ANALOG CIRCUITS LABORATORY MANUAL

(R22A0481)
(II YEAR–I SEM)
(2024-25)

Designed BY

K. VIJAYA BHARATHI
ASSISTANT PROFESSOR

Department of Electronics and Communication Engineering

MALLA REDDY COLLEGEOF ENGINEERING& TECHNOLOGY
(Autonomous Institution –UGC, Govt. of India)
Recognized under 2(f)and12 (B)ofUGCACT1956
Affiliated to JNTUH, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2015 Certified) Maisammaguda ,Dhulapally (Post Via. Kompally), Secunderabad– 500100, Telangana ,India

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S.No	Date	Name of the Activity/Experiment	Grade/ Marks	Faculty Signature

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION

To evolve into a center of excellence in Engineering Technology through creative and innovative practices in teaching-learning, promoting academic achievement & research excellence to produce internationally accepted competitive and world class professionals.

MISSION

To provide high quality academic programmes, training activities, research facilities and opportunities supported by continuous industry institute interaction aimed at employability, entrepreneurship, leadership and research aptitude among students.

QUALITY POLICY

PROGRAMME EDUCATIONAL OBJECTIVES

- Impart up-to-date knowledge to the students in Electronics & Communication area to make them quality engineers.
- Make the students experience the applications on quality equipment and tools.
- Provide systems, resources and training opportunities to achieve continuous improvement.
- Maintain global standards in education, training and services.

PEO1: PROFESSIONALISM & CITIZENSHIP

To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, ecological and economic issues.

PEO2: TECHNICAL ACCOMPLISHMENTS

To provide knowledge based services to satisfy the needs of society andthe industry by providing hands on experience in various technologies in core field.

PEO3: INVENTION, INNOVATION AND CREATIVITY

To make the students to design, experiment, analyze, interpret in the core field with the help of other multi disciplinary concepts wherever applicable.

PEO4: PROFESSIONAL DEVELOPMENT

To educate the students to disseminate research findings with goodsoft skills and become a successful entrepreneur.

PEO5: HUMAN RESOURCE DEVELOPMENT

To graduate the students in building national capabilities in technology,education and research.

PROGRAM OUTCOMES (POs)

Engineering Graduates should possess the following

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 appropriateconsideration for the public health and safety, and the cultural, societal, and environmentalconsiderations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis 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 responsibilitiesrelevant 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 andnorms 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 multi-disciplinary environments.

CODE OF CONDUCT FOR THE LABORATORIES

1. All students must observe the Dress Code while in the laboratory.
2. Sandals or open-toed shoes are NOT allowed.
3. Foods, drinks and smoking are NOT allowed.
4. All bags must be left at the indicated place.
5. The lab timetable must be strictly followed.
6. Be punctual for your laboratory session.
7. Program must be executed within the given time.
8. Noise must be kept to a minimum.
9. Workspace must be kept clean and tidy at all time.
10. Handle the systems and interfacing kits with care.
11. All students are liable for any damage to the accessories due to their own negligence.
12. All interfacing kits connecting cables must be RETURNED if you taken from the lab supervisor.
13. Students are strictly PROHIBITED from taking out any items from the laboratory.
14. Students are NOT allowed to work alone in the laboratory without the Lab Supervisor
15. USB Ports have been disabled if you want to use USB drive consult lab supervisor.
16. Report immediately to the Lab Supervisor if any malfunction of the accessories, is there.

Before leaving the lab

1. Place the chairs properly.
2. Turn off the system properly
3. Turn off the monitor.
4. Please check the laboratory notice board regularly for updates.

CERTIFICATE

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous Institution – UGC, Govt. of India)
(Affiliated to JNTUH, Hyderabad, Approved by AICTE- Accredited by NBA & NAAC 'A' Grade –
ISO 9001:2015 Certified)

Certificate

*Department of **Electronics and Communication Engineering** certified that in the bonafide Record of the work done by Mr./Miss ___________________________________*

*Reg.No______________________of B.Tech **ECE_____________________year____semester***

for the Academic year 20____to 20______in___________________________________Laboratory.

Date: *Staff In charge* *HOD*

Internal Examiner *External Examiner*

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(R22A0481) ANALOG CIRCUITS LAB

COURSE OBJECTIVES:

1) To design Multistage, Power amplifiers and multivibrators according to given specifications.
2) To analyze various amplifiers such as Common Emitter, Common Source, Cascade and Cascode amplifiers.
3) To build circuit construction skills using circuit simulation software tool.
4) To simulate different amplifier circuits.
5) To design Feedback amplifiers

LIST OF EXPERIMENTS

1. **INPUT & OUTPUT CHARACTERISTICS OF TRANSISTOR CBCONFIGURATION**
2. **INPUT & OUTPUT CHARACTERISTICS OF TRANSISTOR CE CONFIGURATION**
3. **CALCULATION OF h –PARAMETERS of CC CONFIGURATION FROM INPUT & OUTPUT CHARACTERISTICS**
4. **CALCULATION OF h –PARAMETERS of CB CONFIGURATION FROM INPUT & OUTPUT CHARACTERISTICS**
5. **CALCULATION OF h –PARAMETERS of CE CONFIGURATION FROM INPUT & OUTPUT CHARACTERISTICS**
6. **FREQUENCY RESPONSE OF CE AMPLIFIER**
7. **FREQUENCY RESPONSE OF CS AMPLIFIER**
8. **FREQUENCY RESPONSE OF TWO STAGE RC COUPLED AMPLIFIER**
9. **VOLTAGE SERIES FEEDBACK AMPLIFIERS**
10. **CURRENT SHUNT FEEDBACK AMPLIFIERS**
11. **COLIPTSOSCILLATOR**
12. **HARTLEY OSCILLATOR**

COURSE OUTCOMES :

1) Design Multistage, Power amplifiers and multivibrators according to given specifications.
2) Analyze various amplifiers such as Common Emitter, Common Source, Cascade and Cascode amplifiers.
3) Build circuit construction skills using circuit simulation software tool.
4) Simulate different amplifier circuits.
5) Design Feedback amplifiers

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EXPERIMENT 1

1. COMMON BASE INPUT & OUTPUT CHARACTERISTICS

AIM: 1.To observes and draw the input and output characteristics of a transistor Connected in Common Base configuration.

2. To find α of the given transistor and also its input and output Resistances.

APPARATUS:

Transistor, BC107	-1No.
Regulated power supply (0-30V)	-1No.
Voltmeter (0-20V)	- 2No.
Ammeters (0-10mA)	- 2No.
Resistor, 1KΩ	- 2No
Bread board	
Connecting wires	

THEORY:

A transistor is a three terminal active device. The terminals are emitter, base, collector. In CB configuration, the base is common to both input (emitter) and output (collector). For normal operation, the E-B junction is forward biased and C-B junction is reverse biased. In CB configuration, I_E is +ve, I_C is –ve and I_B is –ve.

$$\mathbf{V_{EB} = F1 (V_{CB}, I_E)} \text{ and}$$

$$\mathbf{I_C = F_2 (V_{EB}, I_B)}$$

With an increasing the reverse collector voltage, the space-charge width at the output junction increases and the effective base width 'W' decreases. This phenomenon is known as "Early effect". Then, there will be less chance for recombination within the base region.With increase of charge gradient with in the base region, the current of minority carriers injected across the emitter junction increases.

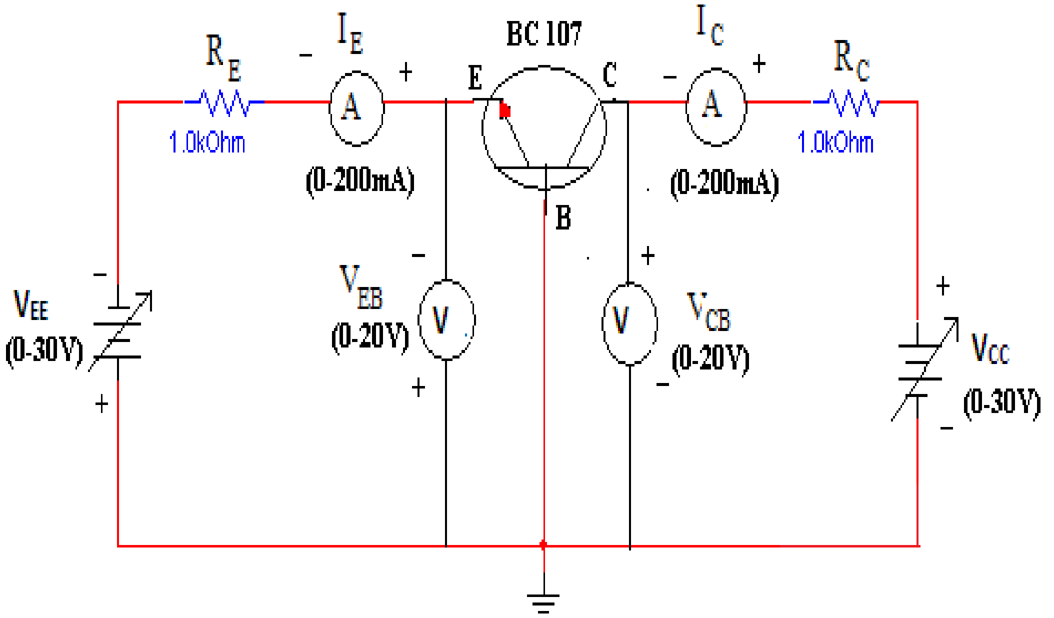
The current amplification factor of CB configuration is given by,

$$\alpha = \Delta I_C / \Delta I_E$$

Input Resistance, $r_i = \Delta V_{BE} / \Delta I_E$ at Constant V_{CB}

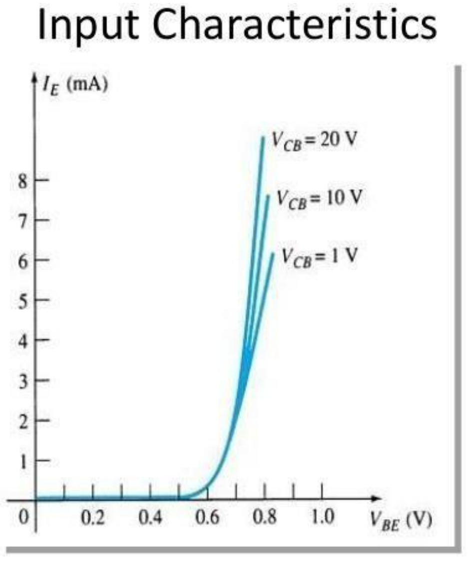
Output Résistance, $r_o = \Delta V_{CB} / \Delta I_C$ at Constant I_E

CIRCUIT DIAGRAM:

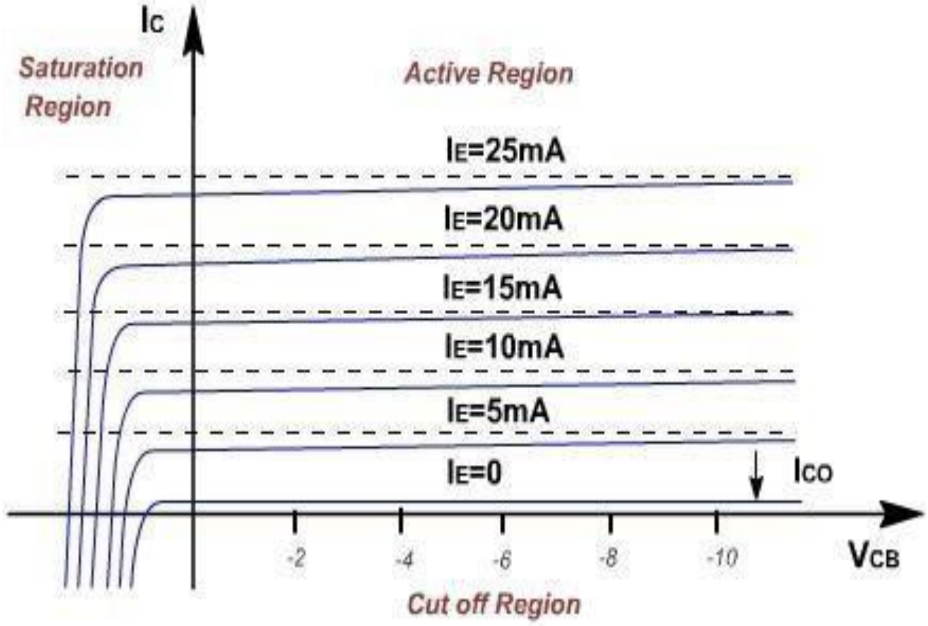


MODEL GRAPHS:

A) INPUT CHARACTERISTICS



B) OUTPUTCHARACTERISTICS



OBSERVATIONS:

A) INPUT CHARACTERISTICS:

V_{EE}(V)	V_{CB}=1V		V_{CB}= = 2V		V_{CB}= 4V	
	V_{EB}(V)	I_E(mA)	V_{EB}(V)	I_E(mA)	V_{EB}(V)	I_E(mA)

B) OUTPUT CHARACTERISTICS:

V_{cc}(V)	I_{E}=10mA		I_{E}=20mA		I_{E}=30mA	
	V_{CB}(V)	I_{C}(mA)	V_{CB}(V)	I_{C}(mA)	V_{CB}(V)	I_{C}(mA)

<u>Operation</u>: The positive going Pulse of input Source increases the emitter voltage. As the base voltage is Constant, the forward bias of emitter base junction reduces. This reduces IB, reducing IC and hence the drop across RC since VO=VCC - IC RC, the reduction in IC results in an increase in VO. Therefore, we can Say that positive going input produces positive going

PROCEDURE:

A) INPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the input characteristics, the output voltage V_{CE} is kept constant at 0V and for different values of V_{EE} note down the values of I_E and V_{BE}
3. Repeat the above step keeping V_{CB} at 2V,4V,and 6V and all the readings are tabulated.
4. A graph is drawn between V_{EB} and I_E for constant V_{CB}.

B) OUTPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the output characteristics, the input I_E is kept constant at 0.5mA and for different values of V_{CC}, note down the values of I_C and V_{CB}.
3. Repeat the above step for the values of I_E at 1mA, 5mA and all the readings are tabulated.
4. A graph is drawn between V_{CB} and Ic for constant I_E

PRECAUTIONS:

1. The supply voltages should not exceed the rating of the transistor.
2. Meters should be connected properly according to their polarities.
3. While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.
4. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
5. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
6. Make sure while selecting the emitter, base and collector terminals of the transistor.

RESULT:

VIVA QUESTIONS:

1. What is the range of α for the transistor?
2. Draw the input and output characteristics of the transistor in CB configuration?
3. Identify various regions in output characteristics?
4. What is the relation between α and β?
5. What are the applications of CB configuration?
6. What are the input and output impedances of CB configuration?
7. Define α (alpha)?
8. What is early effect?
9. Draw Circuit diagram of CB configuration for PNP transistor?

EXPERIMENT 1

1. INPUT & OUTPUT CHARACTERISTICS OF TRANSISTOR CE CONFIGURATION

AIM:

1. To draw the input and output characteristics of transistor connected in CE configuration
2. To find β of the given transistor and also its input and output Resistances

APPARATUS:

1.	Transistor, BC107	-1No.
2.	Regulated power supply (0-30V)	-1No.
3.	Voltmeter (0-20V)	- 2No.
4.	Ammeters (0-20mA)	-1No.
5.	Ammeters (0-200μA)	-1No.
6.	Resistor, 100Ω	-1No
7.	Resistor, 1KΩ	-1No.
8.	Bread board	
9.	Connecting wires	

THEORY:

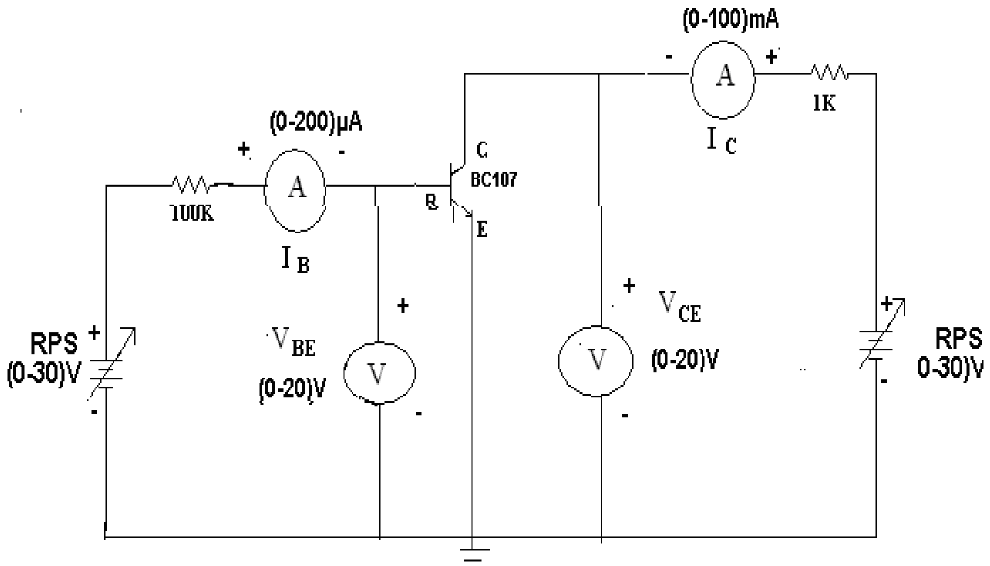
In common emitter configuration, input voltage is applied between base and emitter terminals and output is taken across the collector and emitter terminals. Therefore the emitter terminal is common to both input and output. The input characteristics resemble that of a forward biased diode curve. This is expected since the Base-Emitter junction of the transistor is forward biased. As compared to CB arrangement I_B increases less rapidly with $V_{BE.}$ Therefore input resistance of CE circuit is higher than that of CB circuit.The output characteristics are drawn between I_c and V_{CE} at constant I_B the collector current varies with V_{CE} up to few volts only. After this the collector current becomes almost constant, and independent of $V_{CE.}$ The value of V_{CE} up to which the collector current changes with V_{CE} is known as Knee voltage. The transistor always operated in the region above Knee voltage, I_C is always constant and is approximately equal to I_B. The current amplification factor of CE configuration is given by

$$\beta = \Delta I_C/\Delta I_B$$

Input Resistance, r_i = $\Delta \mathbf{V_{BE}} / \Delta \mathbf{I_B}$ (μA) at Constant V_{CE}

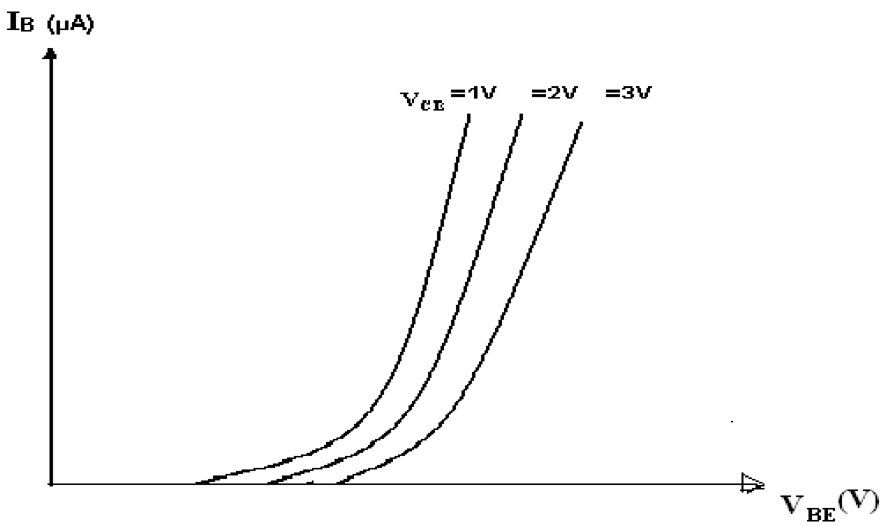
Output Résistance, r_o = $\Delta \mathbf{V_{CE}} / \Delta \mathbf{I_C}$ at Constant I_B (μA)

CIRCUIT DIAGRAM:

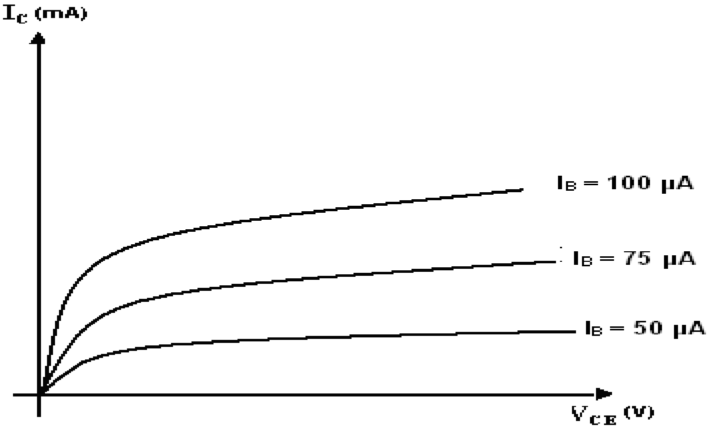


MODEL GRAPHS:

A) INPUT CHARACTERISTICS:



A) OUTPUT CHARACTERSITICS:



OBSERVATIONS:

A) INPUT CHARACTERISTICS:

V_{BB}	V_{CE} = 1V		V_{CE} = 2V		V_{CE} = 4V	
	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)

B) OUTPUT CHARACTERISTICS:

S.NO	I_B = 50 µA		I_B = 75 µA		I_B = 100 µA	
	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)

PROCEDURE:

A) INPUT CHARECTERSTICS:

1. Connect the circuit as per the circuit diagram.
2. For plotting the input characteristics the output voltage V_{CE} is kept constant at 1V and for different values of V_{BB} , note down the values of I_B and V_{BE}
3. Repeat the above step by keeping V_{CE} at 2V and 4V and tabulate all the readings.
4. plot the graph between V_{BE} and I_B for constant V_{CE}

B) OUTPUT CHARACTERSTICS:

1. Connect the circuit as per the circuit diagram
2. for plotting the output characteristics the input current I_B is kept constant at 50µA and for different values of V_{CC} note down the values of I_C and V_{CE}
3. Repeat the above step by keeping I_B at 75 µA and 100 µA and tabulate the all the readings
4. plot the graph between V_{CE} and I_C for constant I_B

PRECAUTIONS:

1. The supply voltage should not exceed the rating of the transistor
2. Meters should be connected properly according to their polarities
3. While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.
4. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
5. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
6. Make sure while selecting the emitter, base and collector terminals of the transistor.

RESULT:

VIVA QUESTIONS:

1. What is the range of β for the transistor?
2. What are the input and output impedances of CE configuration?
3. Identify various regions in the output characteristics?
4. What is the relation between α and β?
5. Define current gain in CE configuration?
6. Why CE configuration is preferred for amplification?
7. What is the phase relation between input and output?
8. Draw diagram of CE configuration for PNP transistor?
9. What is the power gain of CE configuration?
10. What are the applications of CE configuration?

EXPERIMENT 3

h-PARAMETERS OF CC CONFIGURATION

AIM: To draw the input and output characteristics of transistor connected in CC (Common Collector) or Emitter follower configuration.

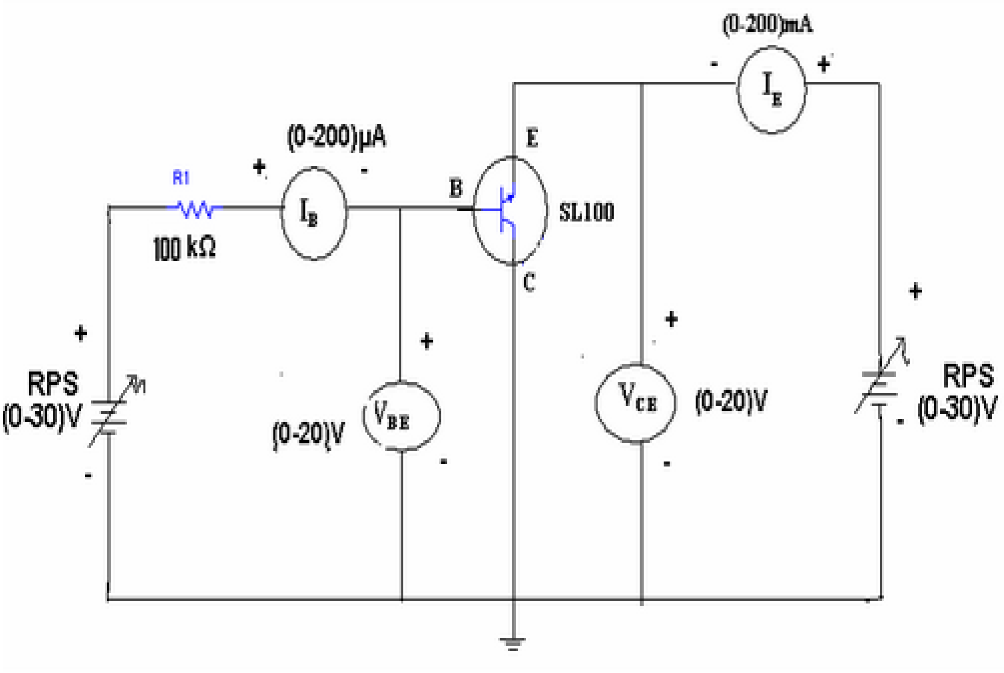
APPARATUS:

1. Transistor (SL100 or BC107)
2. R.P.S (O-30V) 2Nos
3. Voltmeters (0-20V) 2Nos
4. Ammeters (0-200μA),(0-200mA)
5. Resistors 100Kohm
6. Bread board and connecting wires
7.

THEORY:

A transistor is a three terminal device. Bipolar Junction Transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of BJTs, namely NPN and PNP. It consists of two PN junctions, namely emitter junction and collector junction The terminals are emitter, base, collector. In emitter follower configuration, input voltage is applied between base and ground terminals and out put is taken across the emitter and collector terminals. The input characteristics resemble that of a forward biased diode curve. This is expected since the Base-Emitter junction of the transistor is forward biased. The output characteristics are drawn between IE and VCE at constant IB. the emitter current varies with VCE unto few volts only. After this the emitter current becomes almost constant, and independent of VCE. The value of VCE up to which the collector current changes with V CE is known as Knee voltage. The transistor always operated in the region above Knee voltage, IE is always constant and is approximately equal to IB.

Circuit Diagram:



Procedure:

Input Characteristics:

1. Connect the circuit as per the circuit diagram.
2. For plotting the input characteristics the output voltage VCE is kept constant at 2V and note down values of VCB for each value of IB
3. Change VCE to 10 V and repeat the above step.
4. Disconnect the voltmeter from input circuit.
5. Plot the graph between VCB and IB for constant VCE

Output Characteristics:

1. Connect the circuit as per the circuit diagram
2. With IB set at 0µA, vary VCE and note down the corresponding IE value
3. Set IB at 40µA, 80µA and repeat the above step.
4. Plot the output characteristics between V_{CE} and I_E for constant I_B.

Observations:

Input Characteristics:

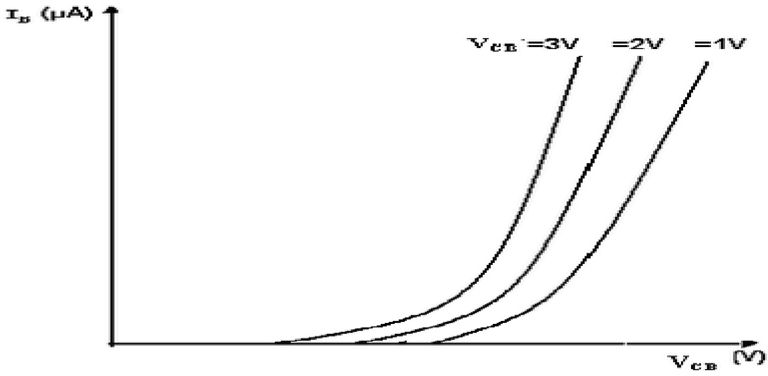
S.No	**VCE = 2V**		**VCE = 4V**		**VCE = 10V**	
	VCB(V)	IB(µA)	VCB(V)	IB(µA)	VCB(V)	IB(µA)

Output Characteristics:

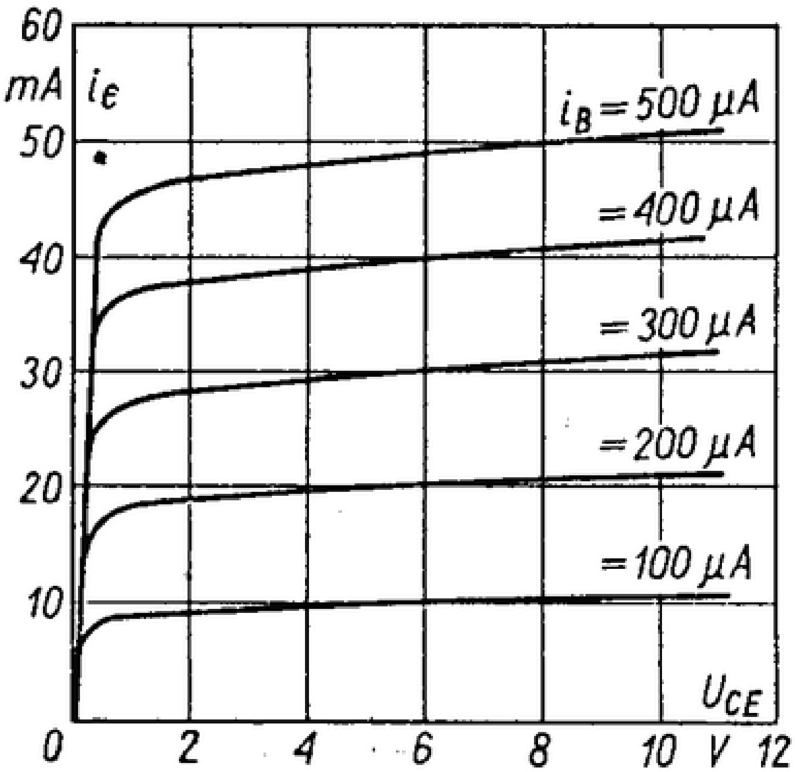
S.No	**I_b=500 µA**		**I_b=400 µA**		**I_b=300 µA**	
	VCE(V)	**IE(µA)**	**VCE(V)**	**IE(µA)**	**VCB(V)**	**I_B(µA)**

Model Graphs:

Input Characteristics:



Output Characteristics:



Calculations from Graph:

The h-parameters are to be calculated from the following formulae:

1. **Input Characteristics:** To obtain input resistance, find ΔV_{CB} and ΔI_B for a constant V_{CB} on one of the input characteristics.

   Input impedance = $h_{ic} = R_i = \Delta V_{CB} / \Delta I_B$ (V_{CE} = constant)

   Reverse voltage gain = hrc = $\Delta V_{CB} / \Delta V_{CE}$ (I_B = constant)

2. **Output Characteristics:** To obtain output resistance, find ΔI_E and ΔV_{CE} at a constant I_E.

   Output admitance = h_{oc} = 1/Ro = $\Delta I_E / \Delta V_{CE}$ (I_B = constant)

   Forward current gain = $h_{fc} = \Delta I_E / \Delta I_B$ (V_{CE} = constant)

PRECAUTIONS:

1. The supply voltage should not exceed the rating of the transistor
2. Meters should be connected properly according to their polarities

The h-parameters for a transistor in CC configuration are:

a. The Input resistance (h_{ic}) ___________________ MOhms.
b. The Reverse Voltage Transfer Ratio (h_{rc}) ___________________.
c. The Output Admittance (h_{oc}) ___________________ Ohms.
d. The Forward Current gain (h_{fc}) ___________________.
e.

RESULT:

Viva Questions:

1. What are the input and output impedances of CC configuration?
2. Identify various regions in the output characteristics?
3. Why CC configuration is preferred for buffering?
4. What is the phase relation between input and output?
5. Draw diagram of CC configuration for PNP transistor?
6. What are the applications of CC configuration?

EXPERIMENT 4

h- PARAMETERS CALCULATION OF CB CONFIGURATION

AIM: To calculate the h-parameters of transistor in CB configuration.

APPARATUS:

S.No.	Name	Quantity
1	Transistor BC 107	1(One) No.
2	Resistors (1KΩ)	2(Two) No.
3	Bread board	1(One) No.

Equipment:

S.No.	Name	Quantity
1	Dual DC Regulated Power supply (0 – 30 V)	1(One) No.
2	Digital Ammeters (0 – 200 mA)	2(Two) No.
3	Digital Voltmeter (0-20V)	2(Two) No.
4	Connecting wires (Single Strand)	2

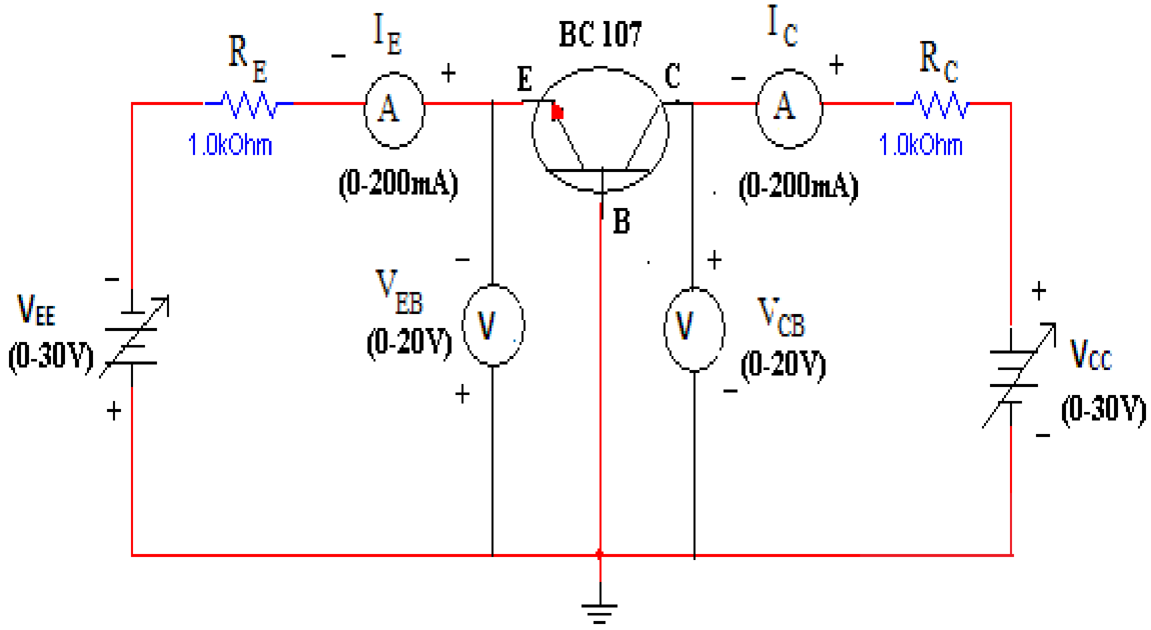
THEORY

The basic circuit diagram for studying input characteristics is shown in the circuit diagram. The input is applied between emitter and base, the output is taken between collector and base. Here base of the transistor is common to both input and output and hence the name is Common Base Configuration.

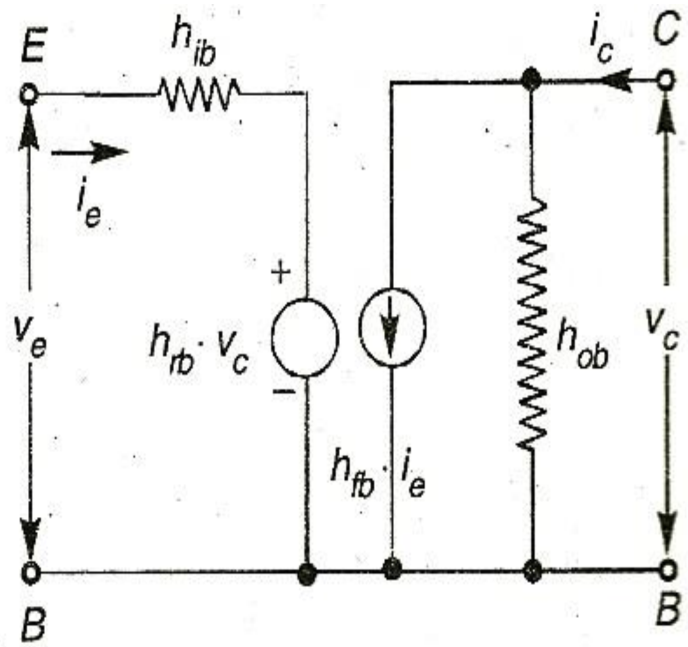
Input characteristics are obtained between the input current and input voltage at constant output voltage. It is plotted between V_{EE} and I_E at constant V_{CB} in CB configuration.

Output characteristics are obtained between the output voltage and output current at constant input current. It is plotted between V_{CB} and I_C at constant I_E in CB configuration.

Circuit Diagram



h – Parameter model of CB transistor:



Procedure:

Input Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. Keep output voltage V_{CB} = 0V by varying V_{CC}.
3. Varying V_{EE} gradually, note down emitter current I_E and emitter-base voltage (V_{EE}).
4. Step size is not fixed because of nonlinear curve. Initially vary V_{EE} in steps of 0.1 V. Once the current starts increasing vary V_{EE} in steps of 1V up to 12V.
5. Repeat above procedure (step 3) for V_{CB} = 4V.

Output Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. Keep emitter current I_E = 5mA by varying V_{EE}.
3. Varying V_{CC} gradually in steps of 1V up to 12V and note down collector current I_C and collector-base voltage e(V_{CB}).
4. Repeat above procedure (step 3) for I_E = 10mA.

Repeat above procedure (step 3) for I_E = 10mA.

PRECAUTIONS:

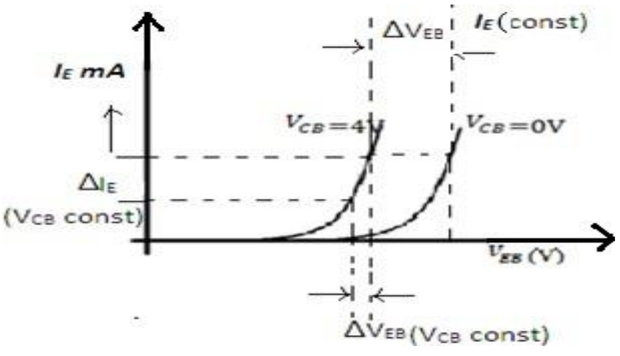
1. While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor
2. .Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram
3. The supply voltage should not exceed the rating of transistor
4. .Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
5. Make sure while selecting the emitter, base and collector terminals of the transistor.
6. Take readings without any parallex error

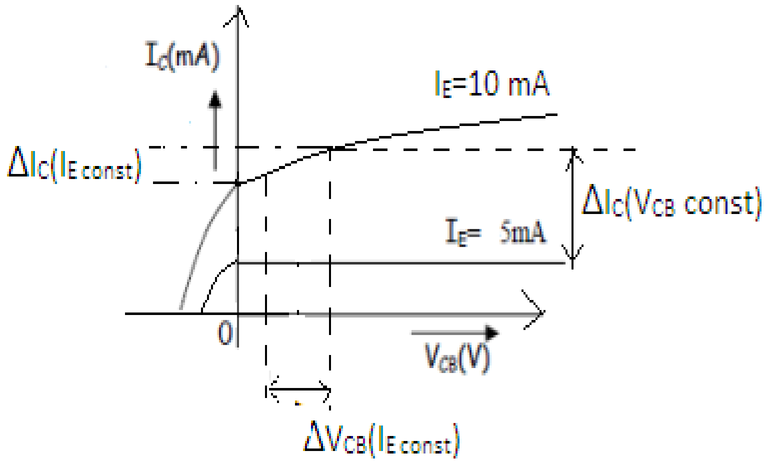
Observations:

Input Characteristics				
V_{EE} (Volts)	V_{CB} = 0V		V_{CB} = 4V	
	V_{EB} (Volts)	I_E (mA)	V_{EB} (Volts)	I_E (mA)

Output Characteristics						
V_{CC} (Volts)	I_E = 0mA		I_E = 5V		IE = 10mA	
	V_{CB} (Volts)	I_C (mA)	V_{CB} (Volts)	I_C (mA)	V_{CB} (Volts)	I_C (mA)

Graph:





1. Plot the input characteristics for different values of $\mathbf{V_{CB}}$ by taking $\mathbf{V_{EE}}$ on X-axis and $\mathbf{I_E}$ on Y-axis taking $\mathbf{V_{CB}}$ as constant parameter.
2. Plot the output characteristics by taking $\mathbf{V_{CB}}$ on X-axis and taking $\mathbf{I_C}$ on Y-axis taking $\mathbf{I_E}$ as a constant parameter.

<u>Calculations from Graph:</u>

The h-parameters are to be calculated from the following formulae:

1. **Input Characteristics:** To obtain input resistance, find ΔV_{EE} and ΔI_E for a constant V_{CB} on one of the input characteristics.

   Input impedance $= h_{ib} = R_i = \Delta V_{EE} / \Delta I_E$ (V_{CB} = constant)

   Reverse voltage gain = hrb = $\Delta V_{EB} / \Delta V_{CB}$ (I_E = constant)

2. **Output Characteristics:** To obtain output resistance, find ΔI_C and ΔV_{CB} at a constant I_E.

   Output admitance = $h_{ob} = 1/Ro = \Delta I_C / \Delta V_{CB}$ (I_E = constant)

   Forward current gain = $h_{fb} = \Delta I_C / \Delta I_E$ (V_{CB} = constant)

The h-parameters for a transistor in CB configuration are:

a. The Input resistance (h_{ib}) ____________________Ohms.
b. The Reverse Voltage Transfer Ratio (h_{rb}) ____________________.
c. The Output Admittance (h_{ob}) ____________________Mhos.
d. The Forward Current gain (h_{fb}) ____________________

Result:

Discussion/Viva Questions:

1. What is transistor?

2. Write the relation between α and β?

3. Define α (alpha)? What is the range of α?

4. Why α is less than unity?

5. Input and output impedance equations for CB configuration?

6. What is carrier lifetime?

7. What is the importance of Fermi level?

8. Can the junction less transistors be realized?

9. What is the doping level of E, B and C layers

10 List the various current components in BJT.

11. Can transistor be replaced by two back to back connected diodes?

12. To operate a transistor as amplifier, emitter junction is forward biased and collector junction is reverse biased. Why?

13. Which transistor configuration provides a phase reversal between the input and output signals?

EXPERIMENT 5

h-PARAMETERS OF CE CONFIGURATION

1.AIM: To calculate the h-parameters of transistor in CE configuration.

2.APPRATUS:

1. Transistor BC107 - 1No.
2. Resistors 100 KΩ 100 Ω - 1No.Each
3. Ammeter (0-200µA) - 1No.
4. Ammeter(0-200mA -1No.
5. Voltmeter (0-20V) - 2Nos
6. Regulated Power Supply (0-30V) - 2Nos
7. Breadboard

3.THEORY:

The basic circuit diagram for studying input characteristics is shown in the circuit diagram. The input is applied between base and emitter, the output is taken between collector and emitter. Here emitter of the transistor is common to both input and output and hence the name Common Emitter Configuration.

Input characteristics are obtained between the input current and input voltage at constant output voltage. It is plotted between $\mathbf{V_{BE}}$ and $\mathbf{I_B}$ at constant $\mathbf{V_{CE}}$ in CE configuration.

Output characteristics are obtained between the output voltage and output current at constant input current. It is plotted between $\mathbf{V_{CE}}$ and $\mathbf{I_C}$ at constant $\mathbf{I_B}$ in CE configuration.

A) INPUT CHARACTERISTICS:

The two sets of characteristics are necessary to describe the behaviour of the CE configuration, in which one for input or base emitter circuit and other for the output or collector emitter circuit. In input characteristics the emitter base junction forward biased by a very small voltage V_{BB} where as collector base junction reverse biased by a very large voltage V_{CC}. The input characteristics are a plot of input current I_B Versus$_s$ the input voltage V_{BE} for a range of values of output voltage V_{CE} . The following important points can be observed from these characteristics curves.

1. Input resistance is high as I_B increases less rapidly with V_B
2. The input resistance of the transistor is the ratio of change in base emitter voltage ΔV_{BE} to change in base current ΔI_B at constant collector emitter

voltage (VCE) i.e... Input resistance or input impedance hie = $\Delta V_{BE} / \Delta I_B$ at V_{CE} constant.

B) OUTPUT CHARACTERISTICS:

A set of output characteristics or collector characteristics are a plot of out put current I_C V_S output voltage V_{CE} for a range of values of input current I_B .The following important points can be observed from these characteristics curves.

1. The transistor always operates in the active region. i.e. the collector current I_C increases with V_{CE} very slowly. For low values of the V_{CE} the I_C increases rapidly with a small increase in V_{CE} .The transistor is said to be working in saturation region.
2. Output resistance is the ratio of change of collector emitter voltage ΔV_{CE} , to change in collector current ΔI_C with constant I_B. Output resistance or Output impedance hoe = $\Delta V_{CE} / \Delta I_C$ at I_B constant.

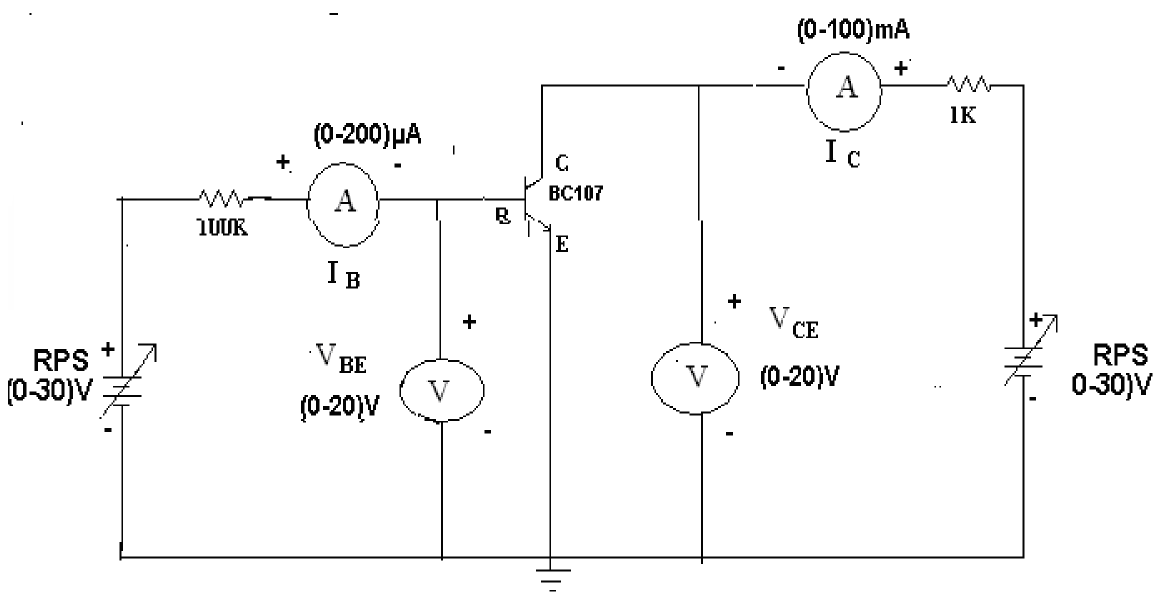
Input Impedance hie = $\Delta V_{BE} / \Delta I_B$ at V_{CE} constant

Output impedance hoe = $\Delta V_{CE} / \Delta I_C$ at I_B constant

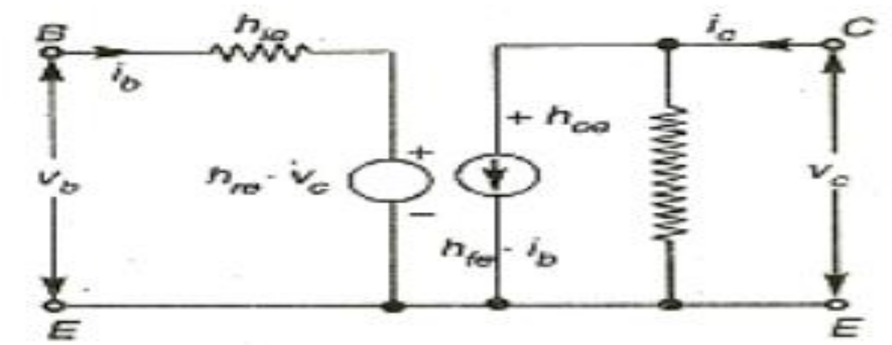
Reverse Transfer Voltage Gain hre = $\Delta V_{BE} / \Delta V_{CE}$ at I_B constant

Forward Transfer Current Gain hfe = $\Delta I_C / \Delta I_B$ at constant V_{CE}

CIRCUIT DIAGRAM:



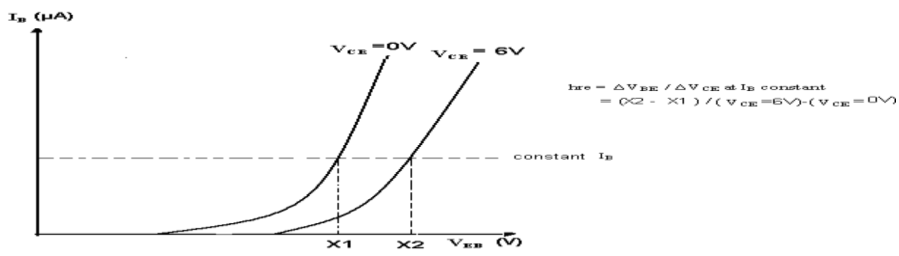
h – Parameter model of CE transistor:



MODEL GRAPH:

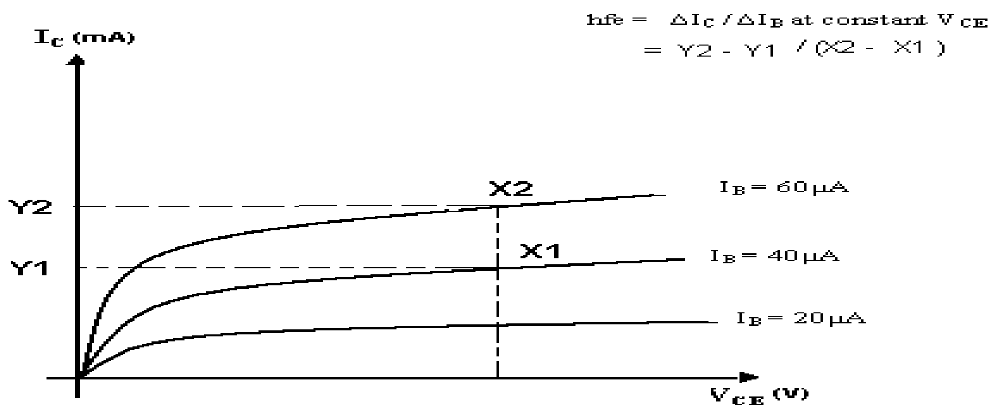
A) INPUT CHARACTERSITICS:

i) calculation of h_{ie} ii) calculation of h_{re}

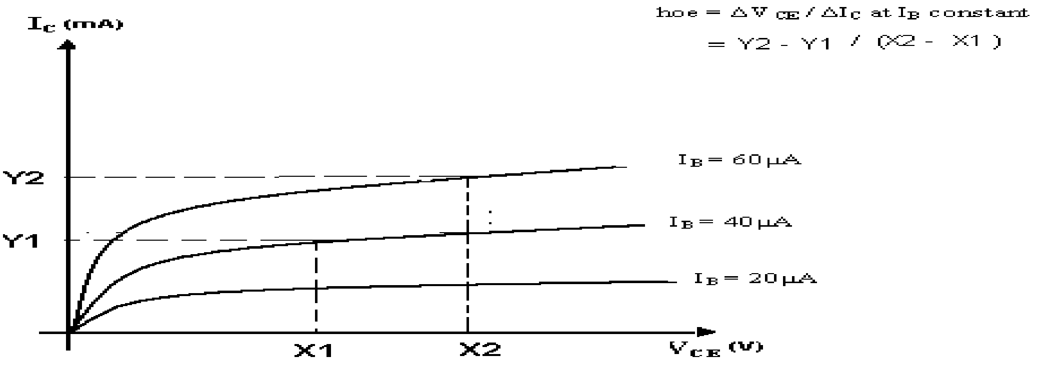


OUPUT CHARACTERISITCS:

i) calculation of h_{fe}



ii) calculation of h_{oe}



TABULAR FORMS:

A) Input Characteristics:

S.NO	V_{CE}=0V		V_{CE}=6V	
	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)

B) Output Characteristics:

S.NO	I_B = 20 μA		I_B = 40 μA		I_B = 60 μA	
	V_{CE} (V)	I_C(mA)	V_{CE} (V)	I_C(mA)	V_{CE} (V)	I_C(mA)

PROCEDURE:

Input Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. Keep output voltage $\mathbf{V_{CE}}$ = 0V by varying $\mathbf{V_{CC}}$.
3. Varying $\mathbf{V_{BB}}$ gradually, note down base current $\mathbf{I_B}$ and base-emitter voltage $\mathbf{V_{BE}}$.
4. Step size is not fixed because of non linear curve. Initially vary $\mathbf{V_{BB}}$ in steps of 0.1V. Once the current starts increasing vary $\mathbf{V_{BB}}$ in steps of 1V up to 12V.
5. Repeat above procedure (step 3) for $\mathbf{V_{CE}}$ = 5V.

Output Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. Keep emitter current I_B = 20μA by varying V_{BB}.
3. Varying V_{CC} gradually in steps of 1V up to 12V and note down collector current I_C and Collector-Emitter Voltage(V_{CE}).
4. Repeat above procedure (step 3) for I_B = 60µA, 0µA.

1. Plot the input characteristics by taking V_{BE} on X-axis and I_B on Y-axis at a constant V_{CE} as a constant parameter
2. Plot the output characteristics by taking V_{CE} on X-axis and taking I_C on Y-axis taking I_B as a constant parameter

Calculations from Graph:

1. **Input Characteristics:** To obtain input resistance find ΔV_{BE} and ΔI_B for a constant V_{CE} on one of the input characteristics.

   Input impedance = h_{ie} = R_i = ΔV_{BE} / ΔI_B (V_{CE} is constant)

   Reverse voltage gain = h_{re} = ΔV_{EB} / ΔV_{CE} (I_B = constant)
2. **Output Characteristics:** To obtain output resistance find ΔI_C and ΔV_{CB} at a constant I_B.

   Output admittance 1/hoe = R_o = ΔI_C / ΔV_{CE} (I_B is constant)

   Forward current gain = hfe = ΔI_C / ΔI_B (V_{CE} = constant)

PRECAUTIONS:

1. While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.
2. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
4. Make sure while selecting the emitter, base and collector terminals of the transistor.

The h-parameters for a transistor in CE configuration are:

a. The Input Resistance (h_{ie}) ________________Ohms.

b. The Reverse Voltage Gain (h_{re}) ________________.

c. The Output Conductance (h_{oe}) ________________ Mhos.

d. The Forward Current Gain (h_{fe}) ________________.

RESULT:

VIVA QUESTIONS:

1. What are the h-parameters?
2. What are the limitations of h-parameters?
3. What are its applications?
4. Draw the Equivalent circuit diagram of H parameters?
5. Define H parameter?
6. What are tabular forms of H parameters monoculture of a transistor?
7. What is the general formula for input impedance?
8. What is the general formula for Current Gain?
9. What is the general formula for Voltage gain?

EXPERIMENT 6
FREQUENCY RESPONSE OF CE AMPLIFIER

AIM: - 1. To Design Transistor CE amplifier and find its voltage gain.

2.To draw the frequency response curve of CE amplifier

COMPONENTS & EQUIPMENTS REQUIRED: -

S.No	Devices / Components	Range/Rating	Quantity
1.	(a) DC supply voltage	12V	1
	(b) BJT	BC107	1
	(c) Capacitors	10µF,100µF	Each 2
	(d) Resistors	2.2K,10k,1K	Each 2
2.	Signal generator	10Hz-1MHz	1
3.	CRO	0Hz-30MHz	1
4.	Connecting wires& CRO Probes		4

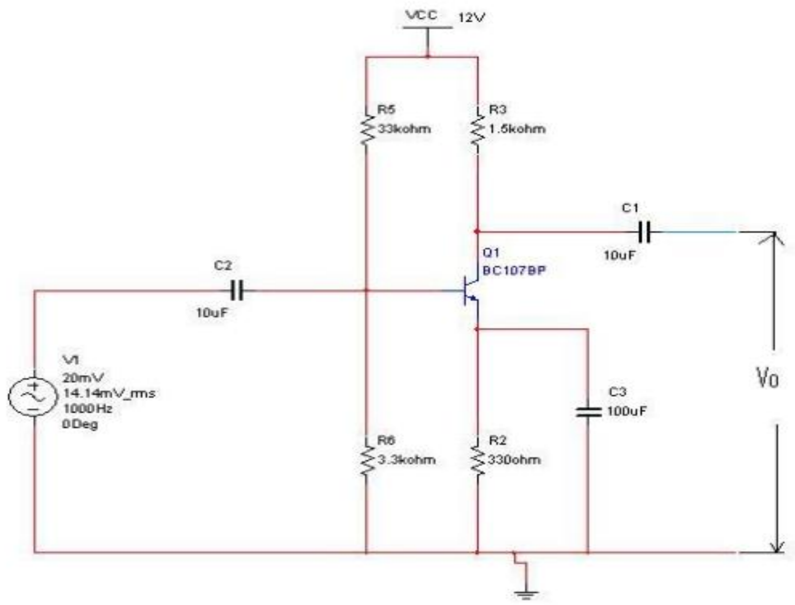
THEORY:

The single stage common emitter amplifier circuit shown above uses what is commonly called "Voltage Divider Biasing" or "self biasing". This type of biasing arrangement uses two resistors as a potential divider network and is commonly used in the design of bipolar transistor amplifier circuits. This type of biasing arrangement greatly reduces the effects of varying Beta, (β) by holding the Base bias at a constant steady voltage. This type of biasing produces the greatest stability.

The Common Emitter Amplifier circuit has a resistor in its Collector circuit. The current flowing through this resistor produces the voltage output of the amplifier. The value of this resistor is chosen so that at the amplifiers quiescent operating point, Q-point this output voltage lies half way along the transistors load line. In Common Emitter Amplifier circuits, capacitors C1 and C2 are used as Coupling Capacitors to separate the AC signals from the DC biasing voltage. This ensures that the bias condition set up for the circuit to operate correctly is not affected by any additional amplifier stages, as the capacitors will only pass AC signals and block any DC component. The output AC signal is then superimposed on the biasing of the following stages. Also a bypass capacitor, CE is included in the Emitter leg circuit. This capacitor is an open circuit component for DC bias meaning that the biasing currents and voltages are not affected by the addition of the capacitor maintaining a good Q-point stability.

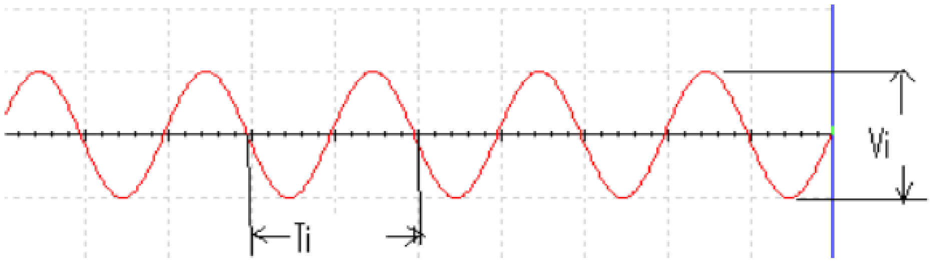
However, this bypass capacitor short circuits the Emitter resistor at high frequency signals and only RL plus a very small internal resistance acts as the transistors load increasing the voltage gain to its maximum. Generally, the value of the bypass capacitor, CE is chosen to provide a reactance of at most, 1/10th the value of RE at the lowest operating signal frequency. A single stage Common Emitter Amplifier is also an "Inverting Amplifier" as an increase in Base voltage causes a decrease in Vout and a decrease in Base voltage produces an increase in Vout. The output signal is 180◦ out of phase with the input signal

CIRCUIT DIAGRAM:

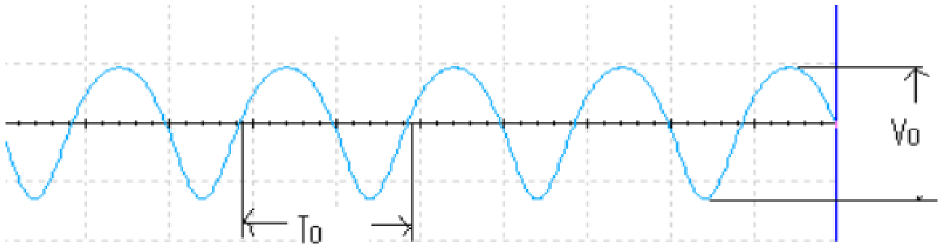


MODELWAVE FORMS:

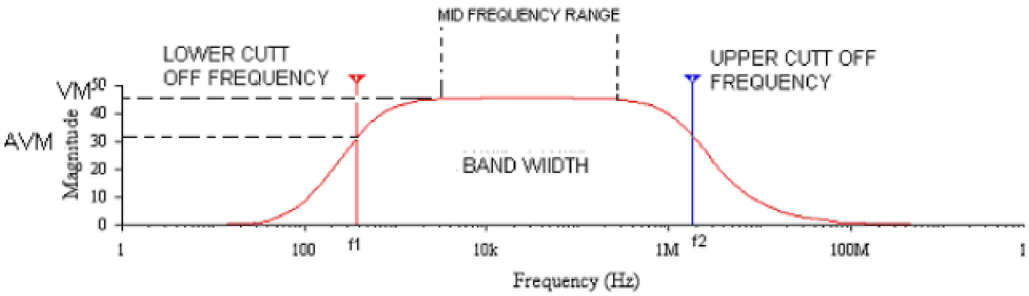
A) INPUT WAVE FORM:



B) OUTPUT WAVE FORM:



FREQUENCY RESPONSE:



OBSERVATIONS

INPUT VOLTAGE =20 MILLI VOLTS

Frequency (in Hz)	Output Voltage (V_o)	Gain Av=Vo/Vi	Gain(in dB) =20log10(Vo/Vi)
20			
50			
100			
1k			
10k			
100k			
200,500K			
1M			

PROCEDURE: -

1. Connect the circuit as shown in circuit diagram
2. Apply the input of 20mV peak-to-peak and 1 KHz frequency using Function Generator
3. Measure the Output Voltage Vo (p-p) for various load resistors
4. Tabulate the readings in the tabular form.
5. The voltage gain can be calculated by using the expression Av= (V0/Vi)
6. For plotting the frequency response the input voltage is kept Constant at 20mV peak-to-peak and the frequency is varied from 100Hz to 1MHz Using function generator
7. Note down the value of output voltage for each frequency.
8. All the readings are tabulated and voltage gain in dB is calculated by Using The expression Av=20 log10 (V0/Vi)
9. A graph is drawn by taking frequency on x-axis and gain in dB on y-axis On Semi-log graph.
10. The band width of the amplifier is calculated from the graph Using the expression, Bandwidth, BW=f2-f1

Where f1 lower cut-off frequency of CE amplifier, and

Where f2 upper cut-off frequency of CE amplifier

11.The bandwidth product of the amplifier is calculated using the Expression

Gain Bandwidth product=3-dBmidband gain X Bandwidth

PRECAUTIONS:

1. Connections should be made carefully and avoid loose connections.
2. Check connections before switching ON power supply.
3. Don’t apply over voltage
4. When you are not using the equipment switch them Off.
5.While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.
6.Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
7.Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
8.Make sure while selecting the emitter, base and collector terminals of the transistor.

APPLICATIONS:

1. Common-emitter amplifiers are also used in radio frequency transceiver circuits.
2. Common emitter configuration commonly used in low-noise amplifiers.

RESULT:

1. Frequency response of BJT amplifier is plotted.
2. Gain = _______dB (maximum).
3. Bandwidth= fH--fL = _________Hz

VIVA QUESTIONS:

1. What is the phase difference between input and output waveforms of CE amplifier?
2. What type of biasing is used in the given circuit?
3. If the given transistor is replaced by P-N-P, can we get the output or not?
4. What is the effect of emitter bypass capacitor on frequency response?
5. What is the effect of coupling capacitor?
6. What is the region of transistor so that it operates as an amplifier?
7. Draw the h-parameter model of CE amplifier.
8. How does transistor acts as an amplifier.
9. Mention the characteristics of CE amplifier

EXPERIMENT 7

FREQUENCY RESPONSE OF CC AMPLIFIER

AIM:

1. To measure the voltage gain of a CC amplifier
2. To draw the frequency response of the CC amplifier

APPRATUS:

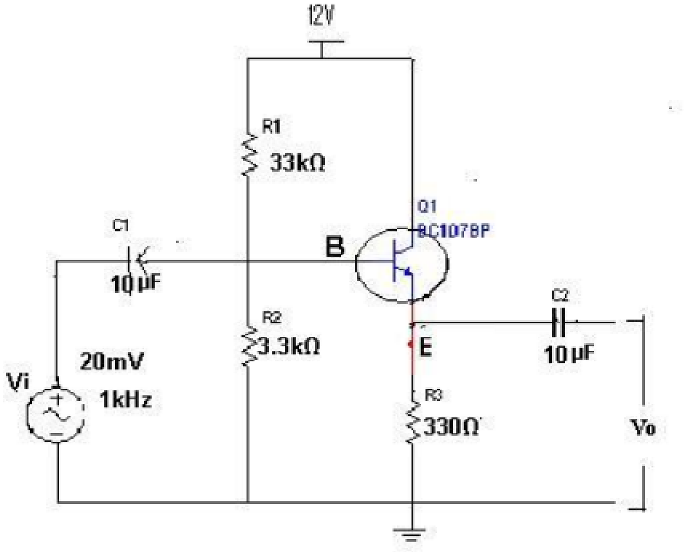
1. Transistor BC 107 -1No.
2. Regulated Power Supply (0-30V) -1No.
3. Function Generator -1No.
4. CRO-1No.
5. Resistors
6. 33KΩ, 3.3KΩ, 330Ω, -1No.Each
7. 1.5KΩ, 1KΩ, 2.2KΩ & 4.7KΩ
8. Capacitors 10µF -2Nos 100µF -1No
9. . Breadboard
10. Connecting wires

THEORY:

In common-collector amplifier the input is given at the base and ground terminals and the output is taken across the emitter and collector terminals. In this amplifier, there is no phase inversion between input and output. The input impedance of the CC amplifier is very high and output impedance is low. The voltage gain is less than unity. Here the collector is at ac ground and the capacitors used must have a negligible reactance at the frequency of operation. This amplifier is used for impedance matching and as a buffer amplifier. This circuit is also known as emitter follower. The most common use of the emitter follower is as a circuit, which performs the function of impedance transformation over a wide range of frequencies.

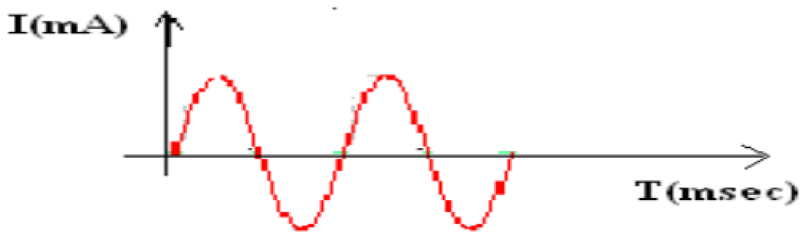
The input characteristics resemble that of a forward biased diode curve. This is expected since the Base-Emitter junction of the transistor is forward biased. The output characteristics are drawn between IE and VCE at constant IB. the emitter current varies with VCE unto few volts only. After this the emitter current becomes almost constant, and independent of VCE. The value of VCE up to which the collector current changes with V CE is known as Knee voltage. The transistor always operated in the region above Knee voltage, IE is always constant and is approximately equal to IB.

CIRCUIT DIAGRAM:

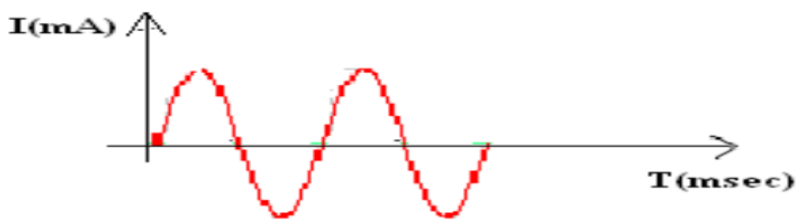


MODEL WAVEFORM:

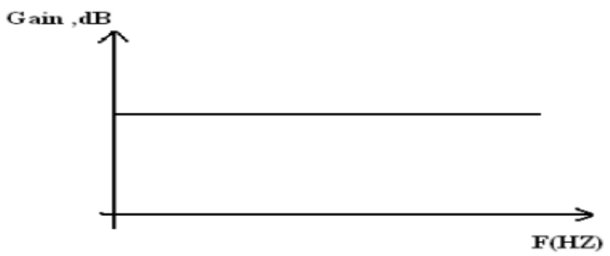
A) INPUT WAVEFORM:



B) OUTPUT WAVEFORM:



FREQUENCY RESPONSE PLOT:



OBSERVATIONS:

A) FREQUENCY RESPONSE, V_i = 20mV

Frequency(HZ)	Output Voltage(Vo)	Gain in dB A_v=20log 10(V0/V_i)

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. The voltage gain calculated by using the expression Av=V0/Vi
3. For plotting the frequency response the input voltage is kept constant a 20mV peak-to- peak and the frequency is varied from 100Hzto 1MHz.
4. Note down the values of output voltage for each frequency.
5. The voltage gain in dB is calculated by using the expression, Av=20log 10(V0/Vi)
6. A graph is drawn by taking frequency on X-axis and gain in dB on y-axis on semi-log graph sheet.
7. The Bandwidth of the amplifier is calculated from the graph using the Expression,

Bandwidth BW=f2-f1

Where f1 is lower cut-off frequency of CE amplifier

f2 is upper cut-off frequency of CE amplifier

8. The gain Bandwidth product of the amplifier is calculated using the Expression,

Gain -Bandwidth product=3-dB midband gain X Bandwidth

PRECAUTIONS:

1. The input voltage must be kept constant while taking frequency response.
2. Proper biasing voltages should be applied.
3. The supply voltages should not exceed the rating of the transistor.
4. Meters should be connected properly according to their polarities.
5. While performing the experiment do not exceed the ratings of the transistor. This may lead to damage the transistor.

6. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
7. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
8. Make sure while selecting the emitter, base and collector terminals of the transistor.

RESULT:

VIVA QUESTIONS:

1. What are the applications of CC amplifier?
2. What is the voltage gain of CC amplifier?
3. What are the values of input and output impedances of the CC amplifier?
4. To which ground the collector terminal is connected in the circuit?
5. Identify the type of biasing used in the circuit?
6. Give the relation between α, β and γ.
7. Write the other name of CC amplifier?
8. What are the differences between CE, CB and CC?
9. When compared to CE, CC is not used for amplification. Justify your answer
10. What is the phase relationship between input and output in CC?

EXPERIMENT 8

8.TWO STAGE RCCOUPLED AMPLIFIER

AIM: To obtain the frequency response of' a two stage RC coupled amplifier. Calculate gain. & Calculate bandwidth.

Apparatus:

1. Transistors BC 107
2. Resistors
3. Capacitors
4. Signal Generators
5. CRO
6. Breadboard
7. Connecting wires

THEORY:

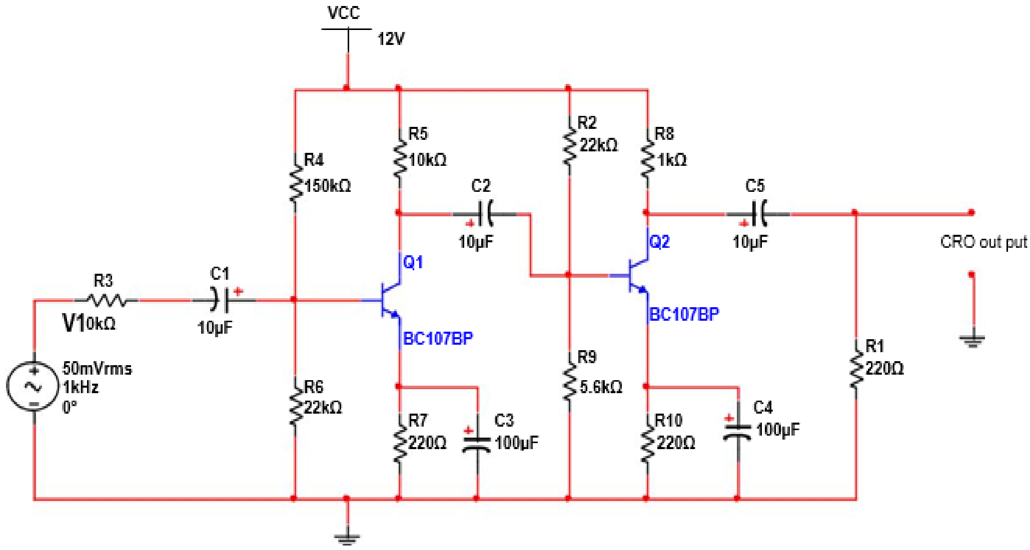
The output from a single stage amplifier is usually insufficient to drive an o/p device. To achieve more gain, the o/p of one stage is given as the input to the other stage which forms multistage amplifier. If the two stages are coupled by R and C, then the amplifier is called RC coupled amplifier. The performance of an amplifier can be determined from the following terms.

Gain:- The gain is defined as ratio of output to input. The gain of multistage amplifier is equal to the product of gains of individual stages i.e G=G1.G2.G3.

Frequency Response:

At low frequencies (<50HZ) the reactance of coupling capacitor cc is high and hence very small part of signal will pass from one stage to next stage. This increases the loading effect of next stage and reduces the voltage gain. At high frequencies, capacitance reduces. Due to this base emitter junction is low which increases the base current. This reduces the amplification factor. At mid frequencies, the voltage gain of the amplifier is Constant. In this range, as frequency increases, reactance of CC reduces which tends to increase the gain. At the same time, lower reactance means higher reactance of first stage and hence lowers gain; these two factors cancel each other resulting in a uniform gain at mid frequency

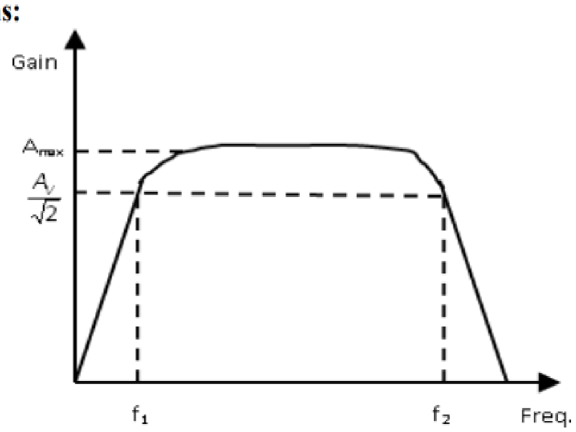
CIRCUIT DIAGRAM:



PROCEDURE

1. Connect the circuit as per the circuit diagram
2. Give 1 KHz signal, 25 mV (p-p) as Vs from signal generator
3. Observe the output on CRO for proper working of the amplifier
4. After ensuring the amplifier function, vary signal frequency from 50 Hz to 600 Hz in proper steps for 15 to 20 readings.
5. Keeping Vs = 25 mV (p-p) at every frequency,
6. note down the resetting output voltage and tabulate in a table.
7. **Calculate gain db**
8. **plot on semi log graph paper for frequency VS gain db.**

Expected waveforms:



TABULAR FORM:

Input voltage =50mv

TABULAR COLUMN: Input = 50mV

Frequency (in Hz)	Output Voltage (V_o)		Gain $A_v=V_o/V_i$		Gain(in dB) =$20\log_{10}(V_o/V_i)$	
	With feedback	Without feedback	With feedback	Without feedback	With feedback	Without feedback
20						
40						
80						
100						
1K						
10k						
50k,100K						
1M						

PRECAUTIONS:

1. Wires should be checked for good continuity
2. Transistor terminals must be identified and connected carefully
3. Avoid loose connections and give proper input Voltage

RESULT:

1. Frequency response of BJT in Two Stage RC Coupled Amplifier is plotted.
2. Gain = _______dB (maximum).
   1. Bandwidth= fH--fL = _________Hz. At stage I
   2. Bandwidth= fH--fL = _________Hz. At stage 2

VIVA QUESTIONS:

1. Why do you need more than one stage of amplifiers in practical circuits?
2. What is the effect of cascading on gain and bandwidth?
3. What happens to the 3dB frequencies if the number of stages of amplifiers increases?
4. Why we use a logarithmic scale to denote voltage or power gains, instead of using the simpler linear scale?
5. What is loading effect in multistage amplifiers?

EXPERIMENT 9

VOLTAGE SERIES FEEDBACK AMPLIFIER

AIM: To study the voltage gain, frequency response, and Bandwidth of a Voltage Series feed-back amplifier with and without feedback.

Apparatus Required:

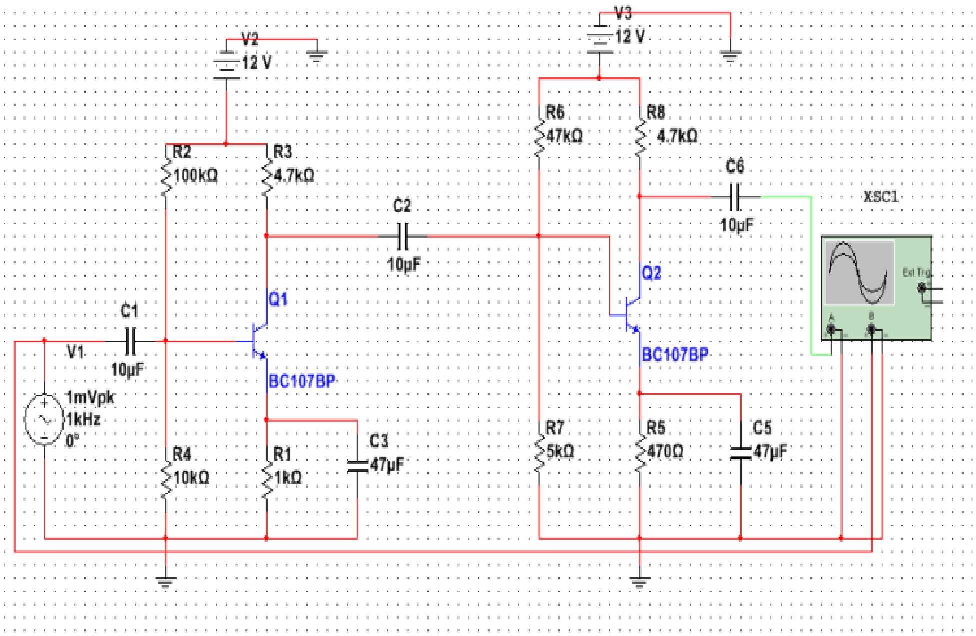
S.No	Device	Range/Rating	Qty
1	(a) DC supply voltage (b) BJT (c) Capacitors (d) Resistors	12V BC107BP 10µF,47uF , 10kΩ,47 kΩ,100kΩ 5 kΩ,4.7kΩ,1kΩ,470Ω	1 1,2 2,1 From each one
2	Signal generator	0.1Hz-1MHz	1
3	CRO	0Hz-20MHz	1
4	Connecting wires		Required

THEORY:

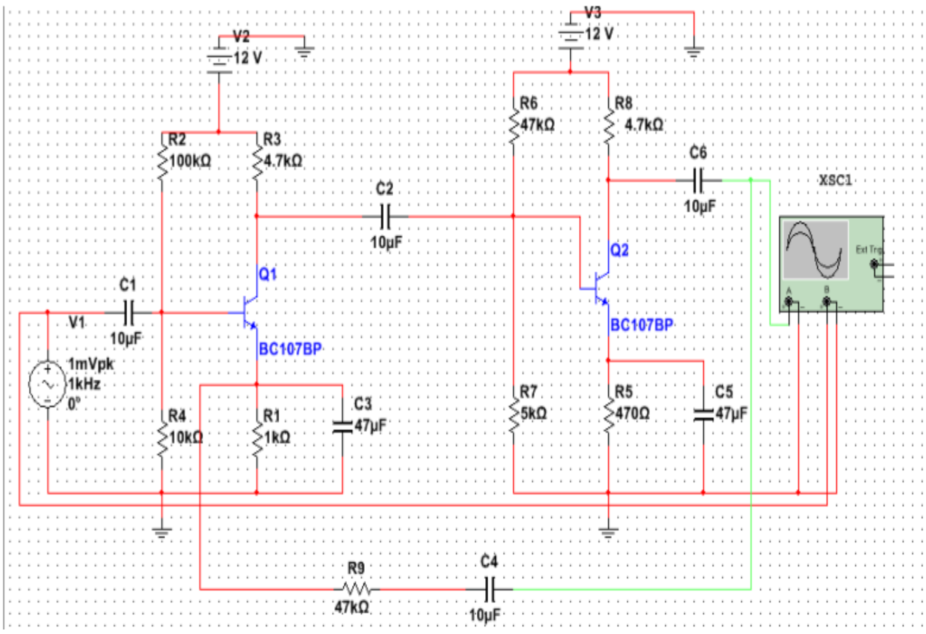
Feedback plays a very important role in electronic circuits and the basic parameters, such as input impedance, output impedance, current and voltage gain and bandwidth, may be altered considerably by the use of feedback for a given amplifier. A portion of the output signal is taken from the output of the amplifier and is combined with the normal input signal and thereby the feedback is accomplished. There are two types of feedback. They are i) Positive feedback and ii) Negative feedback. Negative feedback helps to increase the bandwidth, decrease gain, distortion, and noise, modify input and output resistances as desired.

Here the amplifier and feedback network are connected in series-parallel. A fraction of the output voltage is applied in series opposition to the input voltage through feedback network Thus feedback voltage is given as As seen, the input impedance of the amplifier and output impedance of the feedback network appear in series to the input and therefore input impedance to the amplifier is increased by factor (1 + βA). Similarly input to the feedback network and output of the amplifier appear in parallel to the amplifier output.

CIRCUIT DIAGRAM:
WITHOUT FEEDBACK



WITH FEEDBACK:



PROCEDURE:

1. Connections are made as per circuit diagram.

2. Keep the input voltage constant at 20mV peak-peak and 1kHz frequency.

3.For different values of load resistance, note down the output voltage and calculate the gain by using the expression Av = 20log(V0 / Vi) db

4. Remove the emitter bypass capacitor and repeat STEP 2.And observe the effect of feedback on the gain of the amplifier.

5.For plotting the frequency the input voltage is kept constant at 20mV peak-peak and the frequency is varied from 100Hz to 1MHz.

6. Note down the value of output voltage for each frequency.

7. All the readings are tabulated and the voltage gain in dB is calculated by using expression 8. Av = 20log (V0 / Vi) dB

8.. A graph is drawn by taking frequency on X-axis and gain on Y-axis on semi log graph

9. The Bandwidth of the amplifier is calculated from the graph using the expression

Bandwidth B.W = f2 – f1.

Where f1 is lower cutt off frequency of CE amplifier

f 2 is upper cutt off frequency of CE amplifier

13. The gain-bandwidth product of the amplifier is calculated by using the expression

Gain-Bandwidth Product = 3-dB mid band gain X Bandwidth

APPLICATIONS:

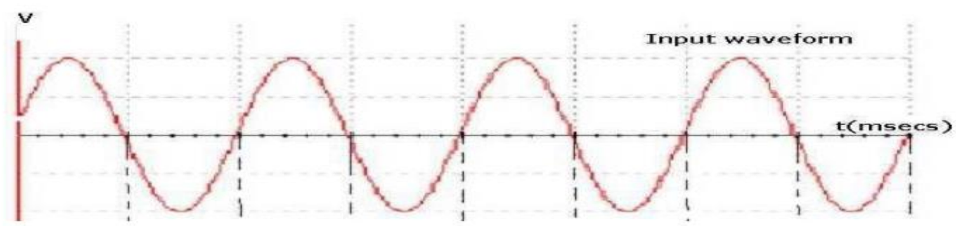
1. They are used in almost all electronic amplifiers.
2. They are used in regulated power supplies.
3. In amplifiers having large bandwidth.

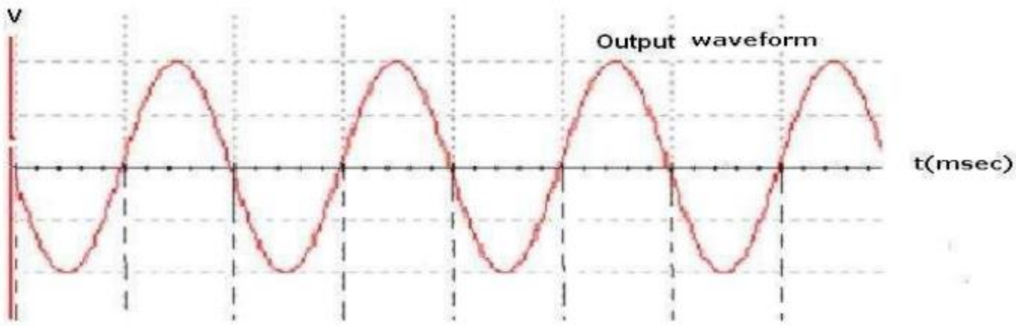
TABULAR COLOUMN:

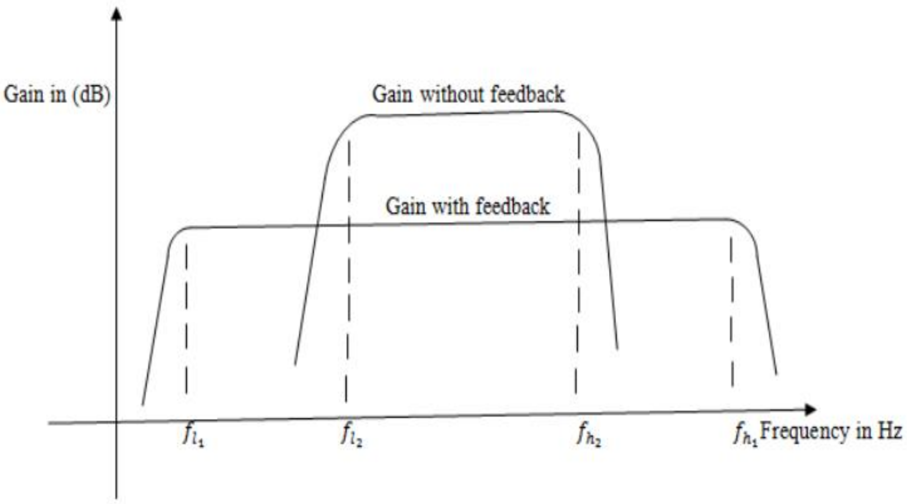
V(in)=20mv

Frequency (in Hz)	Output voltage without feedback	Output voltage with feedback	Gain without feedback $(\frac{V_0}{V_{in}})$	Gain with feedback $(\frac{V_0}{V_{in}})$	Gain in dB without feedback $20\log(\frac{V_0}{V_{in}})$	Gain in dB with feedback $20\log(\frac{V_0}{V_{in}})$
20						
50						
100						
1K						
10K						
100K						
200K,500K						
1M						

Model Graph:







RESULT: - With feed-back, gain decreases and band width increases

1. Frequency response of Voltage-Series Feedback amplifier is plotted.
2. Gain =_______dB (maximum).without Feed-back.
3. Gain =_______dB (maximum).with Feed-back.
4. Bandwidth= f_H-f_L =_________Hz. without Feed-back.
5. Bandwidth= f_H-f_L =_________Hz. with Feed-back.

VIVA QUESTIONS:

1.What is feedback?

2. What are the characteristics of feedback?

3. What is meant by sampling and mixing?

4. What are the configurations of feedback amplifiers?

5. What is the effect of feedback on an amplifier?

6. What is the effect of feedback on input and output resistances?

EXPERIMENT-10

CURRENT SHUNT FEEDBACK AMPLIFIER

AIM:

To determine the effect of feedback on the frequency response of a current shunt feedback amplifier.

1. To calculate gain without feedback.
2. To calculate gain with feedback.

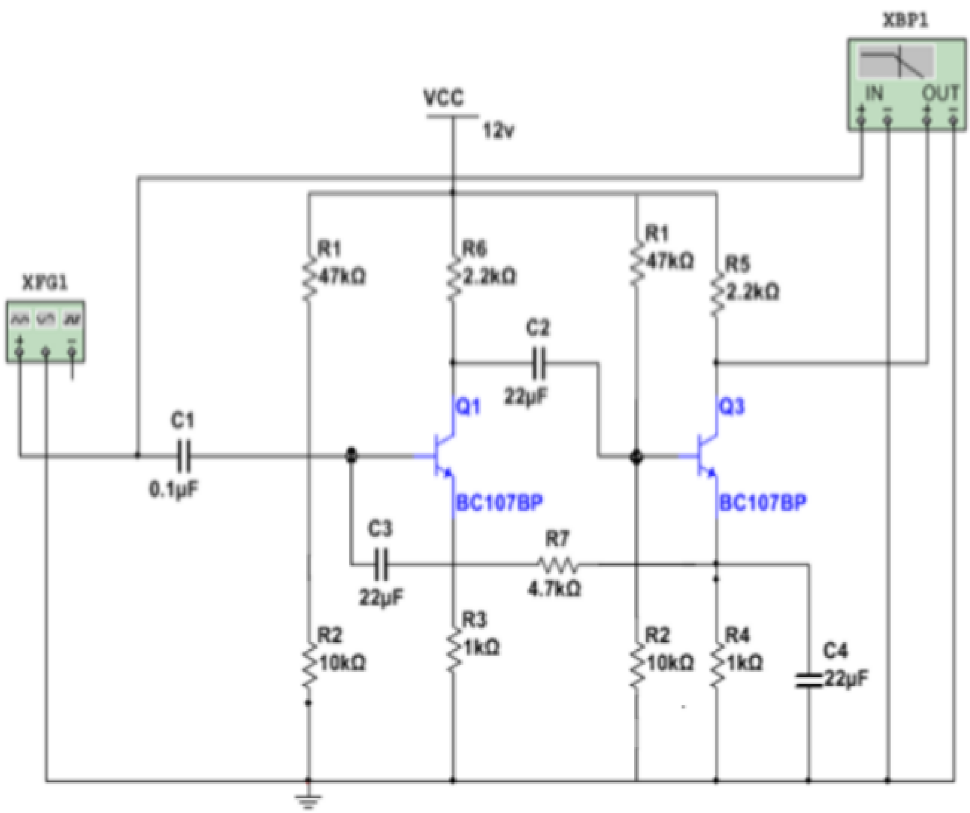
COMPONENTS AND EQUIPMENTS REQUIRED:

S.No	Devices / Components	Range/ Rating	Quantity(in No.s)
1.	a) DC Supply voltage.	12 V	1
2.	b) NPN Transistor.	BC 107	2
3.	c) Resistors.	47kΩ	2
		2.2KΩ	2
		10kΩ	1
		1k	2
4.	d) Capacitor.	0.1μF.	1
		22μF.	3
5.	Function Generator.	0.1 Hz-10 MHz	1
6.	CRO	0-20MHZ	1
7.	Connecting wires and Probes		4

THEORY:

Feedback plays a very important role in electronic circuits and the basic parameters, such as input impedance, output impedance, current and voltage gain and bandwidth, may be altered considerably by the use of feedback for a given amplifier. A portion of the output signal is taken from the output of the amplifier and is combined with the normal input signal and thereby the feedback is accomplished. There are two types of feedback. They are i) Positive feedback and ii) Negative feedback. Negative feedback helps to increase the bandwidth, decrease gain, distortion, and noise, modify input and output resistances as desired. A current shunt feedback amplifier circuit is illustrated in the figure. It is called a series-derived, shunt-fed feedback. The shunt connection at the input reduces the input resistance and the series connection at the output increases the output resistance. This is a true current amplifier.

CIRCUIT DIAGRAM:

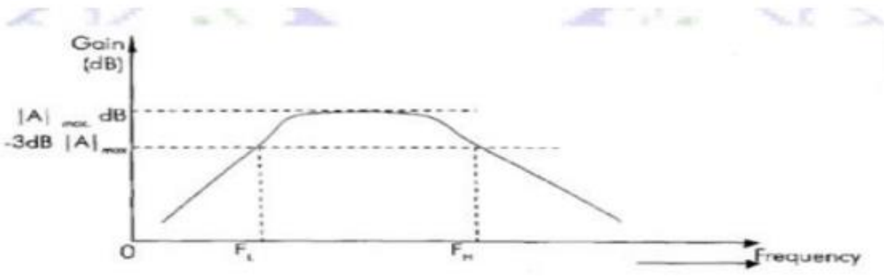


PROCEDURE:

1. Connect the circuit as shown in figure
2. Adjust input signal amplitude in the function generator and observe an amplified voltage at the output without distortion
. 3. By keeping input signal voltage, say at 50 mV, vary the input signal frequency from 10HZ to 1 MHz as shown in tabular column and note the corresponding output voltage.
4. Calculate the voltage gain in dB using the formula Av=20 log(Vo/Vi).
 5. Plot AV VS frequency on the Semi-log Sheet.

6. For current shunt feedback amplifier with feedback connect the output of the feedback amplifier to the other channel of the CRO and Repeat the above procedure.

EXPECTED GRAPH:



OBSERVATIONS

Input = 50mV

Frequency (in Hz)	Output Voltage (Vo)		Gain Av=Vo/Vi		Gain(in dB) =20log10(Vo/Vi)	
	With feedback	Without feedback	With Feedback	Without Feedback	With feedback	Without feedback
10 HZ						
20 HZ						
40 HZ						
80 HZ						
100 HZ						
1K						
10 K						
20 K						
40 K						
50 K						

PRECAUTIONS:

1. All the connections are to be connected properly.
2. Check the connections before giving the power supply
3. Observations should be taken carefully.

APPLICATIONS:

1. They are used in almost all electronic amplifiers.
2. They are used in regulated power supplies.
3. In amplifiers having large bandwidth.

RESULT:

The Av of the current shunt feedback amplifier is and the bandwidth is ________without feedback and The A v of the current shunt feedback amplifier is ________and the bandwidth is _________with feedback

. **VIVA QUESTIONS:**

1. What is feedback?
2. What are the characteristics of feedback?
3. What is meant by sampling and mixing?
4. What are the configurations of feedback amplifiers?
5. What is the effect of feedback on an amplifier?
6. What is the effect of feedback on input and output resistances

EXPERIMENT 11

COLPITTS OSCILLATOR

AIM:

Find practical frequency of Colpitt's oscillator and to compare it with theoretical Frequency for 1. L= 20mH and C= 0.001µF, 2. L= 20mH and 0.1µF

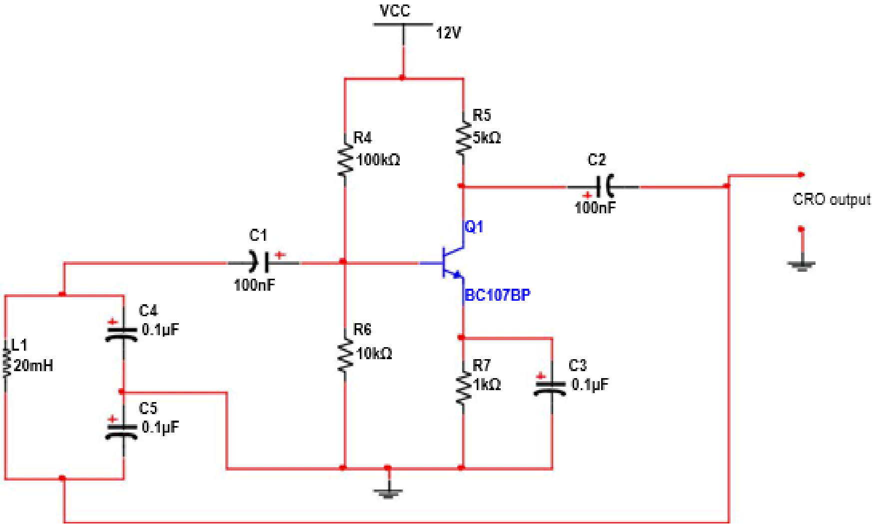
COMPONENTS :

S.No	Devices / Components	Range/Rating	Quantity
1	a) DC supply voltage	12V	1
	b) Inductors	20Mh	1
	c) Capacitor	0.01µF,0.1µF,100nf	1
	d) Resistor	10KΩ,100KΩ,2.5KΩ,5KΩ,1KΩ	1
	e) NPN Transistor	BC 107	1
2	Cathode Ray Oscilloscope	(0-20) MHz	1
3	Connecting wires& CRO Probes		4

THEORY:

The Colpitts circuit, like other LC oscillators, consists of a gain device with its output connected to its input in a feedback loop containing a parallel LC circuit (tuned circuit) which functions as a bandpass filter to set the frequency of oscillation. Colpitts oscillator is the electrical dual of a Hartley oscillator, where the feedback signal is taken from an "inductive" voltage divider consisting of two coils in series (or a tapped coil). L and the series combination of C1 and C2 form the parallel resonant tank circuit which determines the frequency of the oscillator. The voltage across C2 is applied to the base-emitter junction of the transistor, as feedback to create oscillations. Here the voltage across C1 provides feedback. The frequency of oscillation is approximately the resonant frequency of the LC circuit, which is the series combination of the two capacitors in parallel with the inductor. The actual frequency of oscillation will be slightly lower due to junction capacitances and resistive loading of the transistor. As with any oscillator, the amplification of the active component should be marginally larger than the attenuation of the capacitive voltage divider, to obtain stable operation. Thus, a Colpitts oscillator used as a variable frequency oscillator (VFO) performs best when a variable inductance is used for tuning, as opposed to tuning one of the two capacitors. If tuning by variable capacitor is needed, it should be done via a third capacitor connected in parallel to the inductor (or in series as in the Clapp oscillator).

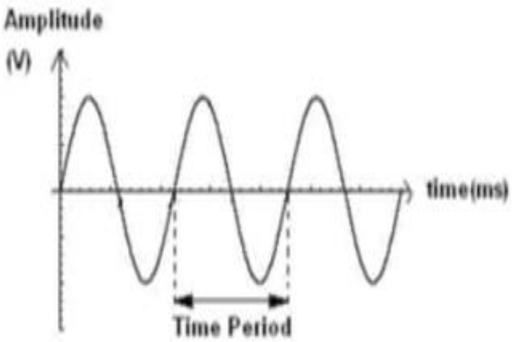
CIRCUIT DIAGRAM:



PROCEDURE:-

1. Connect the circuit as shown in the figure
2. Connect the output of the Colpitts Oscillator kit to the CRO.
3. Observe the sinusoidal signal as an output and note down the time period of the oscillation
4. Compare the practical frequency with the theoretical frequency

EXPECTED GRAPH:



OBSERVATION TABLE:

S.No	L (mH)	C1(µF)	C2(µF)	Theoretical frequency(KHz)	Practical frequency(KHz)
1	20	0.01	0.01		
2	20	0.1	0.1		

PRECAUTIONS:-

1.No loose connections at the junctions & Check the continuity of the connecting terminals before going to connect the circuit.

2. Identify the emitter, base and collector of the transistor properly before connecting it in the circuit.

3. The horizontal length between two successive peaks should accurately be measure

APPLICATIONS

1. Colpitts oscillators are used for high frequency range and high frequency stability
2. It is used for generation of sinusoidal output signals with very high frequencies.
3. A surface acoustical wave (SAW) resonator
4. It is used for the development of mobile and radio communications.
5. Used for applications in which undamped and continuous oscillations are desired for functioning.

RESULT:

1. For C=0.01µF, 0.1uf & L= 20mH
   Theoretical frequency = ______________
   Practical frequency =______________
2. For C=0.1µF, 0.1uf & L= 20mH
   Theoretical frequency =______________
   Practical frequency =_____________

VIVA-QUESTIONS:

1. What is an Oscillator?
2. What is the main difference between an amplifier and an oscillator?
3. State Barkhausen criterion for oscillation.
4. State the factors on which oscillators can be classified.
5. What are the factors which contribute to change in frequency in oscillators
6. State the applications of coliptt’s oscillator?

EXPERIMENT 12

HARTLEY OSCILLATOR

AIM:
Find practical frequency of a Hartley oscillator and to compare it with theoretical frequency for L = 10mH and C = 20nF.

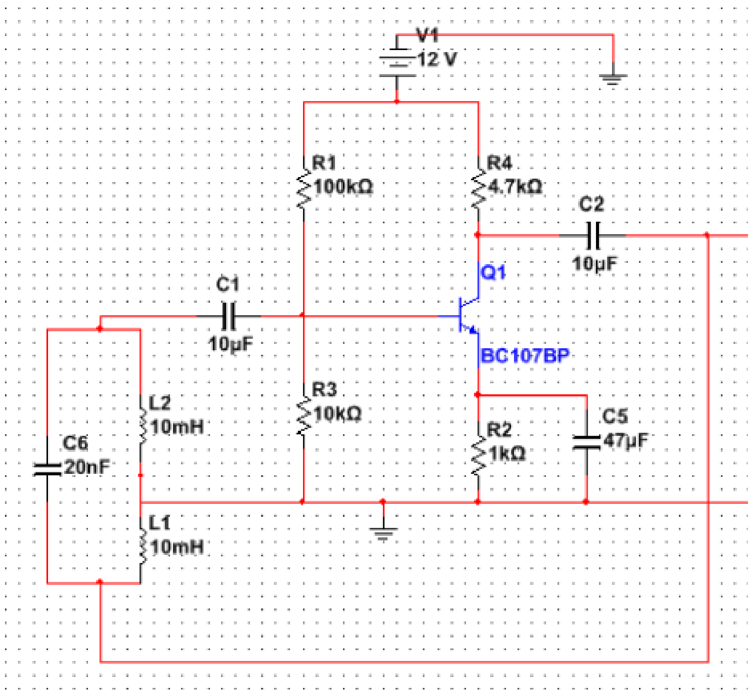
APPARATUS REQUIRED:

S.No	Device	Range/Rating	Quantity
1	a) DC supply voltage b) Inductors c) Capacitor d) Resistor e) NPN Transistor	12V 10mH 20nF, 10uF,47uF 1KΩ,10KΩ,4.7KΩ,100KΩ BC 107	1 2 1,2,1 Each 1 1
2	Cathode Ray Oscilloscope	(0-20) MHz	1
3	BNC Connector		1
4	Connecting wires		Required

THEORY:

In a Hartley oscillator the oscillation frequency is determined by a tank circuit comprising of two inductors and one capacitor. The inductors are connected in series and the capacitor is connected across them in parallel. Hartley oscillators are commonly used in radio frequency (RF) oscillator applications and the recommended frequency range is from 20KHz to 30MHz. Hartley oscillators can be operated at frequencies lower than 20KHz, but for lower frequencies the inductor value need to be high and it has a practical limit.
The circuit diagram of a typical Hartley oscillator is shown in the figure .

CIRCUIT DIAGRAM:



PROCEDURE:

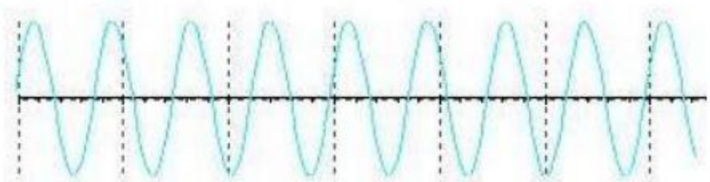
1. Connect the circuit as shown in figure.
2. With C6=20nF capacitor and L1=L2=10mH in the circuit and observe the waveform.
3. Time period of the waveform is to be noted and frequency is to be calculated by the formula f = 1/T .
4. Find the theoretical frequency from the formula

$f = 1\ 2\Pi\sqrt{LtC}$

Where LT = L1 + L2 = 10mH + 10mH = 20mH

5. compare theoretical and practical values

EXPECTED GRAPH:



OBSERVATIONS:

I.Theoretical frequency of oscillation: L1=L2=_____ AND C=____

$$L = L_1 + L_2$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$

II. Practical frequency of oscillation: T=_____

fo=1/ T = _Hz_______

OBSERVATION TABLE:

S.No	L1 mH	L2 mH	C(µF)	Theoretical frequency(KHz)	Practical frequency(KHz)
1					
2					
3					

PRECAUTIONS:

1. Observations should be taken carefully
2. Identify the emitter, base and collector of the transistor properly before connecting it in the circuit.
3. The horizontal length between two successive peaks should accurately be measured.

APPLICATIONS

1. The Hartley oscillator is to produce a sine wave with the desired frequency
2. Hartley oscillators are mainly used as radio receivers
. 3. The Hartley oscillator is Suitable for oscillations in RF (Radio-Frequency) range, up to 30MHZ

RESULT:

1. For C 6= 20nF, & L_T= 20 mH;
   Theoretical frequency =
   Practical frequency =

VIVA QUESTIONS:

1. Classification of oscillators.
2. Give the applications of oscillator
3. Give an example for LC oscillator.
4. Which phenomenon is employed for crystal oscillator.
5. What is the main difference between an amplifier and an oscillator?
6. State Barkhausen criterion for oscillation.
7. State the factors on which oscillators can be classified.
8. What are the factors which contribute to change in frequency in oscillators?