Analog Electronics Circuits Laboratory Manual
(EEE-228)
(II/IV EEE II SEM)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (A)
(Affiliated to AU, Approved by AICTE & Accredited by NBA) Sangivalasa-531 162,Visakhapatnam District, Phone: 08933-225083/84/87

Vision of the Institute

ANITS envisions to emerge as a world-class technical institution whose products represent a good blend of technological excellence and the best of human values.

Mission of the Institute

To train young men and women into competent and confident engineers with excellent communication skills, to face the challenges of future technology changes, by imparting holistic technical education using the best of infrastructure, outstanding technical and teaching expertise and an exemplary work culture, besides molding them into good citizens

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision of the Department

To become a centre of excellence in Education, research and produce high quality engineers in the field of Electronics and Communication Engineering to face the challenges of future technological changes.

Mission of the Department

1) To achieve vision department will
2) Transform students into valuable resources for industry and society by imparting contemporary technical education.
3) Develop interpersonal skills and leadership qualities among students by creating an ambience of academic integrity to participate in various professional activities
4) Create a suitable academic environment to promote research attitude among students.

Program Educational Objectives (PEOs):

PEO1 : Graduates excel in their career in the domains of Electronics, Communication and Information Technology.

PEO2 : Graduates will practice professional ethics and excel in professional career through interpersonal skills and leadership qualities.

PEO3 : Graduates demonstrate passion for competence in higher education, research and participate in various professional activities.

Program Outcomes (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.

11. **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.
12. **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):

PSO1 : Implement Signal & Image Processing techniques using modern tools.

PSO2 : Design and analyze Communication systems using emerging techniques.

PSO3 : Solve real time problems with expertise in Embedded Systems.

ANALOG ELECTRONIC CIRCUITS LABORATORY	
EEE-228	**Credits:2**
Instruction: 3 Practicals/week	Sessional Marks:50M
End Exam: 3hrs	End Exam Marks:50M

Course outcomes:
At the end of the course, students will be able to

CO1:	Design amplifier circuits using BJTs in different configurations and determine f_L and f_H from the frequency response characteristics.
CO2:	Design multistage amplifier circuits using BJTs and determine f_L and f_H from the frequency response characteristics.
CO3:	Analyze and Design feedback amplifiers.
CO4:	Analyze and Design tuned voltage amplifiers to determine the resonance frequency .
CO5:	Analyze and Design sinusoidal oscillator circuits.

CO-PO Mapping:

Mapping of course outcomes with program outcomes & program specific outcomes:

	PO1	PO2	PO3	PO4	PO8	PO9	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	1	0	0	0	2
CO2	2	2	2	2	1	1	1	0	0	0	2
CO3	2	2	2	2	1	1	1	0	0	0	2
CO4	2	2	2	2	1	1	1	0	0	0	2
CO5	2	2	2	2	1	1	1	0	0	0	2

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Scheme of Evaluation

(ANALOG ELECTRONIC CIRCUITS LABORATORY)

Total marks for each student to evaluate in lab: 100 marks
Out of 100 marks:

External exam Evaluation: 50 marks

Internal Evaluation marks: 50 marks

Internal Marks (50M):

Internal lab Exam	:25M
Continuous evaluation	:25 M

Distribution of Continuous evaluation marks:

a) Viva on every lab session	: 5M
b)Observation with final results	: 5M
c) Record	: 10M
d) Attendance	: 5M

Distribution of Record Marks (20M): (scaled to 10M)

a) Aim and apparatus	: 3M
b) Circuit diagrams	: 2M
c) Theory	: 4M
d) Tabular from & calculations	: 4M
e) Procedure with theoretical calculations	: 4M
f) Graph	: 2M
g) Result/Conclusion	: 1M

Internal / External Lab Marks division:

Internal Exam (25 M)		**External Exam (50 M)**	
Write Up	: 10M	Write Up	:10M
Execution/Performance	: 10M	Execution	:20M
Graphs & Result	: 5M	Graphs & Result	:10M
Viva	: 5M	Viva	:10M

LIST OF MAJOR EQUIPMENT IN EDC-II/AEC LABORATORY

SL.No	NAME OF THE EQUIPMENT	MAKE	QUANTITY
1.	20 MHz DUAL TRACE OSCILLOSCOPE	AP LAB /SCIENTIFIC	16
2.	1 MHz FUNCTION GENERATOR WITH DIGITAL DISPLAY	AP LAB/ PACIFIC	14
3.	TRPS 0-30V, 2A DUAL CHANNEL	ITL/PACIFIC /FALCON	16
4.	DC MICRO & MILLI AMMETERS	MECO/HI- Q/AQUILA	47
5.	DC MICRO VOLTMETER	MECO/HI- Q/AQUILA	13
6.	BENCH TOP DIGITAL MULTIMETER	METRAVI/ MECO	15
7.	5KVA SERVO CONTROLLED STABILIZER	HI- Q	01

TOTAL EXPENDITURE OF THE LABORATORY (including consumables): Rs. 13,78,942.41/-

RUBRICS
(ANALOG ELECTRONIC CIRCUITS LABORATORY)

S.No	Competency	Performance Indicator
1.	Demonstrate an ability to conduct experiments consistent with their level of knowledge and understanding.	Laboratory preparation & finding the appropriate values of the components to meet the specifications (verification of Lab observation)
		Stating clearly the aim of the experiment, its scope and importance for purpose of doing experiment & Oral Presentation (Based on viva)
2.	Demonstrate an ability to design experiments to get the desired output.	Experimental procedures & ability to construct the circuit diagram on a bread board and use meters/ instruments to record the measured data according to the range selected (Based on physical observation)
3.	Demonstrate an ability to analyze the data and reach valid conclusions.	Presentation of record & Conclusions of the lab experiment performed. (Based on Lab record)

S.No	Performance Indicator	Excellent (A) 100%	Good(B)80%	Need improvement (C) 60%	Fail (D) <40%
1.	Laboratory preparation & ability to construct the circuit diagram on a bread board and use meters/ instruments to record the measured data according to the range selected (Based on physica lobservation) (5M)	Read and understand the lab manual before coming to lab. Observations are completed with necessary theoretical calculations including the use of units and significant figures & Obtain the correct values of the components after calculations. Follow the given experimental procedures, to obtain the desired output.	Observations are completed with necessary theoretical Calculations but With-out proper understanding & Obtain the correct values for only few components after calculations. Follow the given experimental procedures, but obtained results with some errors.	Observation s are incomplete &Obtain the incorrect values for components. Lacks the appropriate knowledge of the lab procedures. Has noidea what to do	No effort exhibited
2.	Stating clearly the aim of the experiment, its scope and importance for purpose of doing experiment & Oral Presentation (Based on viva)(5M)	Clearly describes the purpose of doing experiment and its scope. Responds confidently, and precisely in giving answers to questions correctly	Clearly describes the purpose of doing experiment. Responds in giving answers to questions but some answers are wrong.	Some idea of doing experiment but not very clear & responds in giving answers to questions but all answers are wrong.	No effort exhibited
3.	Presentation of record & Conclusions of the lab experiment performed. (Based on Lab record)(10M)	Well-organized, interesting, confident presentation of record & able to correlate the theoretical concepts with the concerned lab results with appropriate reasons.	Presentation of record acceptable	Presentation of record lacks clarity and organized	No effort exhibited

About AEC Lab

The objective of this lab is to give students hands-on practice on obtaining parameters of different amplifiers, finding its frequency response; designing & analyzing oscillators and also study the characteristics of OP-AMP by measuring various parameters. With this knowledge, students will be able to do mini-projects with the help of amplifiers and Oscillators.

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EDC-II Laboratory

Do's

1. Be punctual and regular to the laboratory.
2. Maintain Discipline all the time and obey the instructions.
3. Check the connections properly before turning ON the circuit.
4. Turn OFF the circuit immediately if you see any component heating.
5. Dismount all the components and wires before returning the kit.
6. Any failure / break-down of equipment must be reported to the faculty

Don'ts

1. Don't touch live electric wires.
2. Don't turn ON the circuit unless it is completed.
3. Avoid making loose connections.
4. Don't leave the lab without permission.
5. Do not handle any equipment without reading the instructions/Instruction manuals

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ANALOG ELECTRONIC CIRCUITS LABARATORY

LIST OF EXPERIMENTS

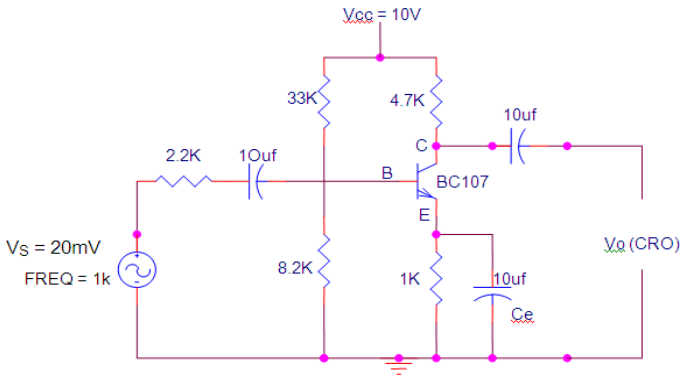
1. FREQUENCY RESPONSE OF CE AMPLIFIER

AIM: 1. To obtain the Frequency response characteristics of Common emitter amplifier and to determine the Bandwidth.

APPARATUS:

S.No	Apparatus	Type	Range	Quantity
01	Transistor	BC107		01
02	Resistance		33KΩ,4.7 KΩ,2.2 KΩ 8.2 KΩ,1 KΩ	01
03	Regulated Power supply		(0-30V)	01
04	Capacitor		10μF	03
05	Signal Generator		10-1M Hz	01
06	CRO			01
07	Breadboard and Wires ,CRO Probes			

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. A 10V supply is given to the circuit.
3. A certain amplitude of input signal (say 20mv at 1 kHz) is kept constant using signal generator and for different frequencies, the output voltage (V_0) from CRO are noted.

Gain for with and without feedback is calculated using Gain (in dB)= $20 \log (V_0/V_i)$

Where V_o is output voltage, V_i is input voltage.

4. Plot the graph between Gain (in dB) and frequency.

TABULAR COLUMN:

S.no.	Input frequency (Hz)	o/p voltage(v_o) (mv)	voltage gain $Av=\frac{V_0}{V_i}$	$Gain(dB) = 20\log\frac{V_0}{V_i}$
	100Hz To 1MHz			

MODEL GRAPH:

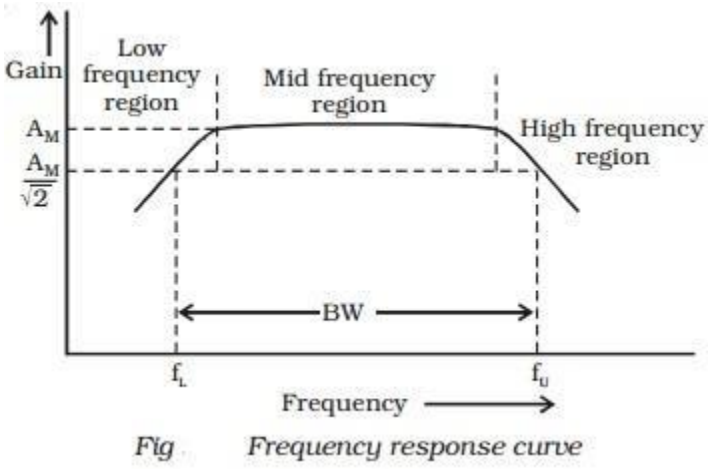
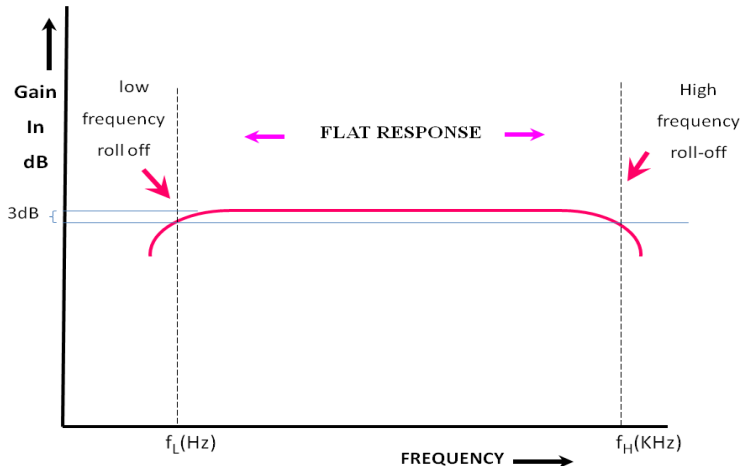


Fig Frequency response curve

Caluculations from Graph:

1. Draw a line at maximum gain(dB) less than by 3dB parallel to the X-axis as shown in the figure
2. Draw two lines at the intersection of the characteristic curve and the 3dB line onto the X-axis which gives the (f_H) and (f_L)
3. The difference between f_H and f_L gives the Bandwidth of the amplifier.



PRECAUTIONS:

1. While doing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.
2. Do not switch **ON** the power supply unless you have checked the circuit connections as per the circuit diagram.
3. Make sure while selecting the emitter, base and collector terminals of the transistor.

RESULT: The Frequency response characteristics of Common emitter amplifier are obtained andthe graph was plotted. From the graph, the Bandwidth was obtained as __.

VIVA QUESTIONS:

1. What is an amplifier?
2. What is the need for an amplifier circuit?
3. Explain the effect of capacitors on frequency response?
4. How do you classify amplifiers?
5. What is the relation between bandwidth and gain?
6. What do you mean by frequency response of an amplifier?
7. What are gain, Bandwidth, lower cutoff frequency and upper cutoff frequency?
8. Why a 3db point is taken to calculate Bandwidth?
9. What are the merits of an CE amplifier circuit?
10. What is semi-log graph sheet? Why it is used to plot frequency response?

2. **TWO STAGE R-C COUPLED AMPLIFIER**

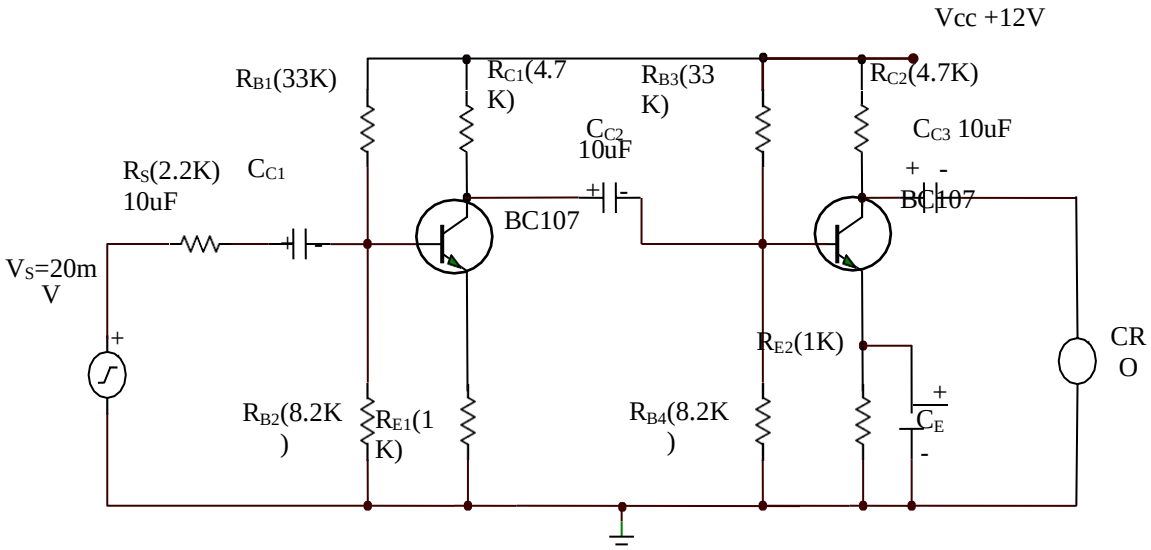
AIM:

1. To observe the frequency response of RC coupled amplifier and to find the bandwidth of the amplifier.
2. To observe that the total voltage gain is equal to the product of the individual gains.

APPARATUS:

Power supply	0-30V	1No.
CRO	20MHz	1No.
Signal generator	1-1MHz	1 No
Resistors	1kΩ, 4.7k, 8.2k, 33k	2
	No2.2k	1 No
Capacitors	10µF	3 No
	100µF	1 No
Transistors	BC107	2 No

CIRCUIT DIAGRAM:



TWO STAGE RC COUPLED AMPLIFIER

PROCEDU RE:

1. Connect the circuit as shown in the figure**.**
2. A 10V supply is given to the circuit and a certain amplitude of input signal is keptconstant using signal generator.
3. Measure the output voltage (say V_{o2})and also output voltage at the output of 1st stage (say V_{o1}) from CRO.
4. Calculate total voltage gain and also individual voltage gain.
5. Now, by varying the input frequency note the output voltages from CRO and calculate the gain.

TABULAR FORM: V_{in}=

INPUT FREQUENCY(Hz)	O/P Voltage(Vo)(V)	Voltage gain AV=Vo/Vi	Gain in dB =20 log AV
100 To 1M			

Model Graph:

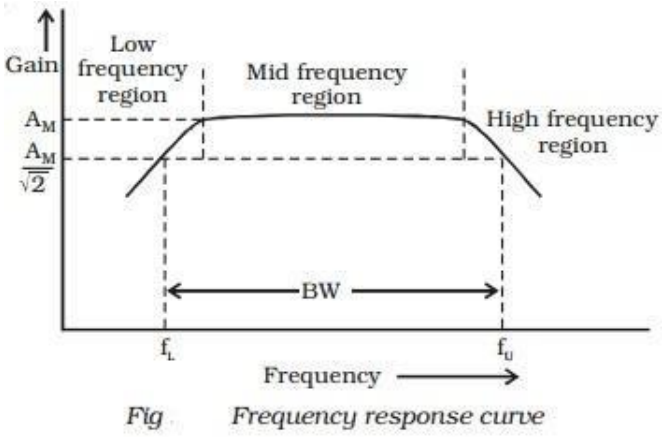


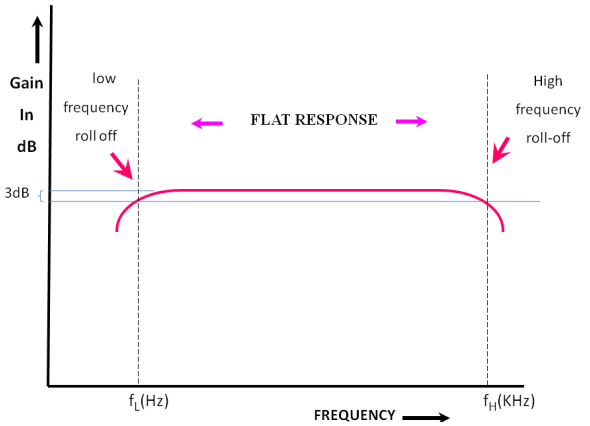
Fig Frequency response curve

Calculations from Graph

1.Draw a line at maximum gain(dB) less than by 3dB parallel to the X-axis as shown in the figure

2.Draw two lines at the intersection of the characteristic curve and the 3dB line onto the X-axis which gives the (f_H) and (f_L)

3. The difference between f_H and f_L gives the Bandwidth of the amplifier.



OBSERVATIONS:

I/P Voltage V_{in} =

O/P Voltage V_{o2}

=O/P Voltage

V_{o1}=

1st Stage voltage gain= $\frac{Vo1}{Vin}$

2nd Stage voltage gain $\frac{Vo2}{Vo1}$

Overall voltage gain $\frac{Vo2}{Vin}$ =

Bandwidth = $f_h - f_l$ =

GRAPH:

A graph is plotted between gain (dB) and frequency (Hz) for both with and without feedback.

PRECAUTIONS :

1. Connections must be made with proper polarity.
2. Avoid loose and wrong connections.

RESULT: The frequency response of RC coupled amplifier was obtained and the graph wasplotted. From the graph, the bandwidth of the amplifier was obtained as __.
The total voltage gain is equal to the product of the individual gains was obtained.

VIVA QUESTIONS:

1. What are half power points in the frequency response of an amplifier?
2. What is the effect of coupling capacitor on output of amplifier?
3. Define cascading of amplifier
4. What are the advantages of RC coupled amplifier?

3.FREQUENCY RESPONSE OF COMMON SOURCE FET AMPLIFIER

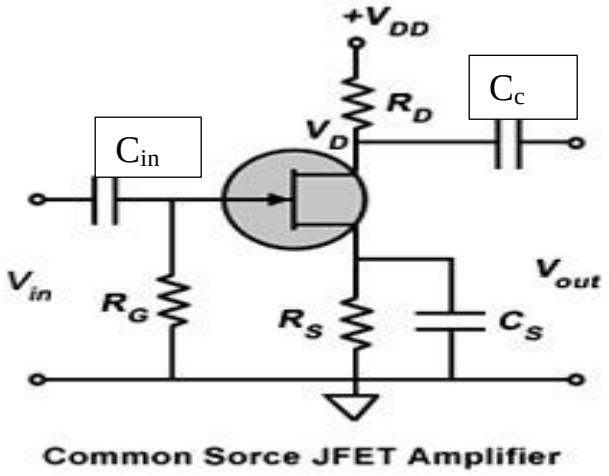
AIM:

1. To obtain the Frequency response characteristics of Common Source FET amplifier.
2. To determine the Bandwidth.

APPARATUS:

S.No	Apparatus	Type	Range	Quantity
01	N-Channel FET	BFW10		01
02	Resistance		(6.8KΩ, 1MΩ, 1.5KΩ)	01
03	Regulated Power supply		(0-30V)	01
06	Capacitor		(0.1µF, 0.1µF, 47µF)	01
07	Signal Generator		10-1M Hz	01
08	CRO			01
09	Breadboard and Wires ,CRO Probes			

CIRCUIT DIAGRAM:



Common Sorce JFET Amplifier

C_s=47µF, C_{in} =C_c= 0.1µF, R_G= 1MΩ R_D= 1.5KΩ R_S=6.8KΩ, V_{DD}=12V

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. A 10V supply is given to the circuit.
3. A certain amplitude of input signal (say 20mv at 1 kHz) is kept constant using signal generator and for different frequencies, the output voltage (V_0) is taken at Drain from CRO .
4. Gain of the amplifier is calculated using $Gain(dB) = 20 \log \frac{V_0}{V_i}$ Where V_0 is output voltage,

V_i o

V_i is input voltage.

5. Plot the graph between Gain in dB and frequency.

TA**BULAR COLUMN:** **V_{in}=**

S.no.	Input frequency (Hz)	O/p voltage(V_O)(mv)	voltage gain Av=$\frac{V_0}{V_i}$	$Gain(dB) = 20 \log \frac{V_0}{V_i}$
	10Hz To 1MHz			

Model Graph

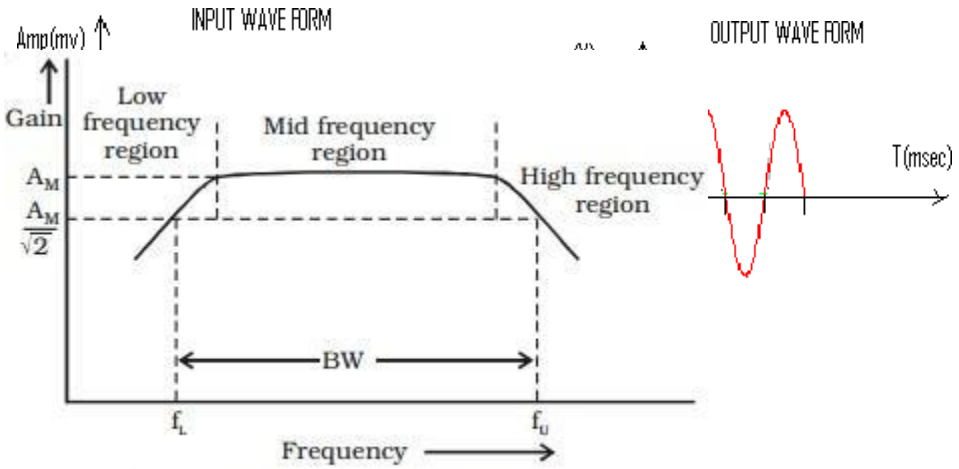


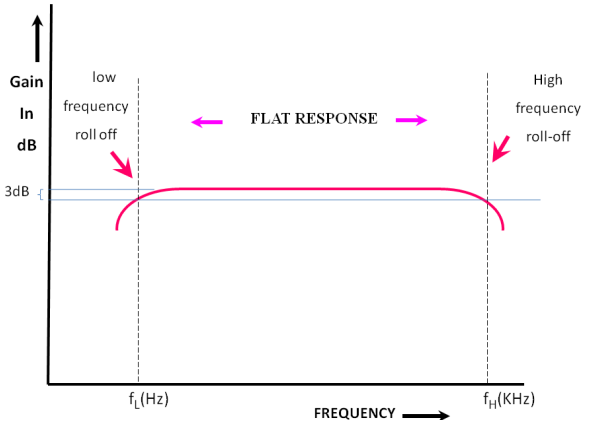
Fig Frequency response curve

Calculations from Graph

1.Draw a line at maximum gain(dB) less than by 3dB parallel to the X-axis as shown in the figure

2.Draw two lines at the intersection of the characteristic curve and the 3dB line onto the X-axis which gives the (f_H) and (f_L)

3.The difference between f_H and f_L gives the Bandwidth of the amplifier.



PRECAUTIONS:

1. While doing the experiment do not exceed the ratings of the transistor. This may lead to damage of the transistor.
2. Do not switch **ON** the power supply unless you have checked the circuit connections as per the circuit diagram.
3. Transistor terminals must be identified properly.

RESULT: The Frequency response characteristics of Common Source FET amplifier were obtained and the graph was plotted. From the graph, the bandwidth was obtained as ___.

VIVA QUESTIONS:

1. What is an amplifier?
2. Explain the effect of capacitors on frequency response?
3. Why gain is constant in mid frequency region?
4. What is bandwidth?
5. What is the relation between bandwidth and gain?
6. How do you test a diode, transistor, FET?
7. How do you identify the terminals of Diode, Transistor& FET?
8. Define FET parameters and write the relation between them.
9. Explain the construction and working of FET\
10. What are the merits of an FET amplifier circuit?

4. PARAMETERS CALCULATION OF A CURRENT SERIES FEEDBACK AMPLIFIER

AIM: To calculate the input impedance, output impedance and voltage gain of current series feedback amplifier with and without feedback.

APPARATUS:

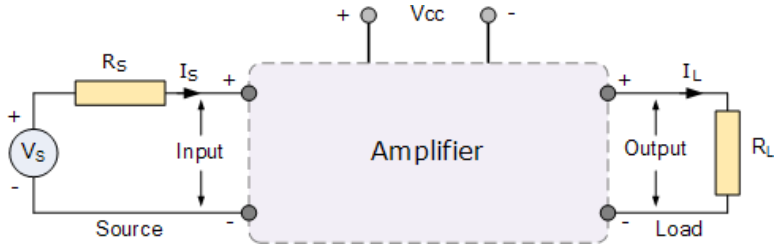
Power supply	0-30V	1No.
CRO	20MHz	1No.
Signal generator	1-1MHz	1 No
Resistors	1kΩ, 4.7k, 8.2k	1 No
	2.2k,33k,10K	1 No
Capacitors	10µF	3 No
Transistors	BC107	1 No
Bread board		
CRO Probes		

THEORY:

An amplifiers impedance value is particularly important for analysis especially when cascading individual amplifier stages together one after another to minimize distortion of the signal.

The input impedance of an amplifier is the input impedance "seen" by the source driving the input of the amplifier. If it is too low, it can have an adverse loading effect on the previous stage and possibly affecting the frequency response and output signal level of that stage. But in most applications, common emitter and common collector amplifier circuits generally have high input impedances.

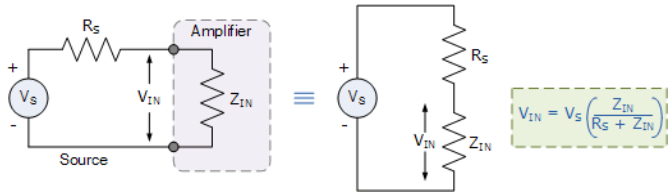
Output and Input Impedance Model



Where, VS is the signal voltage, RS is the internal resistance of the signal source, and RLis the load resistance connected across the output. We can expand this idea further by looking at how the amplifier is connected to the source and load.

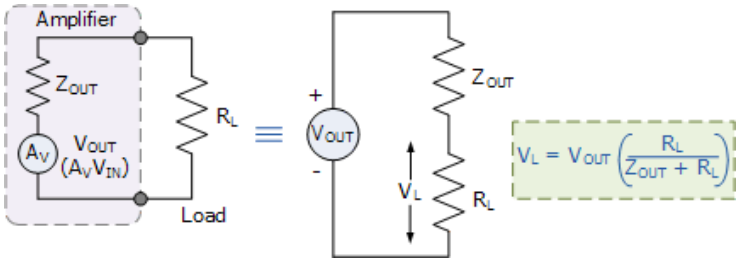
When an amplifier is connected to a signal source, the source "sees" the input impedance, Zin of the amplifier as a load. Likewise, the input voltage, Vin is what the amplifier sees across the input impedance, Zin. Then the amplifiers input can be modelled as a simple voltage divider circuit as shown.

Amplifier Input Circuit Model



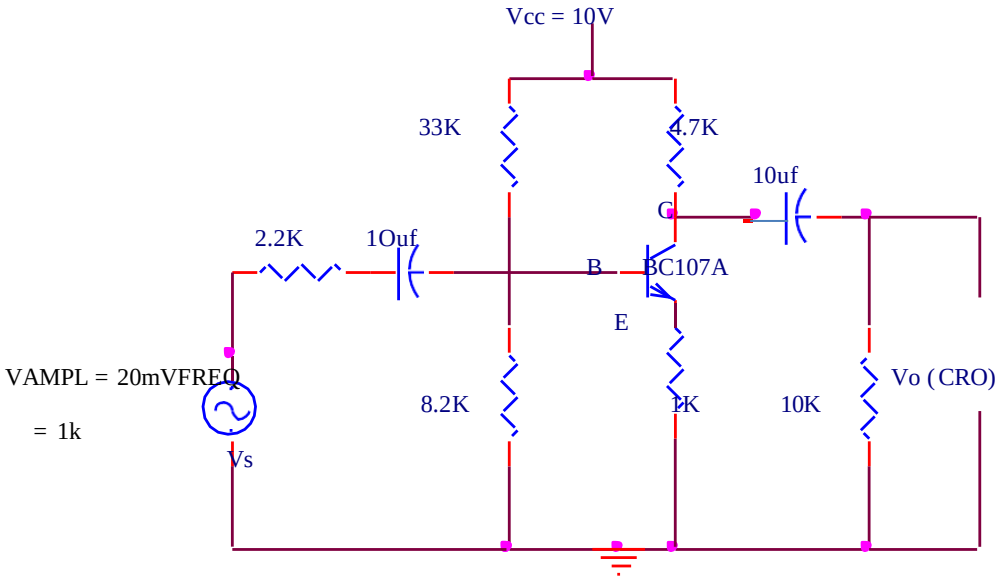
The same idea applies for the output impedance of the amplifier. When a load resistance, RL is connected to the output of the amplifier, the amplifier becomes the source feeding the load. Therefore, the output voltage and impedance automatically becomes the source voltage and source impedance for the load as shown.

Amplifier Output Circuit Model

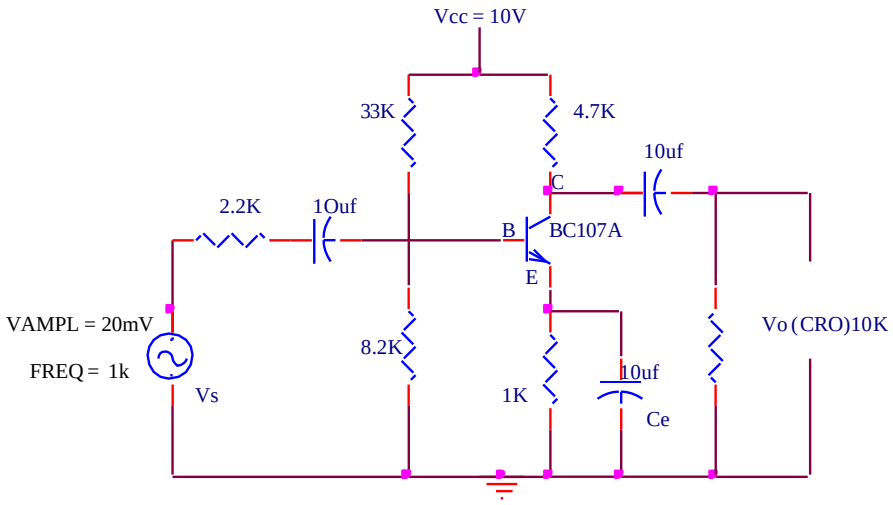


Then we can see that the input and output characteristics of an amplifier can both be modelled as a simple voltage divider network. The amplifier itself can be connected inCommon Emitter (emitter grounded), Common Collector (emitter follower) or inCommon Base configurations. In this tutorial we will look at the bipolar transistor connected in a common emitter configuration seen previously.

CIRCUIT DIAGRAMS:-



CURRENT SERIES AMPLIFIER WITH FEEDBACK



CURRENT SERIES AMPLIFIER WITHOUT FEEDBACK

Theoretical Calculations:

Calculation of h_{ie}= h_{fe}x r_e

h_{fe}= using multimeter calculate hfe value for the given transistor

r_e= 26mV/I_E

I_E=V_E/R_E(calculate drop across R_E using multimeter for DC bias circuit)

Input impedancae without Feedback:

$$Z_{IN} = R_1 \,//\, R_2 \,//\, h_{ie}$$

Output impedancae without Feedback:

$$Z_O = R_C \,//\, R_L$$

Voltage gain without feedback:

$$A_V = -hfe\frac{Z_O}{Z_{IN}}$$

Input impedancae with Feedback:

$$Z_{IN} = R_1 \,//\, R_2 \,//\, (h_{ie} + (1 + hfe)R_e)$$

Output impedancae with Feedback:

$$Z_O = R_C \,//\, R_L$$

Voltage gain with feedback:

$$A_V = -hfe\frac{Z_O}{Z_{IN}}$$

Practical Observations (with and without feedback):

1. Vs =_____V (using CRO)
2. Vin =_____V (using CRO)
3. V_L=_____V (using CRO / multimeter)
4. V_{NL}=_____V (using CRO / multimeter)

Calculate:

Without feedback:	**With feedback :**
$Z_{IN} = Rs \left[\frac{V_{IN}}{V_S - V_{IN}}\right] =$	$Z_{INf} = Rs \left[\frac{V_{IN}}{V_S - V_{IN}}\right] =$
$Z_O = R_L \left[\frac{V_{NL} - V_L}{V_L}\right] =$	$Z_{Of} = R_L \left[\frac{V_{NL} - V_L}{V_L}\right] =$
$A_V = \frac{V_L}{V_{IN}} =$	$A_{Vf} = \frac{V_L}{V_{IN}} =$

PROCEDURE:

1. Connections are made as per the circuit diagram. Without input source, Ce and load i.e in DC bias
2. A 10V DC supply is given to the circuit for biasing
3. Calculate emitter voltage across Re and find emitter current Ie
4. Circuit is connected as per circuit diagram without feedback i.e., without Ce.
5. A certain amplitude of input signal (say 20mV) is kept constant using the function at a constant frequency of 1KHz
6. Note down the V_{IN} ,V_L , V_{NL} using multimeter
7. Now the Circuit is connected as per circuit diagram with feedback i.e keeping Ce
8. Note down the V_{IN} ,V_L , V_{NL} using multimeter
9. Calculate input impedance Z_{IN} ,output impedance Z_O ,and voltage gain A_V and compare with theoretical values.

PRECAUTIONS:

1. Avoid loose and wrong connections.
2. Avoid parallax error while taking readings.

RESULT: The input impedance Z_{IN}, output impedance Z_O and voltage gain A_V with & without feedback are calculated and compared with the theoretical values.

VIVA QUESTIONS:

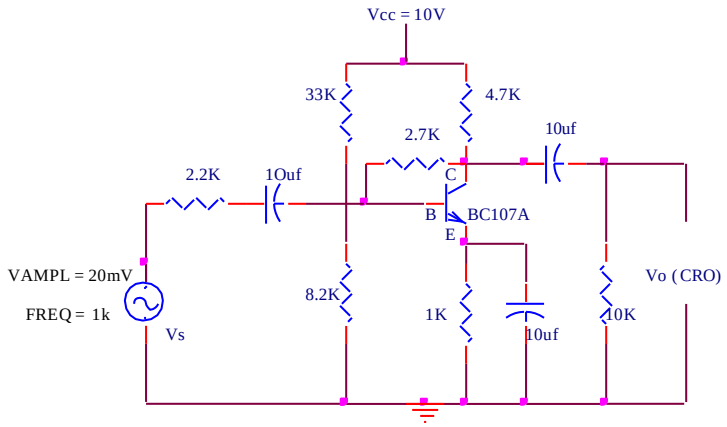
1. What is the relationship between the transfer gain with feedback A_f and that withoutfeedback
2. What are the advantages of negative feedback?
3. How is the i/p impedance and o/p impedance of a voltage shunt feedback amplifier
4. What are the types of feedback amplifiers?

5. FREQUENCY RESPONSE OF VOLTAGE SHUNT FEEDBACK AMPLIFIER

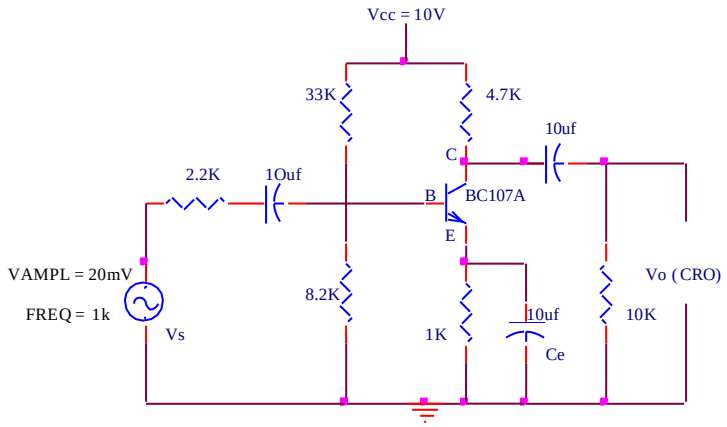
AIM: To obtain the frequency response characteristics of a Voltage shunt amplifier with and without feedback and determine the upper and lower cut off frequencies.

APPARATUS:
1. Transistor BC 107
2. Resistors – 33KΩ (1), 4.7KΩ (1), 2.2KΩ (1), 8.2KΩ (1), 1KΩ (1), 2.7KΩ (1) and 10KΩ (1),
3. Capacitors – 10μf (3),
4. Signal Generator,
5. Regulated Power Supply,
6. Bread Board with connecting wires,
7. CRO with probes.

CIRCUIT DIAGRAMS:



VOLTAGE SHUNT AMPLIFIER WITH FEEDBACK



VOLTAGE SHUNT AMPLIFIER WITHOUT FEEDBACK

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. A 10V DC supply is given to the circuit for biasing.
3. The circuit is connected without feedback i.e., without R_F
4. At certain amplitude of input signal (say 20mV at 1 kHz) is kept constant using the function generator and for Different Frequencies the output voltage from CRO is noted.
5. Now, the circuit is connected with feedback i.e., with R_F.
6. By keeping the input signal constant the output voltages for different frequencies are noted from CRO.
7. Gain with and without feedback is calculated from the Formula

Gain = 20 log Vo / Vi (dB)

Where V_O is output voltage, V_I is input voltage.

TABULAR FORM:

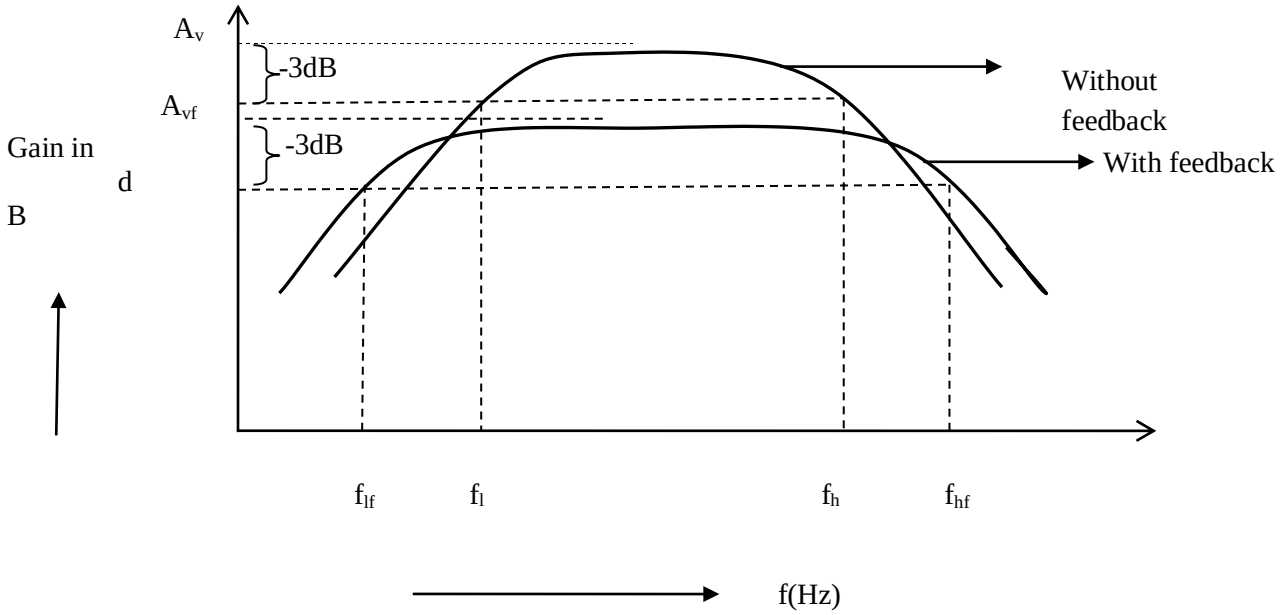
WITH FEEDBACK: **I/P VOLTAGE V_i = 20mV =0.02V**

S.NO.	FREQUENCY (Hz)	O/P VOLTAGE (Vo)	Gain in dB = 20 log Vo / Vi
	100H **zTO** **1MHz**		

WITHOUT FEEDBACK: **I/P VOLTAGE V_i = 20mV =0.02V**

S.NO.	FREQUENCY (Hz)	O/P VOLTAGE (Vo)	Gain in dB = 20 log Vo / Vi
	100Hz **TO** **1MHz**		

MODEL GRAPH :



GRAPH: A graph is plotted between gain (dB) and frequency (Hz) which is frequency response of voltage shunt feedback amplifier for without feedback and with feedback.

PRECAUTIONS: 1. Avoid loose and wrong connections.
2. Avoid parallax error while taking readings.

RESULT: The frequency response characteristics of the given voltage shunt amplifier with & without feedback were obtained and the graphs were plotted. And the values from the graph was obtained as

Bandwidth with feedback =
Bandwidth without feedback =

VIVA QUESTIONS:

1. What is meant by voltage shunt feedback?
2. Draw the circuit diagram of a voltage shunt feedback?
3. What is the difference between voltage series and voltage shunt feedback
4. What is another name for voltage shunt amplifier?
5. What is the effect of voltage shunt feedback on input and output impedance?

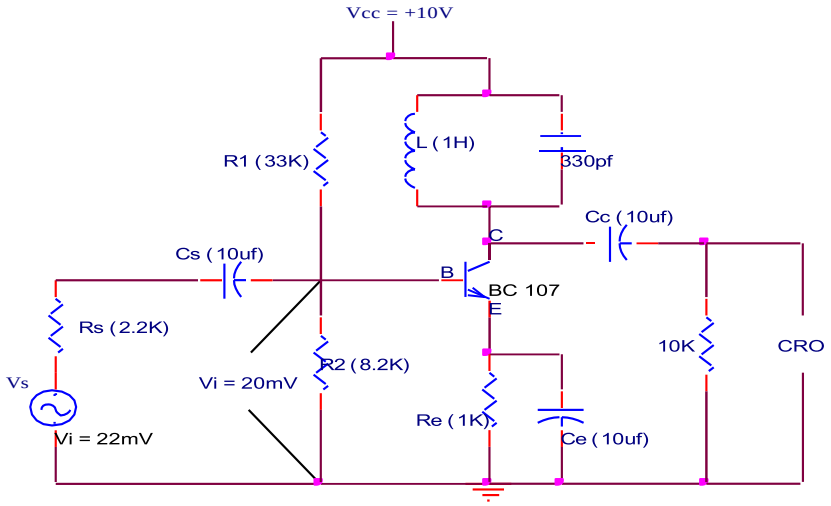
6. TUNED VOLTAGE AMPLIFIER

AIM: To obtain the frequency response and bandwidth of a Tuned voltage amplifier.

APPARATUS:

1. TRPS (0-30v)
2. BC 107 transistor,
3. Resistors- 2.2K(1), 33K(1), 8.2K(1), 1K(1) and 10K(1).
4. Capacitors 330pf(1)& 10µf (3),
5. Inductor 1H,
6. Signal Generator,
7. CRO with probes,
8. Bread Board with connecting wires.

CIRCUIT DIAGRAM:



TUNED VOLTAGE AMPLIFIER

PROCEDURE:

1. The circuit is connected as shown in the figure.
2. A 10V DC supply is given to the circuit for biasing.
3. An input signal of say 22mV is given from the output of the signal generator.
4. The output voltage V_o is noted for different values of the frequencies.
5. In each case the gain is calculated using the formula

$$\mathbf{A_V = 20 \log_{10} V_o/V_i \ (dB).}$$

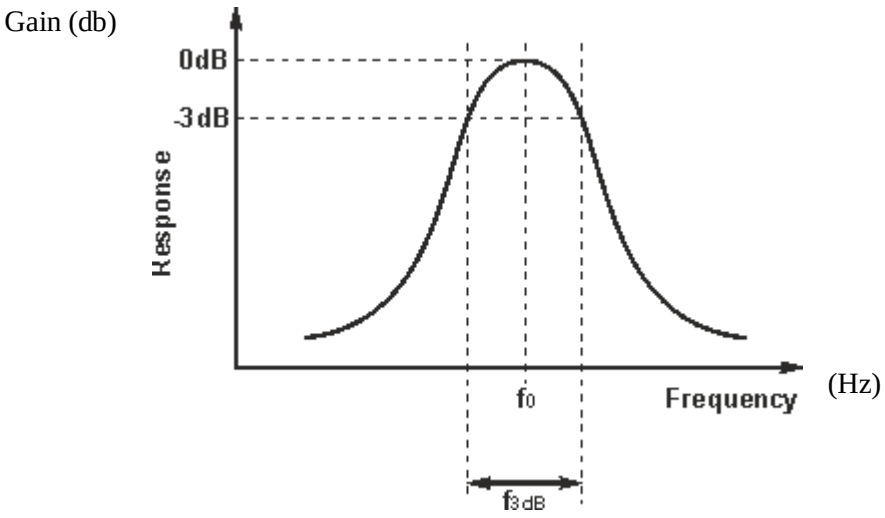
6. It is observed that at certain frequency the obtained value is maximum. The frequency is known as the resonant frequency at which $\mathbf{X_L = X_C}$ and it is approximately

$$\mathbf{f_r \ (theoretical) = 1 / 2\Pi\sqrt{LC}}$$

TABULAR FORM: **I/P Voltage, V_i = 20mV**

Frequency (Hz)	O/P Voltage, V_o (V)	Gain $A_V = 20 \log_{10} V_o/V_i$ (dB)
100Hz **TO** **1MHz**		

MODEL GRAPH :



PRECAUTIONS: 1. Avoid loose and wrong connections.
2. The amplitude of the input voltage must be maintained constant throughout the experiment.
3. Waveforms must be obtained without any distortion.

RESULT: The frequency response and bandwidth of a Tuned voltage amplifier was obtained andthe graph was plotted. And the value of f_0 was obtained from the graph as ___.

VIVA QUESTIONS:

1. What is tuned voltage amplifier?
2. What is selectivity?
3. What is bandwidth and the relation between bandwidth and selectivity.
4. What is frequency response?
5. Explain the operation of above circuit?
6. Why gain is expressed in dB?

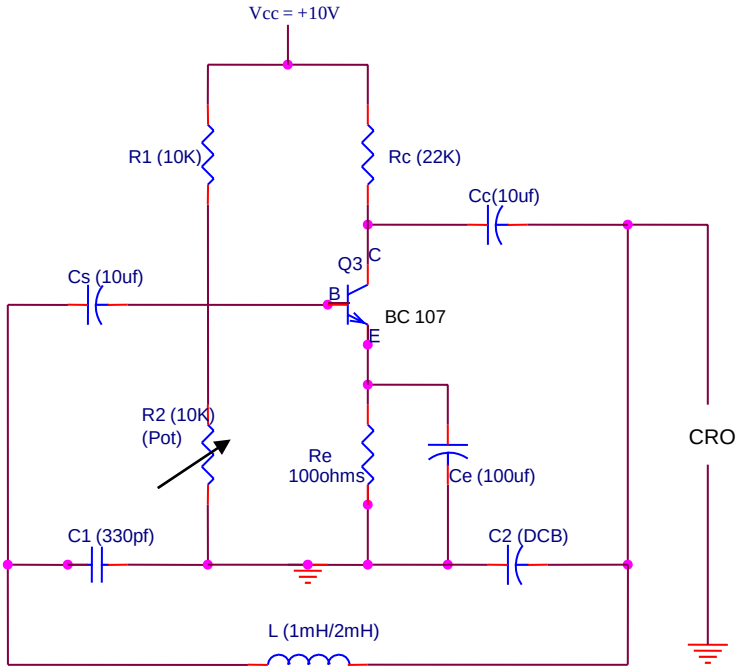
7. COLPITTS OSCILLATOR

AIM: To determine the frequency of oscillations of the Colpitts oscillator.

APPARATUS

1. Transistor BC 107,
2. Capacitors – 10μf (2) & 330pf (1) & 100uf (1),
3. Resistors – 10KΩ (1), 100Ω (1) & 22KΩ (1),
4. Inductor – 2mH (2),
5. Decade Capacitance Box,
6. Potentiometer – 10K (1),
7. Regulated Power Supply,
8. Bread Board & Connecting Wires.

CIRCUIT DIAGRAM:



COLPITTS OSCILLATOR

PROCEDURE:

1. The circuit is connected as shown in figure.
2. The capacitor C_1 is kept constant and C_2 is up to some value.
3. The resistor R_2 is adjusted until sinusoidal waveform is observed on the CRO.
4. Then the time period and hence the frequency are calculated which is nearly equal to the theoretical frequency.
5. The theoretical and practical values of frequency are verified using the formula.

$f_o = 1 / 2\Pi \sqrt{LC_{eq}}$ where **$C_{eq} = \frac{C_1C_2}{C_1+C_2}$**

f_o practical = 1 /T (Hz) T = Time period.

6. The experiment is repeated for different values of C_2.

TABULAR FORM:

S.NO.	INDUCTANCE(L)	CAPACITANCE			Theoretical $f_o=1/2\Pi\sqrt{LC_{eq}}$ (kHz)	T (Sec)	f=1/T (Hz)
		C_1	C_2	C_{eq}			
1.	**2mH**	**330pf**	**330pf**				
2.	**2mH**	**330pf**	**470pf**				
3.	**2mH**	**330pf**	**570pf**				

PRECAUTIONS:

1. Avoid loose and wrong connections.
2. The sinusoidal waveform obtained must be distortion.
3. Readings should be taken without parallax error.

RESULT: The frequency of oscillations of Colpitts oscillator for different values of L, C1 & C2 wasobtained as __.

VIVA QUESTIONS:

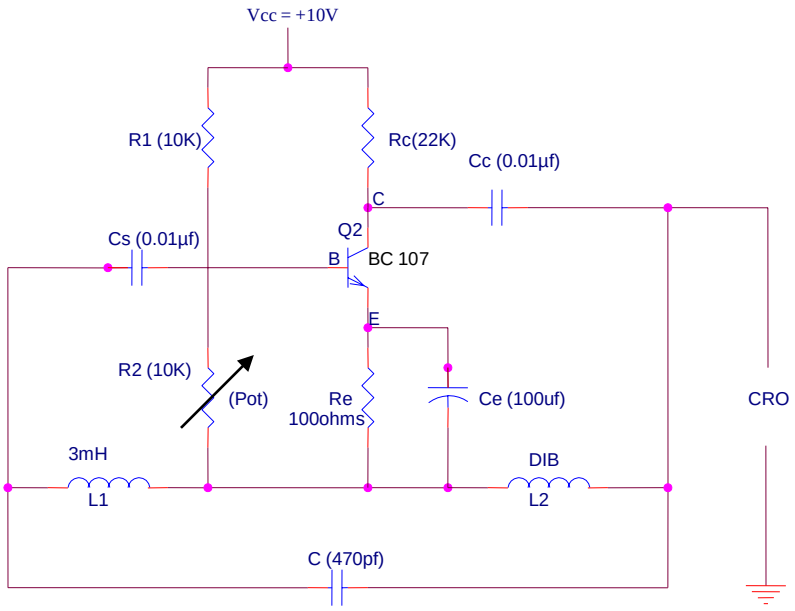
1. What is an oscillator?
2. Mention the condition for oscillations in colpitts oscillator?
3. What type of feedback is used in oscillator?
4. What is the range of frequencies?
5. What are the characteristics of positive feedback?
6. What is the total phase shift in an oscillator?

8. HARTLEY OSCILLATOR

AIM: To determine the frequency of oscillations of Hartley oscillator.

APPARATUS: 1. BC 107 Transistor,
2. Potentiometer 10KΩ (1),
3. Resistors – 10KΩ (1), 22KΩ (1) & 100Ω (1),
4. Capacitors –10µf(2), 100µf(1) & 470pf(1),
5. Decade Inductance Box (2),
6. TRPS,
7. Bread Board and connecting wires,
8. CRO with probes

CIRCUIT DIAGRAM:



HARTLEY OSCILLATOR

PROCEDURE:

1. Connections are made as shown in circuit diagram.
2. The inductor 'L_2' is up to some value, keeping inductor 'L_1' constant.
3. The potentiometer 'R_2' is adjusted until sinusoidal waveform is observed on CRO.
4. The time period and hence the frequency are calculated for the wave obtained which is nearly equal to the theoretical frequency.
6. The experiment is repeated for different values of 'L_2' and each time the time period is noted.

TABULAR FORM:

C	Inductance			Theoretical $f = 1/2\Pi\sqrt{L_{eq}C}$	Time T (Sec)	PRACTICAL f = 1 /T (Hz)
	L_1	L_2	$L_{eq} = L_1 + L_2$			
470pf 470pf 470pf	3mH 3mH	3mH 5mH				

GRAPH: A graph is plotted between time period on x-axis and Amplitude on y-axis to obtained a sinusoidal waveform at a particular value of L_2.

PRECAUTIONS: 1. Avoid loose contacts.
2. Avoid wrong connections.

RESULT: The frequency of oscillations of Hartley oscillator for different values of C,L1 & L2 wasobtained as __.

VIVA QUESTIONS:

2. What is an oscillator?
3. Mention the condition for oscillations in Hartley oscillator?
4. What type of feedback is used in oscillator?
5. What is the range of frequencies?
6. What are the characteristics of positive feedback?

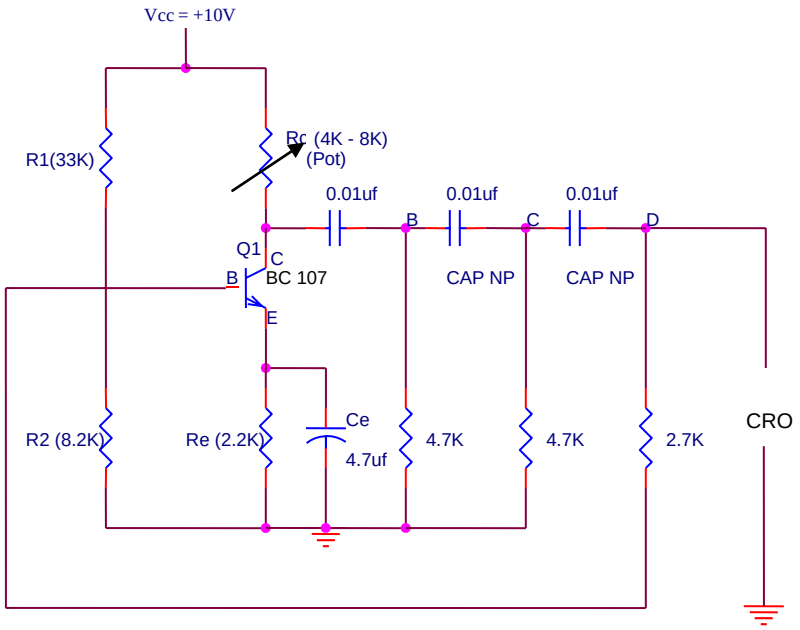
9. RC PHASE SHIFT OSCILLATOR

AIM: To find the frequency of oscillations of the RC phase Shift oscillator and to measure thephase shift of each section of the RC network.

APPARATUS

1. Transistor BC 107,
2. Resistors – 4.7KΩ (2), 33KΩ (1),2.2KΩ (1), 8.2KΩ (1) and 2.7KΩ (1).
3. Capacitors – 0.01µf (3) & 4.7µf(1),
4. Potentiometer 10KΩ (1),
5. Regulated Power Supply,
6. CRO with probes,
7. Bread Board & wires.

CIRCUIT DIAGRAM :



RC PHASE SHIFT OSCILLATOR

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Set the value of Rc (4KΩ – 8KΩ) by varying DRB and observe the output waveform at 'O' onCRO which is sinusoidal.
3. Now, the CRO probe is changed to position 'B' such that the output waveform at B is observed on CRO which is shifted by 60^o w.r.t '0'.
4. The output waveform at 'C' is observed on CRO, which is shifted by 120 ^{o} w.r.t '0'. 5 . The output waveform at 'D' is observed on CRO, which is shifted by 180^o w.r.t '0'.
6. Theoretically the frequency of oscillations is calculated by the formula,

$$f=1/2\pi RC\sqrt{6+4K}, \quad K = R_C / R$$

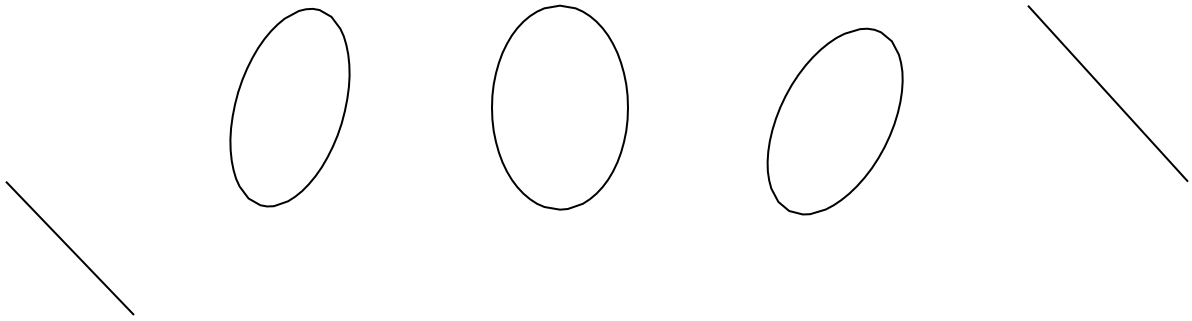
Practically the time period 'T' on CRO is noted and frequency **f = 1/T** is calculated.

7. The readings for different values of R_C at 4K,5K,6K,7K and 8K are noted. And are tabulated as shown in the tabular form for different Lissajous pattern.
8. A graph is plotted for phase and amplitude locating the phase shift observed on CRO at different positions of (B,C,D).

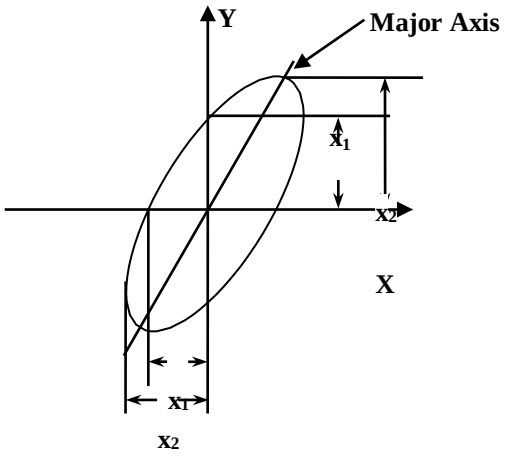
TABULAR FORM :

S.NO	R_C (KΩ)	Position w.r.t Collector	Lissajous Pattern	Y_1 (V)	Y_2 (V)	$\theta=\sin^{-1}(Y_1/Y_2)$	T (Sec)	f_0 (Hz) Theoretical	f_0 (Hz) Practical
1	4.7KΩ	B C D							

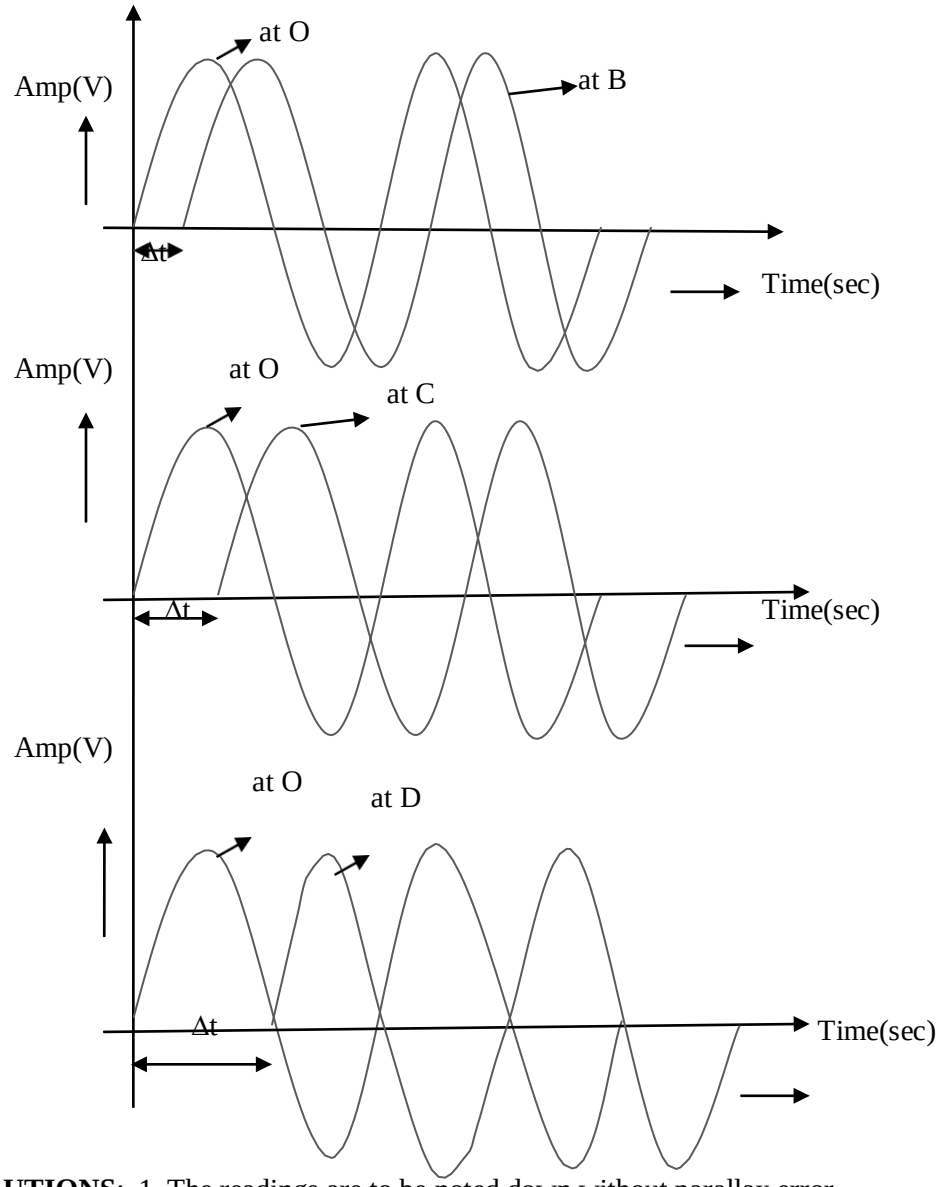
LISSAZEOUS PATTERN:



$\Phi = 0^0$ $0 < \Phi < 90^0$ $\Phi = 90^0$ $90^0 < \Phi < 180^0$ $\Phi = 180^0$



MODEL GRAPH: OUTPUT WAVEFORMS



PRECAUTIONS: 1. The readings are to be noted down without parallax error.
2. Wrong connections should be avoided.

RESULT: The frequency of oscillations and the Lissajous pattern of RC phase shift oscillator areobtained & the phase shifts at different positions of RC network w.r.t 'O' are calculated as _ .

VIVA QUESTIONS:

1. What is an oscillator?
2. Mention the condition for oscillations in RC phase shift oscillator?
3. What type of feedback is used in oscillator?
4. What is the range of frequencies? What is the phase shift produced by transistor.
5. What are the characteristics of positive feedback?

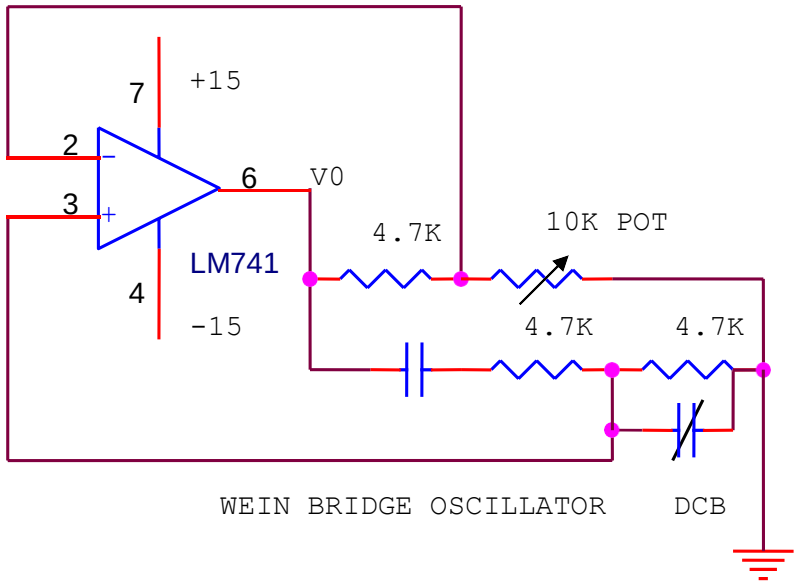
10. WEIN BRIDGE OSCILLATOR

AIM: To obtain the frequency of oscillations of Wein Bridge oscillator.

APPARATUS:

1. 741 OP – Amp,
2. Resistors – 4.7K (2) & 10K (1),
3. Potentiometer 10K (1),
4. Decade Capacitance Boxes (2),
5. Bread Board and connecting wires,
6. CRO with probes,
7. TRPS

CIRCUIT DIAGRAM :



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. The two capacitances are varied by using variable capacitance box.
3. The output wave is observed on the CRO.
4. The time period of the wave for each value of capacitor is noted.
5. The frequency of the wave is calculated from the time period using the formula **f = 1/T**
6. Theoretical frequency is calculated by using the
   Formula **f = 1/2Π√$R_1R_2C_1C_2$**
7. Compare the practical and theoretical values.

TABULAR FORM:

$R_1 = R_2$ (KΩ)	C		Theoretical $f = 1/2\Pi\sqrt{R_1R_2C_1C_2}$	Time Period T (Sec)	Practical $f = 1/T$ (Hz)
	C_1	C_2			
4.7K	0.1µF	0.1µF			
4.7K	0.01µF	0.01 µF			
4.7K	0.01 µF	0.1 µF			

PRECAUTIONS: 1. Avoid loose and wrong connections.

2. Connections should be made properly and theOutput should be a proper sine wave, such that the Time Period and amplitude may be obtained accurately.

RESULT: The frequency of oscillations of Wein Bridge oscillator for different values ofR1,R2,C1,C2 was obtained as ___.

VIVA QUESTIONS:

1. What is an oscillator?
2. Mention the condition for oscillations in wein bridge oscillator?
3. What type of feedback is used in oscillator?
4. What is the range of frequencies?
5. What are the characteristics of positive feedback?

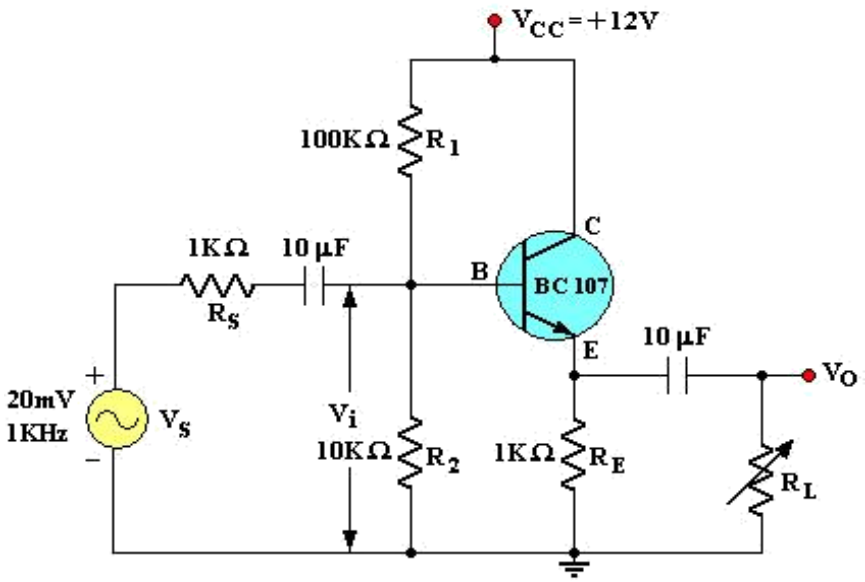
11. FREQUENCY RESPONSE OF CC AMPLIFIER

AIM: To find the frequency response of a Common Collector Transistor Amplifier and to findthe Bandwidth from the Response, Voltage gain, Input Resistance, output resistance.

APPARATUS:

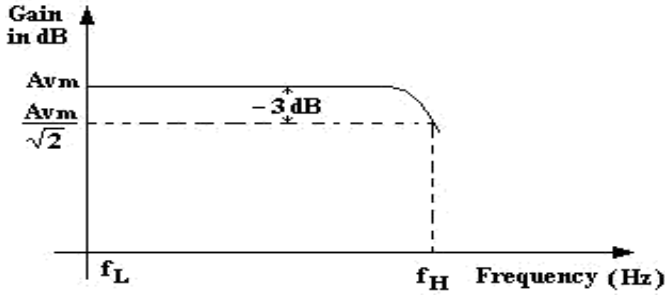
S.No	Name	Range / Value	Quantity
1	Dual Regulated D.C Power supply	0–30 Volts	1
2	Transistor	BC-107	1
3	Capacitors	10□f	2
4	Resistors	100k□ , 10K□	Each 1
5	Resistors	1K□	2
6	Bread Board and connecting wires	-	1 Set
7	Signal Generator	(0 – 1MHz)	1
8	Dual Trace CRO	20MHz	1

CIRCUIT DIAGRAM:



Common Collector Transistor Amplifier

MODEL GRAPH:



PROCEDURE:

1. Connect the circuit as per the Fig., Apply Vcc of 12 Volts DC.
2. Apply I/P Voltage of 20mV at 1KHz from the Signal Generator and observe the O/P onCRO.
3. Vary the frequency from 100 Hz to 1MHz in appropriate steps and note down thecorresponding O/P Voltage Vo in a tabular form .
4. Calculate the Voltage Gain Av = Vo/Vs and note down in the tabular form.
5. Plot the frequency (f) Vs Gain (Av) on a semi-log Graph sheet
6. Draw a horizontal line at 0.707 times Av and note down the cut off points and theBandwidth is given by B.W = $f_2 - f_1$.

TABULAR FORMS:

I/P Voltage, V_s =20mV

S.No	Frequency (Hz)	O/P Voltage, Vo (V)	Voltage Gain Av =Vo/Vi	Av in dB = 20 log (Av)
1	100			
2	200			
3	300			
4	500			
5	700			
6	1K			
7	3K			
8	5K			
9	7K			
10	10K			
11	30K			
12	50K			
13	70K			
14	100K			
15	300K			
16	500K			
17	700K			
18	1M			

RESULT: The frequency response of a Common Collector Transistor Amplifier was obtained and the graph was plotted. From the graph, the values of Bandwidth, Voltage gain, Input Resistance,output resistance are obtained as __.

PRECAUTIONS:

1. Check the wires for continuity before use.
2. Keep the power supply at Zero volts before Start
3. All the contacts must be intact

VIVA QUESTIONS:

1. What is the other name for CC Amplifier?
2. What are the uses of CC Amplifier?
3. Why this amplifier has got the name Emitter Follower?
4. What is the maximum Voltage gain of an Emitter Follower?
5. Why it is used as a Buffer amplifier?