MUFFAKHAM JAH

COLLEGE OF ENGINEERING AND TECHNOLOGY

EC-291 ELECTRONIC ENGINEERING - II LAB

(*For EEE & EIE*)

(With effect from the academic year 2015-2016)

STUDENT'S MANUAL

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

Vision and Mission of the Institution

Vision

To be part of universal human quest for development and progress by contributing high calibre, ethical and socially responsible engineers who meet the global challenge of building modern society in harmony with nature.

Mission

- To attain excellence in imparting technical education from the undergraduate through doctorate levels by adopting coherent and judiciously coordinated curricular and co-curricular programs
- To foster partnership with industry and government agencies through collaborative research and consultancy
- To nurture and strengthen auxiliary soft skills for overall development and improved employability in a multi-cultural work space
- To develop scientific temper and spirit of enquiry in order to harness the latent innovative talents
- To develop constructive attitude in students towards the task of nation building and empower them to become future leaders
- To nourish the entrepreneurial instincts of the students and hone their business acumen.
- To involve the students and the faculty in solving local community problems through economical and sustainable solutions.

Vision and Mission of ECE Department

Vision

To be recognized as a premier education center providing state of art education and facilitating research and innovation in the field of Electronics and Communication.

Mission

We are dedicated to providing high quality, holistic education in Electronics and Communication Engineering that prepares the students for successful pursuit of higher education and challenging careers in research, R& D and Academics.

Program Educational Objectives of B. E (ECE) Program:

1. Graduates will demonstrate technical competence in their chosen fields of employment by identifying, formulating, analyzing and providing engineering solutions using current techniques and tools
2. Graduates will communicate effectively as individuals or team members and demonstrate leadership skills to be successful in the local and global cross-cultural working environment
3. Graduates will demonstrate lifelong learning through continuing education and professional development
4. Graduates will be successful in providing viable and sustainable solutions within societal, professional, environmental and ethical contexts

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY

BANJARA HILLS, ROAD NO-3, TELANGANA

LABORATORY MANUAL

FOR

ELECTRONIC ENGINEERING -II LAB

Prepared by:

Checked by:

Approved by:

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING

(Name of the Subject/Lab Course): ELECTRONIC ENGINEREERING-II LAB

Code: EC291	**Programme: UG**
Branch: ECE	**Version No: 1**
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Distribution List :Department, Lab, Library, Lab Incharge

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4) Date :	**4) Date :**
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4) Date :	**3) Designation :**
	4) Date :

Approved by: (HOD) 1) Name:

2) Sign :

3) Date :

ELECTRONIC ENGINEERING-II LAB

Instruction	3 Periods per Week
Duration of University Examination	3Hours
University Examination	50Marks
Sessional	25Marks

Objectives:

1. Evaluate the frequency response of amplifier circuits.
2. Design various oscillator circuits.
3. Design power amplifier, clipper and clamper circuits.

INDEX

1. Frequency response of two stage RC Coupled BJT amplifier
2. Current-Series Feedback Amplifier with & with-out Feedback
3. Voltage-Series Feedback Amplifier with & with-out Feedback
4. Current-Shunt Feedback Amplifier with & with-out Feedback
5. Voltage-Shunt Feedback Amplifier with & with-out Feedback
6. RC phase shift oscillator,
7. Hartley oscillator
8. Colpitts Oscillator
9. Clipping Circuits
10. Clamping Circuits

Suggested Reading:

1. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, *Basic Electronics, A Text - Lab Manual*, 7th ed., McGraw Hill Education, 2001.

ELECTRONICS ENGINEERING-II LAB

GENERAL GUIDELINES AND SAFETY INSTRUCTIONS

1. Sign in the log register as soon as you enter the lab and strictly observe your lab timings.
2. Strictly follow the written and verbal instructions given by the teacher / Lab Instructor. If you do not understand the instructions, the handouts and the procedures, ask the instructor or teacher.
3. **Never work alone!** You should be accompanied by your laboratory partner and / or the instructors / teaching assistants all the time.
4. It is mandatory to come to lab in a formal dress and wear your ID cards.
5. Do not wear loose-fitting clothing or jewellery in the lab. Rings and necklaces are usual excellent conductors of electricity.
6. Mobile phones should be switched off in the lab. Keep bags in the bag rack.
7. Keep the labs clean at all times, no food and drinks allowed inside the lab.
8. Intentional misconduct will lead to expulsion from the lab.
9. Do not handle any equipment without reading the safety instructions. Read the handout and procedures in the Lab Manual before starting the experiments.
10. Do your wiring, setup, and a careful circuit checkout before applying power. Do not make circuit changes or perform any wiring when power is on.
11. Avoid contact with energized electrical circuits.
12. Do not insert connectors forcefully into the sockets.
13. **NEVER** try to experiment with the power from the wall plug.
14. Immediately report dangerous or exceptional conditions to the Lab instructor / teacher: Equipment that is not working as expected, wires or connectors are broken, the equipment that smells or “smokes”. If you are not sure what the problem is or what's going on, switch off the Emergency shutdown.
15. Never use damaged instruments, wires or connectors. Hand over these parts to the Lab instructor/Teacher.
16. Be sure of location of fire extinguishers and first aid kits in the laboratory.
17. After completion of Experiment, return the bread board, trainer kits, wires, CRO probes and other components to lab staff. Do not take any item from the lab without permission.
18. Observation book and lab record should be carried to each lab. Readings of current lab experiment are to be entered in Observation book and previous lab experiment should be written in Lab record book. Both the books should be corrected by the faculty in each lab.
19. Handling of Semiconductor Components:Sensitive electronic circuits and electronic components have to be handled with great care. The inappropriate handling of electronic component can damage or destroy the devices. The devices can be destroyed by driving to high currents through the device, by overheating the device, by mixing up the polarity, or by electrostatic discharge (ESD). Therefore, always handle the electronic devices as indicated by the handout, the specifications in the data sheet or other documentation.
20. Special Precautions during soldering practice
    a. Hold the soldering iron away from your body. Don't point the iron towards you.
    b. Don't use a spread solder on the board as it may cause short circuit.
    c. Do not overheat the components as excess heat may damage the components/board.
    d. In case of burn or injury seek first aid available in the lab or at the college dispensary

List of Experiments **Page #**

Experiment No:1

Frequency response of two stage RC Coupled BJT amplifier

Aim:-

1. To design a two stage R-C coupled Common Emitter BJT amplifier and plot its frequency response.
2. To see the effect of cascading upon gain and bandwidth,

Components:

Name	Quantity
Transistor BC547	2
Resistor 100KΩ, 8.2KΩ, 820Ω, 680Ω, 120Ω, 4.7KΩ, 2.2KΩ,	2,4,1,1,1,1,1
Capacitor 10µF,100µF, 1 KPF	3, 2,1

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Function Generator	(0-1)MHz	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

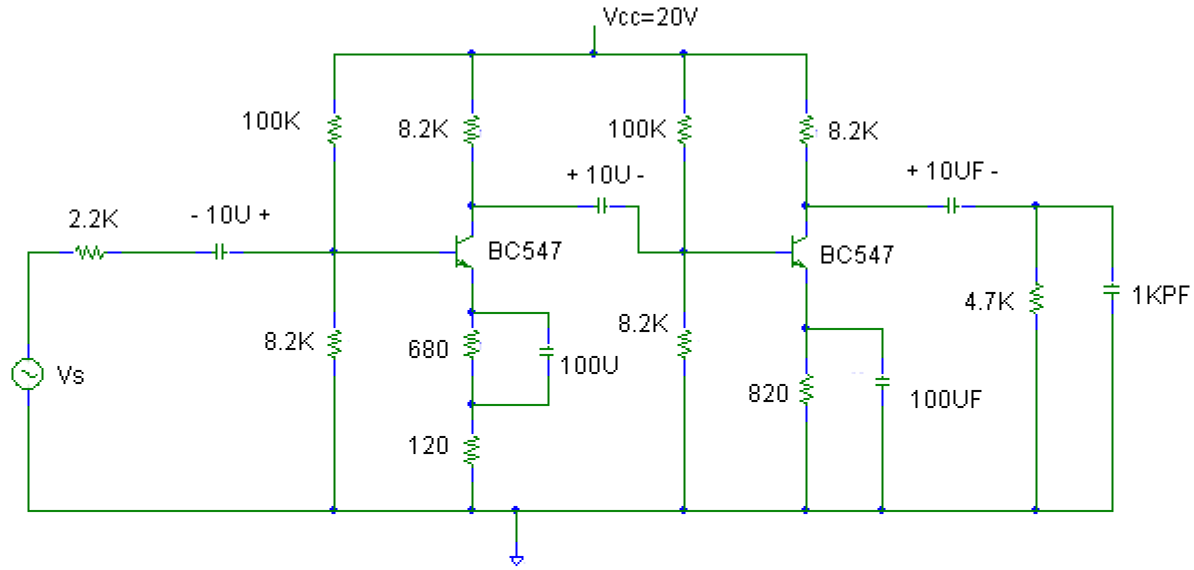
- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:

Cascading in amplifiers is a process of connecting the output of one amplifier to the input of the next and so on so forth. Cascading is used to increase the gain of the amplifier, but due to cascading bandwidth gets reduced.

In a multistage amplifier the overall voltage gain is the product of individual voltage gains. But the bandwidth of a multistage amplifier is always smaller than the bandwidth of individual stages.

Circuit diagram:



Procedure:

1) Connect the circuit as shown in figure1.

2) Note the DC conditions i.e, the values of base, collector currents and base to emitter, collector to emitter voltages for each stage.

3) Connect the circuit as shown in figure 2, Adjust the input signal frequency to 1 KHz and the peak to peak value of V_{i1} to 2 or 3mV. Note the peak to peak value of output voltage V_{o1} and V_{o2}. Calculate the voltage gain of each stage.

For stage-1, $$A_{V1} = \frac{V_{O1}}{V_{i1}}$$

For stage-2, $$A_{V2} = \frac{V_{O2}}{V_{O1}}$$

And overall voltage gain is, $$A_V = A_{V1} \times A_{V2}$$

4) Vary the frequency of the input signal from 30 Hz to 500 KHz in appropriate steps, maintain the V_{i1} constant at 2mV and note the output voltages in each step.

5) Calculate the gains A_{V1}, A_{V2}, and A_V for each value of frequency. Plot a graph between gain and frequency for each stage and the overall stage

6) Calculate bandwidth of each stage and the overall stage from the graph.

Observations:

DC conditions:

For stage-1, V_{BE1} = ……………. V_{CE1} = ………………

I_{B1} = ……………… I_{C1} = ………………..

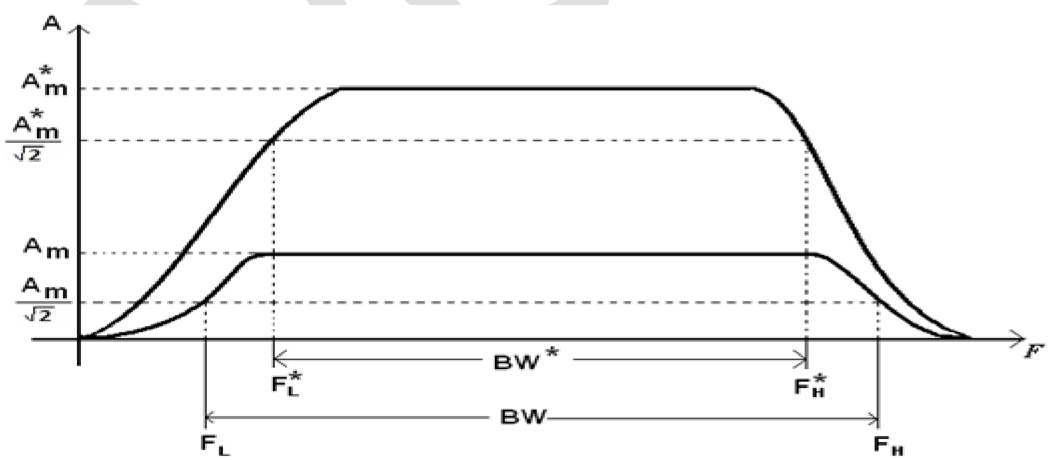
For stage-2, V_{BE2} = ……………. V_{CE2} = ………………

I_{B2} = ……………… I_{C2} = ………………..

Frequency Response:

Sl.No.	Frequency	V_{i1} (mV)	V_{O1} (mV)	V_{O2} (V)	$A_{V1} = \frac{V_{O1}}{V_{i1}}$	$A_{V2} = \frac{V_{O2}}{V_{O1}}$	$A_V = A_{V1} \times A_{V2}$

Expected graph:



Fig(3) frequency response of Two stage RC Coupled CE BJT Amplifier

Result:

1) The frequency response of individual and overall stages is plotted.
2) Mid frequency gains are,

   A_{Vm1} = ……………. A_{Vm2} = …………… A_{Vm} = ………………

3) Bandwidths are,

   BW_1 = …………… BW_2 = ………….. BW = …………..

4) It is observed that cascading in amplifiers increases the voltage gain but decreases the bandwidth.

Experiment No: 2
Current series Feedback Amplifier

Aim: To find the Bandwidth of Current series feedback amplifier without and with feedback.

Apparatus: Dc power supply, Multimeter, Resistors {1kΩ ,33 kΩ,4.7 kΩ(2),5.6 kΩ(2)}, BJT(BC548), Bread Board, Function generator, Connecting wires, Electrolytic capacitors 10µF(2),100 µF, Ceramic capacitor 1kpf(2).

Circuit Diagram

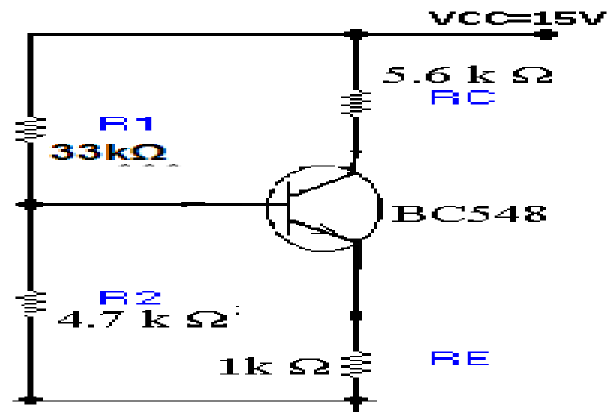


figure 1

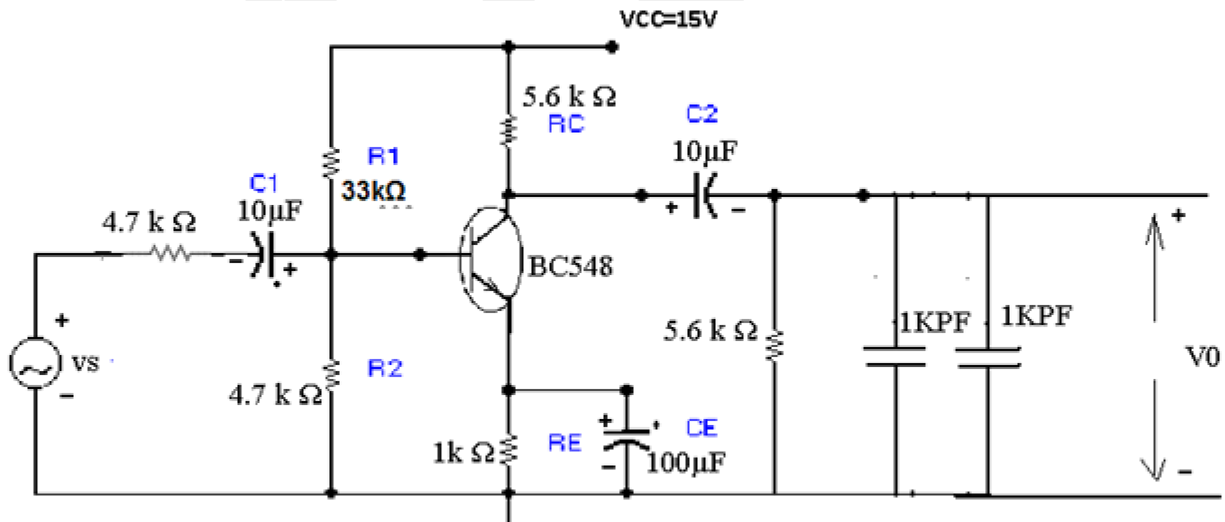


figure 2

Procedure: Without feedback:

1. Connect the circuit as shown in figure 1 and check the Dc Conditions. i.e. Calculate VBE,VCE,IB,IC.
2. Connect the circuit as shown in figure 2.
3. Apply a Sinusoidal wave form of 40 mv p-p (vs) using a function generator.
4. Vary the frequency from 30 Hz to 1MHz and note down the corresponding amplitude of the output.
5. Calculate the gain, $A_V = V_O/V_S$. Plot the Graph of Gain versus Frequency.
6. Find the Lower cutoff and Uppercut off frequency and hence find the bandwidth without feedback.

BW = f2-f1.

With feedback: (Current Series Feedback)

1.Connect the circuit as shown in figure 2 but without the Emitter bypass Capacitor .

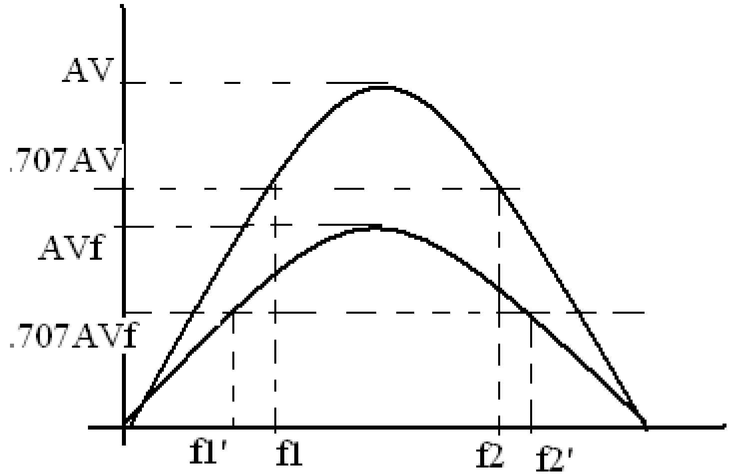
3.Repeat the remaining procedure as above.

BWf = f2'-f1'

Tabular Column: **Vs=40 mV constant.**

S#	Frequency(Hz)	V0	Vof	AV=V0/VS	AVF=VOf/VS
1	30				
2	50				
3	70				
4	100				
5	300				
6	500				
7	700				
8	1K				
9	3K				
10	5K				
11	7K				
12	10K				
13	30K				
14	50K				
15	70K				
16	100K				
17	300K				
18	500K				
19	700K				
20	1M				

Expected graphs:



Results:

1. Bandwidth without feedback ------------------------------
2. Bandwidth with feedback ----------------------------------

EXPERIMENT NO: 3

VOLTAGE SERIES FEEDBACK AMPLIFIER

Aim:

1. To plot the frequency response of a voltage series feedback amplifier
2. To see the effect of feed back upon gain and bandwidth,

Components:

Name	Quantity
Transistor BC547	2
Resistor 100KΩ, 8.2KΩ, 820Ω, 680Ω, 120Ω, 4.7KΩ, 2.2KΩ,	2,4,1,1,1,1,1
Capacitor 10µF,100µF, 1 KPF	3, 2,1

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Function Generator	(0-1)MHz	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:

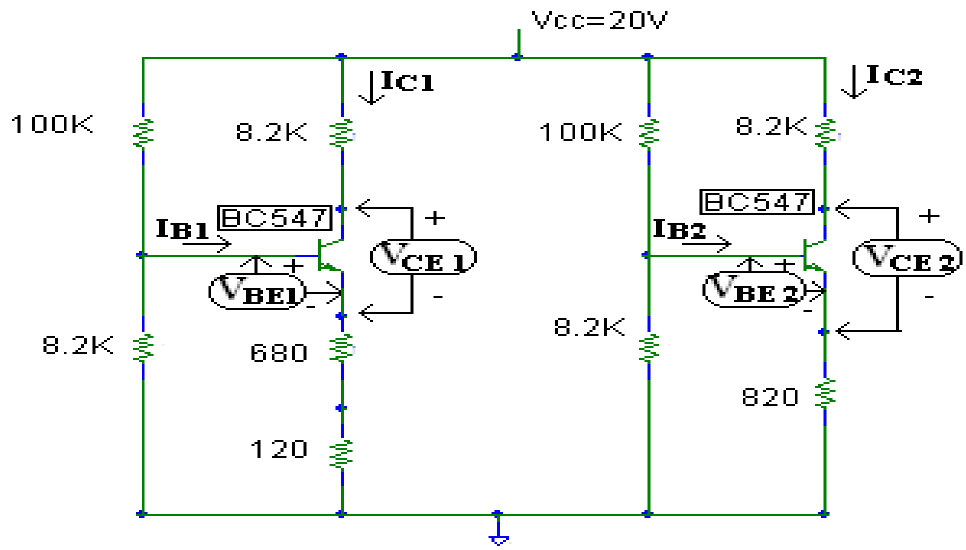
Negative feedback is defined as a process of returning a part of the output signal to the input out of phase with the input signal. It reduces gain and increases bandwidth. Negative feedback is employed in amplifier circuits to improve the stability of the gain, reduce distortion and the effect of noise. It also helps in obtaining desired values of input and output resistances.

A voltage series feedback amplifier samples output voltage and returns the feedback signal to the input in series opposing. Feedback signal is a voltage signal.

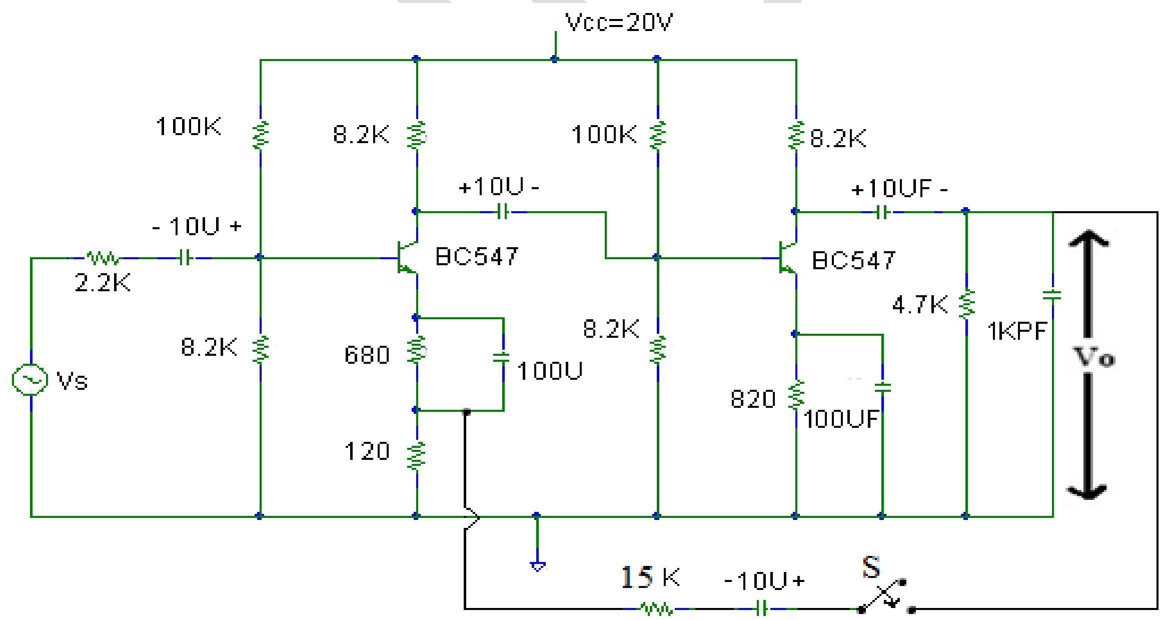
$$V_f = \beta V_O$$

Voltage series feedback increases input resistance and decreases output resistance.

Circuit diagram:



Fig(1) DC bias for the BJT



Fig(2) Voltage Series Feedback Amplifier

Procedure:

1. Connect the circuit as shown in figure 1. Note the DC conditions.
2. Connect the circuit as shown in figure 2. The switch must be open circuit, Then the circuit does not has feedback.
3. Adjust the input signal frequency to 1 KHz and the peak to peak amplitude to 3mV. Note the output voltage and calculate the gain.
4. Vary the frequency from 30 Hz to 500 KHz in appropriate steps and note V_S and V_O in each case. Calculate the gain without feedback as $A_v = \frac{V_O}{V_S}$.
5. Plot a graph between gain and frequency. Calculate bandwidth from the graph.
6. Now connect the switch as short circuit. This will introduce voltage series feedback in the circuit. Repeat steps 3 to 5. in this case vary the frequency from 30 Hz to 2 MHz.
7. Compare the gain and bandwidth with and without feedback

Observations:

DC conditions:-

For stage-1, V_{BE1} = ……………. V_{CE1} = ………………

I_{B1} = ……………… I_{C1} = ………………..

For stage-2, V_{BE2} = ……………. V_{CE2} = ………………

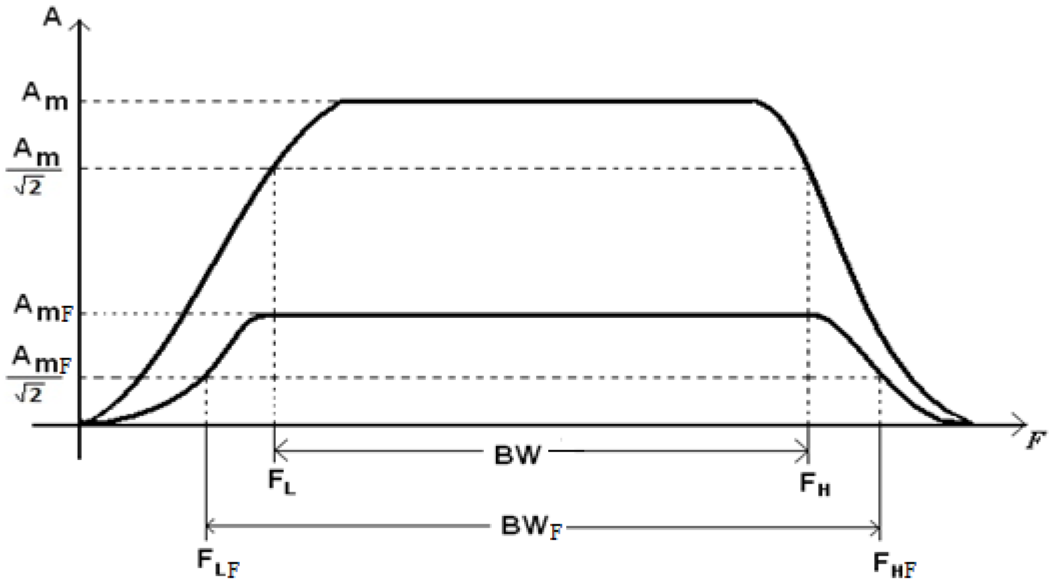
I_{B2} = ……………… I_{C2} = ………………..

Frequency Response:-

Frequency Response:

Sl.No.	Frequency	V_i (mV)	V_O (V)	V_{Of} (V)	$A_V = \frac{V_O}{V_i}$	$A_{Vf} = \frac{V_{Of}}{V_i}$

Expected graph:



Fig(3) Frequency response of Voltage Series Feedback Amplifier

Result:

Gain without feedback = -----------

Bandwidth without feedback = ----------

Gain with feedback = -----------

Bandwidth with feedback = ----------

EXPERIMENT NO: 4

CURRENT SHUNT FEEDBACK AMPLIFIER

Aim:

1. To plot the frequency response of a current shunt feedback amplifier
2. To see the effect of feed back upon gain and bandwidth,

Components:

Name	Quantity
Transistor BC547	2
Resistor 100KΩ, 8.2KΩ, 820Ω, 680Ω, 120Ω, 4.7KΩ, 2.2KΩ,	2,4,1,1,1,1,1
Capacitor 10µF,100µF, 1 KPF	3, 2,1

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Function Generator	(0-1)MHz	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:

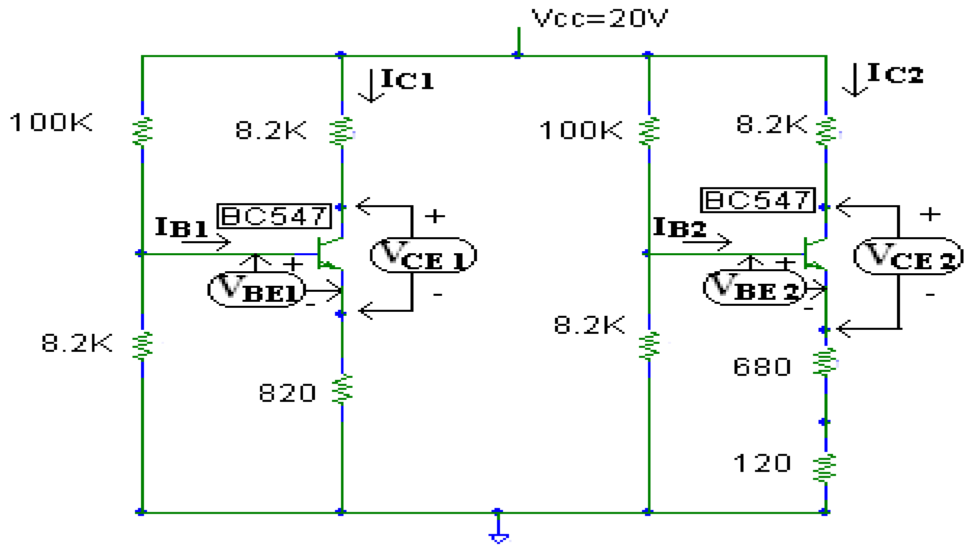
Negative feedback is defined as a process of returning a part of the output signal to the input out of phase with the input signal. It reduces gain and increases bandwidth. Negative feedback is employed in amplifier circuits to improve the stability of the gain, reduce distortion and the effect of noise. It also helps in obtaining desired values of input and output resistances.

A current shunt feedback amplifier samples output current and returns the feedback signal to the input in shunt. Feedback signal is a voltage signal.

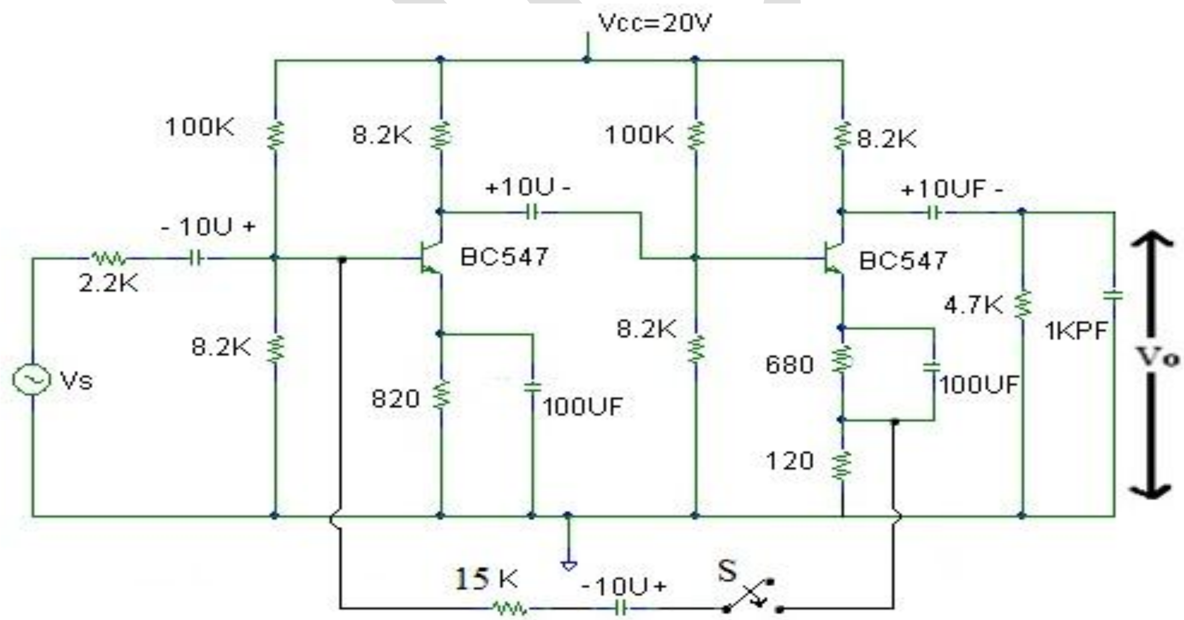
$$I_f = \beta I_L$$

Current shunt feedback increases output resistance and decreases input resistance.

Circuit diagram:



Fig(1) DC bias for the BJT



Fig(2) Current Shunt Feedback Amplifier

Procedure:

1. Connect the circuit as shown in figure 1. Note the DC conditions.
2. Connect the circuit as shown in figure 2. The switch must be open circuit, Then the circuit does not has feedback.
3. Adjust the input signal frequency to 1 KHz and the peak to peak amplitude to 3mV. Note the output voltage and calculate the gain.
4. Vary the frequency from 30 Hz to 500 KHz in appropriate steps and note V_S and V_O in each case. Calculate the gain without feedback as $A_v = \frac{V_O}{V_S}$.
5. Plot a graph between gain and frequency. Calculate bandwidth from the graph.
6. Now connect the switch as short circuit. This will introduce current shunt feedback in the circuit. Repeat steps 3 to 5. in this case vary the frequency from 30 Hz to 2 MHz.
7. Compare the gain and bandwidth with and without feedback

Observations:

DC conditions:

For stage-1, V_{BE1} = ……………. V_{CE1} = ………………

I_{B1} = ……………… I_{C1} = ………………..

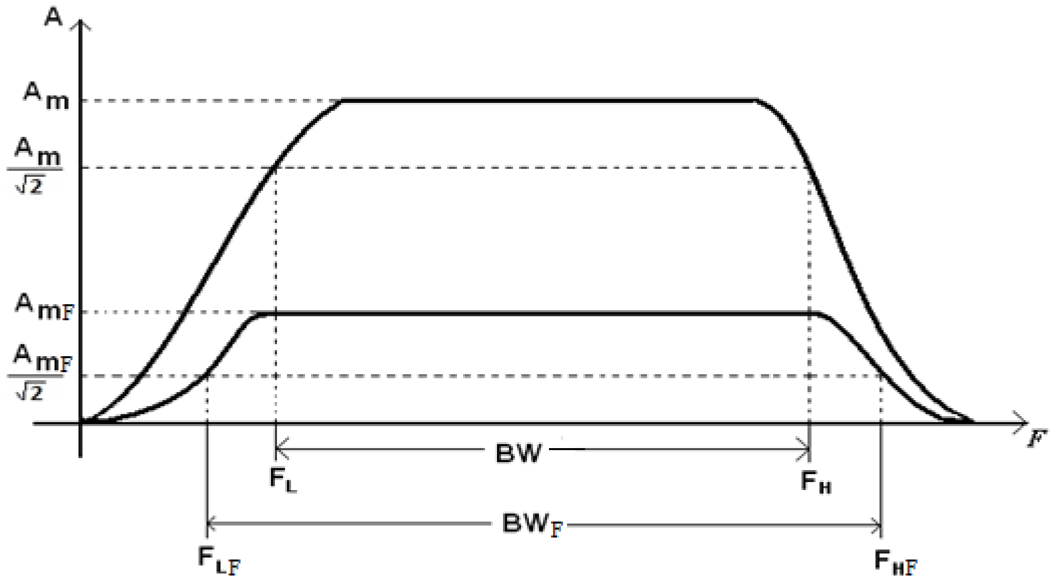
For stage-2, V_{BE2} = ……………. V_{CE2} = ………………

I_{B2} = ……………… I_{C2} = ………………..

Frequency Response:

Sl.No.	Frequency	V_i (mV)	V_O (V)	$V_{O f}$ (V)	$A_V = \frac{V_O}{V_i}$	$A_{V f} = \frac{V_{O f}}{V_i}$

Expected graph:



Fig(3) frequency response of Current Shunt Feedback Amplifier

Result:

Gain without feedback = -----------

Bandwidth without feedback = ----------

Gain with feedback = -----------

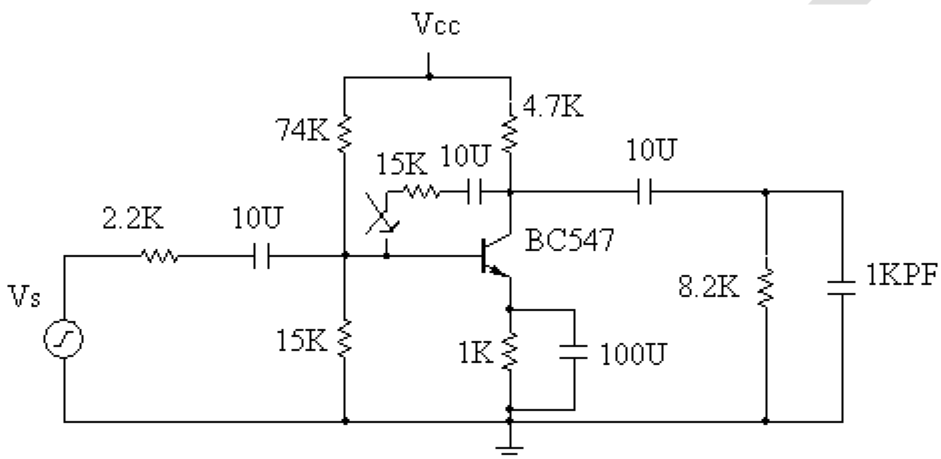
Bandwidth with feedback = ----------

Experiment No: 5

Voltage Shunt Feedback Amplifier

Aim: To plot the frequency response of a voltage shunt feedback amplifier and study the effect of feedback on gain and bandwidth.

Circuit diagram:



Theory:

Negative feedback is defined as a process of returning a part of the output signal to the input out of phase with the input signal. It reduces gain and increases bandwidth. Negative feedback is employed in amplifier circuits to improve the stability of the gain, reduce distortion and the effect of noise. It also helps in obtaining desired values of input and output resistances.

A current series feedback amplifier samples output current and returns the feedback signal to the input in series opposing. Feedback signal is a voltage signal.

$$V_f = \beta I_L$$

Current series feedback increases both input and output impedances.

Procedure:

1.Connect the circuit as shown in figure but with switch open. This circuit does not have feedback.

2.Note the DC conditions.

3.Adjust the input signal frequency to 1 KHz and the peak to peak amplitude to 30mV. Note the output voltage and calculate the gain.

4.Vary the frequency from 30 Hz to 500 KHz in appropriate steps and note V_S and V_O in each case. Calculate the gain without feedback as $A_v = \frac{V_O}{V_S}$.

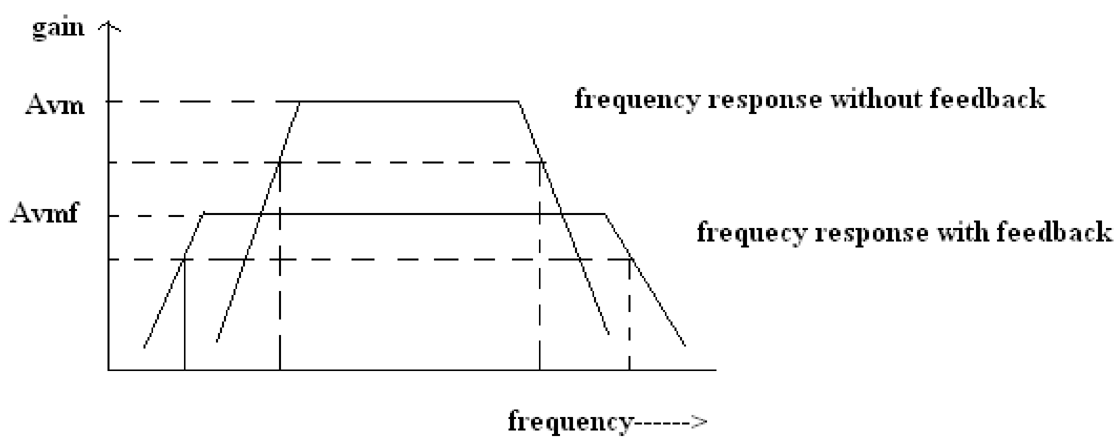
5.Plot a graph between gain and frequency. Calculate bandwidth from the graph.

6.Close the switch now this will introduce the voltage shunt feedback

7. Repeat the above steps 1 to 5 again

8.Compare the gain and bandwidth with and without feedback.

Expected graph:



Observations:

Tabular Column: **Vs=40 mV constant.**

S#	Frequency(Hz)	V0	Vof	AV=V0/VS	AVF=VOf/VS
1	30				
2	50				
3	70				
4	100				
5	300				
6	500				
7	700				
8	1K				
9	3K				
10	5K				
11	7K				

12	10K				
13	30K				
14	50K				
15	70K				
16	100K				
17	300K				
18	500K				
19	700K				
20	1M				

Calculations:

Theoretical Calculations:

Voltage gain without feedback is given by

$$A_V = \frac{-h_{fe} \times R_L^{'}}{h_{ie}} \times \frac{R_i^{'}}{R_i^{'} + R_S}$$

Voltage gain with feedback is given by

$$A_{Vf} = \frac{-h_{fe} \times R_L^{'}}{R_i} \times \frac{R_i^{'}}{R_i^{'} + R_S} \text{ where, } R_i = h_{ie} + (1 + h_{fe})R_e$$

Result:

Gain without feedback = -----------

Bandwidth without feedback = ----------

Gain with feedback = -----------

Bandwidth with feedback = ----------

EXPERIMENT NO : 6

RC PHASE-SHIFT OSCILLATOR

Aim:

To design and study the operation of RC Phase-shift Oscillator using BJT and verify Barkhausen's criterion.

Components:

Name	Quantity
Transistor BC547	1
Resistor 74KΩ, 15KΩ, 4.7KΩ, 1KΩ, 6.8K,2.2K	1,1,2,1,2,1
Capacitor 10µF,100µF, 1 KPF	2, 1,3

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Function Generator	(0-1)MHz	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:-

An oscillator is an electronic circuit that provides an AC output without using any AC input. All Sinusoidal oscillator circuits use the concept of positive feedback to produce oscillations. An oscillator circuit must satisfy the Barkhausen's criterion of unity loop gain to produce oscillations.

The Common Emitter amplifier provides a phase shift of 180˚. Additional 180˚ of phase shift required to satisfy the Barkhausen's criterion of phase shift is provided by the RC phase-shifting network. RC Phase-shift oscillator is used at Audio Frequencies.

Design:

Q: Design RC Phase-shift oscillator circuit to provide oscillations at a frequency of 8 KHz. Use BJT BC547 for which β = 200, h_{fe} = 50, h_{ie} = 1.5 KΩ and $V_{BE(active)}$ = 0.65V. The biasing conditions are as follows. V_{CC} = 12V, I_C = 1mA, V_{CE} = 6V and Stability factor is S = 10.
Use R_C = 4.7KΩ.

Solution:

Use, $I_C = \beta \times I_B$

$$\Rightarrow I_B = 5\mu A$$

Apply KVL to the output loop:

$$-V_{CC} + I_C \times R_C + V_{CE} + I_C \times R_E = 0$$

$$\Rightarrow R_E = 1.3K\Omega$$

Apply Thevenin's theorem to the base circuit, then

$$V_B = \frac{V_{CC} \times R_2}{R_1 + R_2} \text{ And } R_B = \frac{R_1 \times R_2}{R_1 + R_2}$$

We know that the stability factor for a self bias circuit is given by,

$$S = \frac{1+\beta}{1+\dfrac{\beta \times R_E}{R_B + R_E}}$$

$$\Rightarrow R_B = 12.31K\Omega$$

Apply KVL to the input loop, then

$$-V_B + I_B \times R_B + V_{BE} - I_E \times R_E = 0$$

$$\Rightarrow V_B = 2.01\text{V}$$

Divide R_B with V_B:

$$\Rightarrow R_1 = \frac{V_{CC} \times R_B}{V_B} = 73.5K\Omega$$

Also, $R_B = \dfrac{R_1 \times R_2}{R_1 + R_2}$ $\Rightarrow R_2 = 14.8K\Omega$

We know that $f_o = \dfrac{1}{2\pi \times RC\sqrt{6+4K}}$

where $K = \dfrac{R_C}{R}$

Assume that $R = 6.8K\Omega$. Then $C = 1KPF$.

Also $R_3 + h_{ie} = R$ $\Rightarrow R_3 = 4.7K\Omega$

Circuit diagram:-

For Part-I:

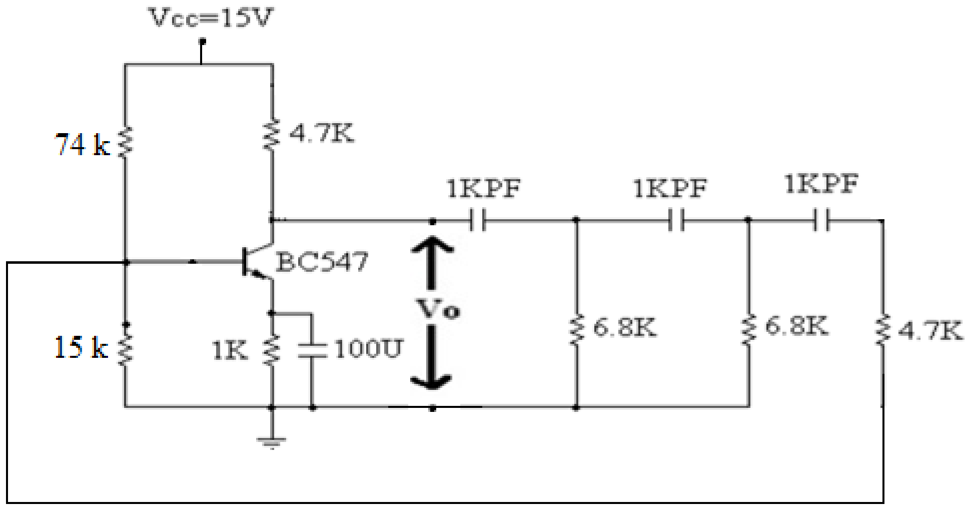


Fig (1) : RC Phase shift oscillator

For Part-II:

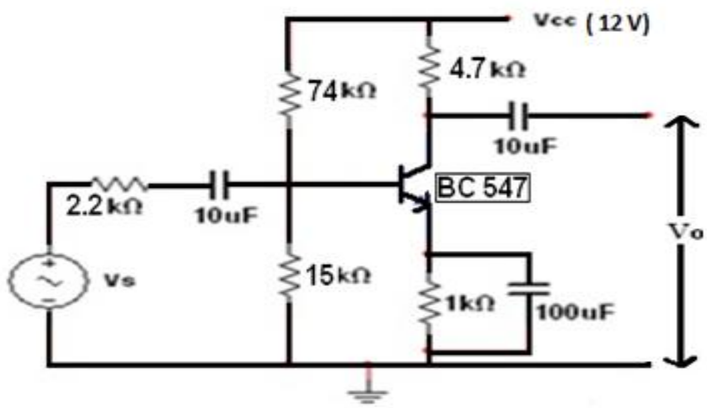


Fig (2): Amplifier Circuit diagram

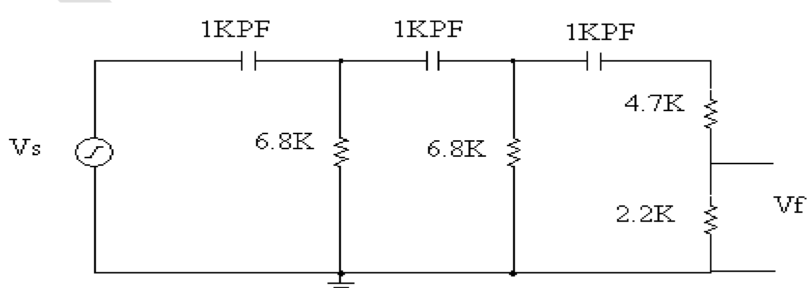


Fig (3): Feedback network

Procedure:-

Part-I: Study of operation

1) Connect the self bias circuit and check the DC conditions.

2) Connect other components of the oscillator circuit as shown in figure. Observe the output voltage waveform on CRO screen. Note down its peak to peak amplitude and frequency.

Part-II: Verification of Barkhausen's criterion

1) Connect only the amplifier circuit and find its gain at the frequency of oscillations. Apply an input of 30mV. Also observe the phase shift between input and output voltages.

2) Connect only the feedback network as shown and compute the feedback factor β as
$$\beta = \frac{V_f}{V_S}.$$

3) Compute the loop gain as $A \times \beta$. This product should be greater than or equal to unity.

4) Observe the phase shift between V_f and V_S.

5) Add the phase shift provided by the amplifier and feedback network. The sum should be equal to 360˚.

Observations: -

Draw the output waveform; mark its peak-to-peak amplitude and time period.

Result:-

Frequency of oscillations, f_o = ------------

Peak to peak amplitude of output = -------------------

Loop gain = --------------------

Phase shift = ---------------------------

Hence Barkhausen's criterion is satisfied.

EXPERIMENT NO: 7

COLPITTS OSCILLATOR

Aim:

To design and study the operation of colpitts Oscillator using BJT and determine the frequency of oscillation.

Components:

Name	Quantity
Transistor BC547	1
Resistor 74KΩ, 15 KΩ, 4.7KΩ, 1KΩ,	1,1,1,1
Capacitor 4.7µF, 1 KPF	2, 1
Inductor 70 µH	1

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:-

An oscillator is an electronic circuit that provides an AC output without using any AC input. All Sinusoidal oscillator circuits use the concept of positive feedback to produce oscillations. An oscillator circuit must satisfy the Barkhausen's criterion of unity loop gain to produce oscillations.

Colpitt's oscillator is a popular LC Oscillator circuit used at Radio Frequencies.

Design:

Q: Design Colpitt's oscillator circuit to provide oscillations at a frequency of 850 KHz. Use BJT BC547 for which β = 200, h_{fe} = 50, h_{ie} = 1.5 KΩ and $V_{BE(active)}$ = 0.65V. The biasing conditions are as follows. V_{CC} = 12V, I_C = 1mA, V_{CE} = 6V and Stability factor is S = 10. Use R_C = 4.7KΩ.

Solution:

Use, $I_C = \beta \times I_B$

$$\Rightarrow I_B = 5\mu A$$

Apply KVL to the output loop:

$$-V_{CC} + I_C \times R_C + V_{CE} + I_C \times R_E = 0$$

$$\Rightarrow R_E = 1.3K\Omega$$

Apply Thevenin's theorem to the base circuit, then

$$V_B = \frac{V_{CC} \times R_2}{R_1 + R_2} \text{ And } R_B = \frac{R_1 \times R_2}{R_1 + R_2}$$

We know that the stability factor for a self bias circuit is given by,

$$S = \frac{1+\beta}{1 + \frac{\beta \times R_E}{R_B + R_E}}$$

$$\Rightarrow R_B = 12.31K\Omega$$

Apply KVL to the input loop, then

$$-V_B + I_B \times R_B + V_{BE} - I_E \times R_E = 0$$

$$\Rightarrow V_B = 2.01\text{V}$$

Divide R_B with V_B:

$$\Rightarrow R_1 = \frac{V_{CC} \times R_B}{V_B} = 73.5K\Omega$$

Also, $R_B = \frac{R_1 \times R_2}{R_1 + R_2}$ $\Rightarrow R_2 = 14.8K\Omega$

We know that $f_o = \frac{1}{2\pi} \times \sqrt{\frac{1}{L}(\frac{1}{C_1} + \frac{1}{C_2})}$

Assume that $C_1 = C_2 = 1KPF$. Then $L = 70\mu H$

Circuit diagram:-

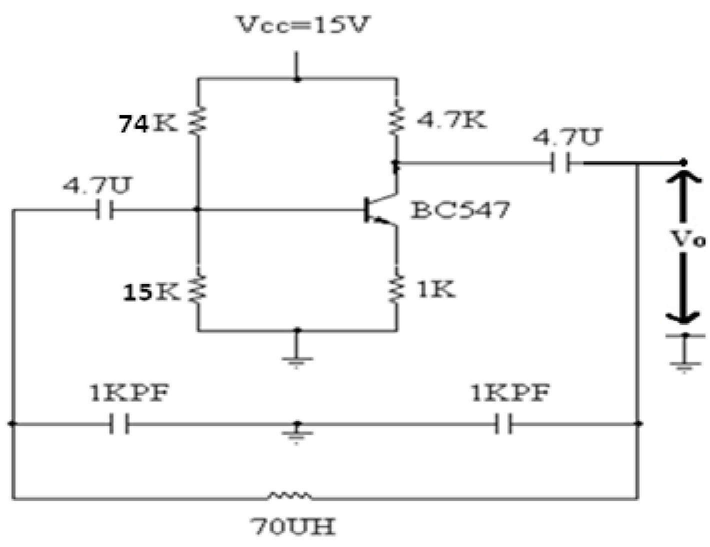


Fig (1): Colpitts Oscillator

Procedure:-

1) Connect the self bias circuit and check the DC conditions.
2) Connect other components of the oscillator circuit as shown in figure 1. Adjust the capacitance to 800 PF.
3) Observe the output voltage waveform on CRO screen. Note down its peak to peak amplitude and frequency.
4) Vary the inductance in appropriate steps and record the frequency in each case.
5) Calculate the frequency theoretically and record it in the table. Compare the theoretical and practical values.

Observations:-

DC conditions:-

V_{BE} = ……………. V_{CE} = ………………

I_B = ……………… I_C = ………………..

Sl. No.	**Inductance (µH)**	**Frequency (Practically) (KHz)**	**Frequency** $f_o = \frac{1}{2\pi} \times \sqrt{\frac{1}{L}(\frac{1}{C_1} + \frac{1}{C_2})}$

Result:-

Colpitts oscillator circuit is designed for the given specifications and its operation is studied.

EXPERIMENT NO: 8

HARTLEY OSCILLATOR

Aim:

To design and study the operation of Hartley Oscillator using BJT and determine the frequency of oscillation.

Components:

Name	Quantity
Transistor BC547	1
Resistor 74KΩ, 15 KΩ, 4.7KΩ, 1KΩ,	1,1,1,1
Capacitor 4.7µF, 100 PF	2, 1
Inductor 70 µH	2

Equipment:

Name	Range	Quantity
Bread Board		1
Dual DC power supply	0-30V	1
Digital Ammeter, Voltmeter	[0-200µA/200mA], [0-20V]	1
CRO	(0-20)MHz	1
CRO probes, Connecting Wires		

Specifications:

For Transistor BC 547:

- Max Collector Current= 0.1A
- V_{ceo} max= 50V
- V_{EB0} = 6V
- V_{CB0} = 50V
- Collector power dissipation = 500mW
- Temperature Range = -65 to +150 ^{0}C
- h_{fe} = 110 - 220

Theory:-

An oscillator is an electronic circuit that provides an AC output without using any AC input. All Sinusoidal oscillator circuits use the concept of positive feedback to produce oscillations. An oscillator circuit must satisfy the Barkhausen's criterion of unity loop gain to produce oscillations.

Hartley's oscillator is a popular LC Oscillator circuit used at Radio Frequencies.

Design:

Q: Design Hartley's oscillator circuit to provide oscillations at a frequency of 850 KHz. Use BJT BC547 for which β = 200, h_{fe} = 50, h_{ie} = 1.5 KΩ and $V_{BE(active)}$ = 0.65V. The biasing conditions are as follows. V_{CC} = 12V, I_C = 1mA, V_{CE} = 6V and Stability factor is S = 10. Use R_C = 4.7KΩ.

Solution:

Use, $I_C = \beta \times I_B$

$$\Rightarrow I_B = 5\mu A$$

Apply KVL to the output loop:

$$-V_{CC} + I_C \times R_C + V_{CE} + I_C \times R_E = 0$$

$$\Rightarrow R_E = 1.3K\Omega$$

Apply Thevenin's theorem to the base circuit, then

$$V_B = \frac{V_{CC} \times R_2}{R_1 + R_2} \text{ And } R_B = \frac{R_1 \times R_2}{R_1 + R_2}$$

We know that the stability factor for a self bias circuit is given by,

$$S = \frac{1+\beta}{1+\dfrac{\beta \times R_E}{R_B + R_E}}$$

$$\Rightarrow R_B = 12.31K\Omega$$

Apply KVL to the input loop, then

$$-V_B + I_B \times R_B + V_{BE} - I_E \times R_E = 0$$

$$\Rightarrow V_B = 2.01\text{V}$$

Divide R_B with V_B:

$$\Rightarrow R_1 = \frac{V_{CC} \times R_B}{V_B} = 73.5K\Omega$$

Also, $R_B = \dfrac{R_1 \times R_2}{R_1 + R_2}$ $\Rightarrow R_2 = 14.8K\Omega$

We know that $f_o = \dfrac{1}{2\pi\sqrt{(L_1 + L_2 + 2M)C}}$

Assume that $L_1 = L_2 = 70\mu H$ and $M = 45\mu H$. Then $C = 100$ PF.

Circuit diagram:-

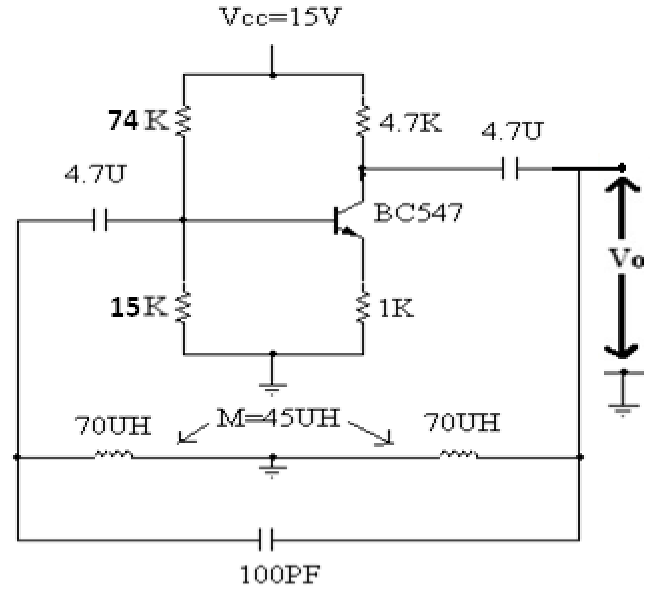


Fig (1): Hartley's Oscillator

Procedure:-

1) Connect the self bias circuit and check the DC conditions.
2) Connect other components of the oscillator circuit as shown in figure. Adjust the capacitance to 800 PF.
3) Observe the output voltage waveform on CRO screen. Note down its peak to peak amplitude and frequency.
4) Vary the capacitance in appropriate steps and record the frequency in each case.
5) Calculate the frequency theoretically also and record it in the table. Compare the theoretical and practical values.

Observations:-

DC conditions:-

V_{BE} = …………….　　　　V_{CE} = ………………

I_B = ………………　　　　I_C = ………………..

Sl. No.	Capacitance (PF)	Frequency (Practically) (MHz)	Frequency $f_o = \frac{1}{2\pi\sqrt{(L_1 + L_2 + 2M)C}}$

Result:-

Hartley oscillator circuit is designed for the given specifications and its operation is studied.

Experiment No. 9

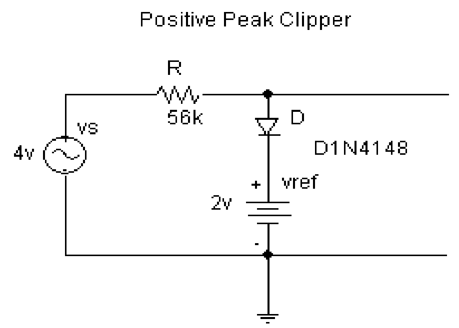
Clippers

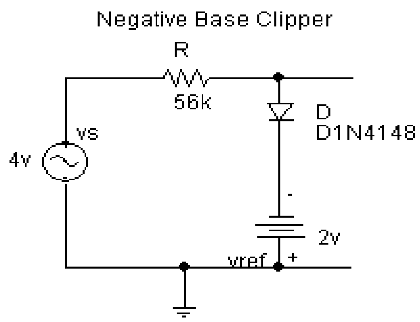
AIM:-TO Study the positive Peak, Positive Base , Negative peak , Negative Base & Double ended Clipper Circuits for Different reference Voltages (0,1v,2v)& Observe the output.

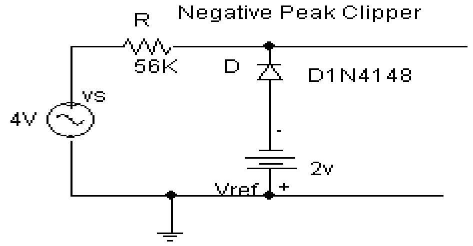
APPARATUS REQUIRED:-

1. Diode -1N4148
2. Resistor -56K
3. DC Regulated Power Supply
4. Signal Generator & CRO

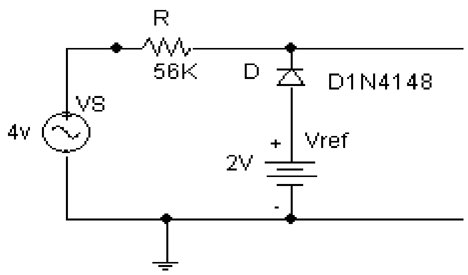
CIRCIUT DIGARAMS:-



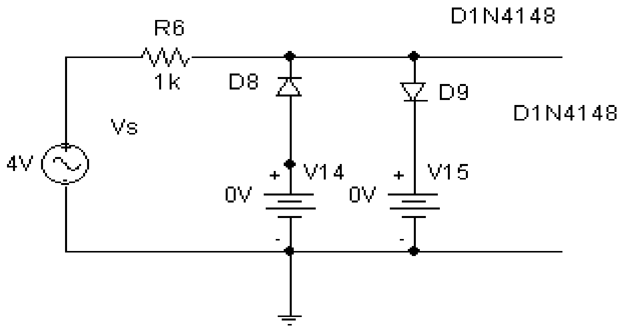




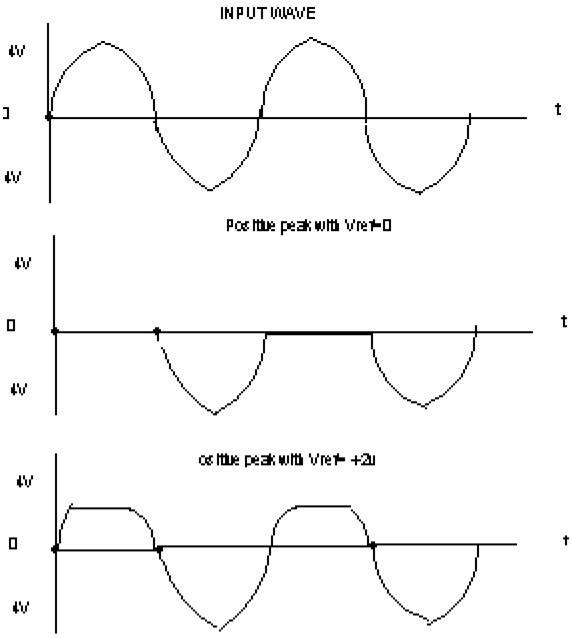
Positive Base Clipper

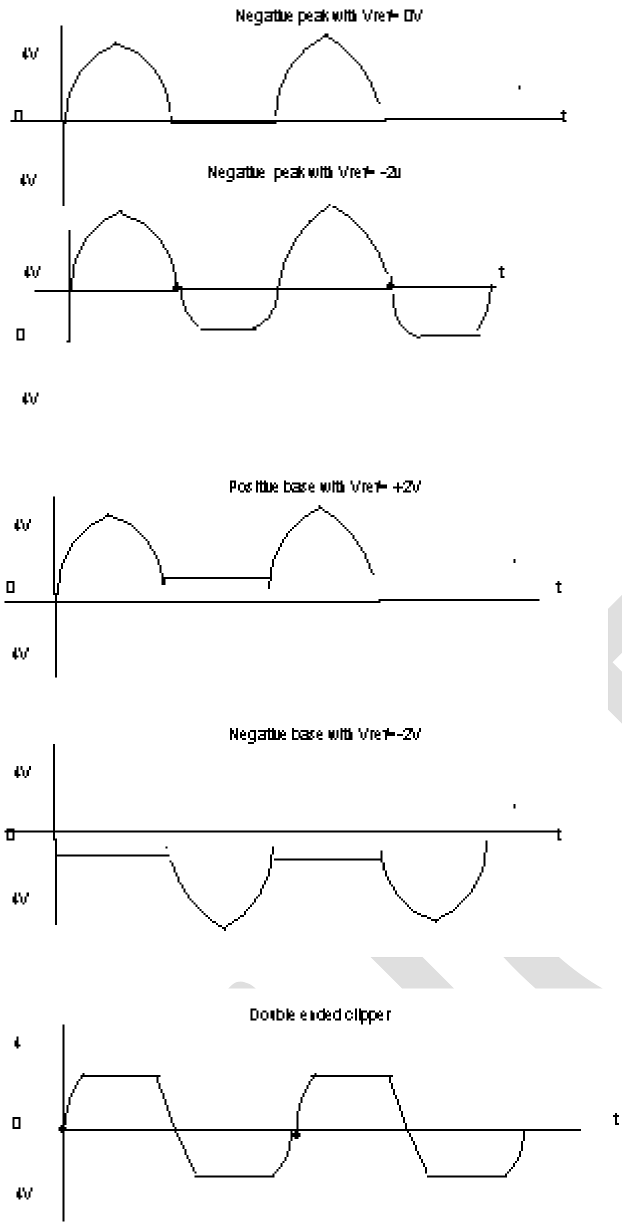


Double ended Clipper



Expected Graphs:-





PROCEDURE:-

1**.** Connect the Circuit as shown in figure.

2. Apply the sinusoidal voltage at input.

3. Adjust the reference voltage at zero volts.

4. Note the same procedure for various reference voltages & for various circuits.

RESULT:- The output of different clipper circuits are observed & Plotted on graph.

Experiment No. 10

Clampers

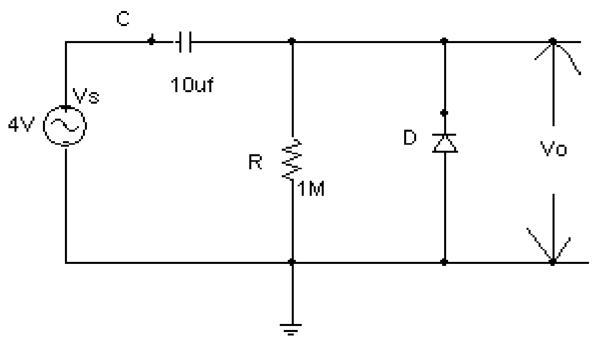
Aim: - To study the response of different clamper circuits for different reference voltage levels.

Apparatus Required:-

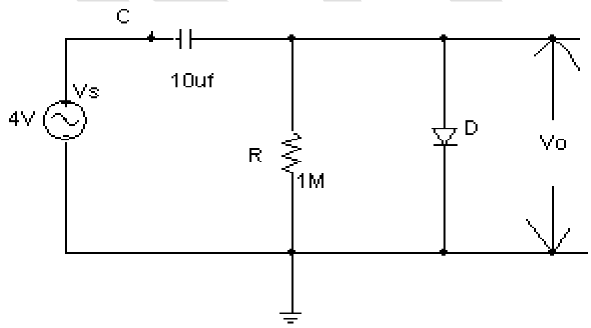
1. Diode -1N4148
2. Resistor-1M
3. Capacitor-10uf
4. DC Regulated power supply
5. Signal generator & CRO.

Circuit Diagrams:-

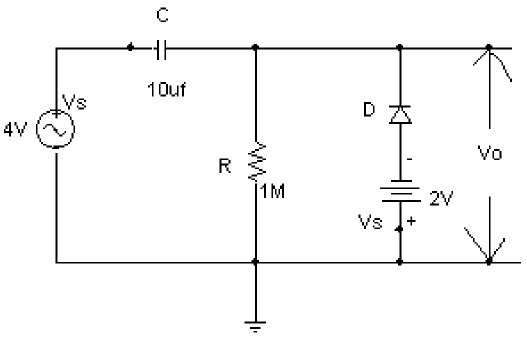
Negative Peak Clamper



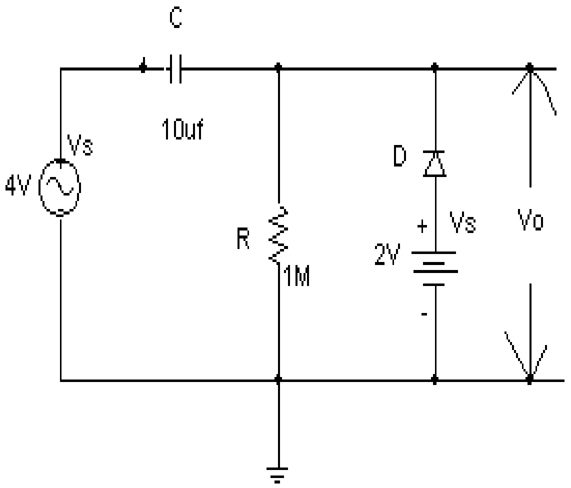
Positive Peak Clamper:-



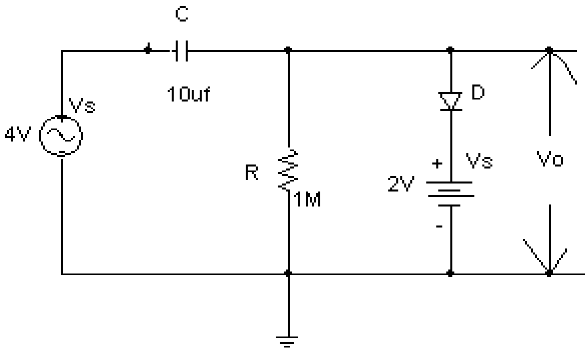
Positive Peak Clamper With Negative Reference Voltage



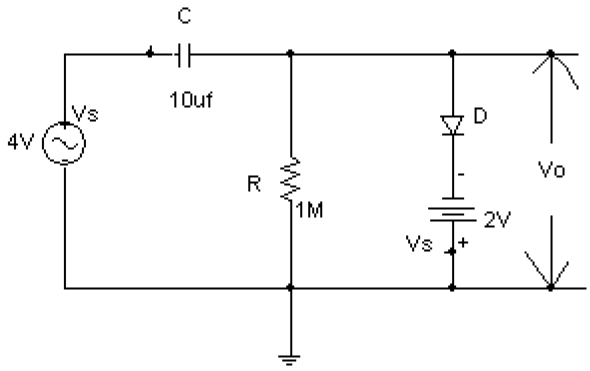
Negative Peak Clamper With Positive Reference Voltage



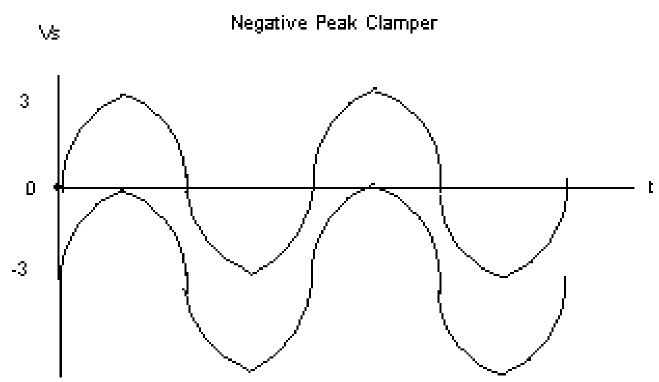
Positive Peak Clamper With Positive Reference Voltage

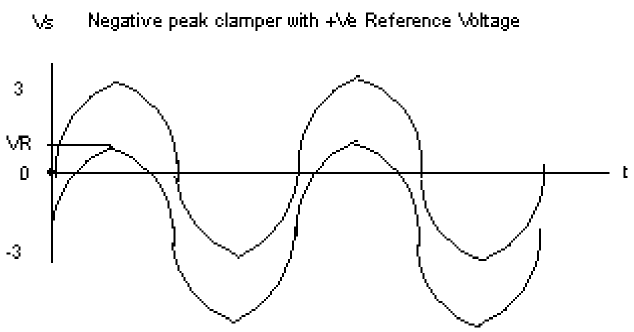


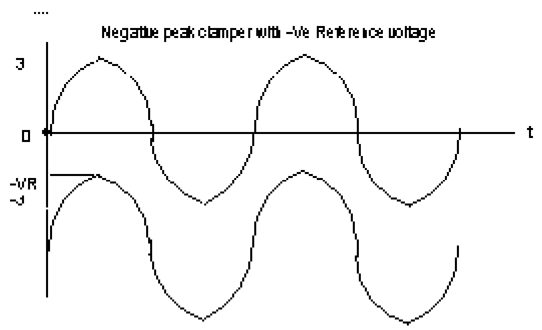
Positive Peak Clamper With Negative reference Voltage

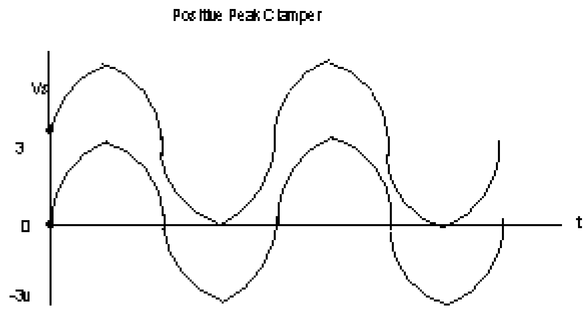


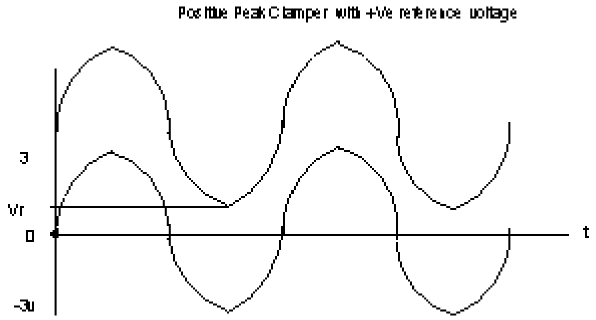
EXPECTED GRAPHS:-

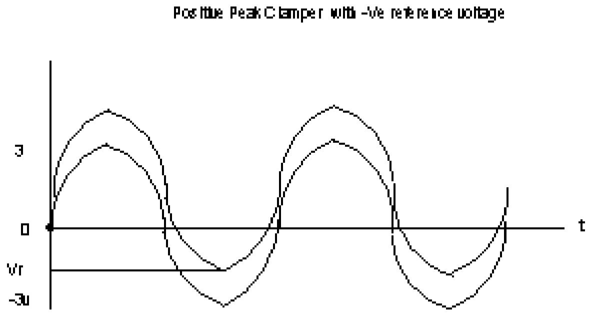












PROCEDURE:-

1.Connect the Circuit as shown in figure.

2. Apply the input signal VS at 1Khz & 10V (P-P) & observe the output.

3. Repeat the same for different circuits & for different voltage levels.

RESULT:- The output of different Clamper circuits are observed & Plotted on graph.

APPENDIX

LABORATORY COURSE ASSESSMENT GUIDELINES

i. The number of experiments in each laboratory course shall be as per the curriculum in the scheme of instructions provided by OU. Mostly the number of experiments is 10 in each laboratory course under semester scheme and 18 under year wise scheme.

ii. The students will maintain a separate note book for observations in each laboratory course.

iii. In each session the students will conduct the allotted experiment and enter the data in the observation table.

iv. The students will then complete the calculations and obtain the results. The course coordinator will certify the result in the same session.

v. The students will submit the record in the next class. The evaluation will be continuous and not cycle-wise or at semester end.

vi. The internal marks of 25 are awarded in the following manner:
   a. Laboratory record - Maximum Marks 15
   b. Test and Viva Voce - Maximum Marks 10

vii. Laboratory Record: Each experimental record is evaluated for a score of 50. **The rubric parameters are as follows:**
   a. Write up format - Maximum Score 15
   b. Experimentation Observations & Calculations - Maximum Score 20
   c. Results and Graphs - Maximum Score 10
   d. Discussion of results - Maximum Score 5

While (a), (c) and (d) are assessed at the time of record submission, (b) is assessed during the session based on the observations and calculations. Hence if a student is absent for an experiment but completes it in another session and subsequently submits the record, it shall be evaluated for a score of 30 and not 50.

viii. The experiment evaluation rubric is therefore as follows:

Parameter	**Max Score**	**Outstanding**	**Accomplished**	**Developing**	**Beginner**	**Points**
Observations and Calculations	20					
Write up format	15					
Results and graphs	10					
Discussion of Results	5					

LABORATORY EXPERIMENT EVALUATION RUBRIC

CATEGORY	OUTSTANDING (Up to 100%)	ACCOMPLISHED (Up to 75%)	DEVELOPING (Up to 50%)	BEGINNER (Up to 25%)
Write up format	Aim, Apparatus, material requirement, theoretical basis, procedure of experiment, sketch of the experimental setup etc. is demarcated and presented in clearly labeled and neatly organized sections.	The write up follows the specified format but a couple of the specified parameters are missing.	The report follows the specified format but a few of the formats are missing and the experimental sketch is not included in the report	The write up does not follow the specified format and the presentation is shabby.
Observations and Calculations	The experimental observations and calculations are recorded in neatly prepared table with correct units and significant figures. One sample calculation is explained by substitution of values	The experimental observations and calculations are recorded in neatly prepared table with correct units and significant figures but sample calculation is not shown	The experimental observations and calculations are recorded neatly but correct units and significant figures are not used. Sample calculation is also not shown	The experimental observations and results are recorded carelessly. Correct units significant figures are not followed and sample calculations not shown
Results and Graphs	Results obtained are correct within reasonable limits. Graphs are drawn neatly with labeling of the axes. Relevant calculations are performed from the graphs. Equations are obtained by regression analysis or curve fitting if relevant	Results obtained are correct within reasonable limits. Graphs are drawn neatly with labeling of the axes. Relevant calculations from the graphs are incomplete and equations are not obtained by regression analysis or curve fitting	Results obtained are correct within reasonable limits. Graphs are not drawn neatly and or labeling is not proper. No calculations are done from the graphs and equations are not obtained by regression analysis or curve fitting	Results obtained are not correct within reasonable limits. Graphs are not drawn neatly and or labeling is not proper. No calculations are done from the graphs and equations are not obtained by regression analysis or curve fitting
Discussion of results	All relevant points of the result are discussed and justified in light of theoretical expectations. Reasons for divergent results are identified and corrective measures discussed.	Results are discussed but no theoretical reference is mentioned. Divergent results are identified but no satisfactory reasoning is given for the same.	Discussion of results is incomplete and divergent results are not identified.	Neither relevant points of the results are discussed nor divergent results identified

ix. The first page of the record will contain the following title sheet:

SAMPLE ASSESSMENT SHEET

NAME: **ROLL NO.**

Exp. No.	Date conducted	Date Submitted	Observations &Calculations (Max 20)	Write up (Max 15)	Results and Graphs (Max 10)	Discussion of Results (Max 5)	Total Score (Max 50)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

x. The 15 marks of laboratory record will be scaled down from the TOTAL of the assessment sheet.

xi. The test and viva voce will be scored for 10 marks as follows:

Internal Test - 6 marks

Viva Voce / Quiz - 4 marks

xii. Each laboratory course shall have 5 course outcomes.

The proposed course outcomes are as follows:

On successful completion of the course, the student will acquire the ability to:

1. Conduct experiments, take measurements and analyze the data through hands-on experience in order to demonstrate understanding of the theoretical concepts of ________________________, while working in small groups.

2. Demonstrate writing skills through clear laboratory reports.

3. Employ graphics packages for drawing of graphs and use computational software for statistical analysis of data.

4. Compare the experimental results with those introduced in lecture, draw relevant conclusions and substantiate them satisfactorily.

5. Transfer group experience to individual performance of experiments and demonstrate effective oral communication skills.

xiii. The Course coordinators would prepare the assessment matrix in accordance with the guidelines provided above for the five course outcomes. The scores to be entered against each of the course outcome would be the sum of the following as obtained from the assessment sheet in the record:

a. Course Outcome 1: Sum of the scores under ‘Observations and Calculations’.
b. Course Outcome 2: Sum of the scores under ‘Write up’.
c. Course Outcome 3: Sum of the scores under ‘Results and Graphs’.
d. Course Outcome 4: Sum of the scores under ‘Discussion of Results’.
e. Course Outcome 5: Marks for ‘Internal Test and Viva voce’.

xiv. Soft copy of the assessment matrix would be provided to the course coordinators.

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY

Program Outcomes of B.E (ECE) Program:

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, research literature, and analyse 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 the 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.

PO 12: Life-long learning: Recognise 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) of ECE Department, MJCET

PSO1: The ECE Graduates will acquire state of art analysis and design skills in the areas of digital and analog VLSI Design using modern CAD tools.

PSO2: The ECE Graduates will develop preliminary skills and capabilities necessary for embedded system design and demonstrate understanding of its societal impact.

PSO3: The ECE Graduates will obtain the knowledge of the working principles of modern communication systems and be able to develop simulation models of components of a communication system.

PSO4: The ECE Graduates will develop soft skills, aptitude and programming skills to be employable in IT sector.