MATRUSRI ENGINEERING COLLEGE
(An Autonomous Institution)
Saidabad, Hyderabad-500 059
(Approved by AICTE & Affiliated to Osmania University)
All Eligible Branches Accredited by NBA & NAAC with A+ Grade

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Manual and Observation Book

BASIC ELECTRONICS LAB

(Code: ES352ECU23)

B.E (IT/CME/MECH) III Semester (2025-2026)

Matrusri Engineering College
(An Autonomous Institution)
Approved by AICTE, Affiliated to Osmania University)
#16-1-486, Saidabad, Hyderabad-500059. Ph: 040-24072764

DEAPRTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BASIC ELECTRONICS LAB

(Code: ES352ECU23)

Name of the student : ______________________________

Class : ______________________________

Roll No : ______________________________

Semester : ______________________________

Academic Year : ______________________________

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DEAPRTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

➢ DEPARTMENT VISION

To become a reputed centre of learning in Electronics and Communication and transform the students into accomplished professionals

➢ DEPARTMENT MISSION

M1: To provide the learning ambience to nurture the young minds with theoretical and practical knowledge to produce employable and competent engineers.

M2: To provide a strong foundation in fundamentals of electronics and communication engineering to make students explore advances in research for higher learning.

M3: To inculcate awareness for societal needs, continuous learning and professional practices.

M4: To imbibe team spirit and leadership qualities among students.

➢ PROGRAM OUTCOMES (POs):

The students will be able to:	
PO1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to

	complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

- **PROGRAM SPECIFIC OUTCOMES (PSOs):**

Students will be able to:	
PSO1	**Professional Competence:** Apply the knowledge of Electronics Communication Engineering principles in different domains like VLSI, Signal Processing, Communication, Embedded Systems
PSO2	**Technical Skills:** Able to design and implement products using the state of art Hardware and Software tools and hence provide simple solutions to complex problems

- **COURSE OUTCOMES (COs):**

The course should enable the students to:	
CO1	Ability to design diode circuits & understand the application of Zener diode.
CO2	Ability to analyse characteristics of BJTs & FETs.

CO3	Ability to understand the different oscillator circuits.
CO4	Ability to understand operation of HWR & FWR circuits with & without filters.
CO5	Ability to design Analog-to-Digital converters & Digital-to-Analog converters.

- **MAPPING COURSE OUTCOMES (COs) with POs and PSOs:**
  (3 = High; 2 = Medium; 1 = Low)

COs	**POs**												**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	-	-	-	-	-	-	2	-	-	-	1	-
CO2	2	2	2	1	-	1	1	-	2	-	-	-	1	1
CO3	2	1	-	1	-	-	-	-	2	-	-	-	1	1
CO4	2	1	-	1	-	1	1	-	2	-	-	-	1	1
CO5	2	1	2	1	-	1	1	-	2	-	-	-	1	1

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DEAPRTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

LIST OF EXPERIMENTS (*Along with additional experiments)*

LIST OF EXPERIMENTS MAPPING WITH CO, PO, PSO

S.NO	Name of the experiment	Relevance with CO, POs	Relevance With PSOs
1.	Study of electronic components, CRO Applications, Measurement of R, L, and C using LCR meter	CO1, PO1, PO2	PSO1
2.	Characteristics of Semi-conductor diodes (Ge, Si, Ze).	CO1, PO1, PO2	PSO1
3	Half wave rectifier with and without filters	CO4, PO1, PO2, PO4, PO6, PO7, PO9	PSO1, PSO2
4	Full wave rectifier with and without filters	CO4, PO1, PO2, PO4, PO6, PO7, PO9	PSO1, PSO2
5.	Static Characteristics of BJT-Common Emitter configuration	CO2, PO1, PO2, PO3, PO4, PO6,PO7, PO9	PSO1, PSO2
6.	Static characteristics of BJT-Common Base configuration	CO2, PO1, PO2, PO3, PO4, PO6,PO7, PO9	PSO1, PSO2
7.	Static characteristics of FET	CO2, PO1, PO2, PO3, PO4, PO6,PO7, PO9	PSO1, PSO2
8	Frequency Response of Common Emitter Amplifier.	CO2, PO1, PO2, PO3, PO4, PO6, PO7, PO9	PSO1, PSO2
9.	RC Phase Shift Oscillator	CO3, PO1, PO2, PO4, PO9	PSO1, PSO2
10.	Hartley and Colpitts Oscillator	CO3, PO1, PO2, PO4, PO9	PSO1, PSO2
11.	Operational Amplifier Applications	CO4, PO1, PO2, PO4, PO6, PO7, PO9	PSO1, PSO2

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DEAPRTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BASIC ELECTRONICS LAB

Name of the student :

Class B.E :

Roll No :

Academic Year :

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S.No.	Name of the experiment	Date Conducted	Initials of the staff

EXPERIMENT NO: 1

STUDY OF ELECTRONIC COMPONENTS, CRO APPLICATIONS, MEASUREMENT OF R, L, & C USING LCR METER

AIM: To study electronic components, CRO Applications, Measurement of R, L, and C using LCR meter

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply	0-30 VDC, 2A	1
2	Voltmeters	-	1
3	Ammeters	-	1
4	Digital Multimeter	-	1
5	CRO	-	1

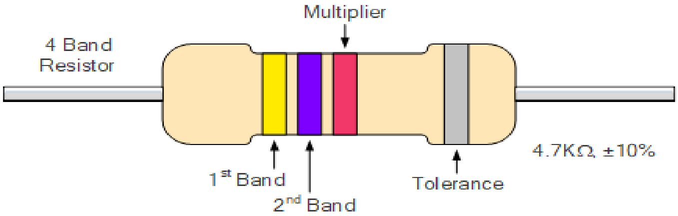
COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Resistors	-	1
2	Capacitors	-	1
3	Bread Board	-	1

1. BASIC ELECTRONIC COMPONENTS

A) RESISTORS: A resistor is a passive two-terminal electronic component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

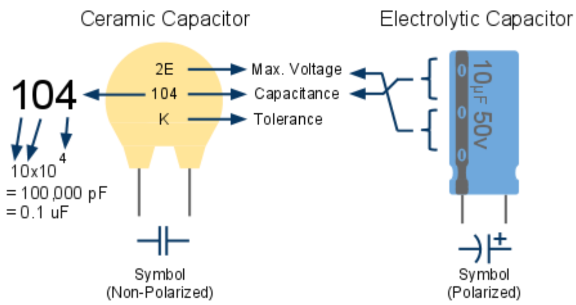
- **Coding Resistor and Capacitor values**



Color	Color	1st Band	2nd Band	3rd Band Multiplier	4th Band Tolerance
Black		0	0	x1Ω	
Brown		1	1	x10Ω	±1%
Red		2	2	x100Ω	±2%
Orange		3	3	x1kΩ	
Yellow		4	4	x10kΩ	
Green		5	5	x100kΩ	±0.5%
Blue		6	6	x1MΩ	±0.25%
Violet		7	7	x10MΩ	±0.10%
Grey		8	8	x100MΩ	±0.05%
White		9	9	x1GΩ	
Gold				x0.1Ω	±5%
Silver				x0.01Ω	±10%

- **CAPACITORS**

A Capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field. By contrast, batteries store energy via chemical reactions. Capacitors are widely used as parts of electrical circuits in many common electrical devices.



Max. Operating Voltage

Code	Max. Voltage
1H	50V
2A	100V
2T	150V
2D	200V
2E	250V
2G	400V
2J	630V

Capacitance Conversion Values

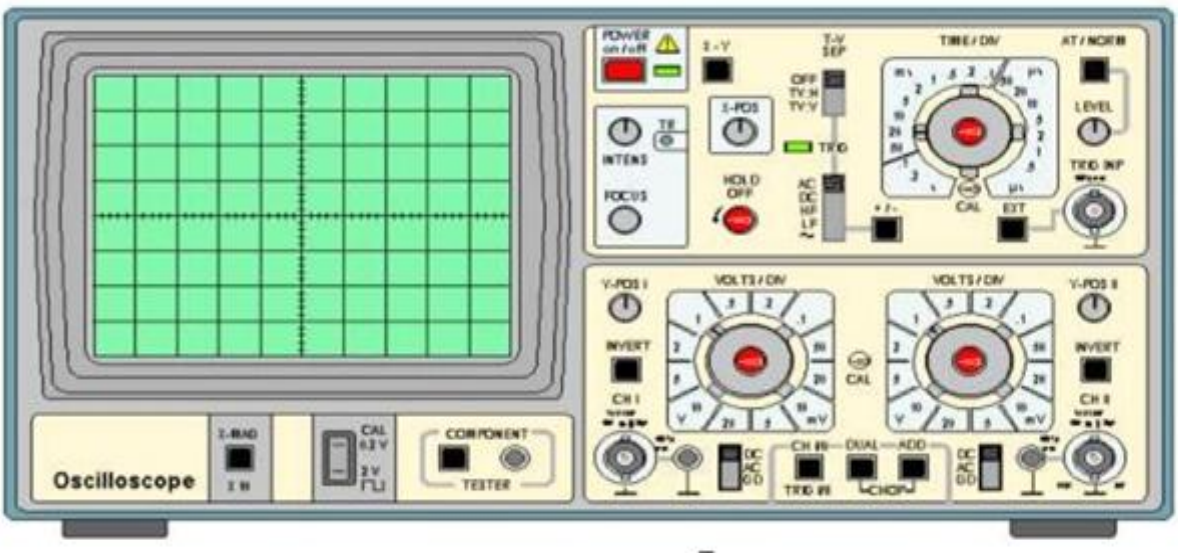
Microfarads (µF)	Nanofarads (nF)	Picofarads (pF)
0.000001 µF	0.001 nF	1 pF
0.00001 µF	0.01 nF	10 pF
0.0001 µF	0.1 nF	100 pF
0.001 µF	1 nF	1,000 pF
0.01 µF	10 nf	10,000 pF
0.1 µF	100 nF	100,000 pF
1 µF	1,000 nF	1,000,000 pF
10 µF	10,000 nF	10,000,000 pF
100 µF	100,000 nF	100,000,000 pF

Tolerance

Code	Percentage
B	± 0.1 pF
C	±0.25 pF
D	±0.5 pF
F	±1%
G	±2%
H	±3%
J	±5%
K	±10%
M	±20%
Z	+80%, -20%

Fig.2 Calculation of capacitors

- **CRO:** An outline explanation of how an oscilloscope works can be given using the block diagram shown below.



MODEL WAVEFORMS:

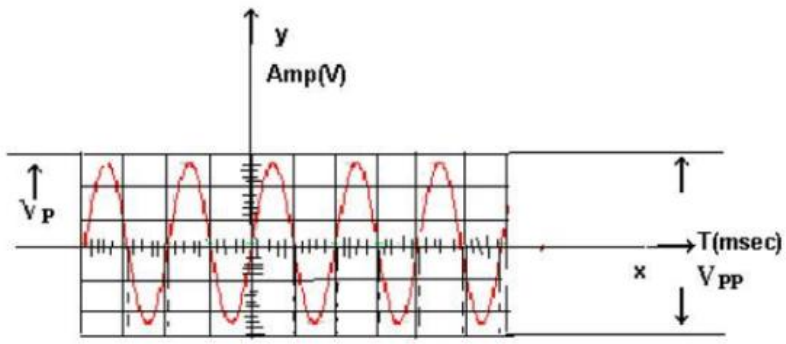


Fig 3: Sinusoidal Waveform

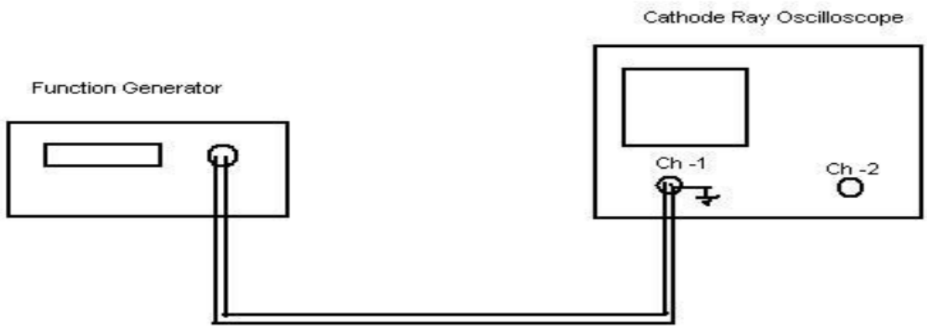


Fig 4: Calculation of amplitude and frequency

A) MEASUREMENT OF AMPLITUDE:
PROCEDURE:

1. Make the connections as shown in above diagram.
2. Put the CRO in single channel mode and bring the CRO into operation by adjusting the trace of the beam to a normal brightness and into a thin line.
3. Now apply the sinusoidal wave of different amplitudes by using the LEVEL and CORASE buttons of Function Generator.
4. Note down on the vertical scale peak to peak amplitude (Vp-p).

Table-1: Calculation of unknown amplitude

S.No	No. of vertical divisions(X)	Voltage/Division(Y)	Vp-p=X*Y	Vm=Vp-p/2

B) MEASUREMENT OF FREQUENCY:
PROCEDURE

1. Make the connections as shown in above diagram.
2. Put the CRO in single channel mode and bring the CRO into operation by adjusting the trace of the beam to a normal brightness and into a thin line.
3. Now apply the sinusoidal wave of different frequencies by using the LEVEL and CORASE buttons of Function Generator.
4. Note down the horizontal scale period (T) in second for one complete cycle.

Table-2: Calculation of unknown frequency

S.No	No. of horizontal divisions(X)	Time/Division(Y)	T=X*Y	f=1/T(Hz)

C) MEASUREMENT OF UNKNOWN FREQUENCY:

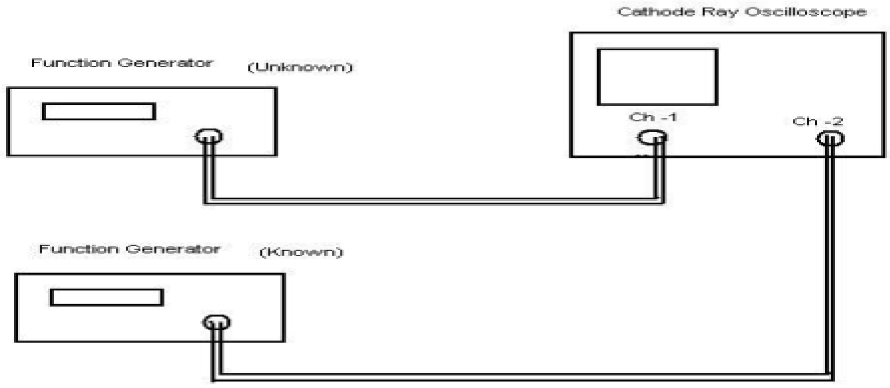


Fig 4: Measurement of Unknown frequency

PROCEDURE:

1. Connect the unknown frequency to the vertical (Y) deflection plates (CH-1) and known frequency to the horizontal (X) deflection plates (CH-2) from two function generators as shown in Fig 4.
2. Press X-Y mode on the CRO and obtain the LISSAJOUS PATTERN. The lissajous pattern is obtained when two sinusoidal signals of different frequencies are applied to the X and Y deflection plates of CRO. If the two frequencies are equal we get a circle or ellipse.
3. Note down Nx (number of touching points on X-axis), Ny (number of touching points on Y-axis), Fx (known signal frequency).
4. If the lissajous pattern is not clear to note the readings, vary the known frequency such that a clear lissajous pattern is obtained.
5. The unknown frequency Fy can be calculated as $\boldsymbol{F_y} = \frac{N_x * F_x}{N_y}$.

$$\text{i.e } \frac{F_y}{F_x} = \frac{number\ of\ intersections\ of\ lissajous\ pattern\ with\ horozontal\ line}{number\ of\ intersectins\ of\ lissajous\ pattern\ with\ vertical\ line}$$

Table-3: Measurement of Unknown frequency

S.No	Known frequency (Fx)	N_x	N_y	Unknown frequency $\boldsymbol{F_y = \frac{N_x * F_x}{N_y}}$

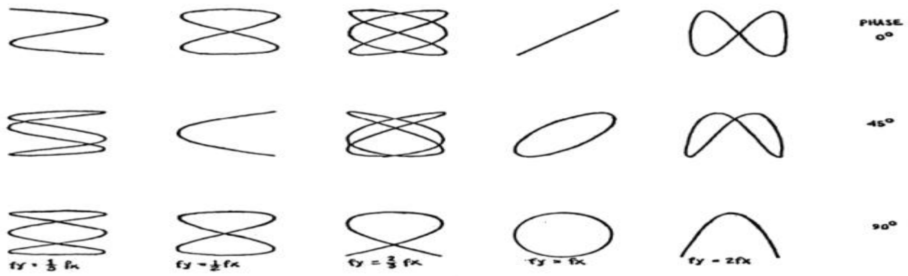


Fig 5: Different LISSAJOUS PATTERN

Examples of Lissajous pattern

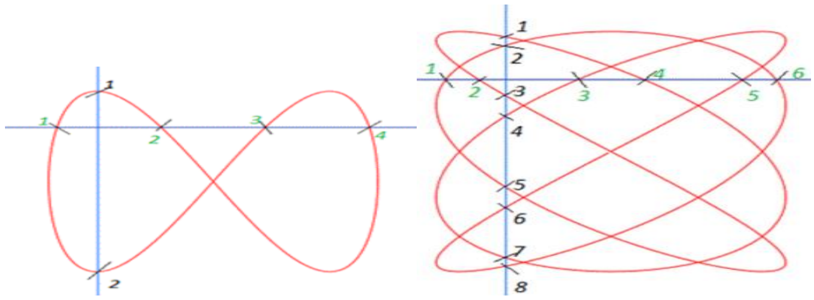


Fig.6 Example of Lissajous pattern

$$\frac{Fy}{Fx} = \frac{4}{2} = 2 \quad \frac{Fy}{Fx} = \frac{6}{8} = \frac{3}{4}$$

C) MEASUREMENT OF PHASE:

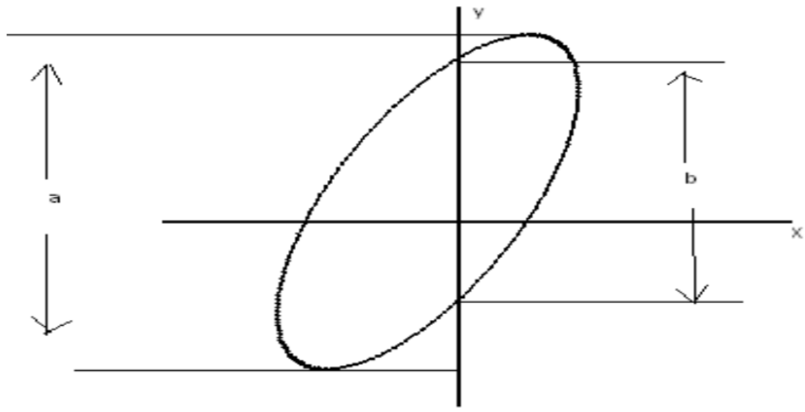


Fig.7 calculation unknown phase through A and B

PROCEDURE:

1. Obtain a sinusoidal signal of 5V (p-p) at 1KHz from the function generator.
2. Connect the signal from the function generator to the input of the RC network and the same signal to the CH-1 of CRO.
3. Connect the output of the phase network to CH-2 of CRO.
4. Press X-Y mode button in CRO and the pattern obtained is ellipse.
5. The phase difference between the two signals is given by $\theta = \sin^{-1}(B/A)$ where $B = A \sin\theta$.
6. By varying the different values of resistances using DRB, frequencies note the values of A,B and θ

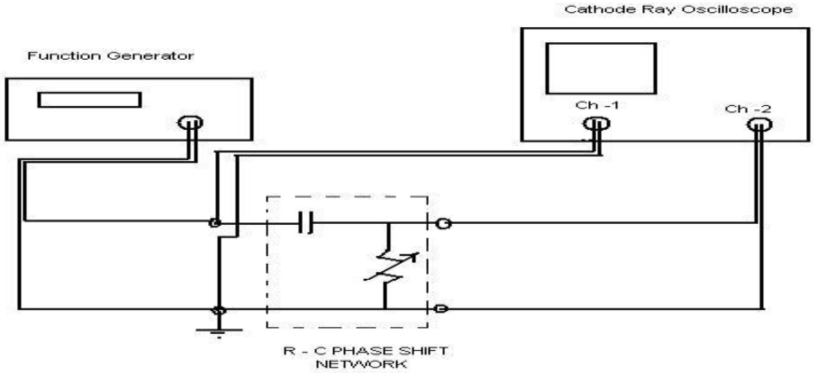
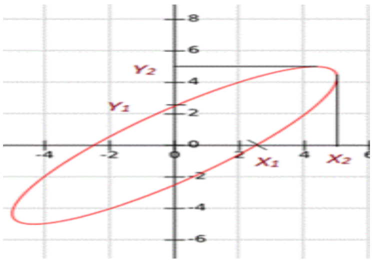


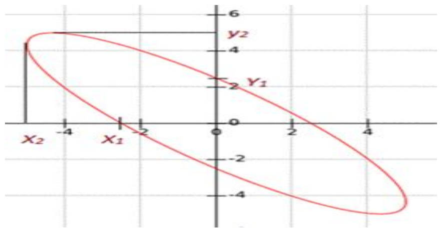
Fig 7: Measurement of Phase difference

CASE 1: 0<θ<90 or 270<θ<360



$$\theta = \sin^{-1}(B/A)$$

CASE 2: 90<θ<180 or 180<θ<270



$$\theta = 180 - \sin^{-1}(B/A)$$

Table 4: Calculation of phase

S.No	F	R	C	$\theta = tan^{-1}(\frac{1}{\omega RC})$	B	A	θ= $\sin^{-1}$ (B/A)

- **LCR meter:** LCR meter is a type of electronic test equipment used to measure the inductance (L), capacitance (C),and resistance (R) of an electronic component. In the simpler versions of this instrument the impedance was measured internally and converted for display to the corresponding capacitance or inductance value.

Fig.8 LCR meter

RESULT:

VIVA VOCE:-

1. List the structural details of a CRO.
2. What is the function of accelerating anode in a CRT?
3. List the various applications of a CRO.
4. What are Lissajous figures? How are they formed?
5. How can you obtain an ellipse on a CRO screen?

EXPERIMENT NO: 2.A

V-I CHARACTERISTICS OF SILICON AND GERMANIUM DIODES

AIM:

To obtain and plot the forward and reverse V-I characteristics of P-N junction diode (Si and Ge) and to determine the static and dynamic resistances

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply	0-30 VDC, 2A	1
2	Voltmeters	0-20 VDC (Digital meter)	1
3	Ammeters	0-50 mA & 0-100 μA (Digital meter)	1

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Si Diode	1N4007	1
2	Ge Diode	OA 79	1
3	Resistors	1 KΩ	1
4	Bread Board	-	1

PROCEDURE:

(A) Silicon Diode

- **Forward Bias**

1. Connect the circuit according to the schematic in Fig. 1. Increase the voltage in steps of 2V up to 8V and then at 16V, 20V, 25V and 30V while noting down in Table 1 the corresponding forward current.
2. Plot the curve of V_F vs I_F on a graph paper and calculate the static forward resistance and dynamic forward resistance.

- **Reverse Bias**

1. Now connect the circuit according to the schematic in Fig 2. Increase the voltage in steps of 2V up to 8V and then at 16V, 20V, 25V and 30V while noting down the reverse current in Table 2.
2. Plot the curve of V_R vs I_R on a graph paper and calculate the static and dynamic Reverse Resistance.

(B) Germanium Diode: Repeat the above procedure both for forward and reverse bias for Germanium diode.

CIRCUIT DIAGRAMS:

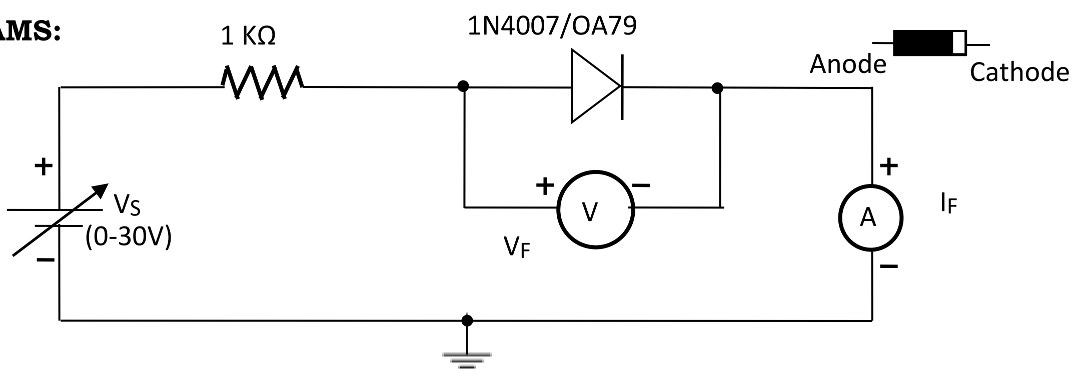


Fig. 1 Schematic for Forward Bias

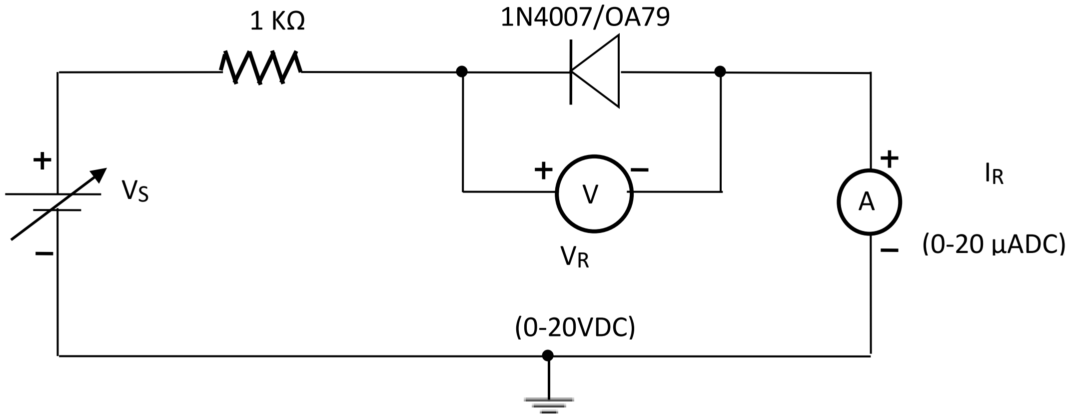


Fig. 2 Schematic for Reverse Bias

PROCEDURE:

- **Forward Bias**

1. Set DC voltage to 0.2 V.
2. Select the diode.
3. Set the resistor.
4. Voltmeter is placed parallel to Silicon diode and ammeter series with resistor.
5. The positive side of battery to the P side (anode) and the negative of battery to the N side (cathode) of the diode.
6. Now vary the voltage up to 5V and note the Voltmeter and Ammeter reading for particular DC voltage.
7. Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
8. Plot the V-I graph and observe the change.
9. Calculate the dynamic resistance of the diode. $r_d = \Delta V / \Delta I$.
10. Therefore from the graph we see that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage.

- **Reverse Bias**

1. Set DC voltage to 0.2 V.
2. Select the diode.
3. Set the resistor.
4. Voltmeter is placed parallel to Silicon diode and ammeter series with resistor.
5. The positive terminal of battery is connected to the N side (cathode) and the negative terminal of battery is connected to the P side (anode) of a diode.
6. Now vary the voltage up to 30V and note the Voltmeter and Ammeter reading for DC voltage.
7. Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
8. Plot the V-I graph and observe the change.

TABLE-1: FORWARD BIAS

Supply Voltage (V_S) (Volts)	V_F (volts)	I_F (mA)	Supply Voltage (V_S) (Volts)	V_F (volts)	I_F (mA)	Supply Voltage (V_S) (Volts)	V_F (volts)	I_F (mA)

TABLE-2: REVERSE BIAS

Supply Voltage (V_S) (Volts)	V_R (volts)	I_R (mA)	Supply Voltage (V_S) (Volts)	V_R (volts)	I_R (mA)	Supply Voltage (V_S) (Volts)	V_R (volts)	I_R (mA)

MODEL GRAPH:

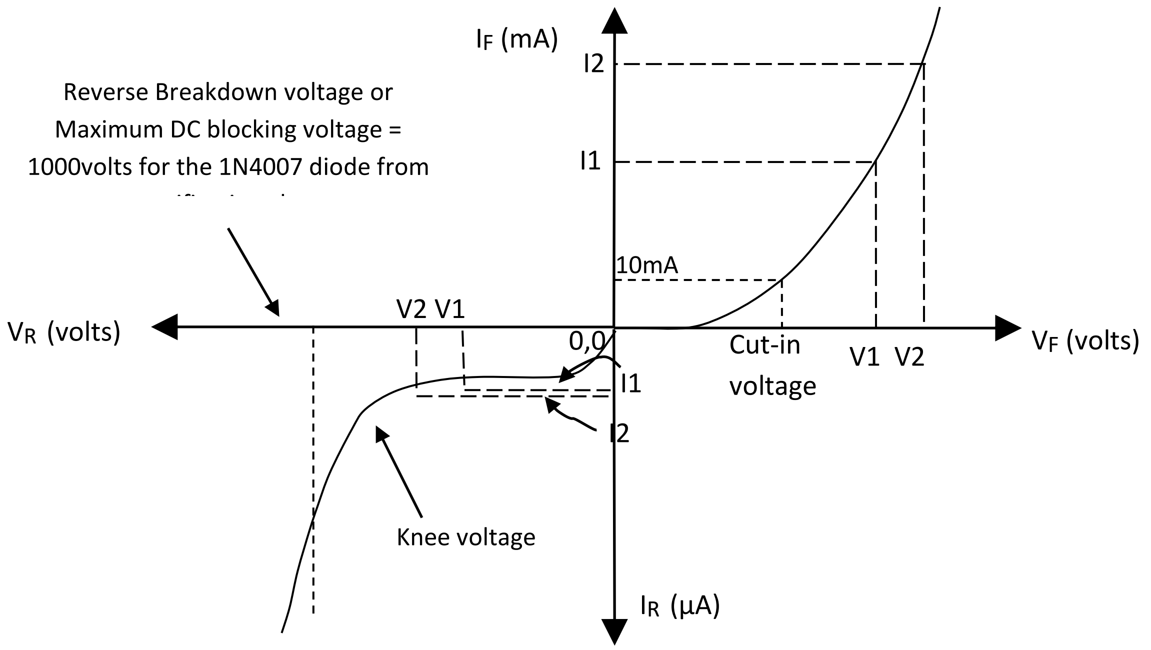


Fig.3 Model graph of PN junction Diode

FORWARD BIAS

Static Resistance = VF/IF

Dynamic Resistance = ∆V/∆I

= V2-V1/ I2-I1

REVERSE BIAS

Static Resistance = VR/IR

Dynamic Resistance = ∆V/∆I

= |V2|-|V1|/ |I2|-|I1|

RESULT:

VIVA VOCE:

1. Is the P-N junction diode a passive element or an active element?
2. What is meant by potential barrier across a P-N junction?
3. What is cut in voltage? What is the value of cut-in voltage for Ge and Si diodes? What is the reason for the difference in cut-in voltage of Ge and Si?
4. Explain physically how a P-N junction functions as a rectifier.
5. What do you understand by a reverse saturation current? What are the typical values?
6. Why is the magnitude of the current in the forward biased diode greater than that in the reverse biased diode?
7. How does the reverse saturation current vary with temperature for Ge and Si diodes? Is it of significance while the circuit designer chooses a particular device in design?

EXPERIMENT NO: 2.B

V-I CHARACTERISTICS OF ZENER DIODE AND MEASUREMENT OF STATIC AND DYNAMIC RESISTANCE

AIM:

To obtain and plot the V-I characteristics of a Zener diode and determine its breakdown voltage and determine its static and dynamic resistances.

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply	0-30 VDC, 2A	1
2	Voltmeters	0-20 VDC	2
3	Ammeters	0-20mA	1(each)

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Diode (Zener, 5V nominal)	BZX79-C5V1	1
2	Resistors	2.2 KΩ Half Watt	1 each
3	Bread Board	-	1

PROCEDURE:

- **Forward Bias**

1. Connect the circuit according to the schematic in Fig 1. Increase the voltage in steps of 2 volts up to 8V and then at 16V, 20V, 25V and 30V while noting down in Table 1 the corresponding forward current.
2. Plot the curve of V_F vs I_F on a graph paper and calculate the static forward resistance and dynamic forward resistance.

- **Reverse Bias**

1. Now connect the circuit according to the schematic in Fig 2. Increase the voltage in steps of 2V up to 12V and then at 16V while noting down the reverse current in Table 2.
2. Plot the curve of V_R vs. I_R on a graph paper and calculate the static reverse resistance and dynamic reverse resistance.
3. From the plot of V_R vs I_R, verify that the breakdown voltage at 5mA of the given Zener diode is within the range specified in the specification sheet.

CIRCUIT DIAGRAMS:

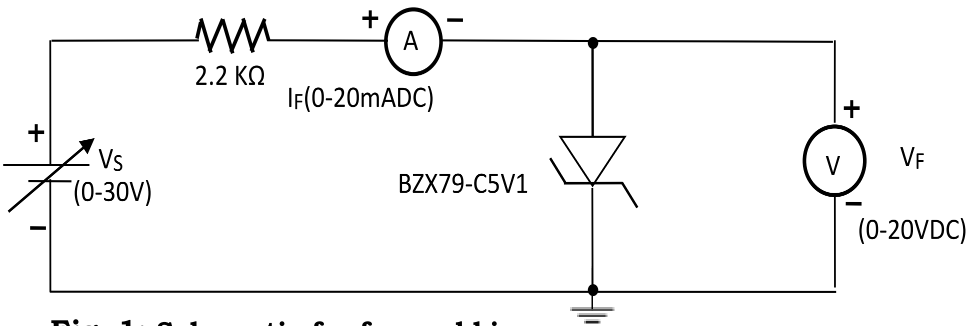


Fig. 1: Schematic for forward bias

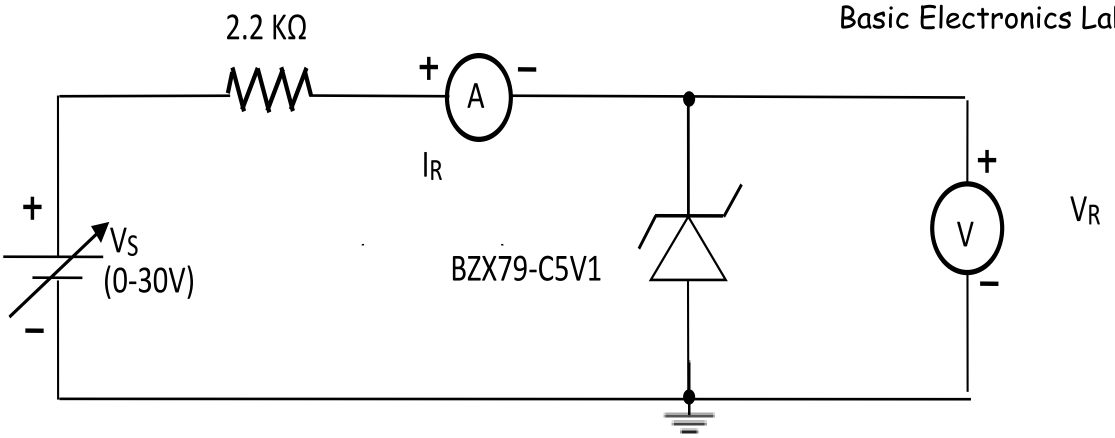


Fig. 2: Schematic for reverse bias

TABLE-1: FORWARD BIAS

Supply Voltage (V_S) (Volts)	**V_F (volts)**	**I_F (mA)**	**Supply Voltage (V_S) (Volts)**	**V_F (volts)**	**I_F (mA)**	**Supply Voltage (V_S) (Volts)**	**V_F (volts)**	**I_F (mA)**

TABLE-2: REVERSE BIAS

Supply Voltage (V_S) (Volts)	**V_R (volts)**	**I_R (mA)**	**Supply Voltage (V_S) (Volts)**	**V_R (volts)**	**I_R (mA)**	**Supply Voltage (V_S) (Volts)**	**V_R (volts)**	**I_R (mA)**

MODEL GRAPH:

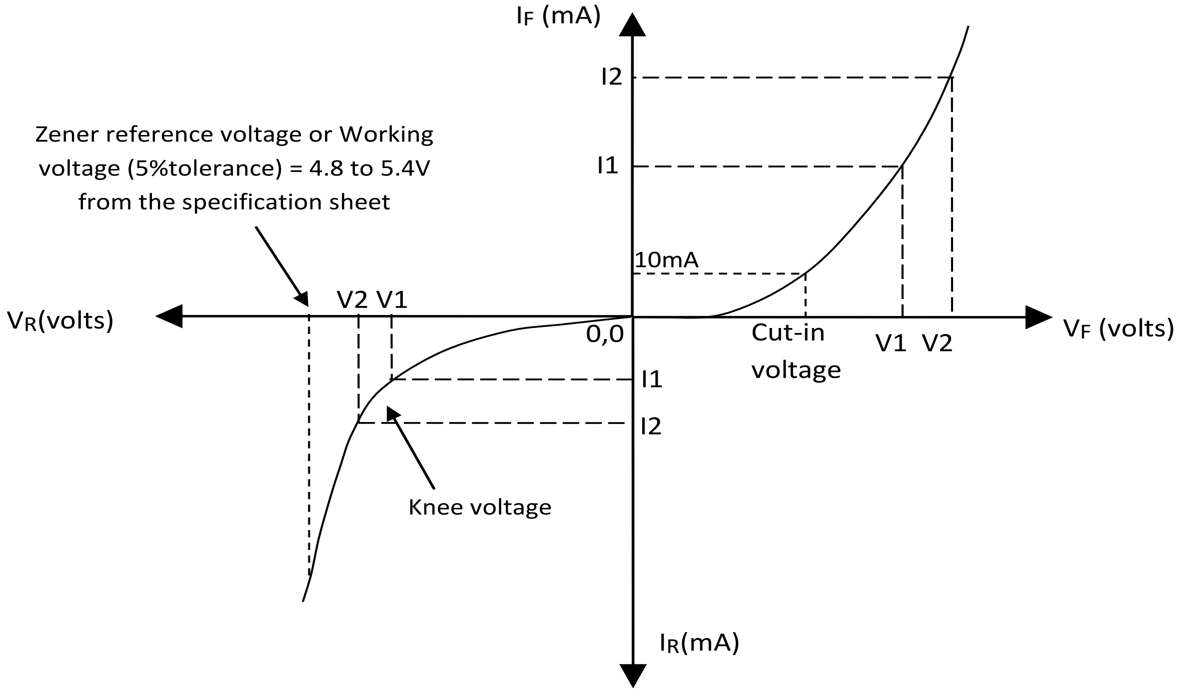


Fig.3 Model graph of Zener Diode

RESULT:

VIVA VOCE:

1. What are the typical applications of a Zener diode?
2. Define the various types of breakdown possible in diodes.
4. Give the typical application of an avalanche breakdown diode.
5. How do we test a diode using a multimeter?

EXPERIMENT NO: 3

HALF-WAVE RECTIFIER WITHOUT AND WITH FILTERS

AIM:
To obtain the ripple factor and percentage regulation of a Half-Wave rectifier without and with filters

APPARATUS:

S.No.	Name of the device	Range/No	Quantity
1.	Diodes	1N 4007	1
2.	Milli ammeter	0 - 25m Amp.	1
3.	CRO	30 MHz	1
4.	Transformer	12V	1
5.	Voltmeter	0-20 V	1
6.	Decade Resistance Box	1Ω – 10 M Ω	1

PROCEDURE:

(A) Half -Wave Rectifier without filter

1. Connect the circuit according to Fig. 1 and Switch ON the power supply.
2. Set R_L to 1 KΩ and note down the load voltage V_L.
3. Note down the output AC and DC voltages in the Table-1. (Since a moving coil analog voltmeter will not respond to AC voltages, a digital voltmeter is used to measure AC voltages, and the values recorded are RMS values).
4. Observe the input and output waveforms on the oscilloscope and plot these on a graph paper and measure the peak voltage V_m from the oscilloscope screen after ensuring that the Volt/div front knob is in the "Cal" position to obtain accurate V_m readings. Calculate and then plot the ripple factor and percentage regulation vs. load current on graph paper.

(B) Half -Wave Rectifier with Capacitor filter

1. Connect the capacitor according to the diagram in Fig. 2.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

(C) Half -Wave Rectifier with Inductor filter

1. Connect the inductor according to the diagram in Fig.3.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

(D) Half -Wave Rectifier with L-section filter

1. Connect the inductor according to the diagram in Fig.4.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

(E) Half -Wave Rectifier with π-section filter

1. Connect the inductor according to the diagram in Fig.5.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

CIRCUIT DIAGRAM:

(A) HALF WAVE RECTIFIER:

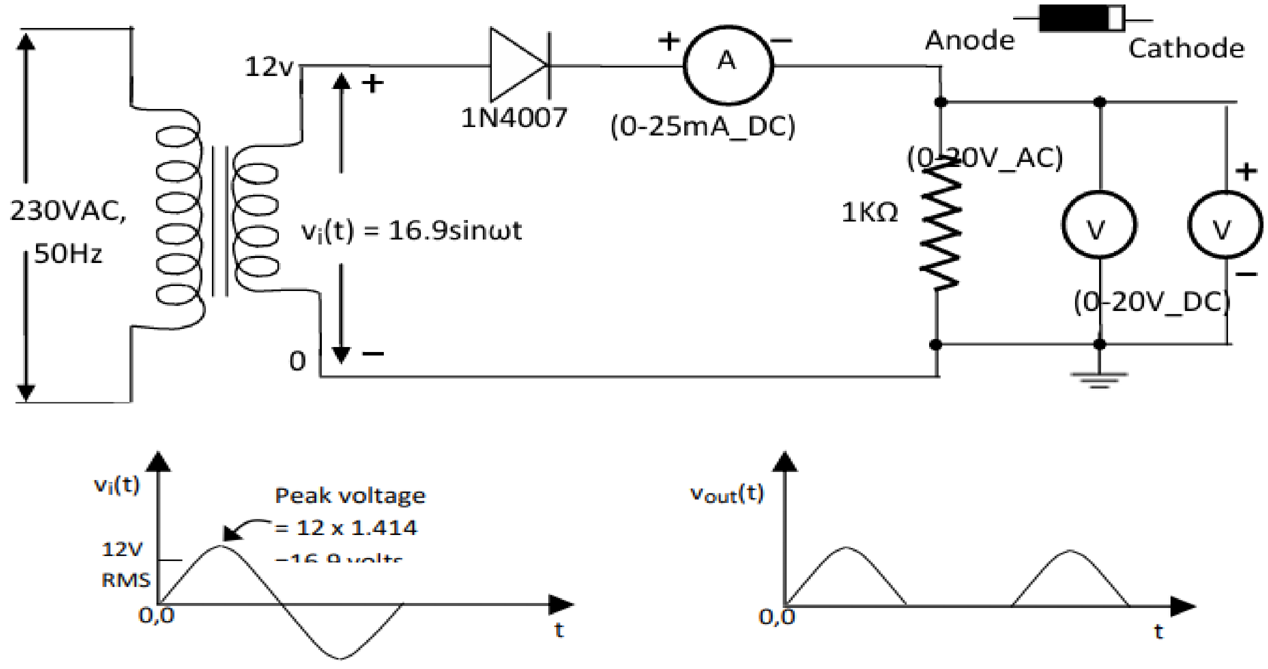


Fig.1 Half -Wave Rectifier without filter

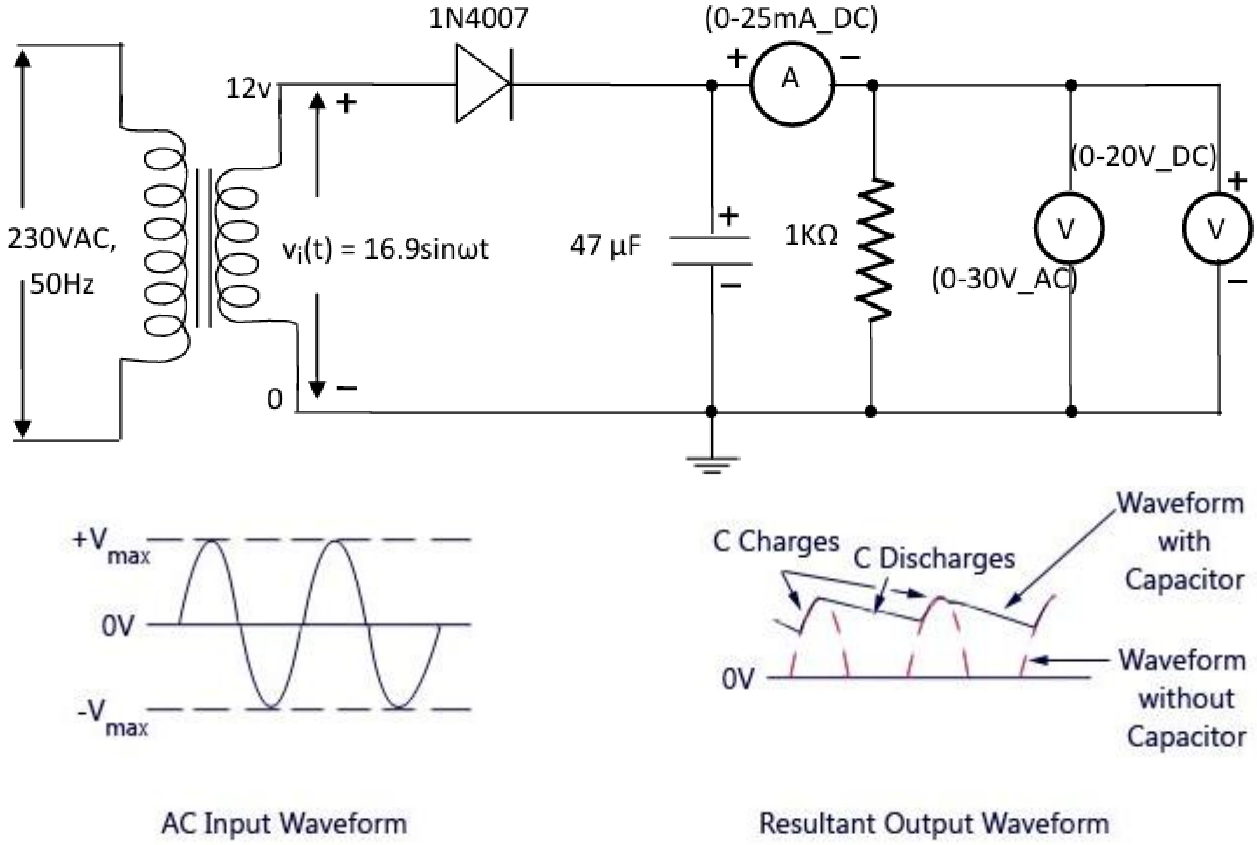


Fig. 2 Half-wave rectifier with capacitor filter

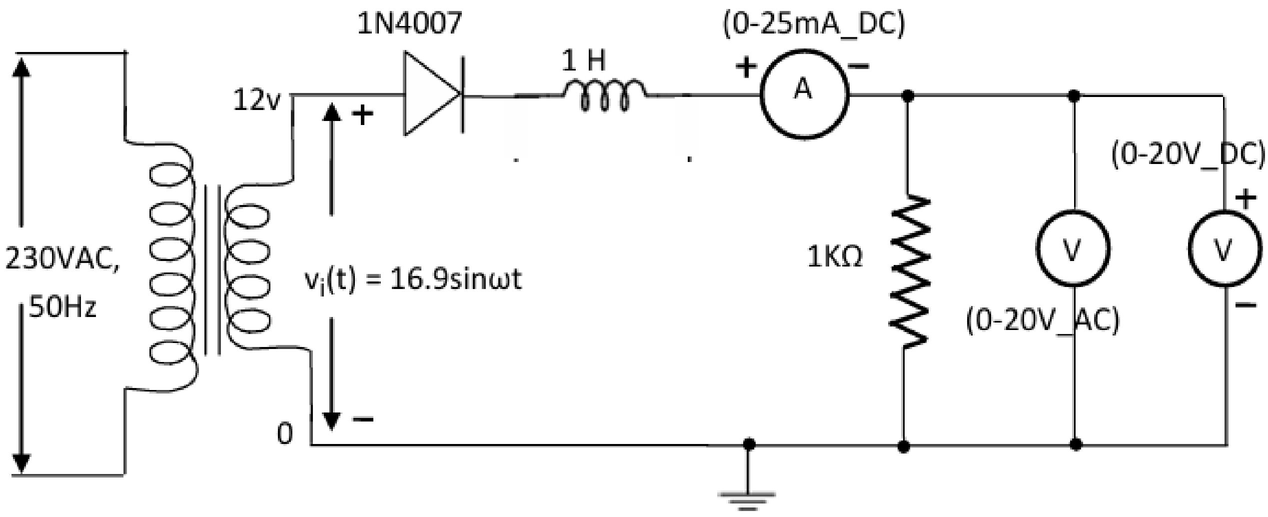


Fig.3 Half-Wave Rectifier with Inductor filter

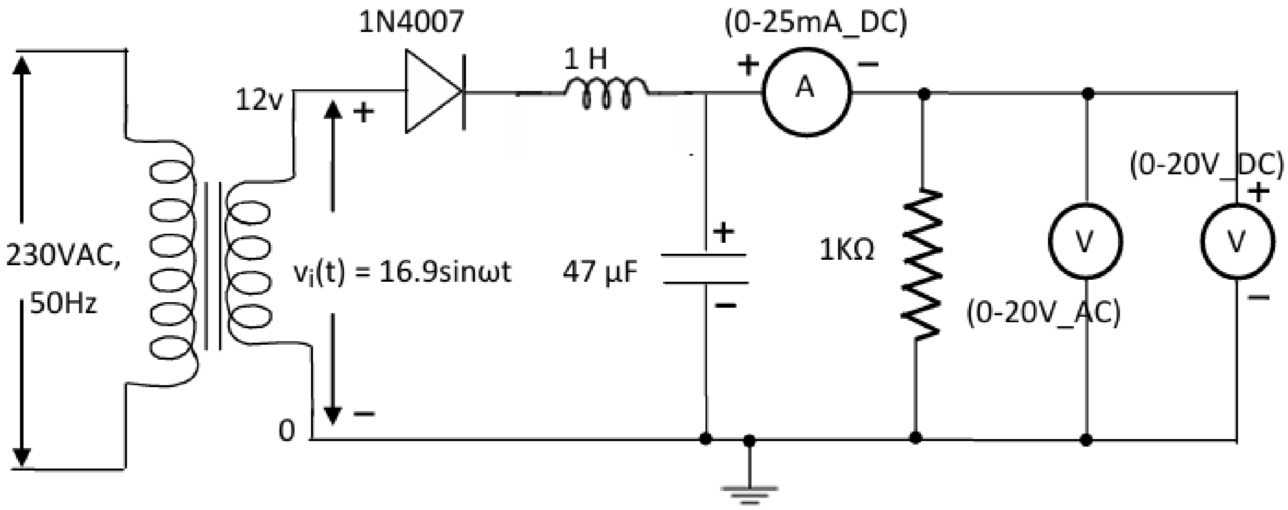


Fig.4 Half-Wave Rectifier with L-section filter

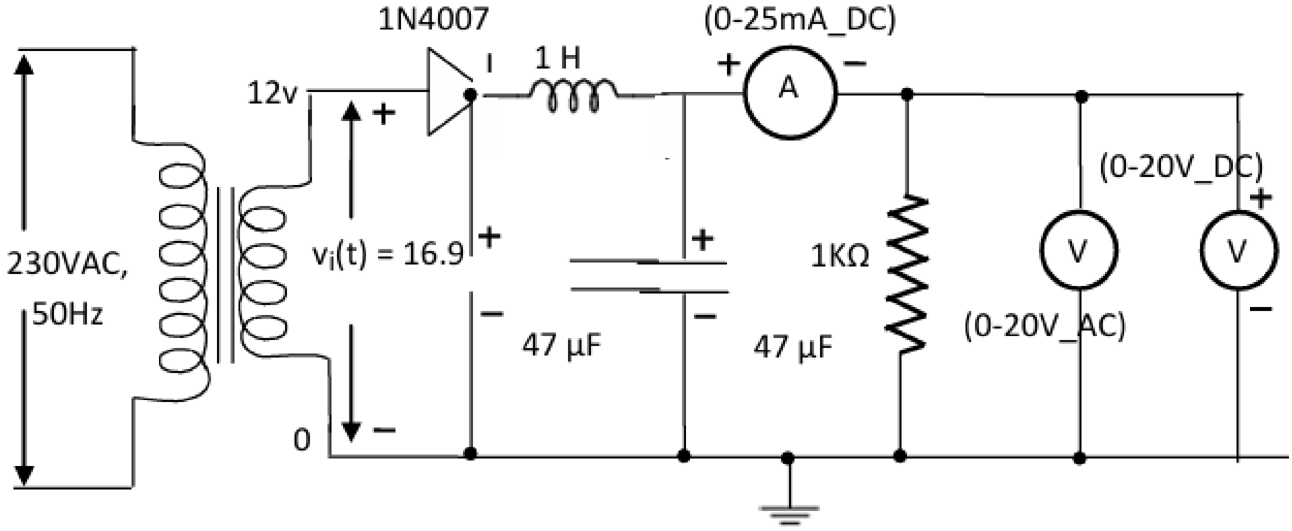


Fig. 5 Half-wave rectifier with π-section filter

TABLE-1: Half-wave rectifier (without and with filters) R_L = 1 KΩ

Circuit	**V_{NL} (DC) (Volts) open circuit or with 20KΩ**	**Vm (V)**	**V_{AC} (V)**	**V_{DC} (V)**	**I_{DC} (mA)**	**I_{AC} (mA)**	**Ripple factor (V_{AC}/V_{DC}) (Theor.)**	**Ripple factor (V_{AC}/V_{DC}) (Practical)**	**% Regulation** $\left[\frac{V_{NL}-V_L}{V_L}\right]\times 100$
Without filter									
With Inductor filter									
With Capacitor filter									
With L-section filter									
With π filter									

RESULT:

1. The ripple factor and percentage regulation of the Half-wave rectifier without the filter capacitor are determined.
2. The input and output waveforms of the Half-wave rectifier without and with filter are plotted.
3. The graphs of the ripple factor vs. load current and percentage regulation vs. load current for the rectifier

VIVA VOCE:

1. Compare the Vdc (output) of a half wave rectifier with that of full wave rectifier without filter and by what ratio do they differ by ignoring source resistance.
2. Define regulation and ripple factors. What are the ideal values for these quantities? What are the practical values?
3. What is the Peak Inverse Voltage in the case of half wave rectified?
4. How are ripples removed from rectifier output?

EXPERIMENT NO: 4

FULL-WAVE RECTIFIER WITHOUT AND WITH FILTERS

AIM:
To obtain the ripple factor and percentage regulation of a Full-Wave rectifier without and with filters

APPARATUS:

S.No.	Name of the device	Range/No	Quantity
1.	Diodes	1N 4007	2
2.	Milli ammeter	0 - 25m Amp.	1
3.	CRO	30 MHz	1
4.	Center tapped Transformer	12-0-12 V	1
5.	Voltmeter	0-20 V	1
6.	Decade Resistance Box	1Ω – 10 M Ω	1

The expression for the dc output voltage V_{dc}(from graphical analysis) may be approximated as $V_{dc} = V_m - \frac{I_{dc}}{4fC}$.The ripple factor can be measured using an AC and a DC voltmeter and the ripple factor computed from $\frac{V_{AC}}{V_{dc}}$.

PROCEDURE:

(A) Full-wave rectifier without filter

1. Connect the circuit according to Fig. 1 and Switch ON the power supply.
2. Set R_L to 1 KΩ and note down the load voltage V_L.
3. Note down the output AC and DC voltages in the Table-1. (Since a moving coil analog voltmeter will not respond to AC voltages, a digital voltmeter is used to measure AC voltages, and the values recorded are RMS values).
4. Observe the input and output waveforms on the oscilloscope and plot these on a graph paper and measure the peak voltage V_m from the oscilloscope screen after ensuring that the Volt/div front knob is in the “Cal” position to obtain accurate V_m readings. Calculate and then plot the ripple factor and percentage regulation vs. load current on graph paper.

Note: Use separate DC and AC (digital) voltmeters.

(B) Full-wave rectifier with Capacitor filter

1. Connect the capacitor according to the diagram in Fig. 2.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

(C) Full-wave rectifier with Inductor filter

1. Connect the inductor according to the diagram in Fig.3.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

(D) Full-wave rectifier with L-Section filter

1. Connect the inductor according to the diagram in Fig.4.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.

3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

(E) Full-wave rectifier with π-section filter

1. Connect the inductor according to the diagram in Fig.5.
2. Repeat the steps in 3) and 4) above, while noting down the readings in Table -1.
3. Plot the ripple factor and percentage regulation vs. load current with capacitor filter on graph paper.

CIRCUIT DIAGRAM:

(A) FULL WAVE RECTIFIER:

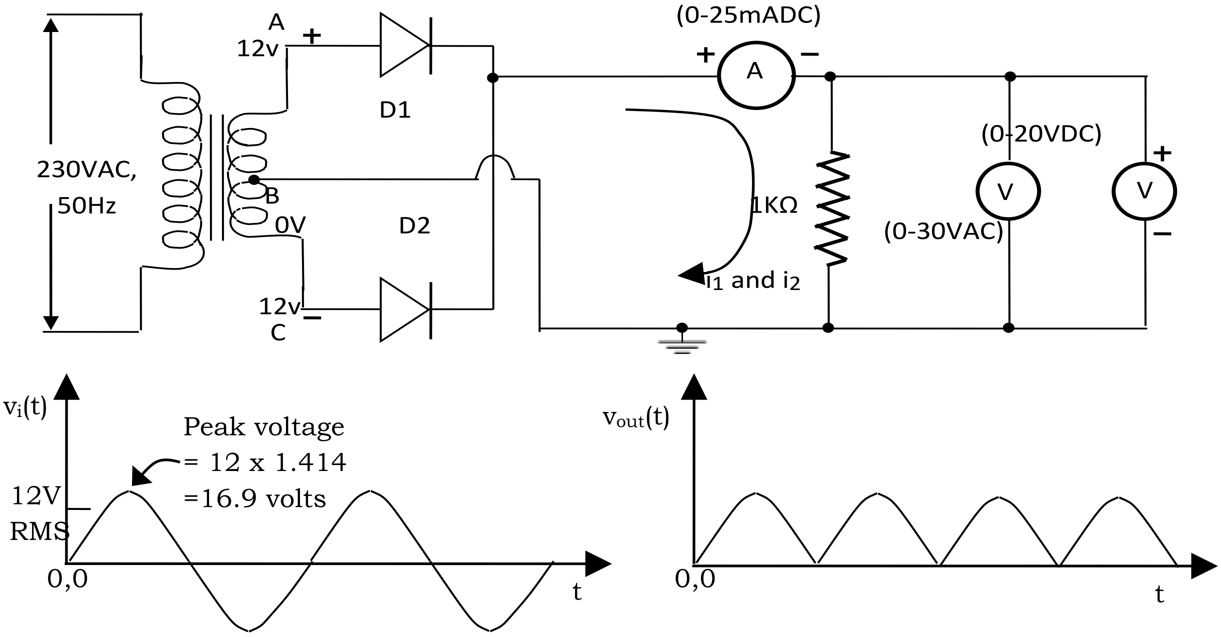


Fig. 1 Full-Wave Rectifier without filter

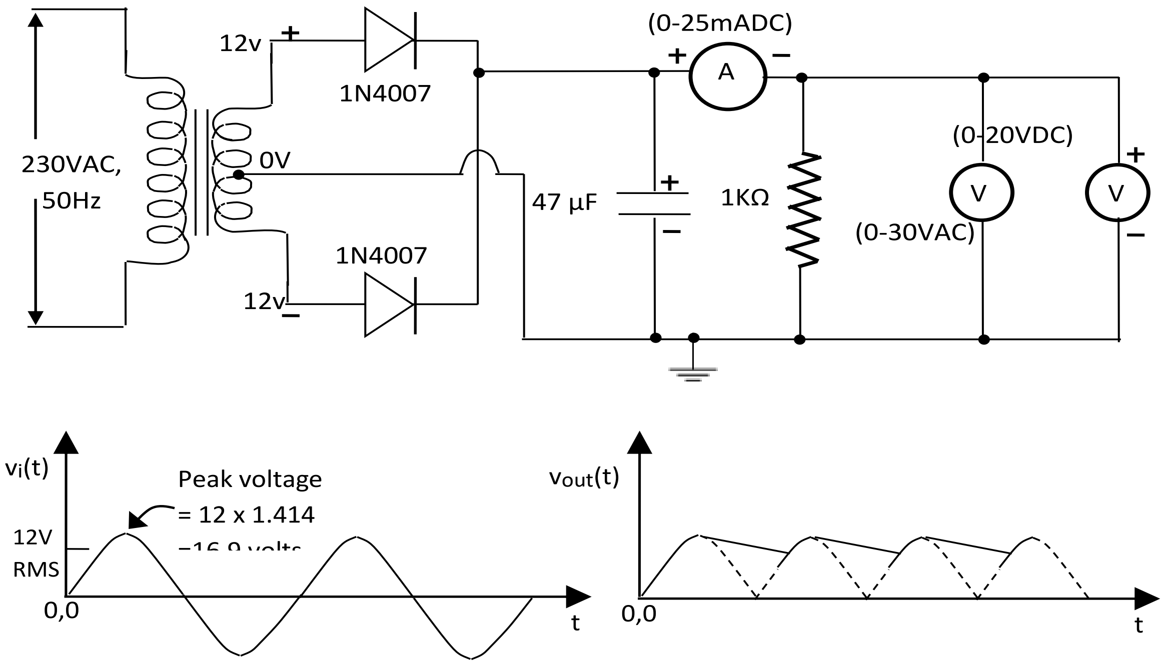


Fig.2 Full-Wave Rectifier with Capacitor filter

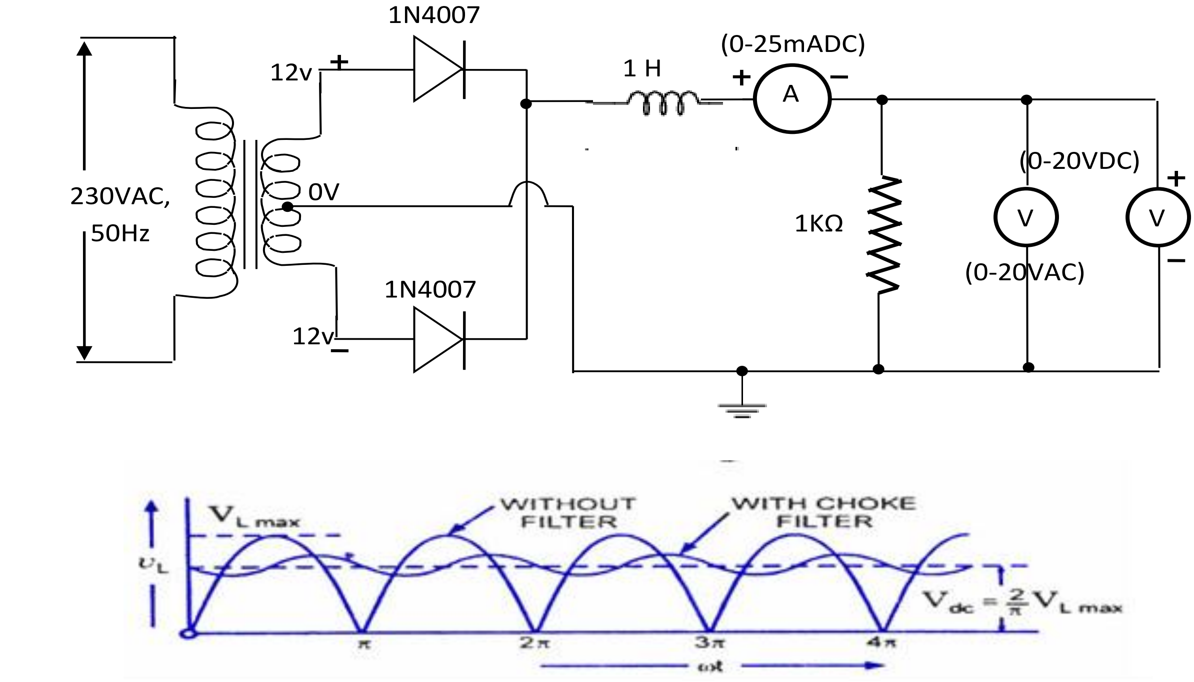


Fig.3 Full-wave rectifier with inductor filter

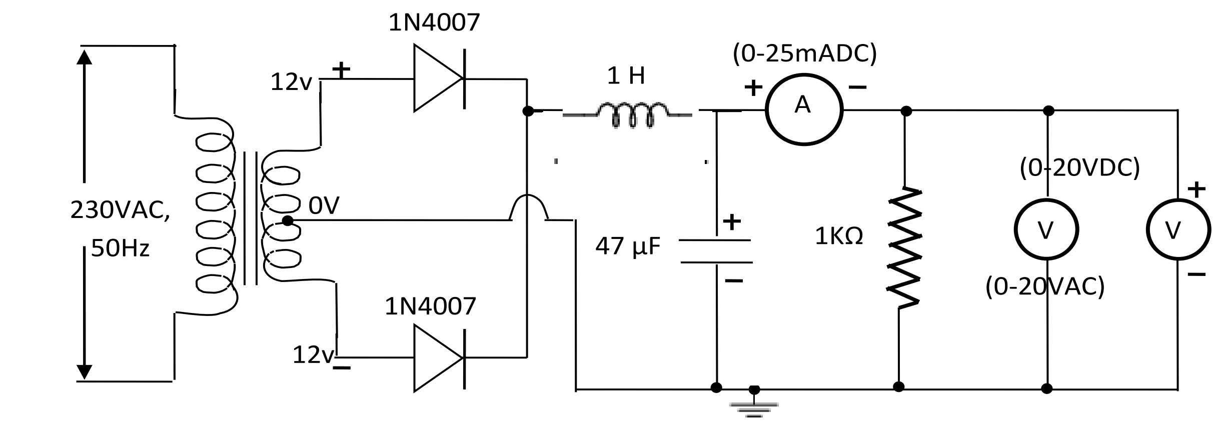


Fig. 4 Full-Wave Rectifier with L-section filter

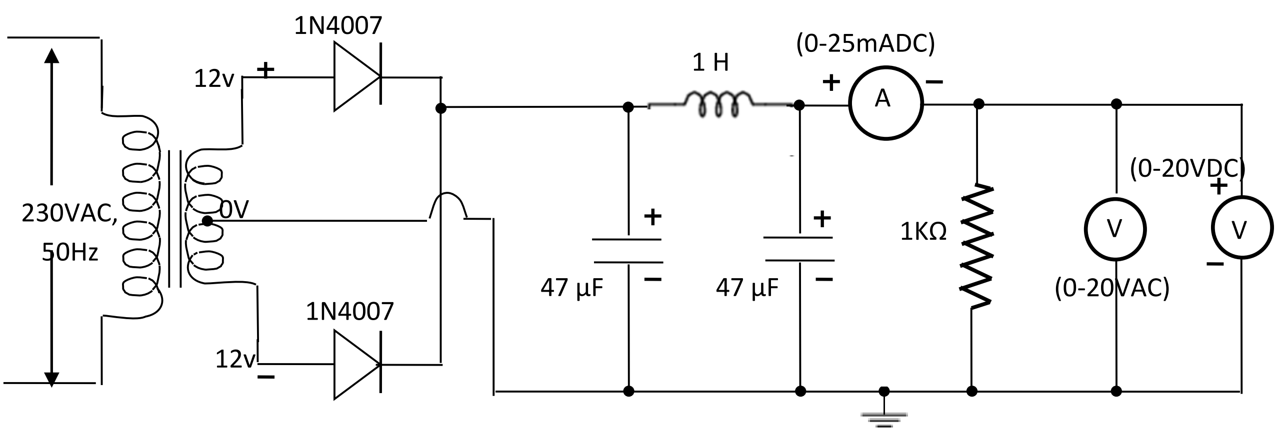


Fig.5 Full-Wave Rectifier with π-section filter

TABLE-1 Full-wave rectifier (without and with filters) R_L = 1 KΩ

Circuit	**V_{NL} (DC) (Volts)** Open circuit or with 20KΩ	**Vm (V)**	**V_{AC} (V)**	**V_{DC} (V)**	**I_{DC} (mA)**	**I_{AC} (mA)**	**Ripple factor (V_{AC}/V_{DC}) (Theor.) Using expression s below**	**Ripple factor (V_{AC}/V_{DC}) (Practical)**	**% Regulation** $\left[\frac{V_{NL}-V_L}{V_L}\right]\times 100$
Without filter									
With Inductor filter									
With Capacitor filter									
With L-section filter									
With π filter									

RESULT:

1. The ripple factor and percentage regulation of the Full-wave rectifier without the filter capacitor are determined.
2. The input and output waveforms of the Full-wave rectifier without and with filter are plotted.
3. The graphs of the ripple factor vs. load current and percentage regulation vs. load current for the rectifier

VIVA VOCE:

1. Compare the Vdc (output) of a half wave rectifier with that of full wave rectifier without filter and by what ratio do they differ by ignoring source resistance.
2. Define regulation and ripple factors. What are the ideal values for these quantities? What are the practical values?

EXPERIMENT NO: 5

STATIC CHARACTERISTICS OF BJT-COMMON EMITTER CONFIGURATION

AIM:
To measure and plot the Input and Output characteristics of a transistor connected in CE configuration.

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply (Dual)	0-30V	1
2	Voltmeters	0-20V(DC)	2
3	Ammeters	0-100 μA(DC), 0-25 mA(DC)	1 & 1

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Transistor	BC107 or SL 100	1
2	Resistors	68 KΩ, 1 KΩ	1 each
3	Bread Board	-	1

PROCEDURE:

(A) Input Characteristics:

1. Connect the circuit according to Fig 1 and switch ON the power supply and adjust V_{CC} such that V_{CE} is 1 Volt.

2. Vary the input voltage V_{BB} so that V_{BE} varies in steps of 0.1 V up to 0.5 V and note down I_B for each value of V_{BE} in Table -1.

Note: The base current I_B should never be allowed to exceed 100μA.

3. Repeat the steps of 2) above after setting V_{CE} to 3 Volts (by adjusting V_{CC}) and again with V_{CE} set to 5 Volts (by adjusting V_{CC}).

4. Plot the graph of V_{BE} vs I_B.

(B) Output Characteristics

1. Switch ON the power supply and adjust V_{CC} so that V_{CE} is 1V and set the input current i.e base current I_B constant at 10μA by adjusting V_{BB}. Note down I_C.

2. Vary the collector voltage V_{CC} so that V_{CE} is 2.5V, 7.5V, 12.5V, 17.5V, 22.5V and 24Volts ensuring that current I_B is constant at 10μA (set by adjusting V_{BB} for each reading) and note down the value of collector current I_C for each value of V_{CE} in Table -2.

3. Repeat the procedure 2) above with I_B set to 20μA and then 30μA.

Note: The base current I_B should never be allowed to exceed 100μA.

4. Plot the graph of V_{CE} vs I_C.

5. Calculate the value of β when I_B is 20μA assuming I_{CBO} as 1 μAmp.

CIRCUIT DIAGRAM:

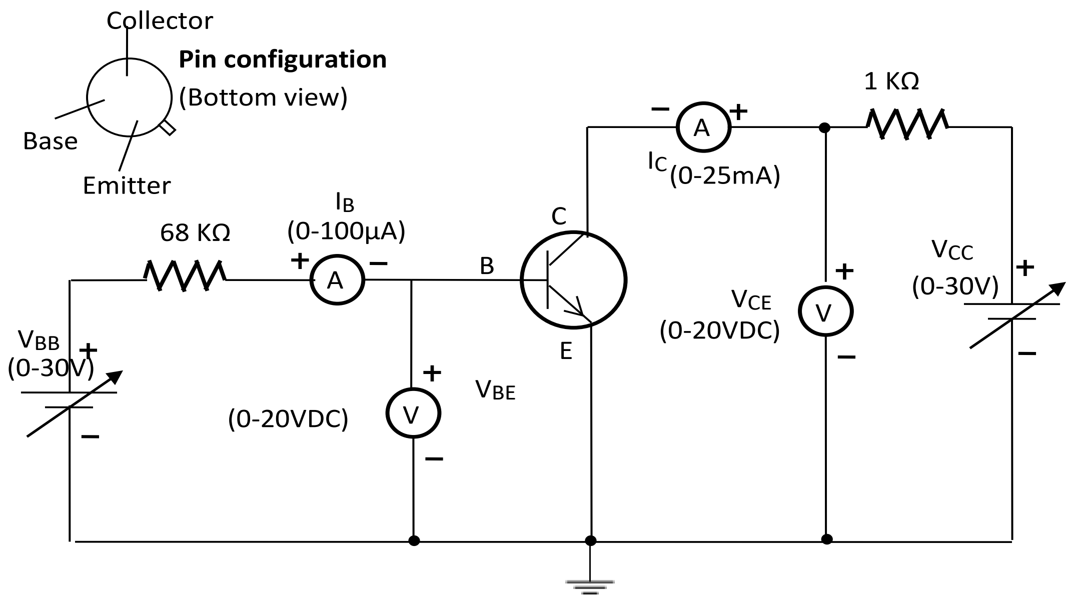


Fig. 1: Schematic for determination of Common-Emitter Characteristics

TABLE 1 (A): Input Characteristics

V_{CE} = 1V				V_{CE} = 3V				V_{CE} = 5V			
V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)

TABLE 1 (B): Output Characteristics

I_B = 10 μA				I_B = 20 μA				I_B =30 μA			
V_{CE} (V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)

MODEL GRAPH:

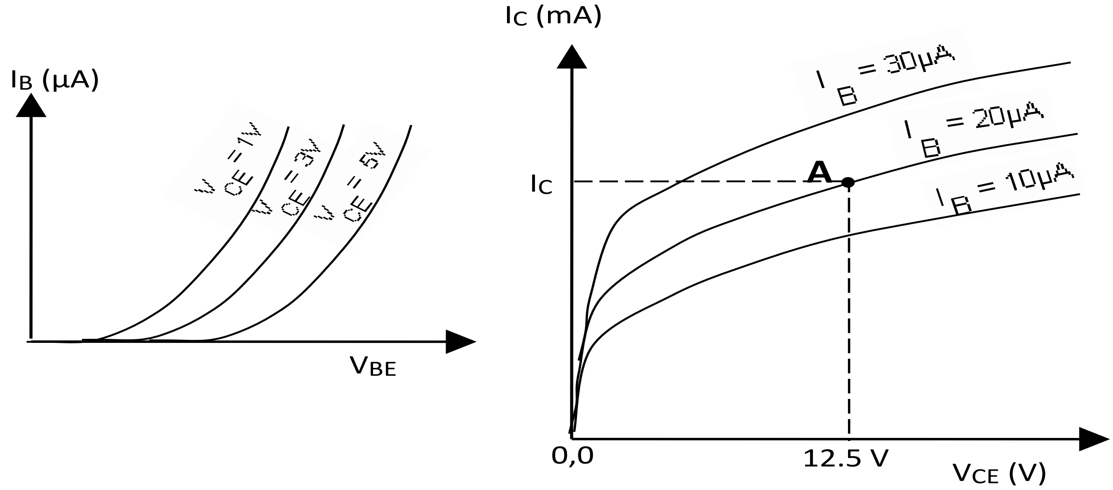


Fig.2: Input and Output characteristics for an N-P-N transistor

RESULT:

1. The input characteristics in CE configuration of the npn transistor are obtained and plotted on a graph
2. The output characteristics in CE configuration of the npn transistor are obtained and plotted on a graph.

VIVA VOCE:

1. What is a transistor? What is the difference between an NPN and a PNP Transistor?
2. Draw the symbolic representations of NPN and PNP transistors.
3. Sketch the characteristics of a BJT in Common-Emitter Configuration. Why is it called Common-Emitter configuration?
4. For amplification, why is the CE mode of BJT preferred over other modes of operation?
5. Is CE Configuration of BJT a current amplifier or a voltage amplifier? Does an impedance transformation also take place?
6. Why do we observe a phase-shift of the output with respect to the input in a common emitter stage?
7. What are h-parameters? What are they used for? Why are these h-parameters preferred over other parameters?

EXPERIMENT NO: 6

STATIC CHARACTERISTICS OF BJT-COMMON BASE CONFIGURATION

AIM:
To obtain input and output characteristics of a common-base transistor.

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply (Dual)	0-30V	1
2	Voltmeters	0-20V(DC)	2
3	Ammeters	0-25 mA(DC)	2

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Transistor	BC107 or SL 100	1
2	Resistors	1 KΩ	2
3	Bread Board	-	1

CIRCUIT DIAGRAM:

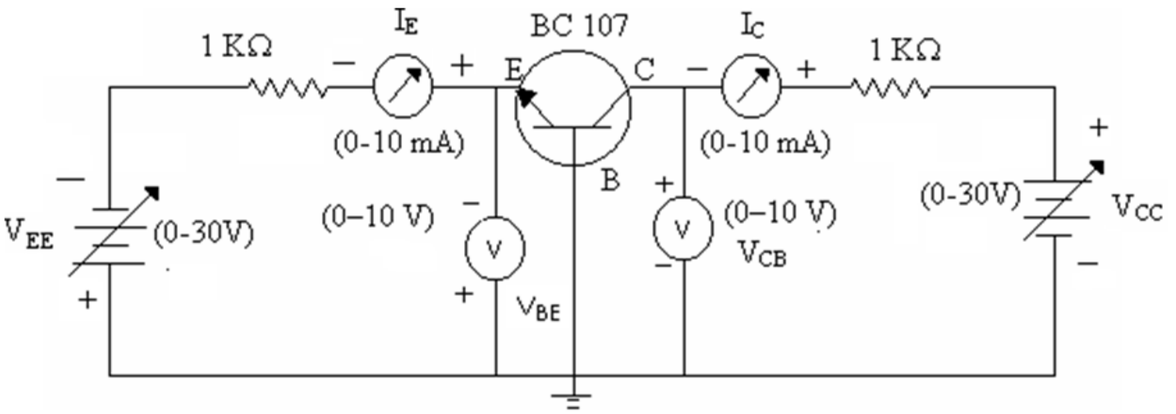


Fig: 1. Schematic for determination of Common-Base Characteristics

PROCEDURE:

(A) Input Characteristics

1. Connect the circuit according to the diagram and switch ON the power supply.
2. Temporarily disconnect the power supply by removing the positive terminal of V_{CC} and connect the base and collector terminals by a short circuit (V_{CB}=0V).
3. Maintaining V_{CB} constant at the chosen value, vary the supply voltage V_{EE} such that V_{BE} varies from 0.5V in steps of 0.04 V up to 0.82V and at 2V, 6V and 10V, noting down the values of V_{EB} and I_E in Table-1.
4. Reconnect the power supply and set V_{CB} to 2V and follow step 3. Repeat step 3 with V_{CB}=6V
5. Plot I_E versus V_{BE}.

(B) Output Characteristics

1. Connect the circuit according to the diagram in Fig 1.
2. Set I_E=2 mA by varying the power supply V_{EE}.

3. Now, vary the power-supply V_{CC} in 5-6 convenient steps until the I_C reading becomes constant noting down the values of V_{CB} and I_C in Table-2.
4. Record I_C values with V_{CB} = 2V, 4V and 6V.
5. Repeat step 3 with I_E=5mA.
6. Choose another value for I_E and repeat the above steps. Plot I_C versus V_{CB}.

OBSERVATIONS:

(A) Input Characteristics:

V_{CB} = 2V				**V_{CB} = 4V**			
V_{EB}(V)	**I_E(mA)**	**V_{EB}(V)**	**I_E(mA)**	**V_{EB}(V)**	**I_E(mA)**	**V_{EB}(V)**	**I_E(mA)**

(B) Output Characteristics:

I_E = 2mA				**I_E = 4mA**			
V_{CB}(V)	**I_C(mA)**	**V_{CB}(V)**	**I_C(mA)**	**V_{CB}(V)**	**I_C(mA)**	**V_{CB}(V)**	**I_C(mA)**

MODEL GRAPHS:

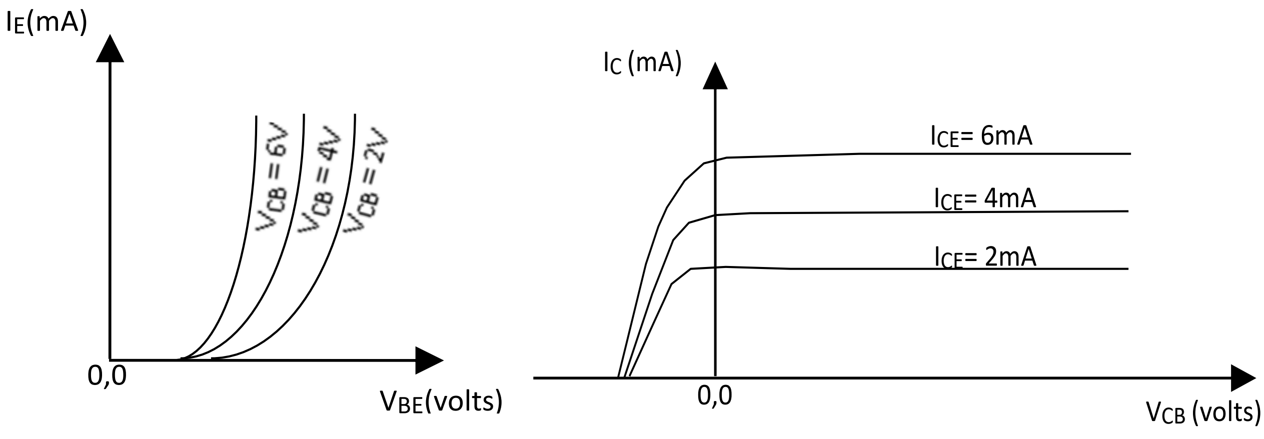


Fig: 2. Common-Base Input and Output Characteristics for an N-P-N transistor

RESULT:

VIVA VOCE:

1. What do you understand by the term Bipolar Junction Transistor?
2. What are the various types of Transistors available? Are there any preferred types if so why?
3. What do you understand by input and output characteristics?
4. Distinguish between active, saturation, cutoff regions and internal operations of a BJT?
5. Discuss the current components in a BJT in CB configuration?
6. Explain why the base width is kept extremely small?
7. Explain Early Effect?
8. Why does the emitter current increase with increase in reverse bias at the collector junction?

EXPERIMENT NO: 7

JUNCTION FIELD-EFFECT (JFET) TRANSISTOR CHARACTERISTICS

AIM:

1. To measure and plot the Drain (output) characteristics of an FET transistor.
2. To calculate the drain resistance and transconductance of the FET transistor by graphically plotting the transfer curve.

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply (Dual)	0-30V	1
2	Voltmeter	0-20V (DC)	2
3	Ammeter	0-25 mA (DC)	1

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	FET Transistor	BFW 11 or BFW 10	1
2	Resistors	68 KΩ, 3.3 KΩ (BFW11) or 1 KΩ (BFW10)	1 each
3	Bread Board	-	1

PROCEDURE:

(A) Drain or Output Characteristics:

1. Connect the circuit according to the schematic in Fig. 1 and note down the transistor type i.e BFW 11 or BFW 10 of the transistor on the board.
2. Switch ON the power supply and set the gate-source voltage V_{GS} to 0 volt by shorting the gate-source terminals.
3. Vary the drain supply voltage V_{DD} so that V_{DS} varies in steps of 1 volt upto 15 V and note down I_{DS} for each value of V_{DS} in Table -1.
4. Connect a power supply to the gate source terminals and repeat the steps 3) with V_{GG} set to a suitable voltage such that V_{GS} = -1 Volt. Repeat the steps 3) with V_{GS} = -3 Volts.
5. Plot the graphs of I_D vs V_{DS} at the three different settings of $V_{GS.}$ A model graph of which is shown in the right of the figure "Model Graph" below.

Important Precaution: Do not set V_{DD} to 20 volts and above for long intervals.

(B) Transfer Characteristic:

1. Extend the x-axis of the model graph to the left marking negative values of V_{GS} upto around 10 volts.
2. Mark the maximum current value I_D of the V_{GS} = 0 V, output characteristic curve on the right on the y-axis as I_{DSS}.
3. Mark the V_P value of the given FET from the manufacturer's sheet on the x-axis to the left. ($V_P$is also called the 'Gate-Source cut-off voltage; for BFW 11 = -6V and BFW 10 = -8V).
4. To draw a smooth curve mark two more points on the left graph, one each corresponding to the constant current value from the plot of V_{GS} = -2V from the right graph and to the constant current value from the plot of V_{GS} = -3V.
5. Draw a smooth curve joining I_{DSS} (step 7) to V_P (step 8) passing through the other two points (step 9). This curve defines the transfer characteristic of I_D (output) vs. V_{GS} (input)

for the given FET. Calculate the drain resistance r_d and transconductance g_m from the graphs.

CIRCUIT DIAGRAM

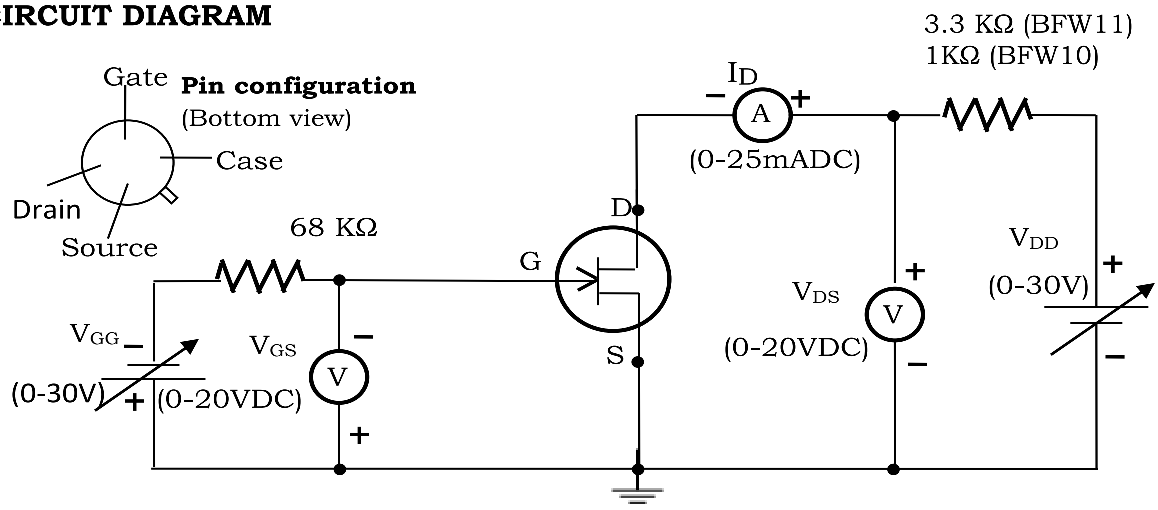


Fig. 1 FET Drain Characteristics

TABLE 1.: Drain Characteristics

V_{GS} = 0V		V_{GS} = -1V & -2V		V_{GS} = -2V & -3V	
V_{DS}(volts)	I_D(mA)	V_{DS}(volts)	I_D(mA)	V_{DS}(volts)	I_D(mA)

MODEL GRAPH:

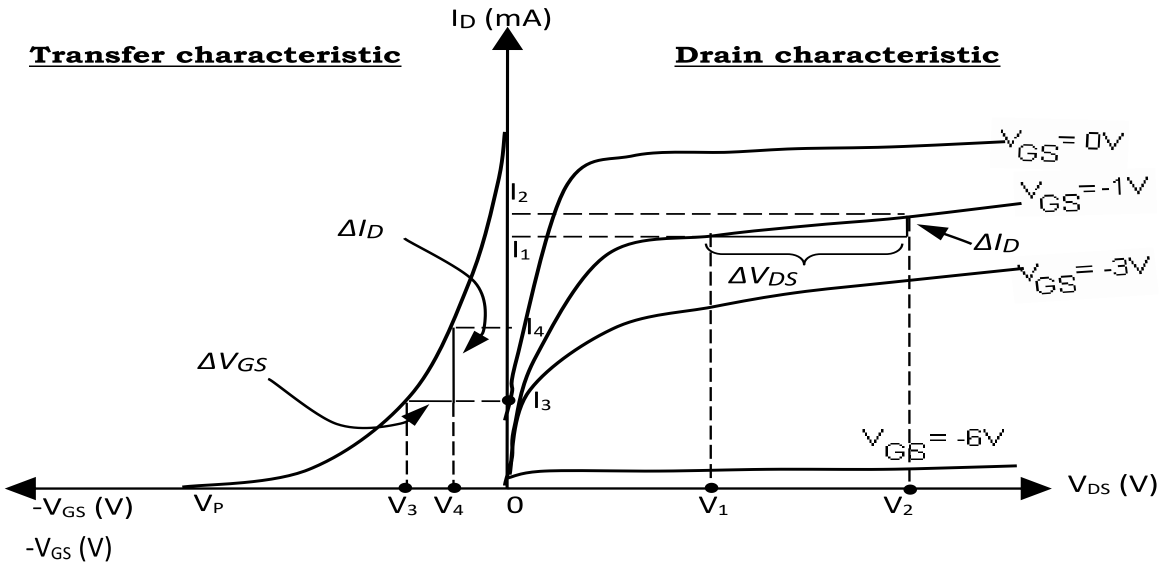


Fig1: Drain (Output) and Transfer Characteristics

RESULT:

1. The drain characteristics of the given FET BFW (specify number) are obtained and plotted on a graph.
2. The transfer characteristic of the given FET (specify number) is plotted from the drain characteristic.

VIVA VOCE:

1. What are the differences between a BJT and a JFET?
2. What is meant by a unipolar device? Why is a JFET known as a Unipolar Device?
3. What are the typical applications of a JFET?
4. What are the parameters of a FET? What are the relations between them?
5. What are n-channel and p-channel JFETs? How are they different from one another?

EXPERIMENT NO: 8.

FREQUENCY RESPONSE OF COMMON-EMITTER AMPLIFIER

AIM: To determine the frequency response of the Common Emitter Amplifier.

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply	0-30VDC	1
2	Function Generator	0.1Hz-1MHz	1
3	Oscilloscope	0-30MHz	1

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Transistor	BC 107	1
2	Resistors	4.7 kΩ, 1.2kΩ, 1kΩ, 470 Ω	1each
3	Capacitors	10µF(2), 1 µF	3
4	Bread Board	-	1

PROCEDURE:

1. Connect the circuit according to the diagram in Fig.1.
2. Switch ON the power supply and set V_{CC} to 12 Volts DC.
3. Set input voltage υ_i (peak-to-peak) to 50mV using the oscilloscope and vary the frequency in steps beginning from 0 Hz, 100 Hz, 500 Hz, 1 kHz, 20 kHz, 30 kHz, 40 kHz, 100 kHz, 200 kHz, 500 kHz, 1 MHz and note down the output voltage υ_o(peak-to-peak) from the oscilloscope in Table 1. Measure three dc voltages i) V_{CE} ii) across R_c and iii) across R_e and record them.
4. Plot the curve Gain (20log υ_o/υ_i) in dB Vs frequency on a semilog graph paper.
5. Determine the lower cut-off and upper cut-off frequency when the gain drops to 0.707 (v_o/v_i) or 3dB below the midrange of frequencies when the gain is relatively constant with varying frequency.
6. Connect input voltage to Ch.1 and output voltage to Ch.2 of the oscilloscope. Set the input frequency to around 5 kHz and the oscilloscope in Alt mode. Ensure that the time base (+ -) trig position knob is in "cal" i.e. calibrate position. Adjust the V/div and the time base to suitable settings so that at most one or two full cycles of the input waveform cover the full screen. Observe the difference in *phase* between the input voltage and the output voltage and measure the phase difference and note down the reading.
7. For the BC 107 transistor used in the amplifier of Fig. 1, BV_{CEO} = 45V, h_{FE}(dc) = β = 150, I_c(max) = 100mA. On a rough sketch of its output characteristics, draw the dc load line and mark the quiescent point of operation indicating I_C and I_B at this point.

Precautions

1. Set the offset of the function generator to OFF.
2. For each reading, ensure that the input voltage v_i is set to 50 mV peak-to-peak.

CIRCUIT DIAGRAM:

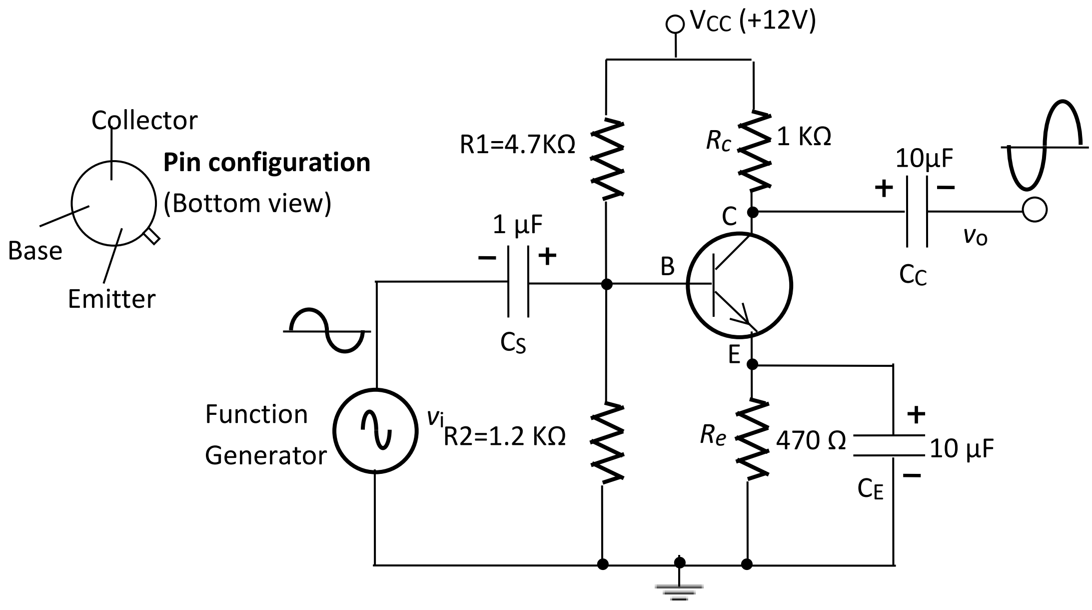
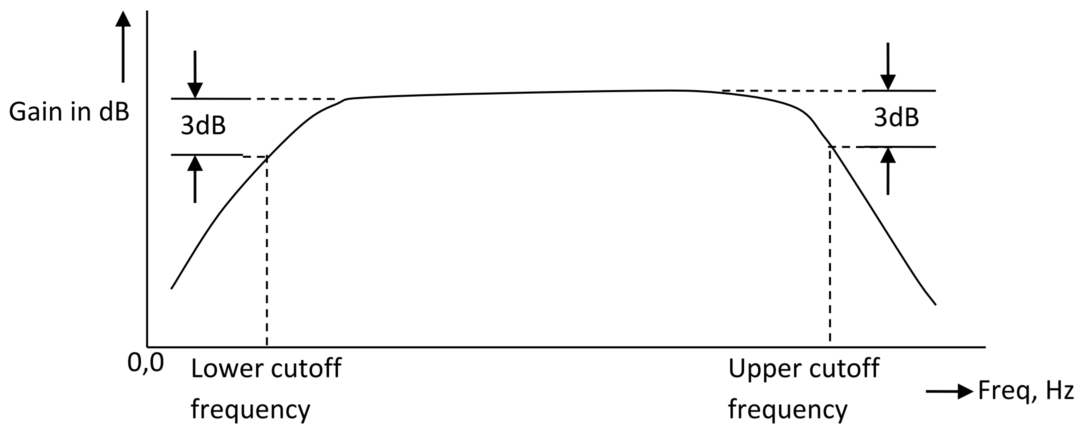


Fig.1: Common Emitter amplifier

Table1:

Frequency	Output Voltage (v_o)	Gain $\left[\frac{v_o}{v_i}\right]$	Gain in dB = $20\log\left[\frac{v_o}{v_i}\right]$
50 Hz --------- 100 kHz --------- 1 MHz			

MODEL GRAPH:



RESULT

1. The frequency response of the Common-emitter amplifier is measured and the graph plotted.
2. From the graph

i) The lower cutoff frequency corresponding to a gain 20log $\left[\frac{v_o}{v_i}\right]$ dB -3dB = ……Hz.

ii) The upper cutoff frequency corresponding to a gain 20log $\left[\frac{v_o}{v_i}\right]$ dB -3dB = ……Hz.

3. On a rough sketch of the output characteristics the Q-point of operation of the amplifier is marked on the load line. V_{CE} = …….volts; I_C = ……..mA and I_B = …….µA.

VIVA VOCE

1. What is the significance of the emitter-bypass capacitor and the coupling capacitor in the CE amplifier circuit?
2. Explain why reversal of phase occurs in a BJT CE Amplifier.
3. What is the significance of the operating point in the operation of an amplifier?
4. What happens if an amplifier is biased at cutoff or at saturation?
5. What is a load line? How is the ac load line different from the dc load line?
6. What is the significance of the bandwidth of an amplifier?
7. What is meant by Gain-Bandwidth Product? What is its significance?

EXPERIMENT NO: 9

RC- PHASE SHIFT OSCILLATOR

AIM:

To design the frequency of RC- Phase Shift Oscillator

APPARATUS:

1. RC-Phase shift oscillator Kit
2. CRO

COMPONENTS:

S.No	Description Of Item	Range	Quantity
1	Cathode Ray Oscilloscope	30MHz	1
2	Regulated Power Supply	0-30V	1
3	Bread Board	-------	1
4	Transistor	BC107	1
5	Resistor	10KΩ	3
		22KΩ	1
		47KΩ	1
		1KΩ	1
6	Capacitor	100µF	2
		0.01 µF	2
		0.001µF	3

PROCEDURE:

1. Connect the circuit according to the schematic in Fig. 1.
2. Switch ON the power supply and apply Vcc of 12V.
3. Find out the frequency of oscillations using CRO.
4. Find the theoretical and practical frequency of RC-Phase shift oscillations.

CIRCUIT DIAGRAM: R_1: 47KΩ, R_L: 10KΩ, R: 10KΩ, Re: 1KΩ, C1, C2, C3: 1nF, Ce: 100µF, Cc: 0.01 µF

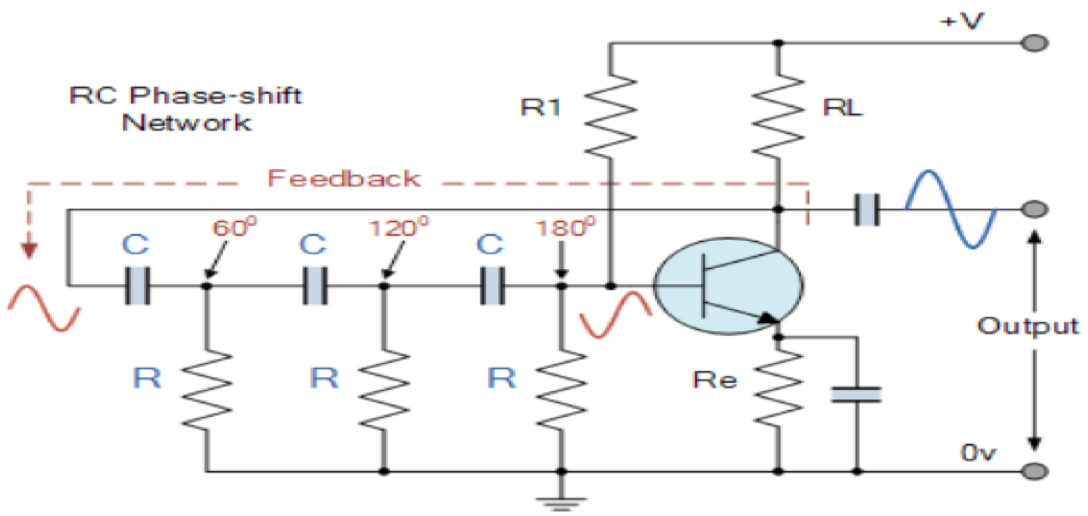
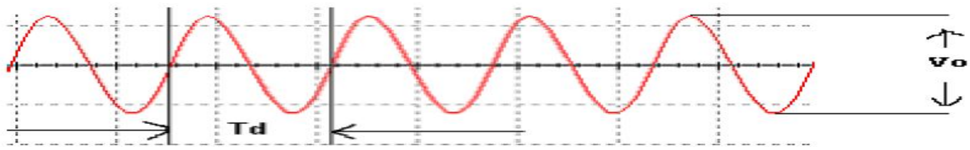


Fig1: RC- Phase Shift

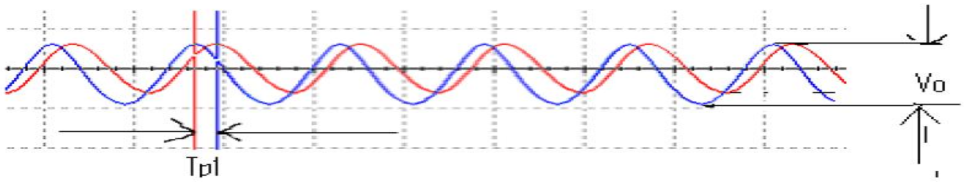
The frequency of oscillations of RC-Phase Shift Oscillator is, $f = \frac{1}{2\pi RC\sqrt{6}}$

MODEL WAVE FORMS:

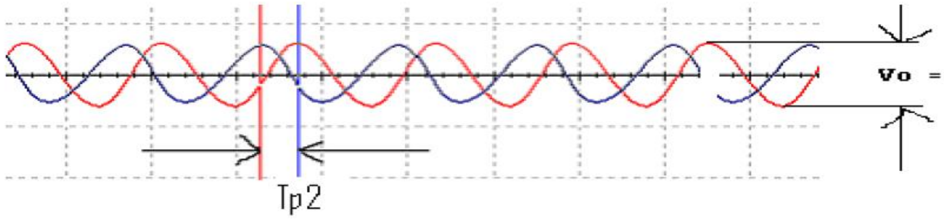
OUT PUT WAVEFORM:



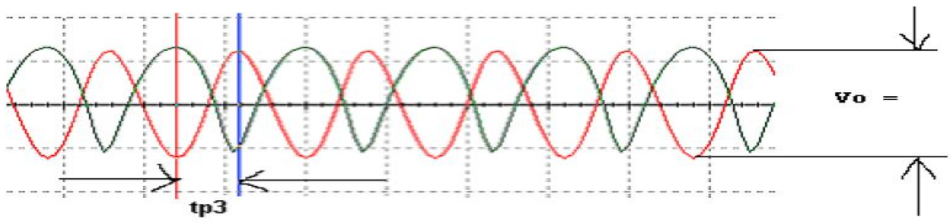
OUT PUT WAVEFORM: $\theta = 60^0$



OUT PUT WAVEFORM: $\theta = 120^0$



OUT PUT WAVEFORM: $\theta = 180^0$



RESULT:

VIVA VOCE:

1. What is feedback? What are the types of feedback?
2. What is Barkhausen criterion for the feedback oscillator?
3. How are oscillators classified?
4. What kind of feedback is used in oscillators?
5. Why three RC networks are used in RC Phase Shift Oscillator.
6. What should be the value of β for sustained oscillations?
7. What are the applications of oscillators?

EXPERIMENT NO: 10

HARTLEY AND COLPITTS OSCILLATOR

AIM:
To study and obtain the frequency of oscillations of Hartley and Colpitts oscillator

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply (Dual)	0-30V	1
2	CRO	0-30MHz	1

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	Transistor	CL100	1
2	Resistors	100KΩ,10KΩ,5.1KΩ,10KΩ(POT)	1 each
3	Capacitors	0.1 μF	4
4	Trainer kit or Bread Board	-	1

PROCEDURE: (HARTLEY OSCILLATOR)
1. Connect the circuit according to the schematic in Fig. 1.
2. Switch ON the power supply and apply Vcc of 12V.
3. By connecting different values of inductances as Z3 and Z2 and capacitance as Z1 find out the frequency of oscillations using CRO.
4. Find the theoretical and practical frequency of oscillations of Hartley Oscillator.

CIRCUIT DIAGRAM:

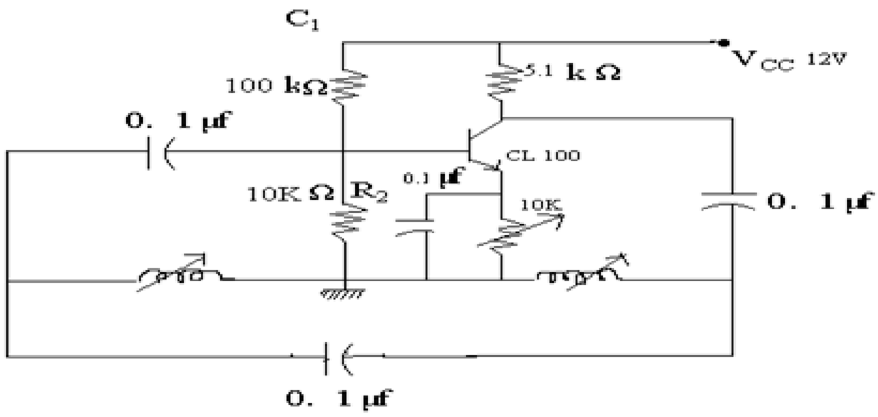


Fig1: Hartley Oscillator

The frequency of oscillations for Colpitts Oscillator is given by $f = \dfrac{1}{2\pi\sqrt{LC}}$.

TABLE 1:

Inductances (H) L=L1+L2	Capacitance(μF)	Theoretical Frequency $f = \dfrac{1}{2\pi\sqrt{LC}}$	Practical Frequency f=1/T

PROCEDURE: (COLPITTS OSCILLATOR)

1. Connect the circuit according to the schematic in Fig. 2.
2. Switch ON the power supply and apply Vcc of 12V.
3. By connecting different values of capacitances as Z3 and Z2 and inductance as Z1 find out the frequency of oscillations using CRO.
4. Find the theoretical and practical frequency of oscillations of Colpitts Oscillator.

CIRCUIT DIAGRAM:

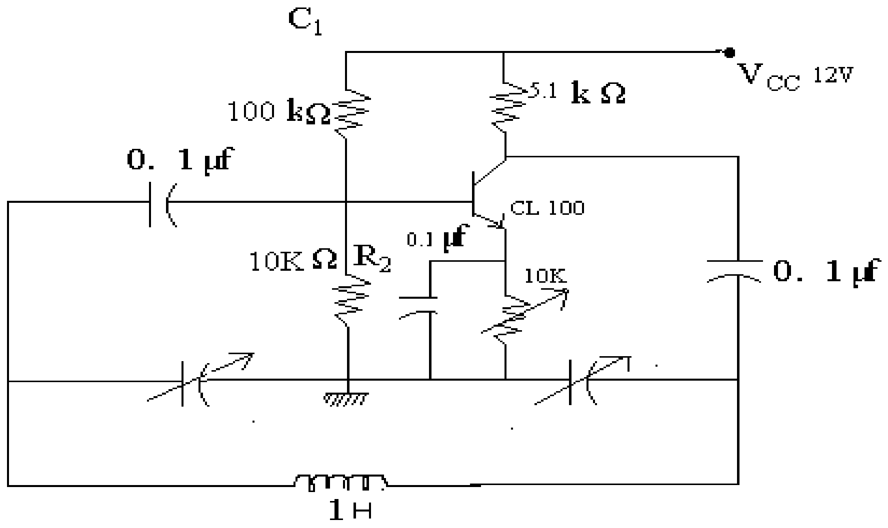


Fig 2: Colpitts Oscillator

TABLE:

Inductance (L) (1H)	**Capacitances(μF)**	**Theoretical Frequency** $f = \frac{1}{2\pi\sqrt{LC}}$	**Practical Frequency f=1/T**

RESULT:

VIVA VOCE:

1. Differentiate between LC and RC oscillators?
2. What are the applications of Hartley and Colpitts Oscillator?
3. What is the condition for sustained oscillator for Hartley and Colpitts Oscillator?
4. What are the other types of LC Oscillators?

EXPERIMENT NO: 11
OPERATIONAL AMPLIFIER APPLICATIONS

AIM:

To study the basic applications of OP-AMP as integrator and Differentiator

APPARATUS:

S. No.	Description	Range	Quantity
1	Regulated Power Supply	0-30VDC	1
2	Oscilloscope	0-30MHz	1
3	Bread Board	-	1
4	Function Generator	0.1Hz-1MHz	1

COMPONENTS:

S. No.	Description	Part No./Value	Quantity
1	IC	741	1
2	Resistors	1KΩ & 100 KΩ	2 & 1
3	Capacitors	0.01µF	2

THEORY:

(A) Integrator: In an integrator circuit, the output voltage is the integration of the input voltage. The output voltage of an integrator is given by $v_0(\mathrm{t}) = \frac{-1}{R_1 C_f}\int_0^t v_i(\mathrm{t})\,\mathrm{dt}$. At low frequencies the gain becomes infinite, so the capacitor is fully charged and behaves like an open circuit. The gain of an integrator at low frequency can be limited by connecting a resistor in shunt with capacitor.

(B) Differentiator: In the differentiator circuit the output voltage is the differentiation of the input voltage. The output voltage of a differentiator is given by $v_0(\mathrm{t}) = -R_f C_1 \frac{dv_i(\mathrm{t})}{dt}$ The input impedance of this circuit decreases with increase in frequency, thereby making the circuit sensitive to high frequency noise. At high frequencies circuit may become unstable.

CIRCUIT DIAGRAMS:

(A) INTEGRATOR:

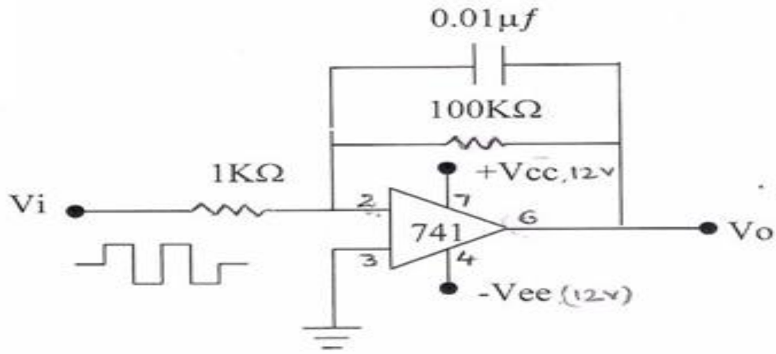


Fig 1: Integrator circuit diagram using OP-AMP

PROCEDURE:

1. Connect the circuit as shown in fig 1.
2. Apply a square wave / sine wave input of 5V/10V at 1 KHz frequency using function generator.
3. Observe the output at Pin 6.
4. Draw the input and output waveforms on a graph sheet as shown in fig 2.

MODEL GRAPH:

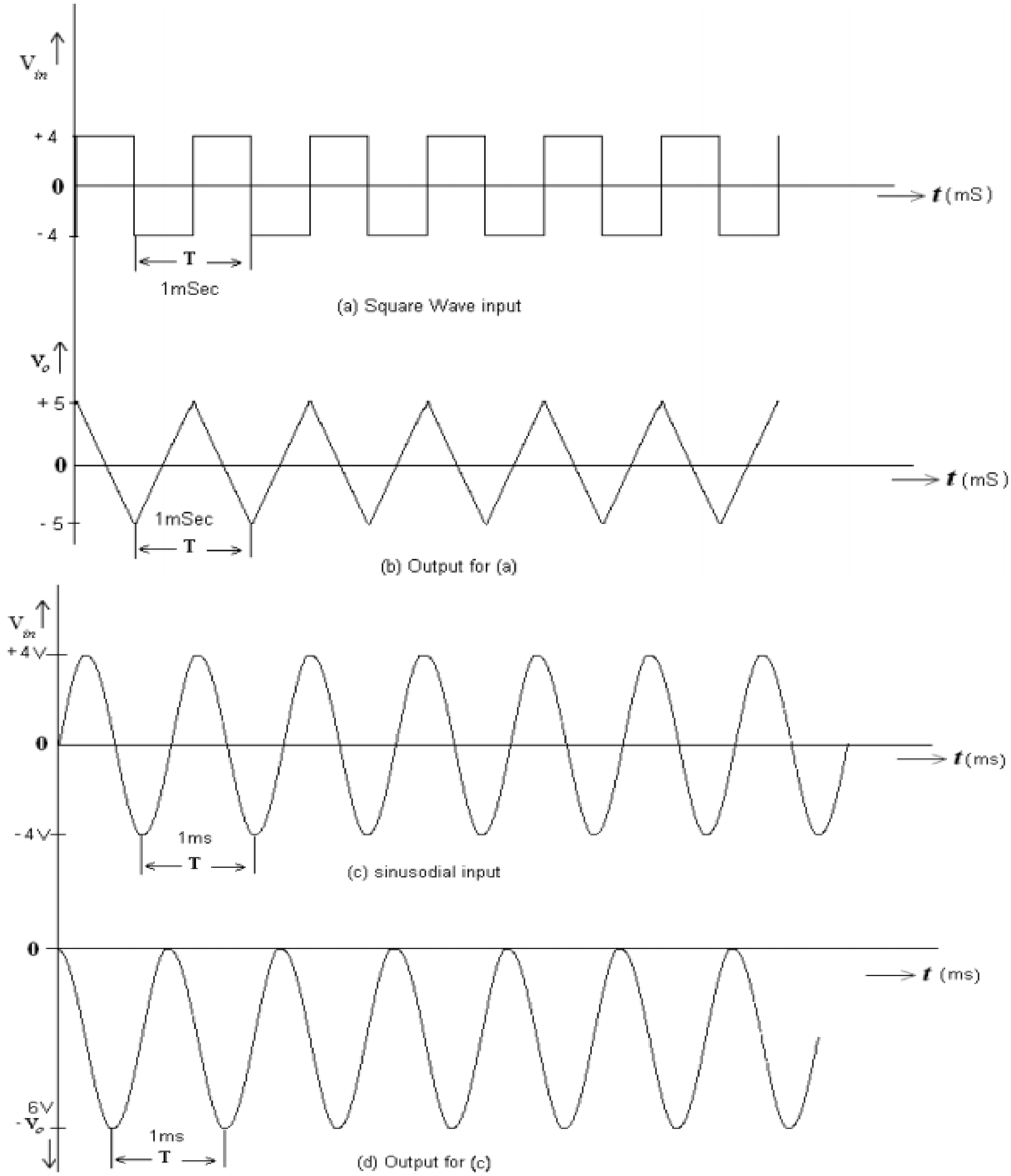


Fig 2: Input and Output waveforms for integrator

(B) DIFFERENTIATOR:

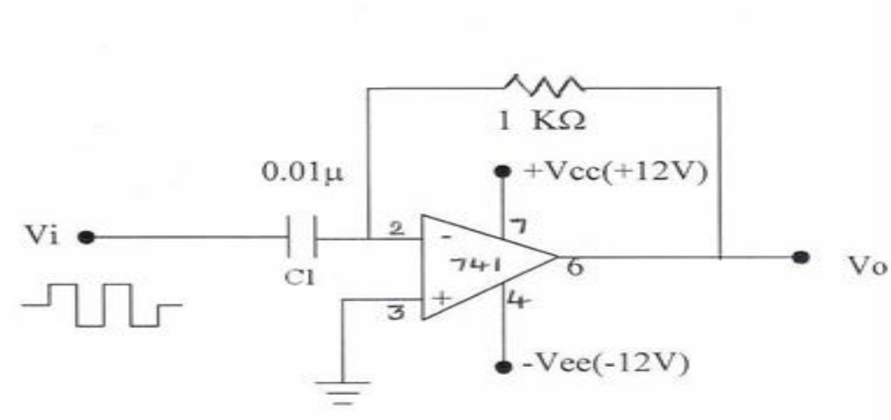


Fig 3: Circuit Diagram for Differentiator

PROCEDURE:

1. Connect the circuit as shown in fig 3.
2. Apply a square wave / sine wave input of 5V/10V at 1 KHz frequency using function generator.
3. Observe the output at Pin 6.
4. Draw the input and output waveforms on a graph sheet as shown in fig 4.

MODEL GRAPH:

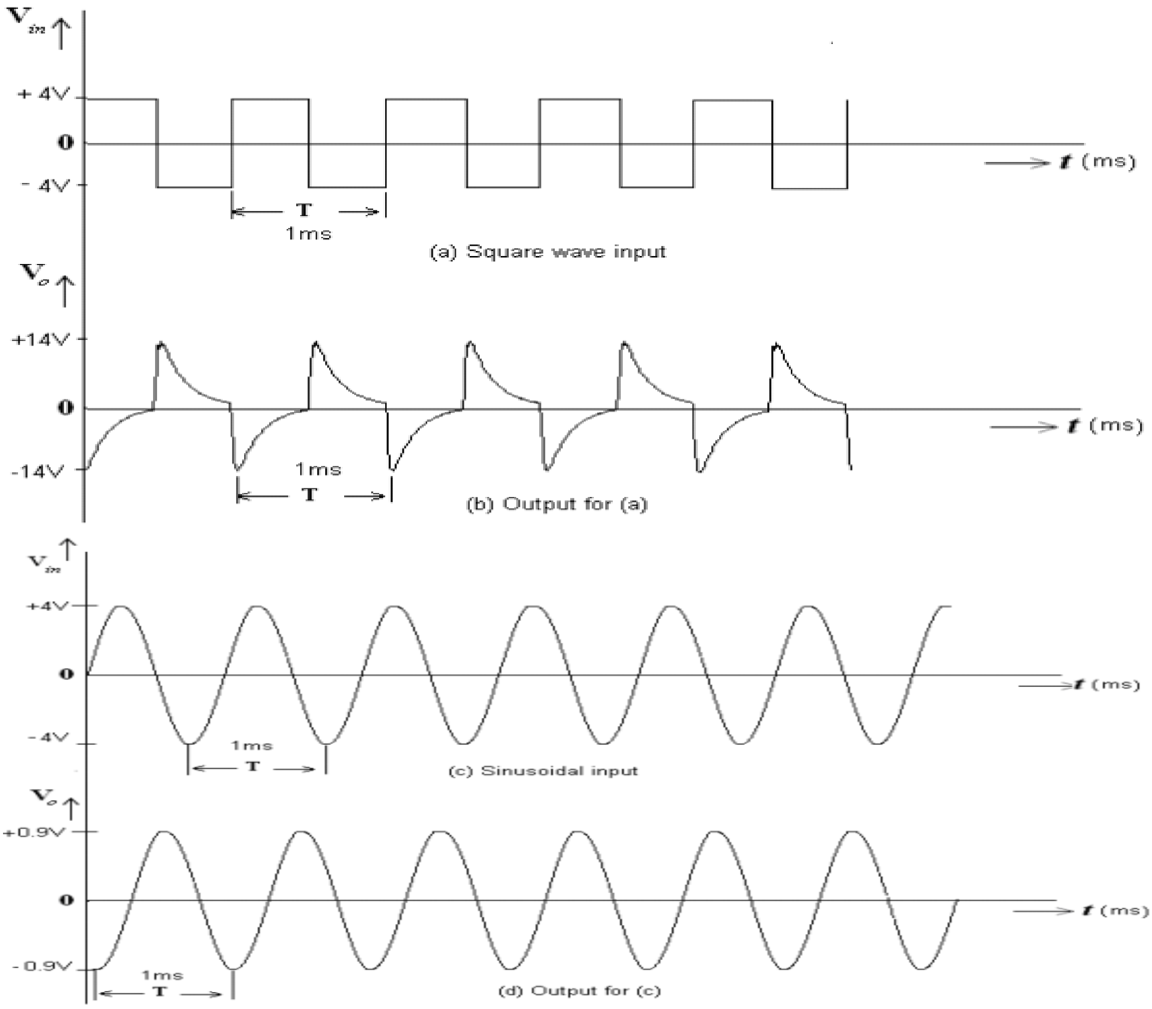


Fig 4: Input and Output waveforms for Differentiator

RESULT:

VIVA QUESTIONS

1) Draw the equivalent circuit of OP-AMP.
2) What are the ideal characteristics of OP-AMP?
3) What are the other applications of OP_AMP?
4) What is the time constant of op-amp integrator?
5) Why integrators are preferred over differentiators?
6) Draw the pin diagram of IC 741.