Lab Manual ON

Electronics Lab Practice

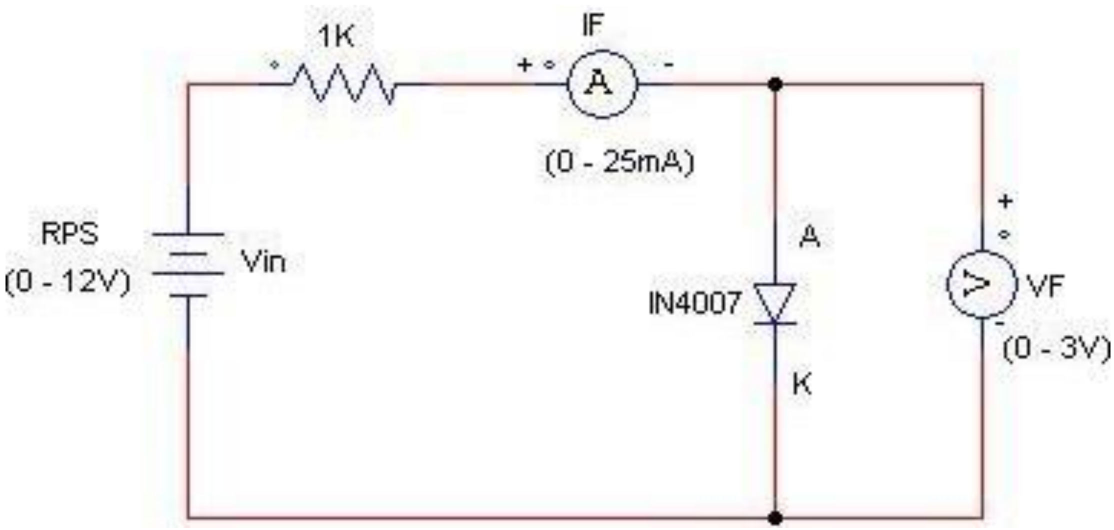
Department of Mechatronics EngineeringITT, CHOUDWAR

INSTRUCTIONS TO STUDENTS WORKING IN ELECTRICAL AND ELECTRONICS LABORATORIES

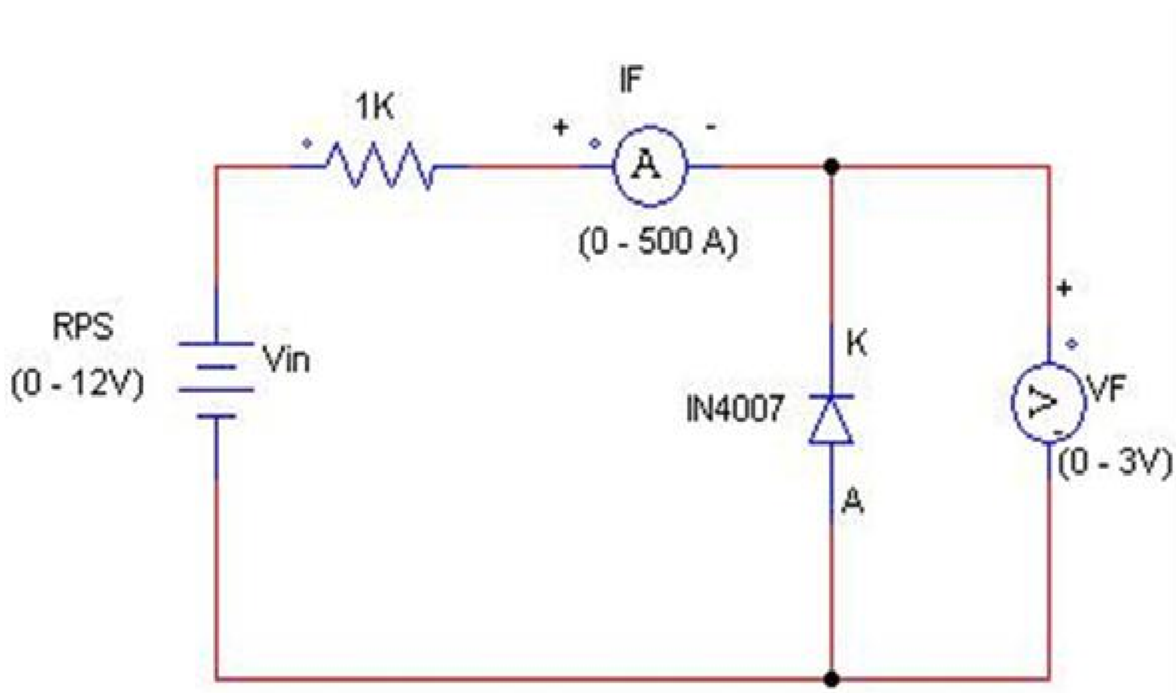
1. Every student should come with right fitting dress & wear shoes with rubber soles.
2. Every student should avoid wearing metal ornaments like ring, bangles, bracelets, chains etc.
3. The circuit diagrams should be approved by the Teaching faculty in the laboratory.
4. The approved indent slip should be given in the store and receive the apparatus box.
5. These apparatus must be brought from the stores and kept on the worktable in a neat manner, such a way that the connections are made conveniently.
6. Make the connections as per the diagram approved.
7. Get the connections be checked by the Lab Instructor in charge in the laboratory.
8. The Lab Instructor will arrange to give the supply to the worktable.
9. After ascertaining, the supply is given to the worktable, and students can proceed to conduct the experiment as per the instruction issued.
10. If there is any difficulty experienced in the conduct of the experiment immediately call the Lab Instructor and get over the difficulty.
11. After finishing the experiment, switch off the supply, show the observations to the Lab Instructor, and get approved.
12. Request the Lab Instructor to make arrangements to switch off the supply to the worktable.
13. After ascertaining that the supply is switched off, disconnect and return the apparatus box to the store.
14. Complete experiment should be recorded in the laboratory record notebook and shown to the Teaching faculty in the next class.
15. If there is any damage to any material during transit or conduct of the experiment, all the students in that particular group/batch are responsible.
16. Every student should take utmost care not to touch any live points, while they work in the laboratory.
17. Every student should keep his/her laboratory record with his/her safely till the concerned practical examination is over

CIRCUIT DIAGRAM:

FORWARD BIAS:



REVERSE BIAS



EX.NO:

DATE:

CHARACTERISTICS OF SEMI CONDUCTOR DIODE

AIM: -

To draw the V-I characteristics of a p-n junction diode and to find the forward resistance R_F and cut- in voltage.

APPARATUS REQUIRED: -

S.No	NAME	RANGE	QUANTITY
1	PN Junction diode	IN4007	1
2	Resistor	1 K	1
3	Ammeter	0-50 mA, 0-500 A	Each 1
4	Voltmeter	0-30V, 0-3V	Each 1
5	RPS	0-30V	1
6	Bread board	-	1

THEORY: -

When a P and N type semi-conductor are formed together a P-N junction is created. There are two types of biasing. When a P-type semiconductor is connected to positive terminal of the battery and N-type Semiconductor is to the negative terminal, the junction barrier vanishes and we get forward current. But When connections are interchanged the junction barrier increases very much and there is no current flow. But a small value of current, due to the minority carriers, known as reverse saturation current, is present there.

TABULATION:

FORWARD BIAS:

SL.NO	V_{IN}(V)	V_F(V)	I_F (A)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			

REVERSE BIAS:

SL.NO	V_{IN}(V)	V_R(V)	I_R (A)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			

PROCEDURE:

FORWARD CHARACTERISTICS:

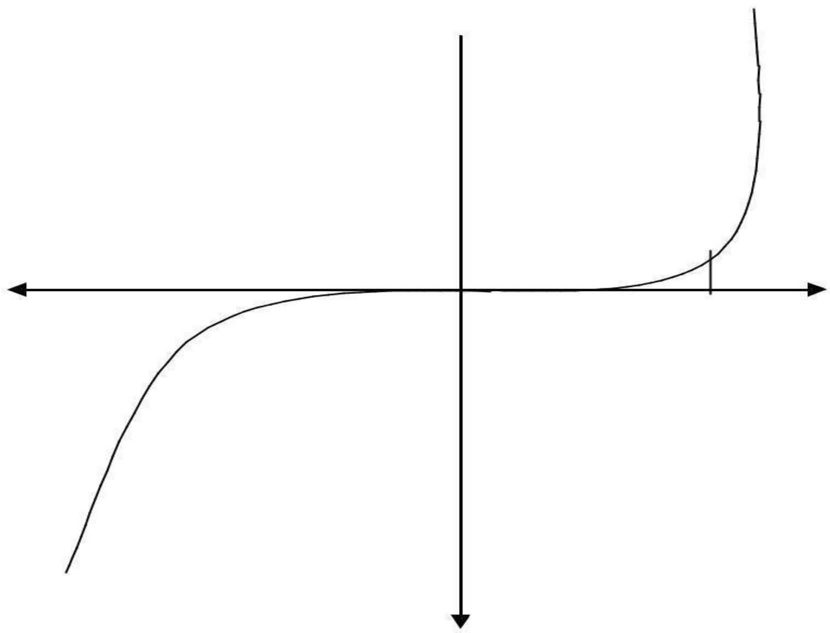
1. The connections are made as per the circuit diagram.
2. Input supply voltage is varied.
3. The corresponding forward voltage and current are noted.
4. The readings are tabulated and the graph is plotted between the voltage on x-axis and current on y-axis.
5. From the graph the forward resistance $R_F = V_f / I_f$ cut-in voltage are calculated.

REVERSE BIAS CHARACTERISTICS:

1. The terminals are reversed and the above steps are repeated. To find Forward Resistance

$$R_F = V_f / I_f$$

MODEL GRAPH:



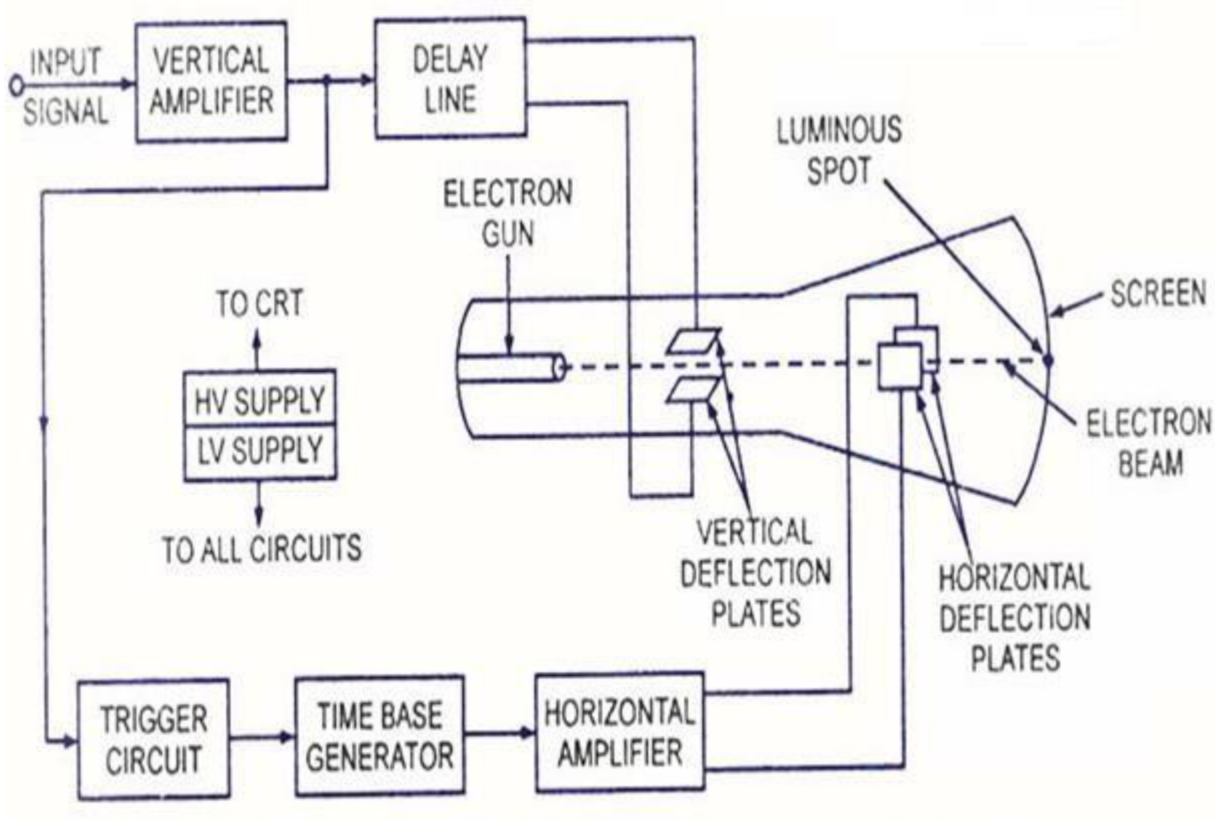
MODEL CALCULATION:

RESULT: -

Thus, the forward and reverse characteristics of a P-N junction diode were plotted and following observations were made.

Forward resistance :

Cut-in voltage :



Block Diagram of a General Purpose CRO

EX.NO:

DATE:

STUDY OF CRO

AIM:

To Study of Cathode Ray Oscilloscope.

APPARATUS REQUIRED :

- CRO

Function Generator

THEORY:

The cathode ray oscilloscope is the most versatile measuring instrument available. We can measure following parameters using the CRO:

1. AC or DC voltage.
2. Time (t=1/f).
3. Phase relationship
4. Waveform calculation: Rise time; fall time; on time; off-time; Distortion, etc

We can also measure non-electrical physical quantities like pressure, strain, temperature, acceleration, etc., by converting into electrical quantities using a transducer.

MAJOR BLOCKS:

1. Cathode ray tube (CRT)
2. Vertical amplifier
3. Horizontal amplifier
4. Sweep generator
5. Trigger circuit
6. Associated power supply

The cathode ray tube is the heart of CRO. The CRT is enclosed in an evacuated glass envelope to permit the electron beam to traverse in the tube easily. The main functional units of CRO are as follows.

Electron gun
assembly
Deflection plate
unit Screen.

Vertical Amplifier is the main factor in determining the bandwidth and sensitivity of an oscilloscope. Vertical sensitivity is a measure of how much the electron beam will be deflected for a specified input signal. On the front panel of the oscilloscope, one can see a knob attached to a rotary switch labeled volts/division. The rotary switch is electrically connected to the input attenuation network. The setting of the rotary switch indicates what amplitude signal is required to deflect the beam vertically by one division.

Horizontal amplifier Under normal mode of operation, the horizontal amplifier will amplify the sweep generator input. When the CRO is being used in the X-Y mode, the horizontal amplifier will amplify the signal applied to the horizontal input terminal. Although the vertical amplifier mush be able to faithfully reproduce low-amplitude and high frequency signal with fast risetime, the horizontal amplifier is only required to provide a faithful reproduction of the sweep signal which has a relatively high amplitude and slow rise time.

Sweep generator and Trigger circuit These two units form the **Signal Synchronization unit of the CRO.**

The input signal may come from an external source when the trigger selector switch is set to EXT or from low amplitude AC voltage at line frequency when the switch is set to LINE or from the vertical amplifier when the switch is set to INT. When set for INT (internal triggering), the trigger circuit receives its inputs from the vertical amplifier.

Major Blocks in a Practical CRO

A CRO consists of a cathode ray tube (CRT) and additional control knobs. The main parts of a CRT are:

1. Electron gun assembly.
2. Deflection plate assembly.
3. Fluorescent screen

Electron Gun Assembly: The electron gun assembly produces a sharp beam of electrons, which are accelerated to high velocity. This focused beam of electrons strike the fluorescent screen with sufficient energy to cause a luminous spot on the screen.

Deflection plate assembly: This part consists of two plates in which one pair of plates is placed horizontally and other of plates is placed vertically. The signal under test is applied to vertical deflecting plates. The horizontal deflection plates are connected to a built-in ramp generator, which moves the luminous spot periodically in a horizontal direction from left to right over the screen. These two deflection plates give stationary appearance to the waveform on the screen. CRO operates on voltage. Since the deflection of the electron beam is directly proportional to the deflecting voltage, the CRT may be used as a linear measuring device. The voltage being measured is applied to the vertical plates through an iterative network, whose propagation time corresponds to the velocity of electrons, thereby synchronizing the voltage applied to the vertical plate with the velocity of the beam.

Synchronization of input signal: The sweep generator produces a saw tooth waveform, which is used to synchronize the applied voltage to obtain a stationary-applied signal. This requires that the time base be operated at a submultiples frequency of the signal under measurement. If synchronization is not done, the pattern is not stationary, but appears to drift across the screen in a random fashion.

Internal synchronization This trigger is obtained from the time base generator to synchronize the signal.

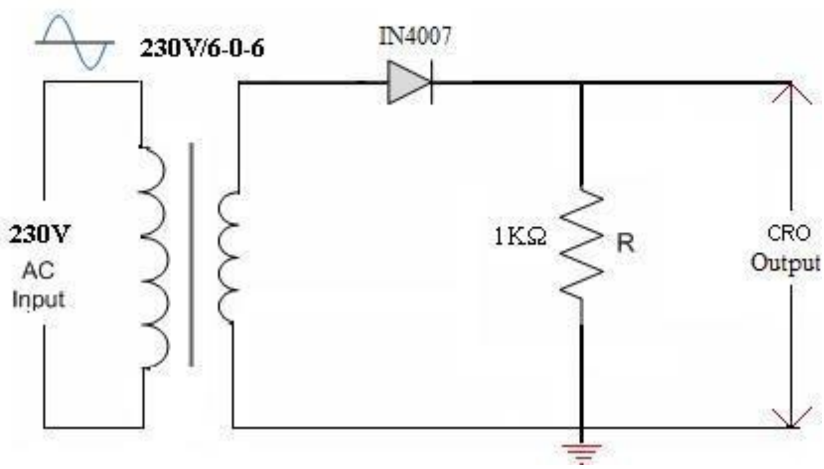
External synchronization An external trigger source can also be used to synchronize the signal being measured.

Auto Triggering Mode The time base used in this case in a self-oscillating condition, i.e., it gives an output even in the absence of any Y-input. The advantage of this mode is that the beam is visible on the screen under all conditions, including the zero input. When the input exceeds a certain magnitude then the internal free running oscillator locks on to the frequency.

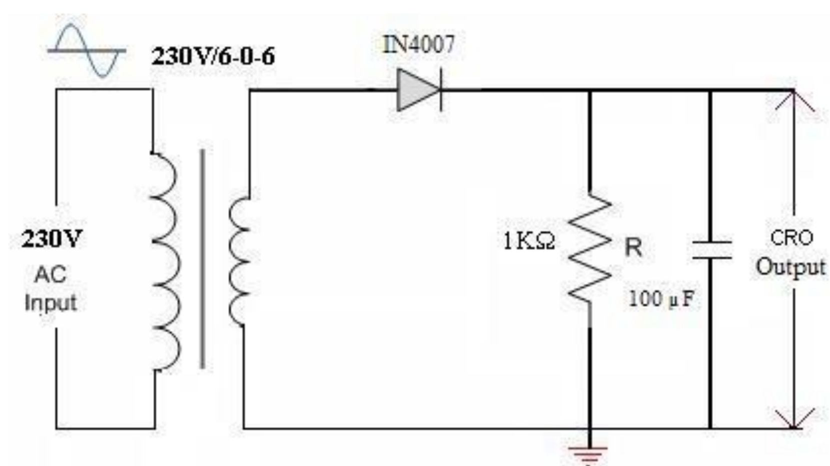
RESULT:

CIRCUIT DIAGRAM:

WITHOUT FILTER



WITH FILTER:



EX.NO:

DATE:

HALF WAVE RECTIFIER

AIM:

To construct half wave rectifier with and without filter and to draw their input and output waveforms.

APPARATUS REQUIRED:

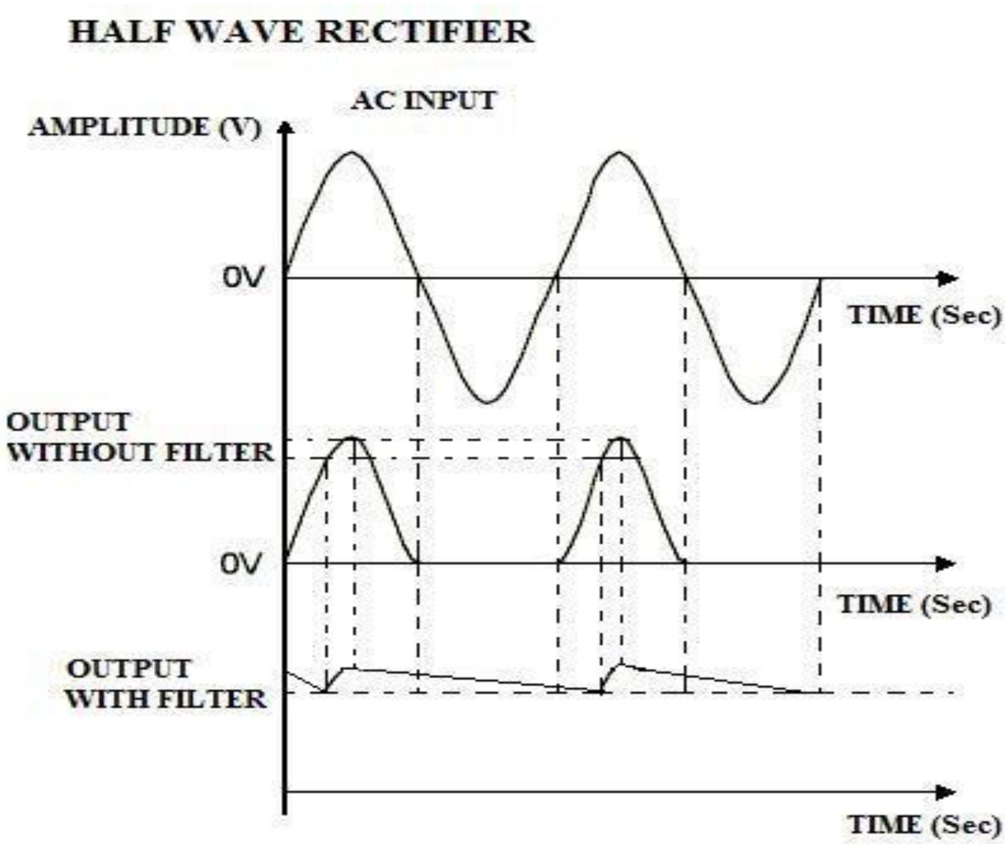
S.No.	Name	Range	Quantity
1.	Transformer	230 V / 6-0-(-6)	1
2.	Diode	IN4007	1
3.	Resistor	1 kΩ	1
4.	Capacitor	100µF	1
5.	CRO	30 MHz	1
6.	Bread Board		1

FORMULA USED:

$$\text{Ripple Factor} = \sqrt{((I_m/2)/(I_m/\pi))^2 - 1}$$

Where I_m is the peak current

MODEL GRAPH:



HALF WAVE RECTIFIER
AC INPUT
AMPLITUDE (V)
0V
TIME (Sec)
OUTPUT
WITHOUT FILTER
0V
TIME (Sec)
OUTPUT
WITH FILTER
TIME (Sec)

THEORY:

HALF WAVE RECTIFIER:

A rectifier is a circuit, which uses one or more diodes to convert A.C voltage into D.C voltage. In this rectifier during the positive half cycle of the A.C input voltage, the diode is forward biased and conducts for all voltages greater than the offset voltage of the semiconductor material used. The voltage produced across the load resistor has same shape as that of the positive input half cycle of A.C input voltage.

During the negative half cycle, the diode is reverse biased and it does not conduct. So there is no current flow or voltage drop across load resistor. The net result is that only the positive half cycle of the input voltage appears at the output.

PROCEDURE:

1. Connect the circuit as per the circuit diagram.
2. Apply a.c input using transformer.
3. Measure the amplitude and time period for the input and output waveforms.
4. Calculate ripple factor.

TABULATION:

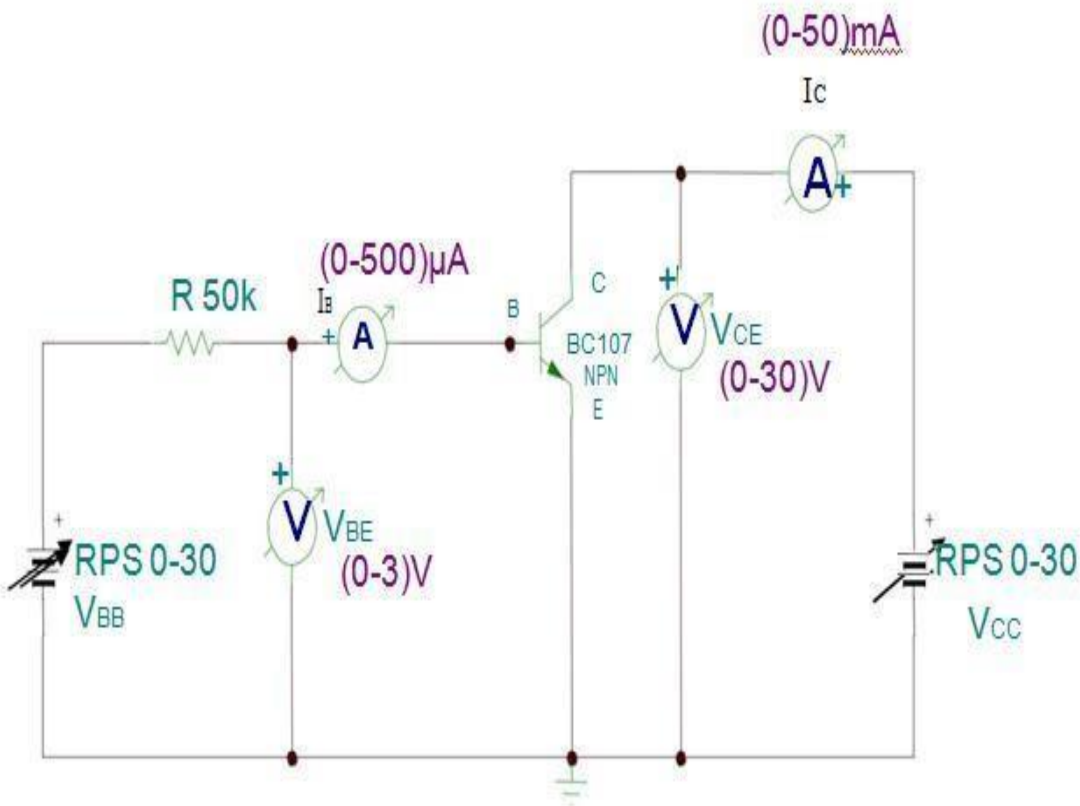
INPUT SIGNAL		OUTPUT SINGAL			
AMPLITUDE	TIME	WITH FILTER		WITHOUT FILTER	
		AMPLITUDE	TIME	AMPLITUDE	TIME

MODEL CALCULATION:

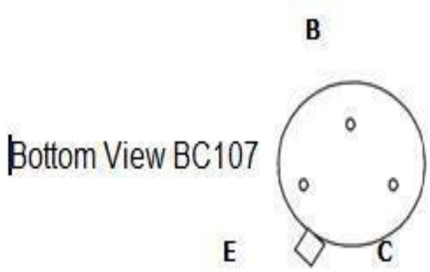
RESULT:

Hence, the half wave rectifier with and without filter was constructed and input and output waveforms are drawn.

Circuit Diagram:



PIN DIAGRAM:



Specification: BC107/50V/0.1A,0.3W,300MHz

EX.NO:

DATE:

CHARACTERISTICS OF BJT IN CE MODE

AIM:

To draw the input and output characteristics of the Bipolar Junction transistor in Common Emitter Mode.

APPARATUS REQUIRED:

S.No	NAME	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	50 K	1
3	Voltmeter	0-50V	1
4	Ammeter	0-50 mA, 0-500 A	Each 1
5	Bread board	-	1

THEORY: -

It is nothing but two junction diodes connected back to back. There is three region named as Emitter, Base and Collector. The base is lightly doped , collector moderately and emitter heavily. The emitter region is made larger to dissipate heat energy. The function of emitter region is to inject charge carriers to the base, which, in turn pass to the collector. The collector collects the charge carriers from the base or emitter.

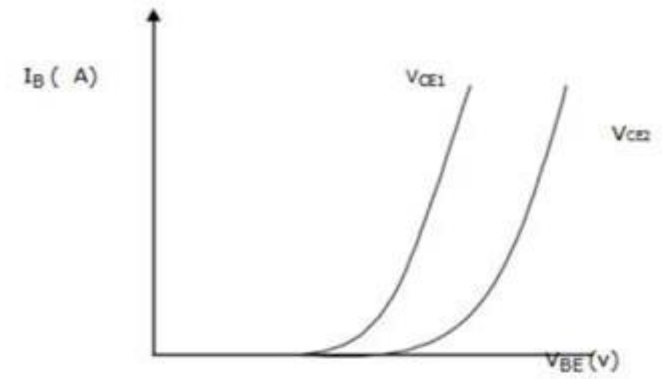
PROCEDURE:

INPUT CHARACTERISTICS:

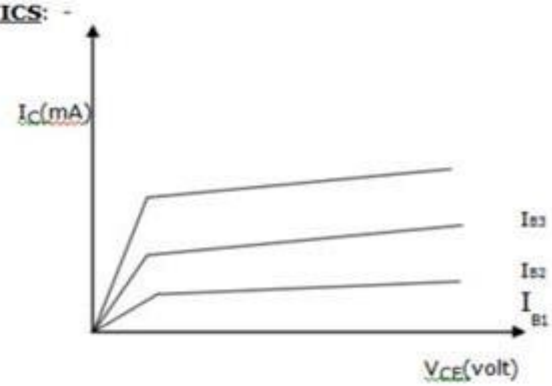
1) Connections are made as per the circuit diagram.
2) The output voltage V_{CE} is kept constant.
3) By varying the input voltage V_{BE} , the corresponding input currents I_B are noted down
4) A graph is plotted between V_{BE} and I_B.
5) The inverse slope of the curve gives forward input resistance

MODEL GRAPH:

INPUT CHARACTERISTICS:-



OUTPUT CHARECTERSTICS: -



OUTPUT CHARACTERISTICS :

1. The connections are made as per the circuit diagram.
2. The input current I_B is kept constant.
3. By varying the output voltage V_{CE} , the corresponding output current I_C is noted down.
4. A graph is plotted between V_{CE} and I_C .
5. The inverse slope of the curve gives forward output resistance

FORMULA:

$R_i = \Delta V_{BE} / \Delta I_B$

$R_o = \Delta V_{CE} / \Delta I_C$

MODEL CALCULATION:

TABULATION :

INPUT CHARACTERISTICS:

V_{CE}:__________V

SL.NO	V_{BB}(V)	V_{BE}(V)	I_B (A)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

OUTPUT CHARACTERISTICS:

I_B:___________A

SL.NO	V_{CC}(V)	V_{CE}(V)	I_C (A)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

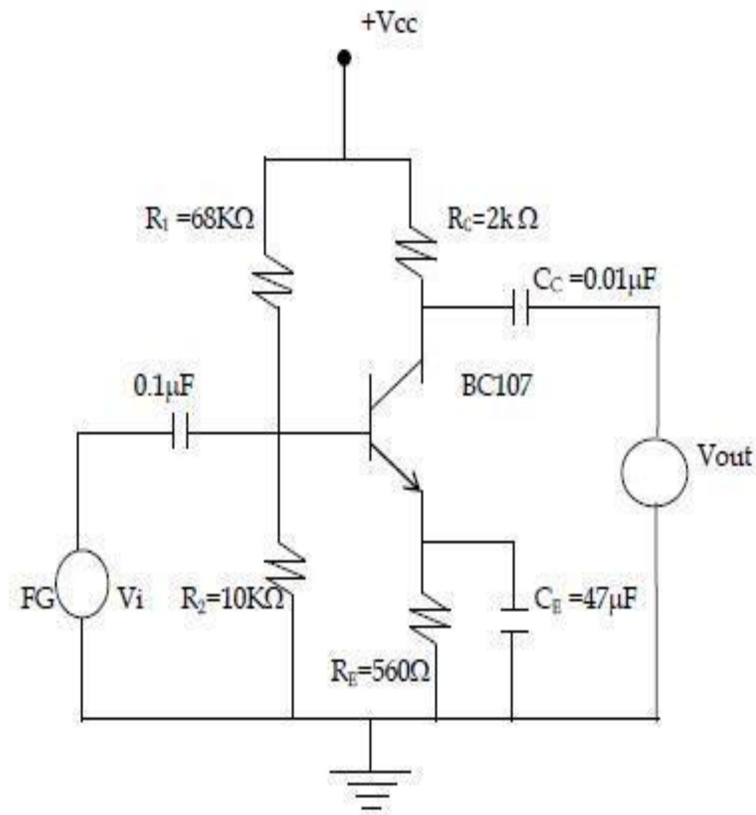
RESULT: -

The input and output characteristics of the transistor in CE mode are drawn and the input and output resistances are calculated.

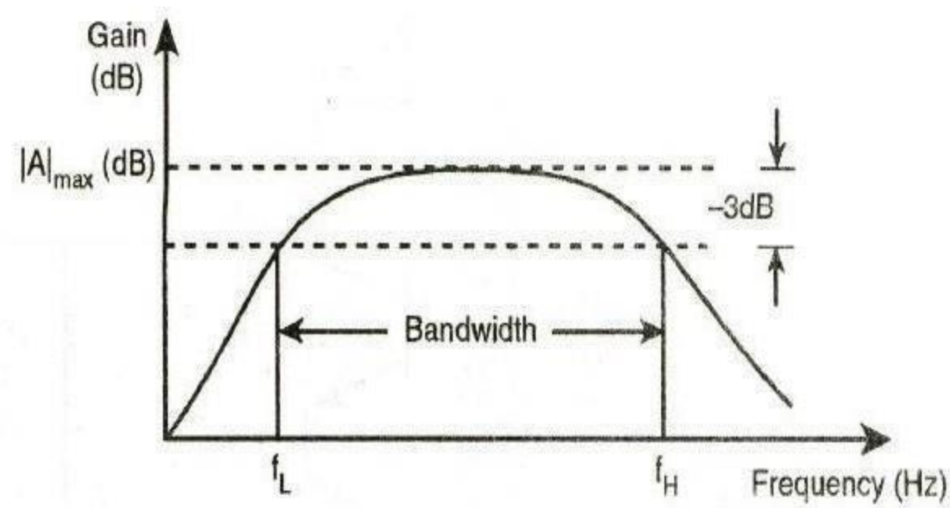
Input resistance =

Output resistance =

CIRCUIT DIAGRAM



MODEL GRAPH:



EX.NO:

DATE:

COMMON EMITTER AMPLIFIER

AIM:-

To study the frequency response of common emitter amplifier.

APPARATUS REQUIRED

SL. No	APPARATUS	RANGE	QTY
1.	Transistor (BC -107)		
2.	Regulated Power Supply		
3.	Resistor		
4.	Capacitor		
5.	Function Generator		
6.	C.R.O		
7.	Bread Board & connecting wires		

THEORY:

An amplifier is an electronic circuit that is capable of increasing the level of the signal applied at its input. The semiconductor devices used for the purpose of amplification are transistors. When a transistor is biased in active region it acts like an amplifier. We apply an ac voltage between the base and emitter terminals to produce corresponding collector current.

An amplified output signal is obtained when this fluctuating collector current flows through a collector resistor Rc.

The capacitor across the collector resistor Rc will act as a bypass capacitor. This will improve high frequency response of amplifier.

The Frequency response of CE Amplifier has three regions.

1) LFR.
2) HFR.
3) MFR

TABULATION: V_{IN} :

SL.NO	Input Frequency in (KHZ)	V_{out}	Gain = 20 log (v_{out} / v_{in})	Input Frequency (KHZ)	V_{out}	Gain = 20 log (v_{out} / v_{in})
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

FREQUENCY RESPONSE CURVE

In the usual application, mid band frequency range are defined as those frequencies at which the response has fallen to 3dB below the maximum gain (|A| max). These are shown as f_L and f_H and are called as the 3dB frequencies (Lower and Upper Cut-Off Frequencies respectively). The difference between higher cut-off and lower cut-off frequency is referred to as bandwidth (f_H - f_L).

PROCEDURE: -

1. The connections are made as per the circuit diagram.
2. The 12v supply is given to the collector terminal.
3. The input voltage is setup as per design value in AFO.
4. By increasing the frequency note down the output voltage and calculate the gain by using the formula.
5. The frequency response was plotted using gain along Y- axis and frequencies along X- axis and from graph calculate the bandwidth by using the formula.

Bandwidth BW = (f2 – f1)

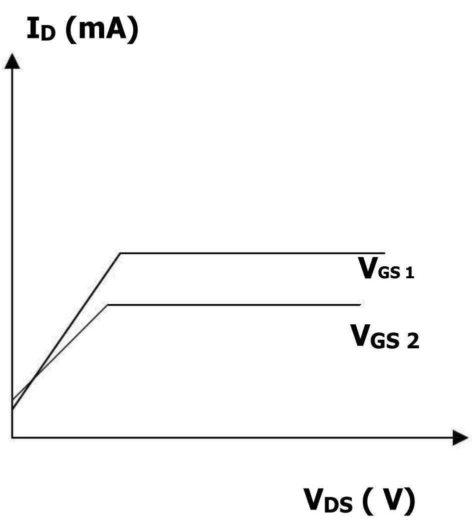
RESULT:

Thus the CE Amplifier was designed and tested and its bandwidth was found to be =____________.

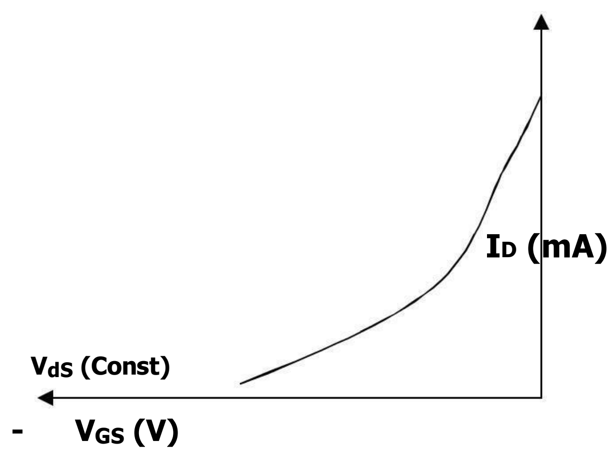
CIRCUIT DIAGRAM:

MODEL GRAPH:-

DRAIN CHARACTERISTICS:



TRANSFER CHARACTERISTICS:-



EX.NO :

DATE :

DRAIN AND TRANSFER CHARACTERISTICS OF MOSFET

AIM

To study and plot the drain and transfer characteristics of MOSFET

APPARATUS REQUIRED:

S.No	NAME	RANGE	QUANTITY
1	MOSFET	IR150	1
2	Ammeter	0-25 mA	1
3	Voltmeter	0-30V	1
4	Resistor	1K	1
5	RPS	0-30V	2
6	Bread board	-	1

THEORY:-

MOSFET is an abbreviation for metal oxide semiconductor filed transistor. Like JFET, it has a source (S), drain(D) and gate(G). However unlike JFET, the gate of MOSFET is insulated from channel. Because of this, MOSFET is sometimes known as IGFET(insulated gate FET). Basically MOSFET are of two types 1) depletion type MOSFET and 2) enhancement type MOSFET.

Enhancement MOSFET has no depletion mode and only operates in enhancement mode. It differs in construction from depletion type MOSFET in the sense that it has no physical channel. The min gate-source voltage (VGS), which produces inversion layer, called as threshold voltage.

TABULATION:

Drain Characteristics:

SL.NO	**V_S (v)**	**V_{GS} =**	
		V_{DS} (V)	**I_D (mA)**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			

Transfer Characteristics:

Sl.NO	**V_S (v)**	**V_{GS} =**	
		V_{DS} (V)	**I_D (mA)**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
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25.			

DRAIN CHARACTERISTICS FOR ENHANCEMENT MOSFET: -

When VGS< (VGS) the no drain current flows. However in actual practice, and extremely small value of drain current does flow through MOSFET. This current flow is generally due to presence of thermally generated electron in P type substrate when value of VGS is kept above (VGS) significant drain current flow.

TRANSFER CHARACTERISTICS OF MOSFET: -

When VGS=0 there is no drain current, however if VGS is increased rapidly. The relation gives the drain current at any instant along the curve.

I_D=k [(VGS-VGS)]

PROCEDURE: -

DETERMINATION OF DRAIN CHARACTERISTICS:

1. Voltage V_{GS} is kept at some fixed level.
2. The Drain to Source voltage V_{DS} is varied and the corresponding drain current I_d is noted. The Graph was plotted between V_{DS} on the x-axis and I_d on y-axis.
3. The drain resistance (r_d) was determined as $r_d = V_{DS}/ I_d$

DETERMINATION OF TRANSFER CHARACTERISTICS:

1. The V_{DS} is kept at some particular value.
2. The Source voltage V_{GS} is varied at some particular level and the corresponding drain current I_d was noted.
3. A graph was plotted between V_{GS} and I_D.
4. The transfer conductance value was determined by $g_m = I_d/ V_{GS}$.

DETERMINATION OF AMPLIFICATION FACTOR:

Amplification factor μ = $g_m * r_d$

RESULT: -

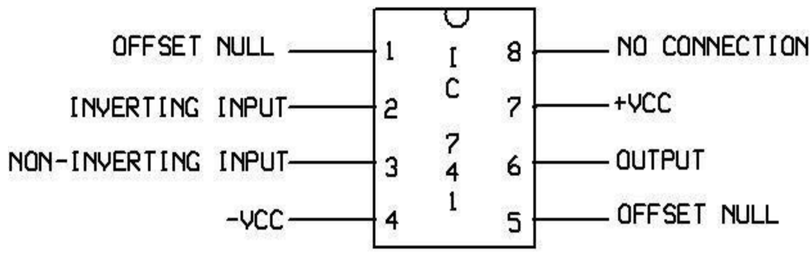
Thus the Drain and transfer characteristics of the given MOSFET were studied and the following values were determined.

a) Drain resistance (r_d) =

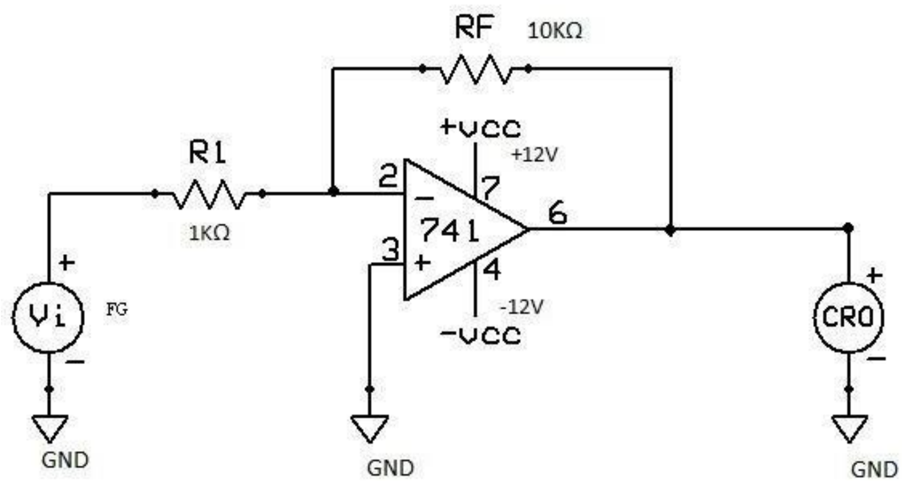
b) Trans-Conductance (g_m) =

c) Amplification factor (μ) =

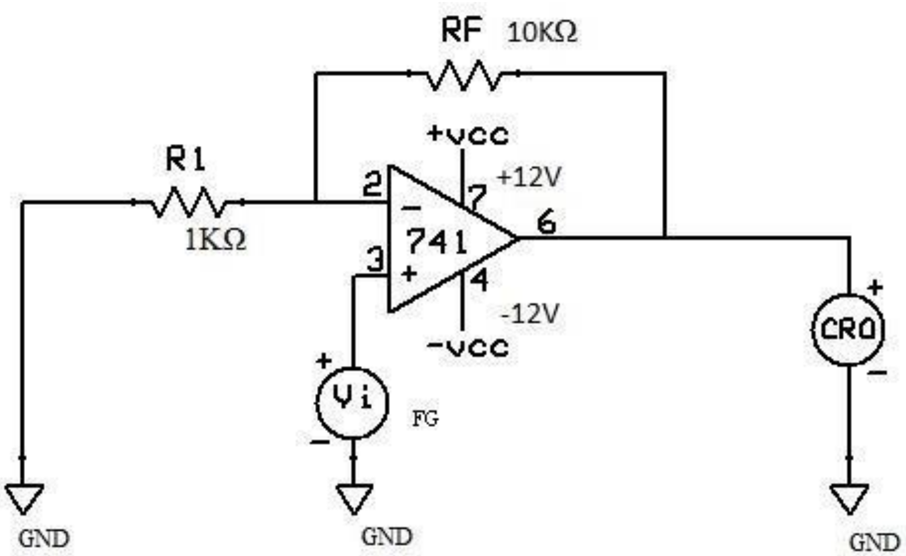
PIN DIAGRAM:



CIRCUIT DIAGRAM: INVERTING AMPLIFIER:



CIRCUIT DIAGRAM: NON INVERTING AMPLIFIER:



EX.NO :

DATE :

INVERTING AND NON-INVERTING AMPLIFIER

AIM:

To design an Inverting Amplifier for the given specifications using Op-Amp IC 741.

APPARATUS REQUIRED :

S.No	Name of the Apparatus	Range	Quantity
1.	Function Generator	3 MHz	1
2.	CRO	30 MHz	1
3.	Dual RPS	0 – 30 V	1
4.	Op-Amp	IC 741	1
5.	Bread Board	-	1
6.	Resistors		As required
7.	Connecting wires and probes		As required

THEORY:

The input signal V_i is applied to the inverting input terminal through R_1 and the non-inverting input terminal of the op-amp is grounded. The output voltage V_o is fed back to the inverting input terminal through the R_f - R_1 network, where R_f is the feedback resistor. The output voltage is given as,

$$V_o = - A_{CL} V_i$$

Here the negative sign indicates that the output voltage is 180^0 out of phase with the input signal.

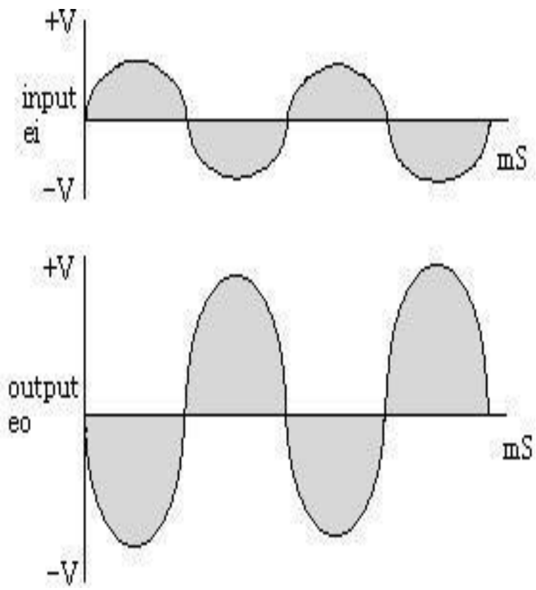
The input signal V_i is applied to the non - inverting input terminal of the op-amp. This circuit amplifies the signal without inverting the input signal. It is also called negative feedback system since the output is feedback to the inverting input terminals. The differential voltage V_d at the inverting input terminal of the op-amp is zero ideally and the output voltage is given as,

$$V_o = A_{CL} V_i$$

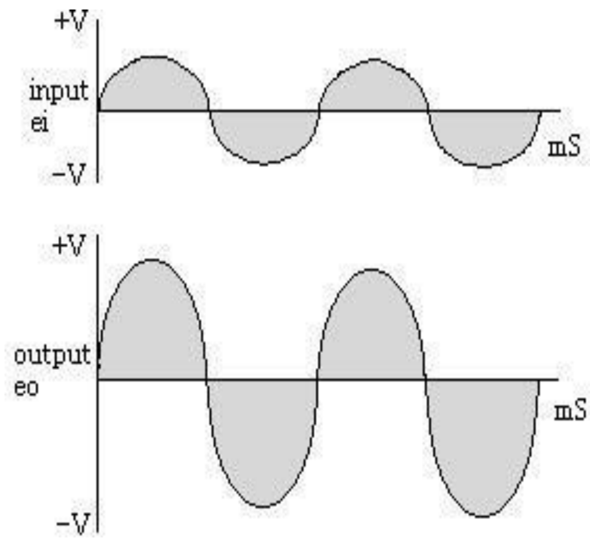
Here the output voltage is in phase with the input signal

Model Graph:

Inverting Amplifier:



Non Inverting Amplifier



TABULATION:

	Inverting Amplifier		Non - Inverting Amplifier	
	Input	Output	Input	Output
Amplitude				
Time				

PROCEDURE:

INVERTING AMPLIFIER:

1. Connections are given as per the circuit diagram.
2. + V_{cc} and - V_{cc} supply is given to the power supply terminal of the Op-Amp IC.
3. By adjusting the amplitude and frequency knobs of the function generator, appropriate input voltage is applied to the inverting input terminal of the Op-Amp.
4. The output voltage is obtained in the CRO and the input and output voltage waveforms are plotted in a graph sheet

NON-INVERTING AMPLIFIER:

5. Connections are given as per the circuit diagram.
6. + V_{cc} and - V_{cc} supply is given to the power supply terminal of the Op-Amp IC.
7. By adjusting the amplitude and frequency knobs of the function generator, appropriate input voltage is applied to the non - inverting input terminal of the Op-Amp.
8. The output voltage is obtained in the CRO and the input and output voltage waveforms are plotted in a graph sheet

DESIGN:

INVERTING AMPLIFIER:

We know that for inverting amplifier

$$A_{CL} = 1 + (R_F/R)$$

Assume R_L (Approximately) 10KΩ and find R_F

Hence, $V_o = -ACL * V_i$

NON-INVERTING AMPLIFIER:

We know that for inverting amplifier

$$A_{CL} = R_F/R$$

Assume R_L (Approximately) 10KΩ and find R_F

Hence, $V_o = -ACL * V_i$

MODEL CALCULATION:

RESULT:

Thus an Inverting Amplifier was designed for the given specifications using Op-Amp IC 741.