circuit and short circuit.	L1	CO1

			BL	CO	Max. Marks
UNIT-I					
2	a)	Estimate current through 2 Ω resistor. 	L3	CO2	5 M

	b)	 Calculate the equivalent Resistance R_{eq}.	L3	CO2	5 M
OR					
3	a)	Calculate form factor and peak factor of the alternative sinusoidal waveform.	L3	CO2	5 M
	b)	In a pure resistive circuit, the instantaneous voltage and current are given by v(t) = 250 sin 314t; i(t) = 10 sin 314t. Estimate (i) the peak power (ii) average power.	L3	CO2	5 M
UNIT-II					
4	a)	Explain the constructional details of single phase transformer.	L2	CO2	5 M
	b)	Explain the construction and working of a MI instrument with neat sketch.	L2	CO2	5 M
OR					
5	a)	Explain the working principle to measure low resistance by using Wheatsone bridge with a neat sketch. Derive the expression for balance equation.	L3	CO2	5 M
	b)	Classify different types of measuring instruments and explain briefly.	L2	CO2	5 M
UNIT-III					
6	a)	Compute the electricity bill amount for a month of 31 days, if the following devices are used as specified: i) 5 bulbs each of 15 watts for 5 hours. ii) 2 tube lights each of 40 watts for 4 hours.	L4	CO3	5 M

		iii)1 refrigerator of 200 watts for 16 hours. iv) 1 TV of 100 watts for 4 hours Given the rate of electricity is 4 Rs. per unit and a GST of 18%.			
	b)	Express the importance of Fuse. Explain the Types and characteristics of Fuse.	L2	CO2	5 M
OR					
7	a)	Classify any 10 house hold appliances used for domestic purpose and give their ratings.	L2	CO2	5 M
	b)	Classify different types of Earthing and explain plate earthing with neat sketch.	L2	CO2	5 M

PART – B

		BL	CO
1.f)	Describe the function of Zener voltage regulator.	L2	CO4
1.g)	List the applications of Transistors.	L1	CO1
1.h)	Label the circuit diagram of CC configuration.	L2	CO4
1.i)	Draw the characteristics of BJT with CB configuration.	L2	CO4
1.j)	Define Excess-3 code.	L1	CO5

			BL	CO	Max. Marks
UNIT-I					
8	a)	Discuss why biasing is required for a transistor?. Illustrate the output characteristics of a common emitter transistor with a neat sketch.	L3	CO4	5 M
	b)	Explain the working of Zener Diode with its Characteristics.	L2	CO4	5 M
OR					

9	a)	Explain the minority and majority charge carriers in P block and N block semiconductors.	L2	CO4	5 M
	b)	Explain the working of the PN junction diode as a switch.	L3	CO4	5 M
UNIT-II					
10	a)	Explain the working of a full wave bridge rectifier.	L2	CO4	5 M
	b)	Articulate the block diagram of an regulated DC power supply and explain the function of each block.	L3	CO4	5 M
OR					
11	a)	Describe the role of Filter in the Rectifier with an example.	L2	CO4	5 M
	b)	Describe the working of CE amplifier with neat circuit and their applications.	L3	CO4	5 M
UNIT-III					
12	a)	Illustrate any four basic logic gates with appropriate truth tables and characteristic equations.	L2	CO5	5 M
	b)	Explain the BCD code, gray code and excess-3 with example.	L2	CO5	5 M
OR					
13	a)	Illustrate the functioning of XOR, XNOR gates with their symbols and truth tables.	L2	CO5	5 M
	b)	Convert the following i) $(115)_{10}$ to Binary number. ii) $(2AB5)_{16}$ to Octal number. iii) $(8964)_{10}$ to Hexa decimal number. iv) $(110111011)_2$ to decimal number.	L3	CO5	5 M

Code No:**23ES11003**

I B.TECH - I SEMESTER - REGULAR EXAMINATIONS - JANUARY 2026

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

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

SCHEME OF VALUATION

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

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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.

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Part - A

1.a) Omit the equivalent inductance for two inductors (L1& L2) connected in series and parallel.

Series and Parallel **1M**

1.b) Define form factor.

Definition **1M**

1.c) List any two applications of Fuse.

Any two applications **1M**

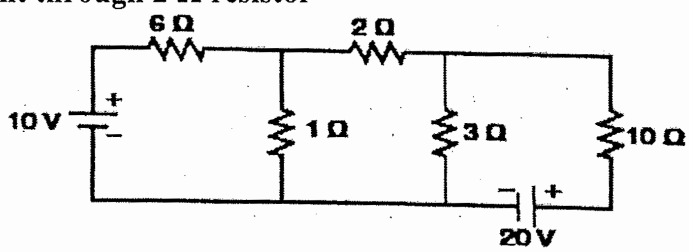
1.d) Define Superposition theorem.

Superposition theorem statement or definition **1M**

1.e) Define open circuit and short circuit.

Open circuit and short circuit definition **1M**

2.(a) Estimate current through 2 Ω resistor

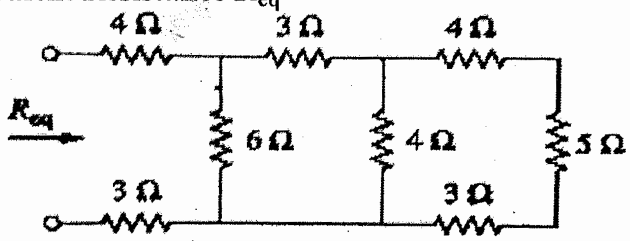


Formula **2M**

Solution **2M**

Answer **1M**

2.(b) Calculate the equivalent Resistance R_{eq}



Formula **2M**

Solution **2M**

Answer **1M**

3.a) Calculate form factor and peak factor of the alternative sinusoidal waveform.

Form factor Calculation	2.5M
Peak factor Calculation	2.5M

3.b) In a pure resistive circuit, the instantaneous voltage and current are given by v(t)= 250 sin 314t; i(t) 10 sin 314t. Estimate (i) the peak power (ii) average power.

i) Peak power Calculation	2.5M
ii) Average power Calculation	2.5M

4.a) Explain the constructional details of single phase transformer.

Figure	2M
Explanation	3M

4.b) Explain the construction and working of a MI instrument with neat sketch.

Figure	2M
Construction and working Explanation (Attraction OR Repulsion)	3M

5.a) Explain the working principle to measure low resistance by using Wheatstone bridge with a neat sketch. Derive the expression for balance equation.

Figure	2M
Explanation & Expression	3M

5.b) Classify different types of measuring instruments and explain briefly.

Classification any two	2M
Explanation	3M

6.a) Compute the electricity bill amount for a month of 31 days, if the following devices are used as specified:

i) 5 bulbs each of 15 watts for 5 hours
ii) 2 tube lights each of 40 watts for 4 hours
iii) 1 refrigerator of 200 watts for 16 hours.
iv) 1 TV of 100 watts for 4 hours
Given the rate of electricity is 4 Rs. per unit and a GST of 18%.

Formula	2M
Solution	2M
Answer	1M

6.b) Express the importance of Fuse. Explain the Types and characteristics of Fuse.

Figure	1M
Explanation and	2M
Characteristics (Any Two)	2M

7.a) Classify any 10 house hold appliances used for domestic purpose and give their ratings.

Any 10 house hold appliances Classification and their ratings	5M

7.b) Classify different types of Earthing and explain plate earthing with neat sketch.

Classification any two	2M
Explanation with Figure	3M

Part - B

1.f) Describe the function of Zener voltage regulator.

Explanation 1M

1.g) List the applications of Transistors.

Any two 1M

1.h) Label the circuit diagram of CC configuration.

Figure 1M

1.i) Draw the characteristics of BJT with CB configuration.

Characteristics 1M

1.j) Define Excess-3 code.

Definition 1M

8.a) Discuss why biasing is required for a transistor?. Illustrate the output characteristics of a common emitter transistor with a neat sketch

Biasing 1M
Figure 2M
Output characteristics 2M

8.b) Explain the working of Zener Diode with its Characteristics

Working 3M
Characteristics 2M

9.a) Explain the minority and majority charge carriers in P block and N block semiconductors.

Figure 1M
Explanation 4M

9.b) Explain the working of the PN junction diode as a switch..

Figure 1M
Explanation 4M

10.a) Explain the working of a full wave bridge rectifier.

Figure 2M
Explanation 3M

10.b) Articulate the block diagram of an regulated DC power supply and explain the Function of each block.

Block diagram 2M
Explanation 3M

11.a) Describe the role of Filter in the Rectifier with an example.

Figure 2M
Explanation 3M

11.b) Describe the working of CE amplifier with neat circuit and their applications.

Figure 2M
Explanation 2M
Any two applications 1M

12.a) Illustrate any four basic logic gates with appropriate truth tables and characteristic equations.

Any four basic logic gates

Figures (symbols)	**2M**
Explanation truth tables and characteristic	**3M**

12.b) Explain the BCD code, gray code and excess-3 with example.

Explanation with example	**5M**

13.a) Illustrate the functioning of XOR, XNOR gates with their symbols and truth tables.

Symbols	**2M**
Explanation truth tables and characteristic	**3M**

13.b) Convert the following

i) $(115)_{10}$ to Binary number.
ii) $(2AB5)_{16}$ to Octal number.
iii) $(8964)_{10}$ to Hexa decimal number.
iv) $(110111011)_2$ to decimal number.

Conversion Procedure	**4M**
Answer	**1M**

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BASIC ELECTRICAL & ELECTRONICS ENGINEERING

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KEY

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Part - A

1.a) Omit the equivalent inductance for two inductors (L1& L2) connected in series and parallel. **1M**

$L_{eq} = L1 + L2$

$$\frac{1}{Leq} = \frac{1}{L1} + \frac{1}{L2}$$

1.b) Define form factor. **1M**

It is the ratio of the Root Mean Square (RMS) value to the Average value of the waveform. It's a measure of the shape of the waveform and is used to compare different waveforms. (Form Factor = RMS Value / Average Value)

1.c) List any two applications of Fuse. (Any two applications) **1M**

Over current protection in electrical circuits
Protection of household appliances like TV, refrigerator, and air conditioner
Short-circuit protection in domestic wiring
Automobile electrical systems to protect wiring and components
Industrial machinery protection from overload conditions
Power supply units (SMPS) for electronic equipment safety
Distribution boards and switchgear in power systems
Consumer electronics such as computers, chargers, and audio systems

1.d) Define Superposition theorem. **1M**

The Superposition Theorem states that in any linear circuit with multiple independent sources, the response (voltage or current) at any point in the circuit is the algebraic sum of the responses caused by each independent source acting alone, while all other independent sources are replaced by their internal resistances

1.e) Define open circuit and short circuit. **1M**

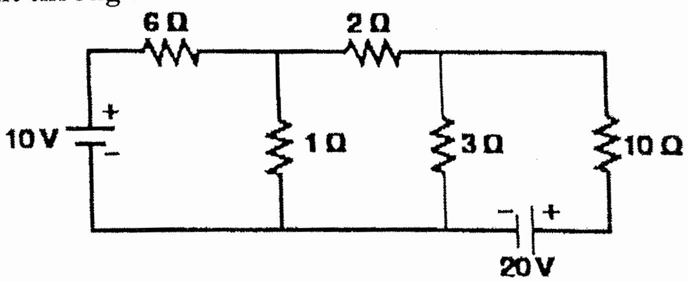
Open Circuit:

An open circuit is a condition in which the electrical path is broken, so no current flows through the circuit, even though voltage may be present across the open terminals..

Short Circuit:

A short circuit is a condition in which two points of different potential are connected by a very low resistance path, causing excessive current to flow.

2.(a) **Estimate current through 2 Ω resistor** **5M**



Mesh 1

$6 I_1 + 1 (I_1 - I_2) = 10$

$7 I_1 - I_2 = 10$ Equation 1

Mesh 2

$2I_2 + 1 (I_2 - I_1) + 3 (I_2 - I_3) = 0$

$-I_1 + 6I_2 - 3 I_3 = 0$ Equation 2

Mesh 3

$3 (I_3 - I_2) + 10 I_3 = 20$

$- 3 I_2 + 13 I_3 = 20$ Equation 3

Solving Equation 1,2& 3

$I_1 = 1.34$ A $I_2 = -0.62$A $I_3 = -1.68$ A

Current through 2 Ω resistor (I_2) = - 0.62 A

(OR)

Applying KCL

At node D:

$$\frac{V_D - 10}{6} + \frac{V_D}{1} + \frac{V_D - V_E}{2} = 0$$

At node E:

$$\frac{V_E - V_D}{2} + \frac{V_E}{3} + \frac{V_E - 20}{10} = 0$$

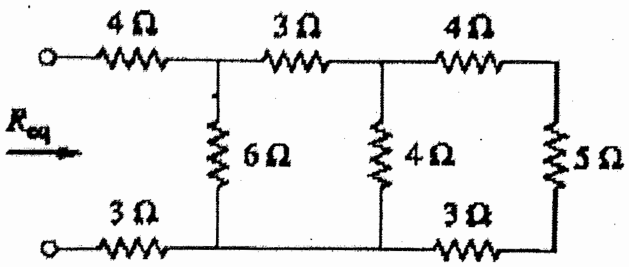
Solving,

$$V_D = \frac{92}{47} \text{ V}, \quad V_E = \frac{150}{47} \text{ V}$$

Current through 2 Ω resistor

$$I_{2\Omega} = \frac{V_E - V_D}{2} = \frac{29}{47} \approx 0.62 \text{ A}$$

2.(b) **Calculate the equivalent Resistance R_{eq}** **5M**



Step 1: Rightmost section

- The right vertical branch has 4Ω (top) –5Ω (vertical) –3Ω (bottom) all in series

$$R=4+5+3=12\Omega$$

Step 2: Parallel with middle vertical resistor

- This12Ω is in parallel with the 4Ω vertical resistor:

$$R = (12 \times 4) / (12 + 4) = 48/16 = 3\Omega$$

Step 3: Combine with top middle resistor

- This 3Ω is in series with the 3Ω (top middle):

$$R= 3+3 = 6\Omega$$

Step 4: Parallel with left vertical resistor

- This 6Ω is in parallel with the 6Ω vertical resistor

$$R = (6 \times 6) / (6 + 6) = 36 / 12 = 3\Omega$$

Step 5: Add remaining series resistors

- Left top resistor = 4Ω
- Left bottom resistor = 3Ω

$$Req = 4+3+3 = 10\ \Omega$$

Req=10 Ω

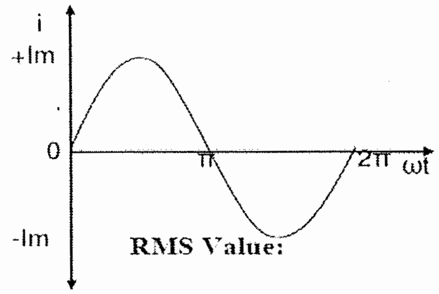
3.a) Calculate form factor and peak factor of the alternative sinusoidal waveform. 5M

Average Value

The arithmetic average of all the values of an alternating quantity over one cycle is called its average value

$$V_{av} = \frac{1}{2\pi}\int_0^{2\pi} v\,d(\omega t)$$

Average value of a sinusoidal current



RMS Value:

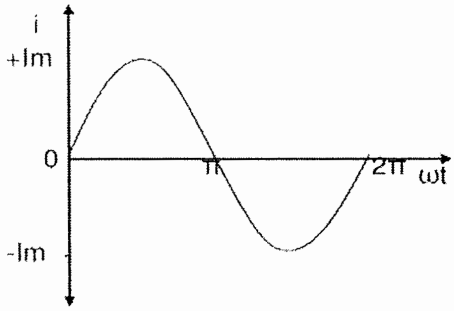
$$i = I_m \sin \quad t$$

$$I_{av} = \frac{1}{\pi}\int_0^{\pi} i\,d(\omega t)$$

$$I_{av} = \frac{1}{\pi}\int_0^{\pi} I_m \sin \omega t\,d(\omega t)$$

$$I_{av} = \frac{2I_m}{\pi} = 0.637 I_m$$

RMS value of a sinusoidal current



$$i = I_m \sin$$

$$I_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} i^2 d(\omega t)}$$

$$I_{rms} = \sqrt{\frac{1}{\pi}\int_0^{\pi} I_m^2 \sin^2 \omega t\,d(\omega t)}$$

$$I_{rms} = \frac{I_m}{\sqrt{2}} = 0.707 I_m$$

Form Factor

The ratio of RMS value to the average value of an alternating quantity is known as Form Factor

$$FF = \frac{RMS Value}{Average Value}$$

Peak Factor or Crest Factor

The ratio of maximum value to the RMS value of an alternating quantity is known as the peak factor

$$PF = \frac{Maximum Value}{RMS\ Value}$$

For a sinusoidal waveform

$$I_{av} = \frac{2I_m}{\pi} = 0.637 I_m$$

$$I_{rms} = \frac{I_m}{\sqrt{2}} = 0.707 I_m$$

$$FF = \frac{I_{rms}}{I_{av}} = \frac{0.707 I_m}{0.637 I_m} = 1.11$$

$$PF = \frac{I_m}{I_{rms}} = \frac{I_m}{0.707 I_m} = 1.414$$

3.b) In a pure resistive circuit, the instantaneous voltage and current are given by v(t)= 250 sin 314t; i(t) 10 sin 314t. Estimate (i) the peak power (ii) average power. **5M**

This is a pure resistive circuit, so voltage and current are in phase.

(i) Peak Power

Instantaneous power:

$$p(t) = v(t)\, i(t)$$

$$= 250 \times 10 \sin^2(314t)$$

$$= 2500 \sin^2(314t)$$

Maximum value of $\sin^2(314t)=1$

$\mathbf{P_{peak}=2500\ W}$

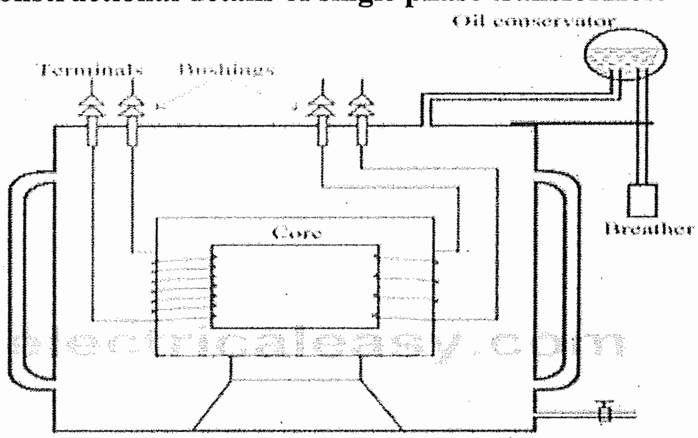
(ii) Average Power

$P_{avg}=P_{peak} / 2$

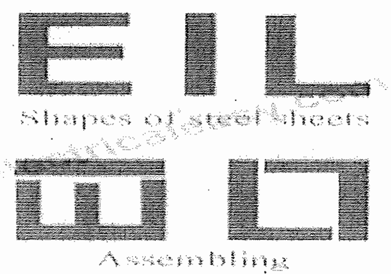
$=2500 / 2$

$\mathbf{P_{avg}=1250\ W}$

4.a) Explain the constructional details of single phase transformer. **5M**



The various parts of transformer are



1. *Core:* It is made up of high grade silicon steel laminations. Its function is to carry the flux, providing low reluctance to it. Generally 'L' shaped or 'T' and 'I' shaped laminations are used as shown in figure.

2. *Limb:* It is vertical portion of the core and its function is to carry the windings.

3. *Yoke:* The top and bottom horizontal portion of the core is called yoke. Its function is to carry the flux produced by one winding to reach to the other winding and provide the low reluctance path to the flux.

4. *Windings*: The coils used are wound on the limbs and are insulated from each other. The function of the windings is to carry the current and produce the flux necessary for the functioning of the transformer.

5. *Conservator:* The oil in the transformer expands when temperature inside the the transformer increases due to heat while it contracts when the temperature decreases the function of the conservator is to take up the expansion and contraction of the oil without allowing it to come in contact with the ambient air.

6. *Breather:* The breather is a device which extracts the moisture from the air when the airis taken in and does not allow oil to come in contact with the moisture. The breather contains silica gel crystals which releases the pressure and protects the transformer.

7. *Buchholz relay:* It is a safety gas operated relay connected to transformer, when the fault gets developed inside the transformer, the gases are released. The buchholz relay is operated with these gases and trips the circuit breaker to protect the device.

8. *Transformer Oil:* It is used as the coolant for cooling purpose and also used in the Insulation purpose.

9. *Bushings:* The purpose of bushings is to provide proper insulation for the incoming and outgoing leads.

10. *Radiators:* Radiators are used in transformers for cooling the transformer winding

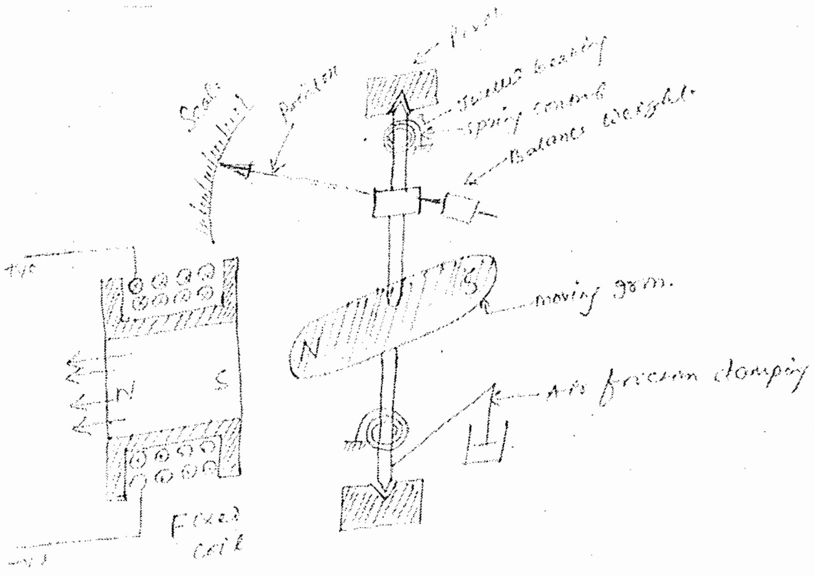
4.b) Explain the construction and working of a MI instrument with neat sketch.(Any One) 5M

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.

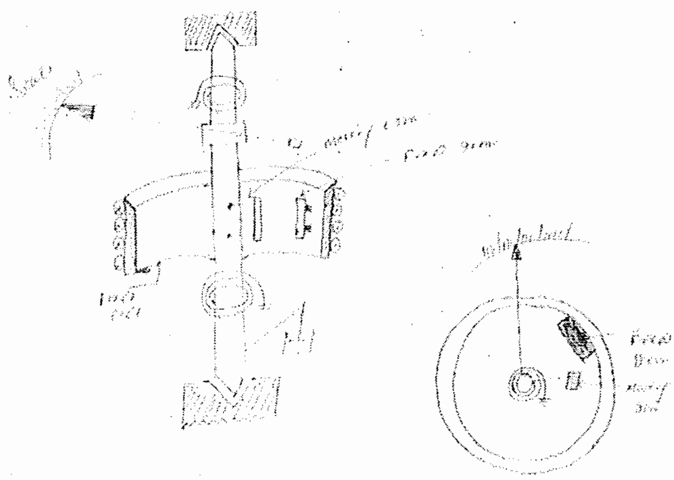
Principle of operation

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.



(OR)

Repulsion type moving iron instrument



Construction: The repulsion type instrument has a hollow fixed iron attached to it (Fig. 1.12). The moving iron is connected to the spindle. The pointer is also attached to the spindle in supported with jeweled bearing.

Principle of operation: When the current flows through the coil, a magnetic field is produced by it. So both fixed iron and moving iron are magnetized with the same polarity, since they are kept in the same magnetic field. Similar poles of fixed and moving iron get repelled. Thus the deflecting torque is produced due to magnetic repulsion. Since moving iron is attached to spindle, the spindle will move. So that pointer moves over the calibrated scale.

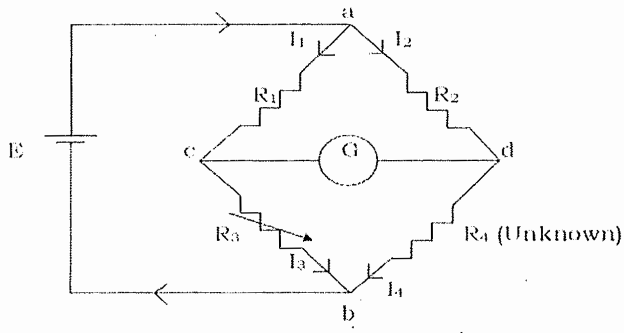
Damping: Air friction damping is used to reduce the oscillation.

Control: Spring control is used

5.a) Explain the working principle to measure low resistance by using Wheatstone bridge with a neat sketch. Derive the expression for balance equation. **5M**

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.Whenthecurrentthroughgalvanometeriszero,atthattimeterminalscand dare said to be at same potential with respect to point,, a" i.e.,

Eac=Ead

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,$I_1R_1 = I_2R_2$

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.b) Classify different types of measuring instruments and explain briefly. (Any One) **5M**

Classification

- Types of instruments

1. Absolute instruments
2. Secondary instruments

indicating   integrating   recording

(OR)

i. Permanent Magnet Moving Coil (PMMC) instrument
ii. Moving Iron (MI) instruments

There are two types of moving iron instrument

a) Attraction type
b) Repulsion type

Permanent Magnet Moving Coil (PMMC) instrument

One of the most accurate type of instrument used for D.C. measurements is PMMC instrument.

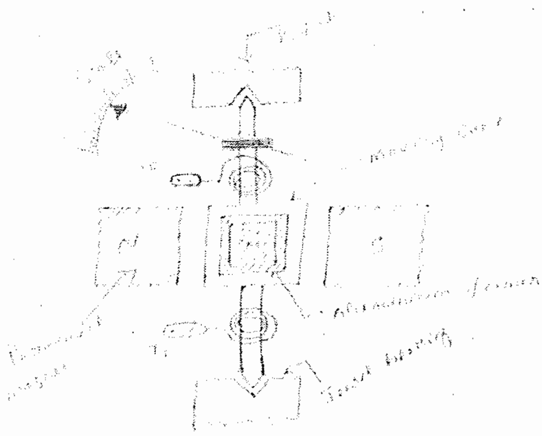
Construction: A permanent magnet is used in this type instrument. Aluminum former is provided in the cylindrical in between two poles of the permanent magnet . Coils are wound on the aluminum former which is connected with the spindle. This spindle is supported with jeweled bearing. Two springs are attached on either end of the spindle. The terminals of the moving coils are connected to the spring. Therefore the current flows through spring 1, moving coil and spring 2.

Damping: Eddy current damping is used. This is produced by aluminum former.
Control: Spring control is used.

Principle of operation

When D.C. supply is given to the moving coil, D.C. current flows through it. When the current carrying coil is kept in the magnetic field, it experiences a force. This force produces a torque and the former rotates. The pointer is attached with the spindle. When the former rotates, the pointer moves over the calibrated scale. When the polarity is reversed a torque is produced in the opposite direction. The mechanical stopper does not allow the deflection in the opposite direction. Therefore the polarity should be maintained with PMMC instrument.

If A.C. is supplied, a reversing torque is produced. This cannot produce a continuous deflection. Therefore this instrument cannot be used in A.C.



Moving Iron (MI) instruments

. There are two types of moving iron instrument.

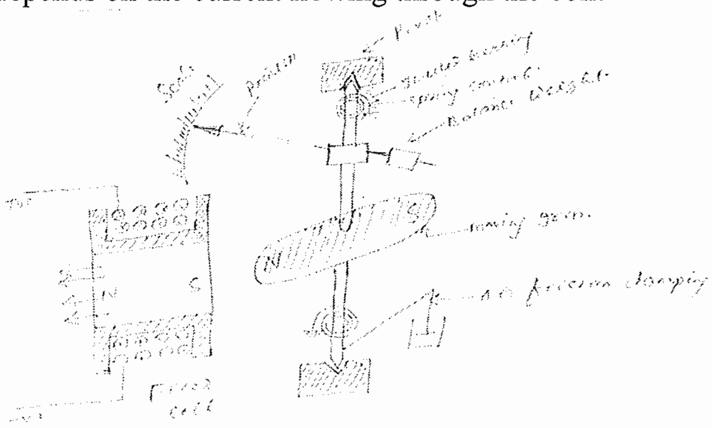
- Attraction type One of the most accurate instrument used for both AC and DC measurement is moving iron instrument
- Repulsion type

Attraction type M.I. instrument

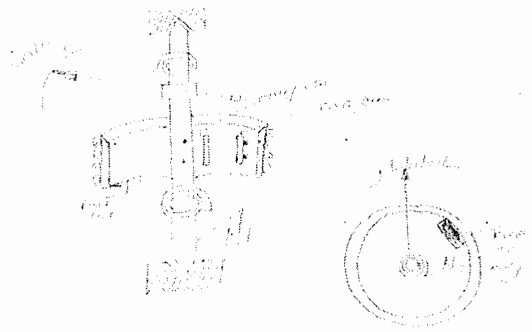
Construction: The moving iron fixed to the spindle is kept near the hollow fixed coil. The pointer and balance weight are attached to the spindle, which is supported with jeweled bearing. Here air friction damping is used.

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.



Repulsion type moving iron instrument



Construction: The repulsion type instrument has a hollow fixed iron attached to it (Fig. 1.12). The moving iron is connected to the spindle. The pointer is also attached to the spindle in supported with jeweled bearing.

Principle of operation: When the current flows through the coil, a magnetic field is produced by it. So both fixed iron and moving iron are magnetized with the same polarity, since they are kept in the same magnetic field. Similar poles of fixed and moving iron get repelled. Thus the deflecting torque is produced due to magnetic repulsion. Since moving iron is attached to spindle, the spindle will move. So that pointer moves over the calibrated scale.

Damping: Air friction damping is used to reduce the oscillation.

Control: Spring control is used

6.a) Compute the electricity bill amount for a month of 31 days, if the following devices are used as specified:

(i) 5 bulbs each of 15 watts for 5 hours
(ii) 2 tube lights each of 40 watts for 4 hours
(iii) 1 refrigerator of 200 watts for 16 hours.
(iv) 1 TV of 100 watts for 4 hours

Given the rate of electricity is 4 Rs. per unit and a GST of 18%. **5M**

<u>Given:</u>

1 unit = 1 kWh
Rate = 4 per unit
GST = 18%
Month = 31 days

Step 1: Daily energy consumption

(i) Bulbs
$5 \times 15\ W \times 5\ h = 375\ Wh = 0.375\ kWh/day$

(ii) Tube lights
$2 \times 40\ W \times 4\ h = 320\ Wh = 0.32\ kWh/day$

(iii) Refrigerator
$200\ W \times 16\ h = 3200\ Wh = 3.2\ kWh/day$

(iv) TV
$100\ W \times 4\ h = 400\ Wh = 0.4\ kWh/day$

Step 2: Total daily consumption
$0.375+0.32+3.2+0.4 = 4.295\ kWh/day$

Step 3: Monthly consumption (31 days)
$4.295 \times 31 = 133.145$ units

Step 4: Electricity bill (without GST)
$133.145 \times 4 = 532.58$/-

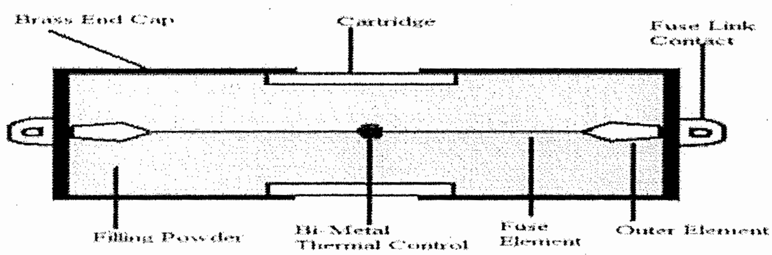
Step 5: GST (18%)
18% of 532.58=95.86 /-

Step 6: Total electricity bill
532.58+95.86=628.44/-

Total electricity bill for 31 days = 628.44/-

6.b) Express the importance of Fuse. Explain the Types and characteristics of Fuse. **5M**

Fuse:



Fuse

A fuse is a protective electrical device used to protect circuits and equipment from over-current and short-circuit conditions. It works on the principle of heating effect of electric current. When current exceeds the safe limit, the fuse element melts and opens the circuit.

Types of Fuses (Any One explanation)

i. Rewirable (Kit-Kat) Fuse

- Consists of a porcelain base and a removable fuse carrier.
- Fuse wire is made of tin, lead, or copper.
- Commonly used in domestic wiring.
- Simple and low cost.

Disadvantages:

- Low accuracy
- Needs manual replacement
- Not suitable for large currents

ii. Cartridge Fuse

- Fuse element enclosed in a glass or ceramic tube.
- Provides better protection than rewirable fuse.
- Used in industrial and commercial circuits.

Types of Cartridge Fuse:

- Glass cartridge fuse – for low-voltage applications.
- Ceramic cartridge fuse – for high current and high voltage.

iii. HRC (High Rupturing Capacity) Fuse

- Made with high-quality ceramic body and silver fuse element.
- Filled with quartz powder to absorb arc energy.
- Used in high-voltage and high-current systems.
- Highly reliable and accurate.

iv. Drop-Out Fuse

- Used in overhead distribution lines.
- Fuse melts and the holder drops down, giving visible indication.
- Suitable for outdoor installations.

v. Thermal Fuse

- Operates due to excessive temperature, not current.
- Used in appliances like irons, heaters, and motors.

Characteristics of a Fuse (Any two)

i. Current Rating

- Maximum current a fuse can carry without melting.

ii. Voltage Rating

- Maximum voltage the fuse can safely interrupt.

iii. Breaking (Rupturing) Capacity

- Maximum fault current that the fuse can safely break without damage.

iv. Fusing Current

- Minimum current at which the fuse element melts.

v. Operating Time

- Time taken by the fuse to blow after over-current occurs.

vi. I^2t Characteristic

- Represents energy let-through during fault conditions.
- Lower I^2t means better protection.

vii. Temperature Sensitivity

- Fuse performance varies with ambient temperature.

7.a) Classify any 10 house hold appliances used for domestic purpose and give their ratings.(Any 10 house hold appliances Classification and their ratings) **5M**

Appliances	Approxomate Wattage
Incandescent Bulbs	60
Single Fluorescent Tube light with conventional choke	55
Night Lamp	15
Fans	80
Air Coolers	120
Air Conditioners – Window (1.0 TR)	1500
Air Conditioners – Window (1.5 TR)	2000
Air Conditioners – Split (1.0 TR)	2000
Air Conditioners – Split(1.5 TR)	2500
Refrigerator (286 Litres)	500
Mixer/Blender	500
Toaster	1000
Induction cooker	1000
OTG	800
Microwave Oven	1200
Electric Kettle	2000
Water heater-Instant Type	3000
Water heater-Storage type	1500
Immersion rod	750
Electric Iron	1000
Mosquito Repellent	5
Vacuum Cleaner	400
Washing Machine	500
TV	120
Audio system	120
Mobile Charger	22
Computer – PC	300
Computer – Laptop	70
Hair Dryer	1000
Water pump (1.0 HP)	746

7.b) Classify different types of Earthing and explain plate earthing with neat sketch. **5M**

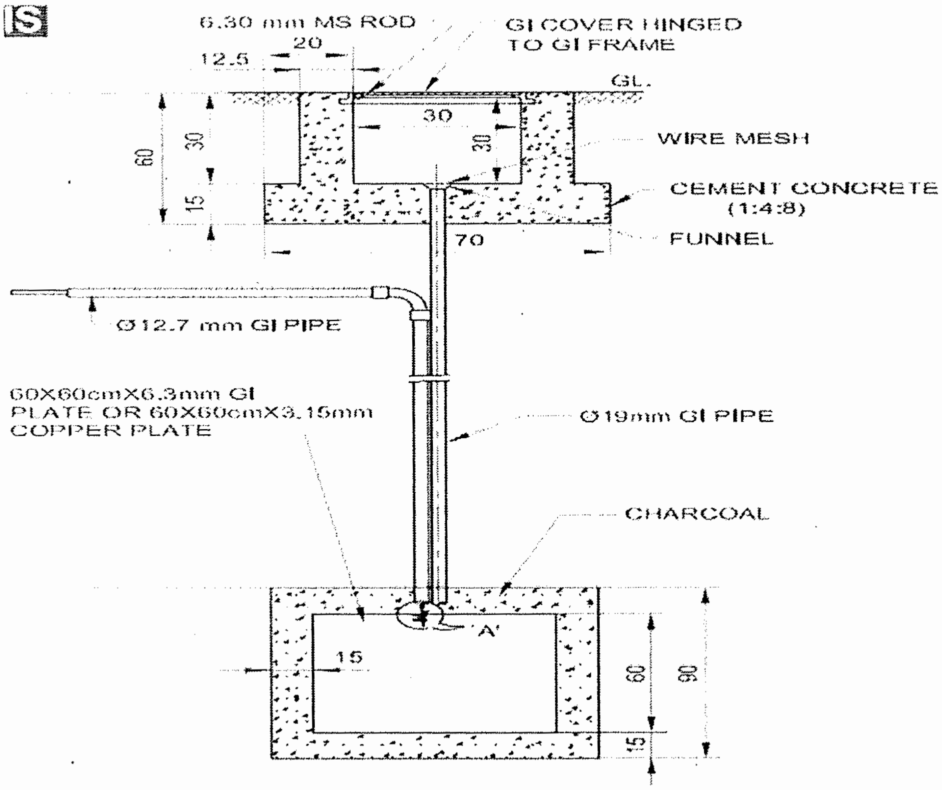
Earthing is defined as "the process in which the instantaneous discharge of the electrical energy takes place by transferring charges directly to the earth through low resistance wire

Types of Earthing: There are three types of earthing, they are

- Pipe earthing
- Strip earthing
- Plate earthing

Plate Earthing is a method where a plate made of galvanized copper or iron is buried vertically at least 3 meters below ground level. This plate connects all conductors to the earth, providing a path for electrical discharge. The Diagram of Plate Earthing typically illustrates this setup, showing the plate's position in relation to the ground level and the conductors it connects.

The Plate Earthing Diagram also often includes the dimensions of the plate. For instance, a copper plate used in this method typically measures 600mm x 600mm x6.35mm. The plate's size and material can vary based on specific requirements, but the principle remains the same, to provide a safe path for fault current to the earth.



Advantages of Earthing

1. Earthing is the safe and the best method of offering safety. We know that the earth's potential is zero and is treated as Neutral. Since low equipment is connected to earth using low resistance wire, balancing is achieved.
2. Metal can be used in electrical installations without looking for its conductivity. proper earthing ensures that metal does not transfer current.
3. A sudden surge in voltage or overload does not harm the device and person if proper earthing measures are done.
4. It prevents the risk of fire hazards that could otherwise be caused by the current leakage.

Part – B

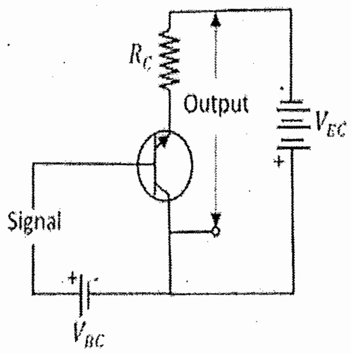
1.f) Describe the function of Zener voltage regulator. **1M**

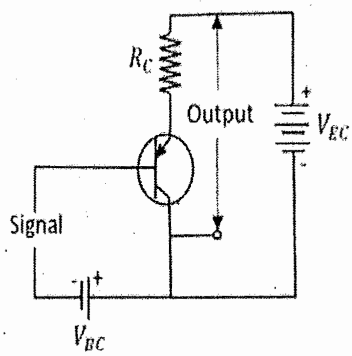
A Zener voltage regulator maintains a constant output voltage by operating the Zener diode in its breakdown region, despite variations in input voltage or load current.

1.g) List the applications of Transistors. (Any two) **1M**

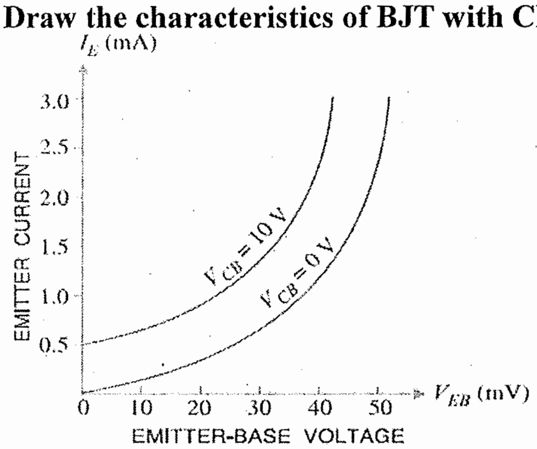
Amplification of audio and signal voltages
Electronic switching in digital circuits
Oscillators and signal generators
Voltage and current regulation
Signal modulation and demodulation
Power control in motor drives and inverters
Logic circuits and microprocessors
Radio, TV, and communication systems

1.h) Label the circuit diagram of CC configuration.(Any One) **1M**

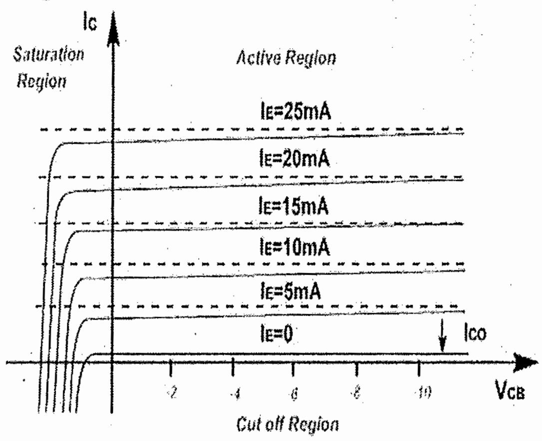




1.i) Draw the characteristics of BJT with CB configuration. **1M**



Input characteristics:



Output characteristics

1.j) Define Excess-3 code. **1M**

Excess-3 code is a non-weighted, self-complementing binary code used to represent decimal digits, in which each decimal digit is encoded by adding 3 to it and then converting the result into binary.

8.a) Discuss why biasing is required for a transistor?. Illustrate the output characteristics of a common emitter transistor with a neat sketch **5M**

Transistor Biasing:

The application of a suitable D.C. voltage, across the transistor terminals is called Biasing

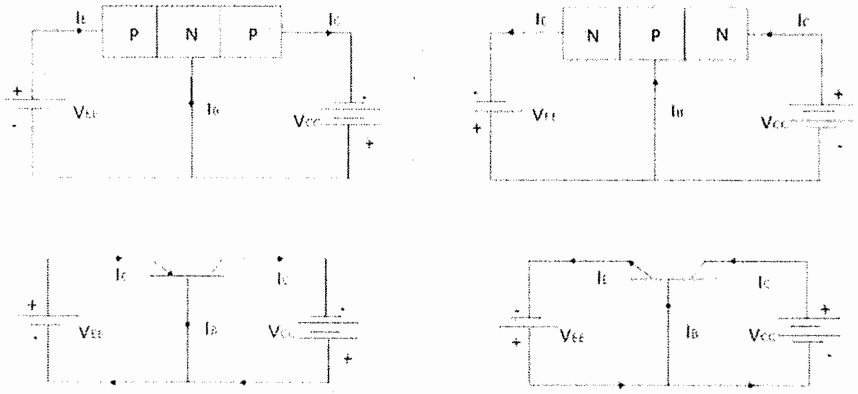
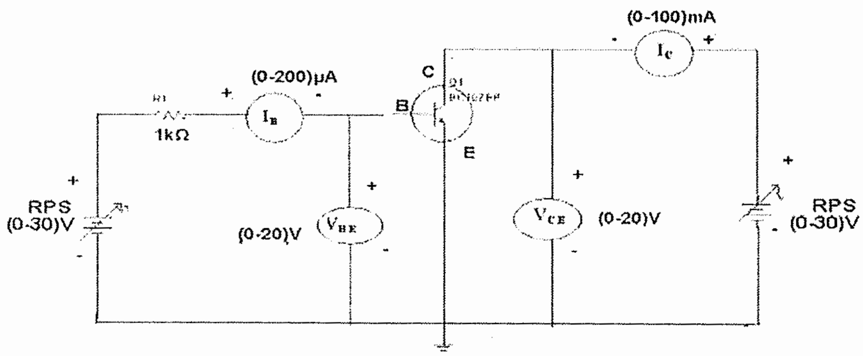


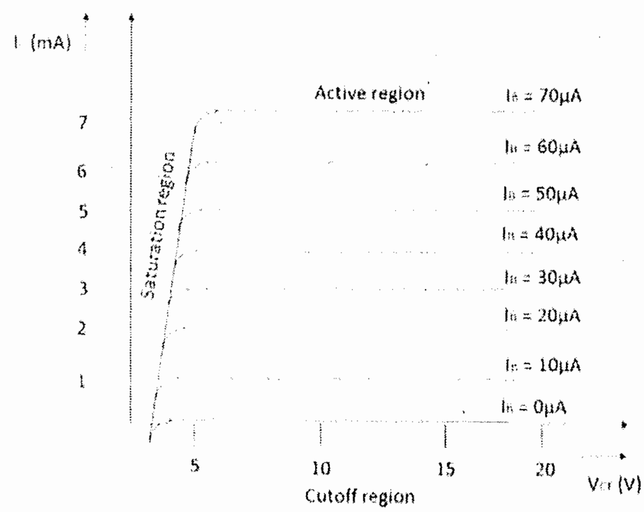
Figure (a) : PNP transistor **Figure (b) : NPN transistor**

Common Emitter Circuit:

A test circuit for determining the static characteristics of an NPN transistor is shown in fig. In this circuit emitter is common to both input and output circuits. To measure the base and collector current milli ammeters are connected in series with the base and the output circuits. Voltmeters are connected across the input and the output circuits to measure V_{BE} and V_{CE}.



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 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.

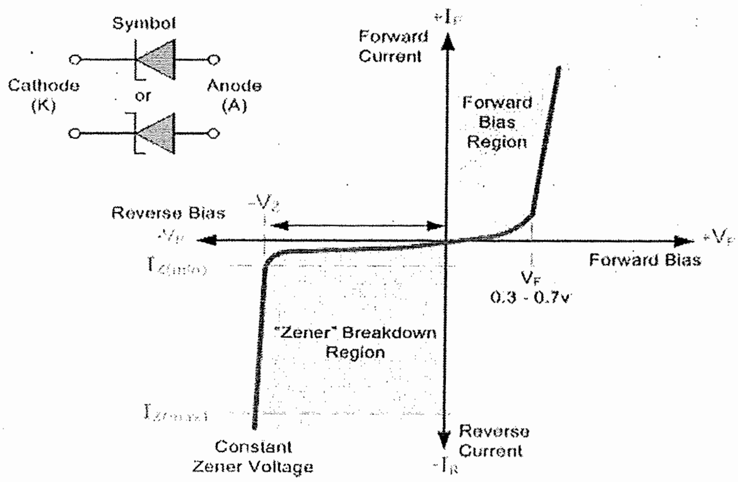
1. The collector current I_C increases rapidly to a saturation level for fixed value of I_B but at thesame time V_{CE} increases from zero.
2. A small amount of collector current flows even when $I_B = 0$. The current is called I_{CEO}. Nowmain collector current is zero and the transistor is cut-off.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

8.b) Explain the working of Zener Diode with its Characteristics **5M**

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.

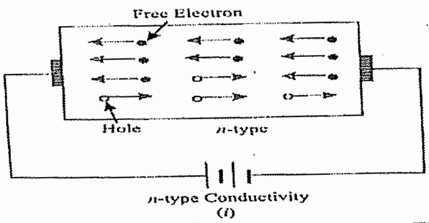
In the third quadrant, the magic happens. The graph shows the current vs voltage curve when we apply a reverse bias to the diode. The Zener breakdown voltage is the reverse bias voltage after which a significant amount of current starts flowing through the Zener diode. Here in the diagram, V_Z refers 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. Due to the unique property of Zener diode, the depletion region regains its original position when the reverse voltage gets removed. The Zener diode doesn't get damaged despite this massive amount of current flowing through it. This unique functionality makes it very useful for many applications.



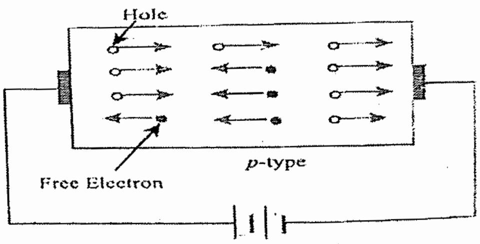
9.a) **Explain the minority and majority charge carriers in P block and N block semiconductors.** **5M**

(*i*) **n-type conductivity.** *The current conduction in an n-type semiconductor is predominantly by free electrons (i.e., negative charges) and is called n-type conductivity.* Fig. 25.11 (*i*) shows the current conduction in an *n*-type semiconductor. The majority carriers (*i.e.*, free electrons) move towards the positive terminal while the holes move towards the negative terminal. The current due to holes in *n*-type semiconductor is very small and may be neglected.



n-type Conductivity
(*i*)

(*ii*) **p-type conductivity.** *The current conduction in a p-type semiconductor is predominantly by holes (i.e., positive charges) and is called p-type conductivity.* Fig. 25.11 (*ii*) shows the current conduction through a *p*-type semiconductor. The majority carriers (*i.e.*, holes) drift towards the negative terminal while the minority carriers (free electrons) move towards the positive terminal. The current due to minority carriers (*i.e.*, free electrons) in a *p*-type semiconductor is so small that it may be neglected.



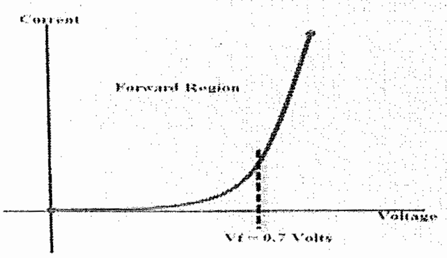
p-type Conductivity
(*ii*)

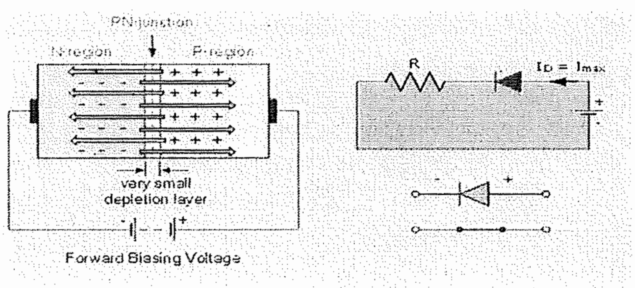
9.b) Explain the working of the PN junction diode as a switch. **5M**

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.

ForwardBias



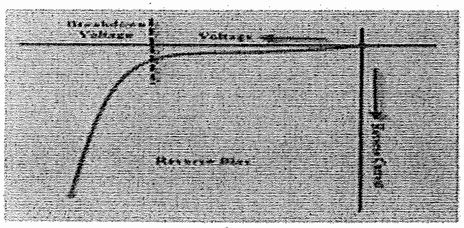


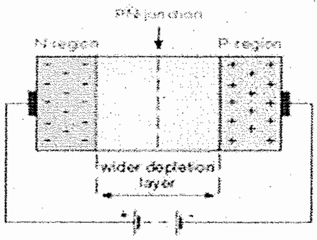
When a diode is connected in a **Forward Bias** condition, a negative voltage is applied to the N-type material and a positive voltage is applied to the P-type material. If this external voltage becomes greater than the value of the potential barrier, approx. 0.7voltsfor silicon and 0.3 volts for germanium, 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.

The application of a forward biasing voltage on the junction diode results in the depletion layer becoming very thin and narrow which represents a low impedance path through the junction thereby allowing high currents to flow. The point at which this sudden increase in current takes place is represented on the static I-V characteristics curve above as the "knee" point.

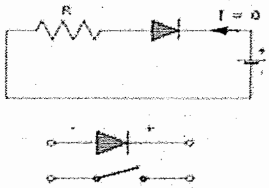
ReverseBias:

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 alack 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.

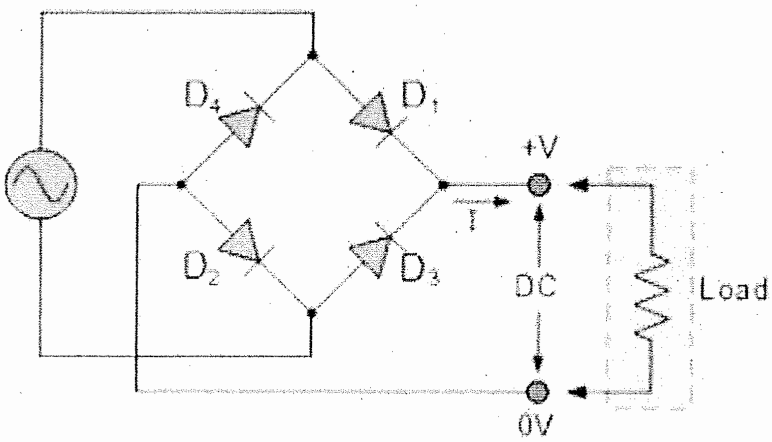




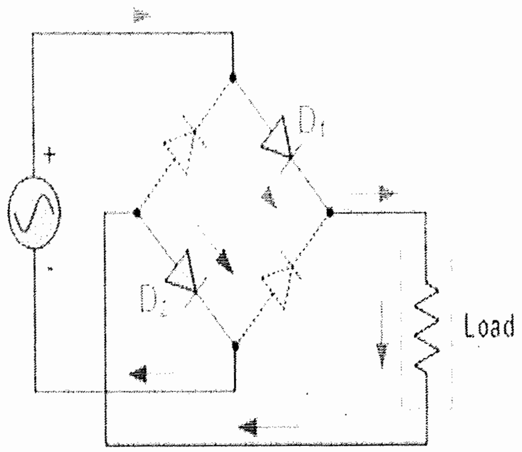
Reverse Biasing Voltage



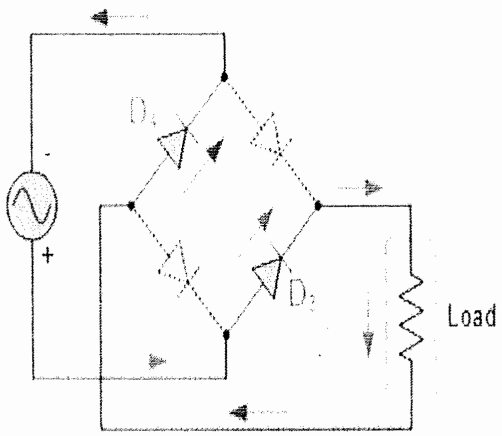
10.a) Explain the working of a full wave bridge rectifier. **5M**



The four diodes labeled D_1 to D_4 are arranged in "series pairs" with only two diodes conducting current during each half cycle.

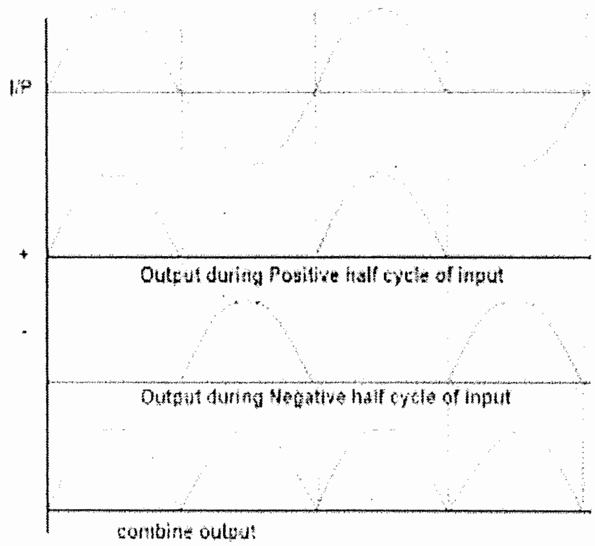


During the positive half cycle of the supply, diodes D_1 and D_2 conduct in series while diodes D_3 and D_4 are reverse biased and the current flows through the load as shown below.



During the negative half cycle of the input ac voltage diodes D_3 and D_4 conduct, whereas diodes D_1 and D_2 do not conduct. The conducting diodes D_3 and D_4 will be in series through the load resistance R_L and the current flows through the R_L, in the same direction as in the previous half cycle. Thus a bidirectional wave is converted into a unidirectional wave.

Waveforms:



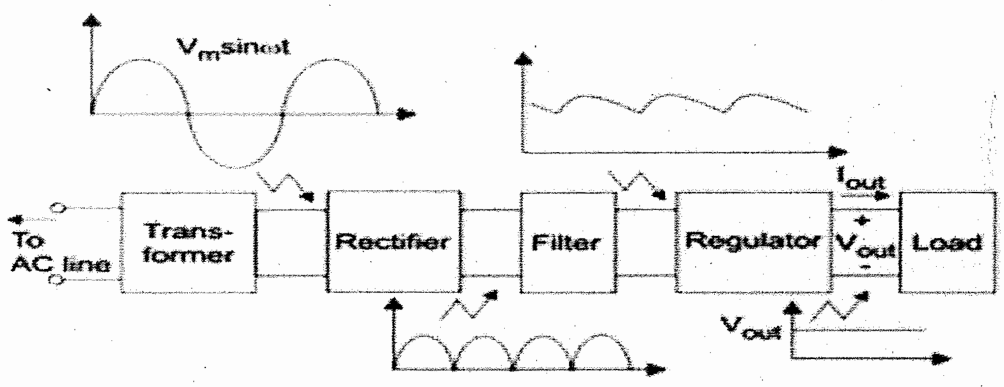
10.b) Articulate the block diagram of an regulated DC power supply and explain the Function of each block. **5M**

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. A regulated DC power supply is also called as a linear power supply, it is an embedded circuit and consists of various blocks.

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.

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



Components of typical linear power supply

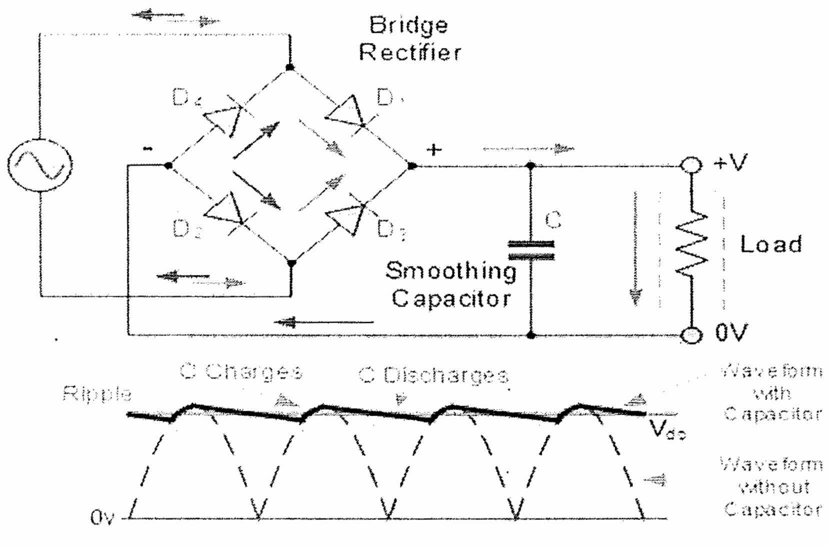
i) **Step Down Transformer**: A step down transformer will step down the voltage from the ac mains to the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit.

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.

11.a) Describe the role of Filter in the Rectifier with an example. **5M**



Resultant Output Waveform

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.

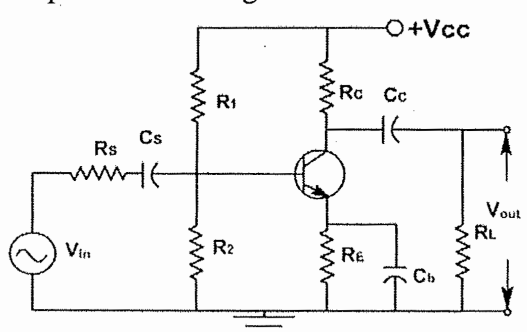
In In the next quarter cycle that is from $3\pi/2$ to 2 , the diodes D_3 , D4 gets reverse biased and the capacitor supplies load current.

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) Describe the working of CE amplifier with neat circuit and their applications. **5M**

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.



From above circuit, it consists of different circuit components. The functions of thesecomponents are as follows:

Biasing Circuit:

Resistors R_1, R_2 and R_E forms the voltage divider biasing circuit for CE amplifier and it sets the proper operating point for CE amplifier.

Input Capacitor C_1:

C_1 couples the signal to base of the transistor. It blocks any D.C. component presentin the signal and passes only A.C. signal for amplification.

Emitter Bypass Capacitor C_E:

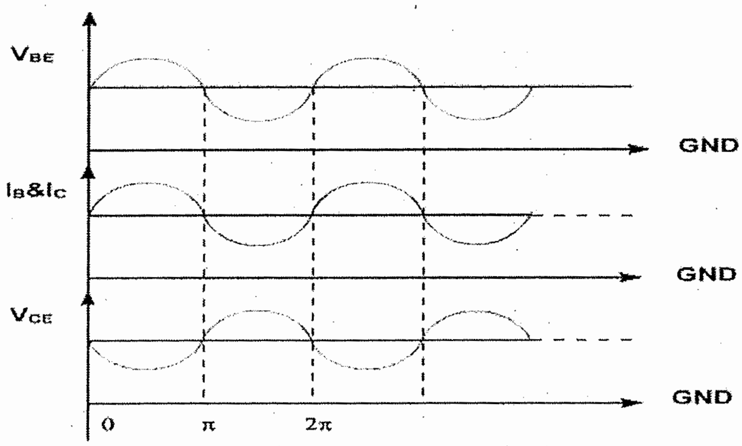
C_E is connected in parallel with emitter resistance R_E to provide a low reactance pathto the amplified A.C. This will reduce the output voltage and reducing the gain value.

Output Coupling Capacitor C_2:

C_2 couples the output of the amplifier to the load or to the next stage of the amplifier.It blocks D.C. and passes only A.C. part of the amplified signal.

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 180^{0} 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.



The Common Emitter amplifier is the most widely used BJT amplifier because it provides high voltage gain, moderate current gain, and phase inversion. Its main applications are:

(i) Audio Amplifiers
(ii) Voltage Amplification
(iii)RF (Radio Frequency) Amplifiers
(iv)Intermediate Amplifier Stages.
(v) Signal Conditioning Circuits
(vi)Switching Applications
(vii) Oscillator Circuits

12.a) Illustrate any four basic logic gates with appropriate truth tables and characteristic equations. **5M**

Name	Graphical Symbol	Algebraic Function	Truth Table
AND		$F = A \cdot B$ or $F = AB$	A B | F: 0 0 | 0; 0 1 | 0; 1 0 | 0; 1 1 | 1
OR		$F = A + B$	A B | F: 0 0 | 0; 0 1 | 1; 1 0 | 1; 1 1 | 1
NOT		$F = \overline{A}$ or $F = A'$	A | F: 0 | 1; 1 | 0
NAND		$F = \overline{AB}$	A B | F: 0 0 | 1; 0 1 | 1; 1 0 | 1; 1 1 | 0
NOR		$F = \overline{A + B}$	A B | F: 0 0 | 1; 0 1 | 0; 1 0 | 0; 1 1 | 0
XOR		$F = A \oplus B$	A B | F: 0 0 | 0; 0 1 | 1; 1 0 | 1; 1 1 | 0

12.b) Explain the BCD code, gray code and excess-3 with example. **5M**

BCD code

Binary Coded Decimal or BCD, is another process for converting decimal numbers into their binary equivalents. In this code each decimal digit is represented by a 4-bit binary number. In the binary system, with four bits we can represent sixteen numbers (0000 to 1111). But in BCD code only first ten of these are used (0000 to 1001). The remaining six code combinations i.e., 1010 to 1111 are invalid in BCD.

In the BCD numbering system, the given decimal number is segregated into chunks of four bits for each decimal digit within the number. Each decimal digit is converted into its direct binary form. Table (8.3) gives the binary and BCD codes for the decimal numbers 0 to 15.

Decimal Number	Binary Number	Binary Coded Decimal
0	0000	0000
1	0001	0001
2	0010	0010
3	0011	0011
4	0100	0100
5	0101	0101
6	0110	0110
7	0111	0111
8	1000	1000
9	1001	1001
10	1010	0001 0000
11	1011	0001 0001
12	1100	0001 0010
13	1101	0001 0011
14	1110	0001 0100
15	1111	0001 0101

$85_{10} = (1000 \quad 0101)_{BCD}$

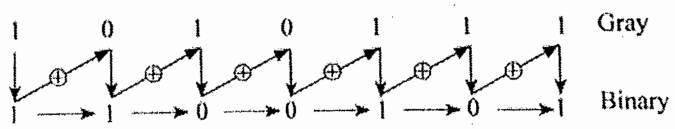
Gray code

The code which exhibits only a single bit change from one number to the next number is known as gray code or cyclic code. In this code, between any two successive code words, there will be change in only one position. This code is also called as unit distance code. It is also called as reflected code, because n-bit gray code can be generated by reflecting the $(n-1)^{th}$ bit code.

Table (8.5): *Grey code representation*

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

(i) 1010111



Therefore, $(1010111)_G = (1100101)_2$

Excess-3 code

Excess-3 code, also known as XS-3 code, is a non-weighted and self-complementary BCD code used to represent decimal numbers. It adds a fixed value of 3 to each decimal digit before converting it into a binary code or it can also add 0011 in each 4-bit BCD code of the decimal number for getting excess-3 code. The Excess-3 code for the decimal numbers are shown in Table 8.4.

We can find the excess-3 code of the given binary number by using the following steps:

1. Convert the binary number into decimal.
2. Add 3 in each digit of the decimal number.
3. Find the binary code of each digit of the newly generated decimal number.

We can also add 0011 in each 4-bit BCD code of the decimal number for getting excess-3 code.

Table (8.4): *Excess-3 code for the decimal numbers*

Decimal Code	BCD Code	Excess-3 Code
0	0000	0011
1	0001	0100
2	0010	0101
3	0011	0110
4	0100	0111
5	0101	1000
6	0110	1001
7	0111	1010
8	1000	1011
9	1001	1100

Decimal number : 6 4 3
Add 3 to each bit : +3 +3 +3
Sum : 9 7 6

By converting the above sum into its equivalent binary code, we have

Sum ⟶ 9 7 6
↓ ↓ ↓
1001 0111 0110

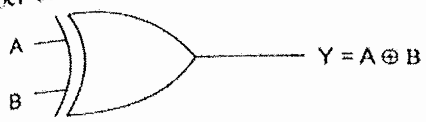
Hence the excess-3 code of $(643)_{10}$ is 1001 0111 0110

13.a) Illustrate the functioning of XOR, XNOR gates with their symbols and truth tables.5M

<u>XOR (Exclusive OR) Gate:</u>

- Functionality: The XOR gate outputs a true (1) value only when the number of true inputs is odd. If the number of true inputs is even or if all inputs are false, the output is false (0).

The Exclusive -OR gate (or) XOR gate is mostly used in logic design. The XOR gate has two inputs and one output. XOR gate operation for three or more than three variables does not exist. If we want to get the XOR operation for three or more than three variables, a number of two input XOR gates will be used.



(a) Logical symbol

Inputs		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(b) Truth table

If the input variables are 'A' and, 'B' then the output 'Y' can be expressed as, this is read as Y is 'an exclusive OR B'. The symbol '⊕' denotes 'Exclusive-OR' operation. The symbol '⊕' is also called modulo sum. From the truth table of two inputs XOR gate, it can say that when the two input variables are different such as '01' and '10', then the output 'Y' will be '1'. The output 'Y' can be calculated for the above two input combinations as follows. Let the input combination = '01'

Now $A = 0, B = 1$

We know that $Y = A \oplus B$

$$Y = A\bar{B} + \bar{A}B$$

$$= 0 \cdot \bar{1} + \bar{0} \cdot 1$$

$$= 0 \cdot 0 + 1 \cdot 1 \qquad [\because \bar{0} = 1, \bar{1} = 0]$$

$$= 0 + 1$$

$\therefore$ $Y = 1$

XNOR (Exclusive NOR) Gate:

- Functionality: The XNOR gate outputs a true (1) value only when all inputs are the same (either all true or all false). If the inputs are mixed (some true and some false), the output is false (0).

(a) Logical symbol

Inputs		Output
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(b) Truth table

Figure (8.12): *Exclusive-NOR Gate*

An exclusive-NOR gate or XNOR gate can be obtained by using XOR gate and a NOT gate. The XNOR gate is also mostly used in logic design. The XNOR gate has two inputs and one output. The XNOR gate operation for three or more than three variables does not exist. If we want to get the XNOR operation for three or more than three variables, a number of two

Now $A = 0,\ B = 1$

We know that

$$Y = A \odot B$$

$$Y = AB + \bar{A}\bar{B}$$

$$= 0 \cdot 1 + \bar{0}.\bar{1}$$

$$= 0 \cdot 1 + 1 \cdot 0 \qquad [\because \bar{0} = 1, \bar{1} = 0]$$

$$= 0 + 0$$

$$Y = 0$$

13.b) Convert the following **5M**

i) $(115)_{10}$ to Binary number.

Divide by 2 repeatedly:

115 ÷ 2 = 57 remainder 1
57 ÷ 2 = 28 remainder 1
28 ÷ 2 = 14 remainder 0
14 ÷ 2 = 7 remainder 0
7 ÷ 2 = 3 remainder 1
3 ÷ 2 = 1 remainder 1
1 ÷ 2 = 0 remainder 1

Reading remainders from bottom to top:

$(115)_{10}=(1110011)_2$

ii) $(2AB5)_{16}$ to Octal number.

Step 1: Convert hexadecimal to binary

Hex	Binary
2	0010
A	1010
B	1011
5	0101

$2AB5_{16}$= 0010 1010 1011 0101_2

Step 2: Group binary digits into sets of 3 (from right)

0010101010110101→0 010 101 010 110 101

Add leading zero if required:

000 010 101 010 110 101

Step 3: Convert each group to octal

Binary	Octal
000	0
001	1
010	2
101	5
011	3
010	2
101	5

Final Answer:

$$\mathbf{(2AB5)_{16}=(025265)_8}$$

iii) $(8964)_{10}$ to Hexa decimal number.

Divide by 16 repeatedly:

8964 ÷ 16 = 560 remainder 4
560 ÷ 16 = 35 remainder 0
35 ÷ 16 = 2 remainder 3
2 ÷ 16 = 0 remainder 2

Reading the remainders from bottom to top:

$$\mathbf{(8964)_{10}=(2304)_{16}}$$

iv) $(110111011)_2$ to decimal number.

The binary number is: 1 1 0 1 1 1 0 1 1

Each digit represents a power of 2, starting from the rightmost digit (2^0):

Binary Digit	Power of 2	Value
1	2^8	256
1	2^7	128
0	2^6	0
1	2^5	32
1	2^4	16
1	2^3	8
0	2^2	0
1	2^1	2
1	2^0	1

Now, add up all the values where the binary digit is 1:

$$256 + 128 + 32 + 16 + 8 + 2 + 1 = \mathbf{443}$$

$$\mathbf{(110111011)_2 = (443)_{10}}$$