Lab manual – ELECTRONICS CIRCUITS AND DEVICES (3047)

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Department of Electronics & Communication Engineering
GOVERNMENT POLYTECHNIC COLLEGE, PERUMBAVOOR
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Exp No. Date: | D | D | - | M | M | - | Y | Y |

VISION AND MISSION

Government Polytechnic College, Perumbavoor Vision and Mission

Vision

Excel as a centre of skill education moulding professionals who sincerely strive for the betterment of society.

Mission

- To impart state of the art knowledge and skill to the graduate and moulding them to be competent, committed and responsible for the well being of society.
- To apply technology in the traditional skills, thereby enhancing the living standard of the community

Department of Electronics & Communication Engineering

Vision

Excel as a centre of skill education in Electronics and Communication Engineering, moulding professionals who sincerely strive for the betterment of themselves and society.

Mission

- To impart state of the art knowledge, skill and attitude to the students and contributing to their sustainable development.
- To merge technologies in the field of Electronics and Communication Engineering with occupational skills, thereby improving quality of living.

Exp No. Date:

PEO, PO and PSOs of the Program

Program Educational Outcome (PEOs)

PEO1: Secure successful careers in manufacturing, testing, maintenance, development and marketing in Electronics and Communication Engineering.

PEO2: Acquire knowledge and competency in the domain to develop innovative, cost effective and socially acceptable solutions to engineering problems in a multi disciplinary work environment.

PEO3: Develop strong fundamental knowledge that prepares them for professional careers/higher studies with attitude for lifelong learning.

PEO4: Instill the attitude to be sensitive to ethical, societal and environmental issues while pursuing their professional duties.

PEO5: Possess leadership qualities and be effective communicator to work efficiently with diverse teams, promote and practice appropriate ethical practices.

Program Outcomes (POs)

1. Ability to communicate effectively with customers and officials, both in writing and orally.

2. An ability to apply knowledge of Electronics, communication, computing, mathematical foundations and theory in the implementation and design of electronics based systems.

3. An ability to interpret data sheets and schematics.

4. An ability to understand and solve real time problems in electronics, electronics and communication domain.

5. An ability to develop real time applications based on communication programming skills.

6. Ability to configure, troubleshoot and maintain electronic, communication and digital circuits.

7. Ability to apply entrepreneurial skills in the awake of incubation centers.

8. Ability to use and design communication systems.

9. An ability to recognize the importance of professional development by pursuing undergraduate studies or face competitive examinations that offer challenging and rewarding career in Electronics & Communication.

10. Understanding professional ethical legal security and social issues and responsibilities further to function effectively in a multi disciplinary environment.

Program Specific Outcome (PSO):

PSO1: Specialization knowledge: Apply concepts and knowledge in the field of semiconductor devices, communication and networking technologies, embedded systems.

PSO2: Professional growth: Generate ideas from the knowledge of engineering specialization leading to professional growth.

PSO3: Entrepreneurship: Apply knowledge and understanding of engineering principles to initiate entrepreneurship ventures.

Exp No. 1 Date:

SAFETY PROCEDURES

Problem Statement:

The safety instructions are presented to the attention of the students as a mean of preventing accidents while performing experiments and activities in the electronic circuits lab of the department .The purpose is to draw attention to the risks involved in lab activities to prevent human suffering and damage to equipment.

Safety in the laboratory:

Working in the lab is not allowed without following electricity precautions displayed.

No individual work is allowed in the lab.

Laboratory in charge is responsible for the arrangements of your lab activities; Listen carefully to his/her instructions and follow them.

To do and not to do:

Inform the lab in charge about dangerous conditions and faults in the lab or nearby environment.

Do not do any action that may harm people or equipments in the lab.

Do not misuse any of the tools or instruments belong to the lab.

Strict discipline should be maintained in the laboratory.

Turn off cell phones before entering the lab.

At the end and beginning of laboratory, follow 5S procedures and leave the work table clean and tidy.

Electrical Safety:

Consult Electrical Engineering section available in the campus for electrical safety queries.

The lab equipment is powered from electrical sockets installed on the tables. Do not use equipment that is powered from a damaged socket.

Do not use equipment that is powered from flexible cable with damaged insulation or if it's plug is not assembled properly.

Do not repair or disassemble electrical equipment including replacement of fuses installed in the equipment.

Do not open the main fuse box, unless it is an emergency and you need to switch off main circuit breaker.

Emergency Switches:

The laboratory has circuit breakers, which is located in the main panel. Identify the place.
In an emergency condition, switch off circuit breakers immediately.

Result

Familiarization of safety precautions performed.

	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No. 2 Date:

HANDLING ELECTROSTATIC DISCHARGE (ESD)

Problem Statement:

Familiarize ESD handling procedures in the laboratory

Theory

In handling electronic devices, datasheets cautions about ESD (Electrostatic Discharge) precautions. These devices are prone to damage because of electrostatic charges made by human body. These charges may be up to 4000 volts and cause damage without being noticed. It is recommended to follow ESD precautions on handling of these devices.

Points for the elimination of ESD damage to electronic components

1. Make sure you have a reliable ground point available near the table.
2. Do not wear clothing which generates static electric charges every time you move.
3. Do not handle static generating objects while working on electronics.
4. Store all chips and other components in appropriate anti-static containers.

5. Keep all ESD sensitive components and spares in anti-static envelopes for storage.
6. Be sure to turn off the power and remove the power plug from all equipment before working repairing or assembling.
7. Do not plug in or remove equipments while the power is on.

Result

Familiarization of ESD protection procedures performed.

	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No. 3

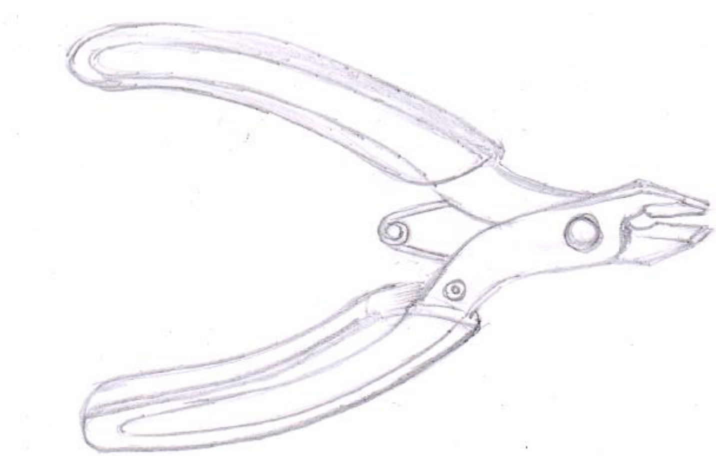
FAMILIARIZATION OF TOOLS AND PROCEDURES

Problem Statement:

To familiarize proper usage of tools used for handling componenets.

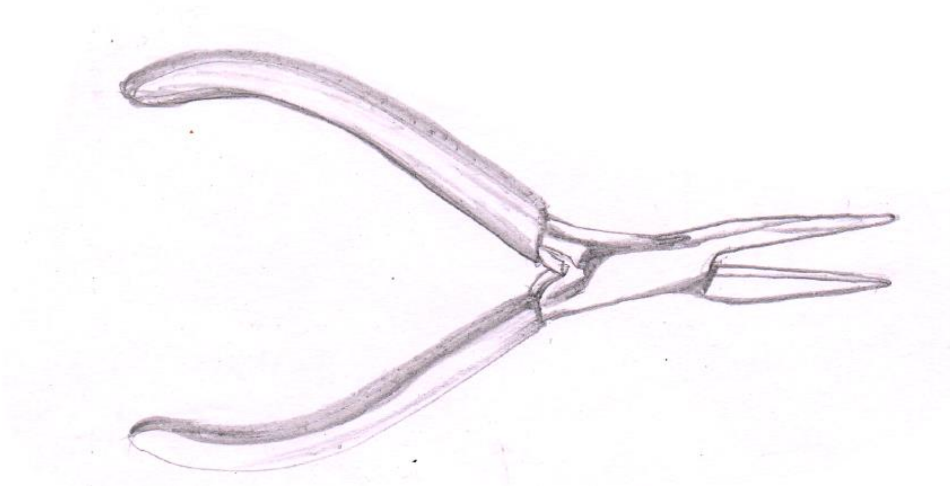
Nipper

These electronic nippers are for cutting wires and component leads. They have a cushioned handle which makes them much more comfortable to use.



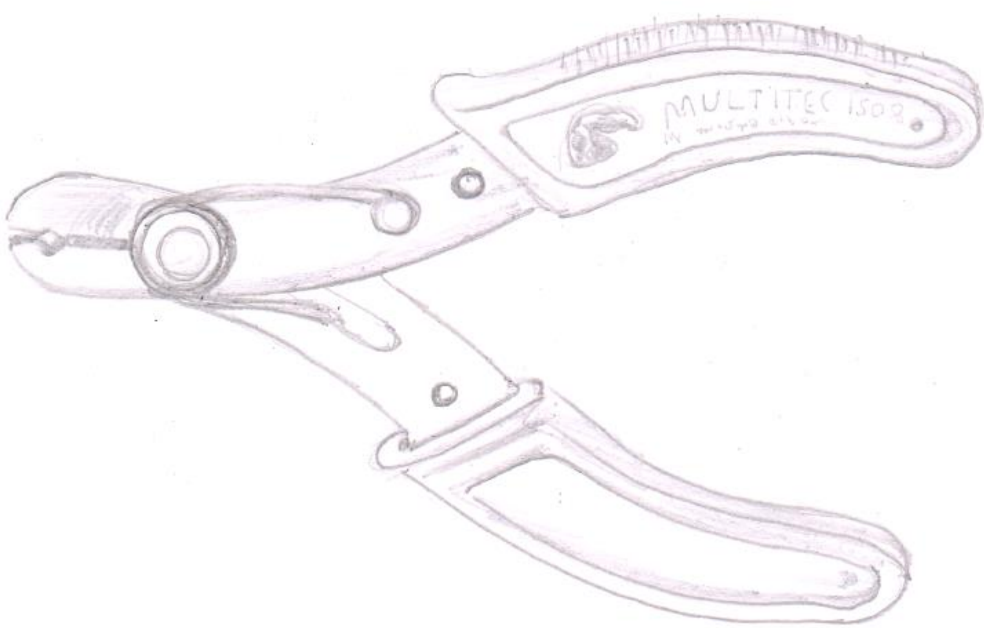
Long nose pliers

Needle-nose pliers are both cutting and holding pliers used to bend, re-position and snip. Because of their long shape they are useful for reaching into small areas where cables or other materials have become stuck or unreachable with fingers or other means.



Wire stripper

A wire stripper is a small, hand-held device used to strip the electrical insulation from electric wires.



Result

Study of proper usage of tools used for handling components.

	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No.	4	Date:							

TRANSISTOR AS SWITCH

Problem Statement

To set up a transistor switch and plot its response in low and high frequency

COMPONENTS/EQUIPMENTS

1. Resistors 1 KΩ (1 no.),47 KΩ(1 no).
2. Transistor BC 107 (1 no)
3. LED (1 No)
4. Function generator 0 to 1 MHz(1 no.) 5.Oscilloscope 0 to 20 MHz (1 no.)
6. Multimeter(1 no).7. Breadboard (1 no.), 8.Connecting wires

THEORY

The areas of operation for a transistor switch are known as the **Saturation Region** and the **Cut-off Region**.

1. Cut-off Region

Here the operating conditions of the transistor are zero input base current (I_B), zero output collector current (I_C) and maximum collector voltage (V_{CE}) which results in a large depletion layer and no current flowing through the device. Therefore the transistor is switched "Fully-OFF".

2. Saturation Region

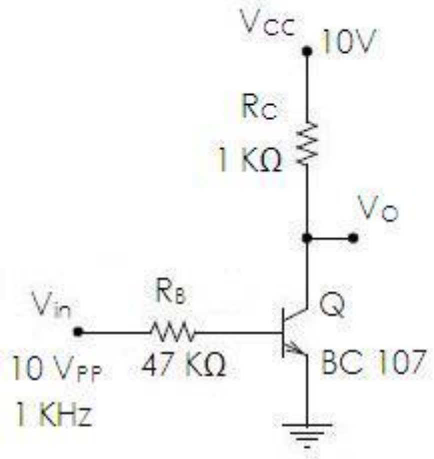
Here the transistor will be biased so that the maximum amount of base current is applied, resulting in maximum collector current resulting in the minimum collector emitter voltage drop which results in the depletion layer being as small as possible and maximum current flowing through the transistor. Therefore the transistor is switched "Fully-ON

PROCEDURE

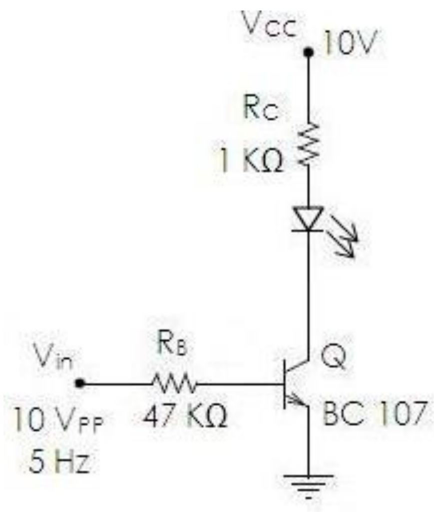
1) Test the components
2) Assemble the circuit on a breadboard
3) Measure the dc condition that is VBE and VCE using multimeter and verify the transistor is inON condition.
4) Apply 1KHz, 10Vpp square wave as input
5) Observe and plot the waveforms at base and collector
6) Connect an LED at the collector and visualize the switching action with 5Hz signal

CIRCUIT DIAGRAM

1. **Square wave Response (the component values provided in the circuit are pretested for output. Students may use the same value for experiment)**



2. Visualization with LED



OBSERVATIONS

1. Square wave response

2. Visualization with LED

RESULT:

Transistor switch at low and high frequency is assembled and response studied.

Tested frequency = 1KHz.

	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No. 5 Date: DD-MM-YY

SINGLE STAGE RC COUPLED AMPLIFIER

Problem Statement

To set up a single stage RC coupled CE amplifier with voltage divider bias and

(i) Observe the phase difference between input and output waveforms
(ii) Measure mid band gain
(iii) Plot its frequency response and determine the bandwidth

EQUIPMENTS COMPONENTS

1. Resistors 470 Ω 1 no ,1 KΩ 1 no,1.8 KΩ 1 no,10 KΩ 1 no,47 KΩ 1 no.
2. Capacitor 10 µF 2 nos, 22 µF 1 no.
3. Transistor BC 1071 no.
4. Function generator 0 to 1 MHz 1 no.
5. Oscilloscope 0 to 20 MHz 1 no.
6. Power supply 12 V dc 1 no.
7. Multimeter 1 no.
8. Breadboard 1 no.
9. Connecting wires

THEORY

RC coupled CE amplifier is widely used in audio frequency applications as voltage amplifiers. In a CE amplifier base current controls the collector current. A small change in IB results in relatively large change in IC. The transistor is biased in active region using potential divider bias. That is emitter - base junction is forward biased and collector – base junction is reverse biased. The output signal is 180degree out of phase with input signal. RC coupled amplifier provides uniform gain at mid frequencies. Gain decreases at low frequencies and high frequencies. The output voltage and hence the voltage gain is decided by RL.

Bandwidth.

The range of frequency that an amplifier can amplify properly is called the bandwidth of that particular amplifier. Usually the bandwidth is measured based on the half power points i.e. the points where the output power becomes half the peak output power in the frequency Vs output graph. Bandwidth is the difference between the lower and upper half power points. The band width of a good audio amplifier must be from 20 Hz to 20 KHz because that is the frequency range that is audible to the human ear.

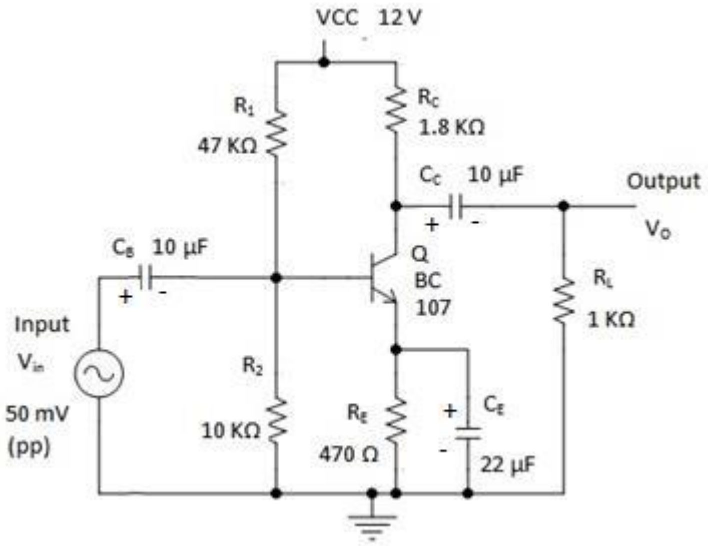
Gain.

Gain of an amplifier is the ratio of output power to the input power. It represents how much an amplifier can amplify a given signal. Gain can be simply expressed in numbers or in decibel (dB). Gain in number is expressed by the equation G = P_{out} / P_{in}. In decibel the gain is expressed by the equation Gain in dB = 10 log (P_{out} / P_{in}). Voltage gain in decibel can be expressed using the equation, Av in dB = 20 log (V_{out} / V_{in}) and current gain in dB can be expressed using the equation Ai = 20 log (I_{out} / I_{in}).

PROCEDURE

*1)*Take precautions for personal safety
2)Take precautions for components and equipments safety
3) Test the components.
4) Assemble the circuit in a bread board.
5) Give VCC and measure the dc bias conditions.
6) Give 1KHz, 50 mV (pp) sinusoidal signal as input, observe and plot the waveforms at input and at the output point.
7) Measure the output voltage without RL, with RL = 10 KΩ and with RL = 1 KΩ.
8) Calculate the voltage gain in each case.
9) To get the frequency response, vary the input frequency from 0 – 1 MHz in suitable steps and measure the output voltage in each step.
8) Enter these values in tabular column and plot the frequency response in a graph sheet.
9) Determine the midband gain and bandwidth from the frequency response plot

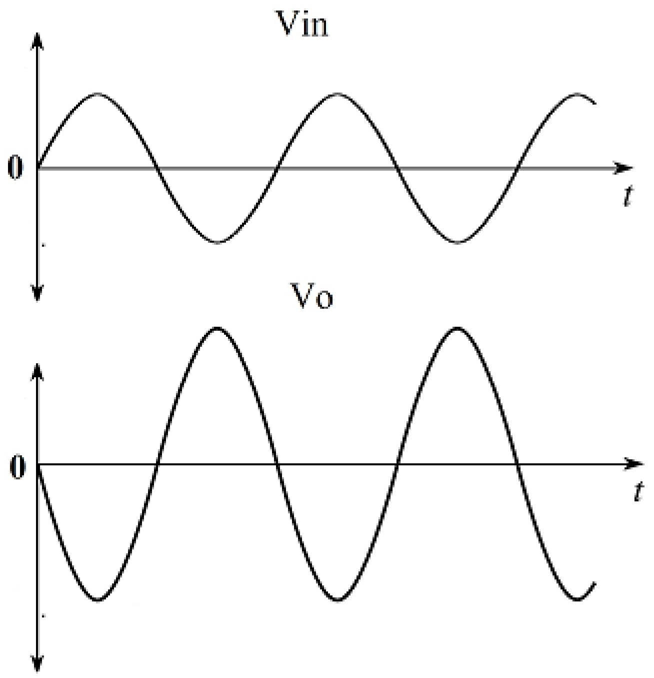
CIRCUIT DIAGRAM



OBSERVATIONS

1. DC conditions
   VCC =
   VBE =
   VCE =

2. Input and output waveforms



3. Calculation of gain at midband

(i) Without RL
Vin = 50 mV (pp)
F = 10 KHz
Gain = Vo/Vin=

(ii) RL = 10 KΩ
Vin = 50 mV (pp)
F = 10 KHz
Gain = Vo/Vin=

(iii) RL = 1 KΩ
Vin = 50 mV (pp)
F = 10 KHz
Gain = Vo/Vin=

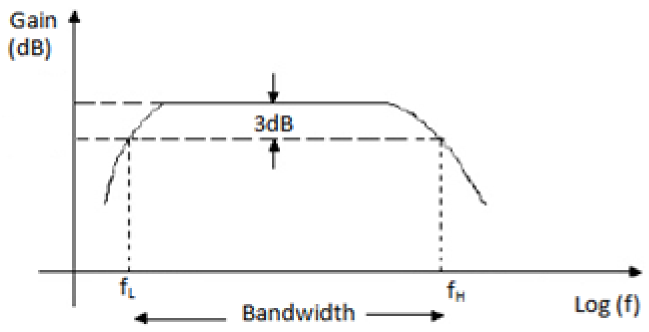
(Note : It can be seen that as the value of RL decreases gain also decreases)

4. Frequency response

Frequency (f) in Hz	Logf	VO in Volt	Gain =Vo/Vin	Gain in dB 20 log (Gain

5. Frequency response plot

Take log f on x-axis, gain in dB on y-axis



From frequency response plot
fL =
fH =
Bandwidth = fH - fL
Midband gain =

RESULT:

INFERENCE:

	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No. 6 Date: D D - M M - Y Y

EMITTER FOLLOWER

Problem statement

To construct an emitter follower circuit and
(i) Measure the gain
(ii) Plot its input and output waveforms

EQUIPMENTS / COMPONENTS

1. Resistors 1 KΩ 1 no.
2.2 KΩ 1 no.
10 KΩ 1 no.
22 KΩ 1 no.
33 KΩ 1 no.
2. Capacitor 1 µF 2Nos
3. Transistor BC 107 1 no.
4. Function generator 0 to 1 MHz 1 no.
5. Oscilloscope 0 to 20 MHz 1 no.
6. Multimeter 1 no.
7. Breadboard 1 no.
8. Connecting wires

THEORY

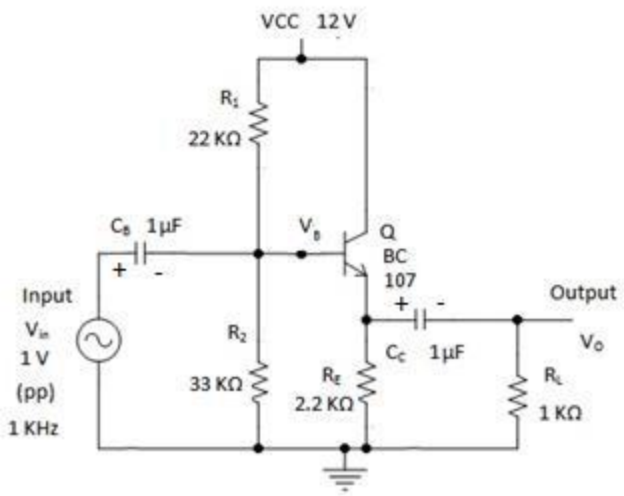
Emitter follower is the popular name for common collector amplifier. Its voltage gain is approximately unity (without RLvoltage gain is unity). It has high input impudence and lowoutput
impedance. Thus emitter follower has less loading effect and is suitable for impedance matching.
Since collector is directly connected to dc source, it appears to be grounded for ac signal.
Output is taken from the emitter terminal. The output voltage is in phase and is equal to the input
signal. Since the amplitude and phase of the output (emitter) follows the input (base), the circuit is
called emitter follower. In this circuit voltage divider biasing is used for base bias. RE acts as the

load for signal at the output circuit.RE also provides a negative feedback in the circuit.

PROCEDURE

1) Test the components
2) Assemble the circuit
3) Measure the dc condition using multimeter and verify whether the transistor is in active
region
4) Apply 1Vpp,1 KHz sinusoidal signal as input
5) Observe the voltages at input point (Vin), at base, at emitter and at the output point(VO)
without RL
6) Measure the amplitudes and dc levels
7) Plot the waveforms
8) Observe and measure VO with RL = 10 KΩ and RL = 1KΩ
9) Calculate the voltage gain for the above three conditions of RL

CIRCUIT DIAGRAM



OBSERVATIONS

1. DC Condition (multimeter)

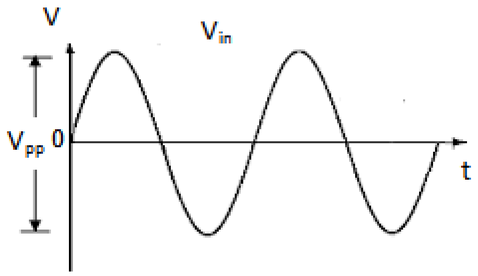
VCC =

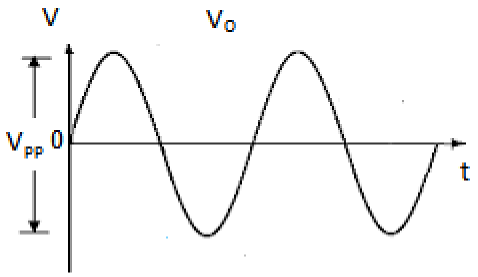
VCE =

VBE =

Note : At proper biased condition, VBE should be 0.6V to 0.7V, VCE should be approximately
half of VCC

2. Input Output waveforms





Vin = 1V (pp), 1 KHz, without RL

3. Voltage gain
(i) Without load (RL = ∞)
VO = 1V
Gain = = 1
(ii) Voltage gain with 10 K load
VO =
Gain =
(iii) Voltage gain with 1 KΩ load
VO =
Gain =

RESULT:

INFERENCE:

Difference in designed and observed value is due to

____

____

____

For Office use only	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No. 7 Date: D D - M M - Y Y

SINGLE STAGE TUNED AMPLIFIER

AIM

To construct a single stage tuned amplifier circuit and

(i) Plot its frequency response
(ii) Measure its peak gain and bandwidth

OBJECTIVES

On completion of the experiment students will be able to

- Assemble a tuned amplifier
- Measure the DC conditions
- Tune the amplifier for a suitable resonant frequency
- Calculate the gain, resonant frequency and bandwidth
- Understand the characteristics of a tuned amplifier

EQUIPMENTS / COMPONENTS

Sl. no.	Name and Specification		Quantity
1.	Resistor	68 KΩ	1 no.
		100 KΩ	1 no.
		5.6 KΩ	1 no.
2.	Capacitor	1 µF	2 nos.
		10 µF	1 no.
3.	Transistor BC 495	BC 495	1 no.
4.	IFT		1 no.
5.	Function generator	0 to 1 MHz	1 no.
6.	Oscilloscope	0 to 20	1 no.
7.	Multimeter		1 no.
8.	Breadboard		1 no.
9.	Connecting wires		

PRINCIPLE

Tuned voltage amplifier amplifies the signals of desired frequency and rejects all other frequencies. The frequencies of amplification are determined by a parallel resonance circuit. A parallel resonance (LC) circuit shows high impedance at the resonant frequency $f_r = \frac{1}{2\pi\sqrt{LC}}$. The gain of the amplifier is maximum at centre frequency because the gain is directly proportional to the impedance at the collector. On either side of the resonant frequency, voltage gain falls. The selectivity of the circuit Q is given by the expression,

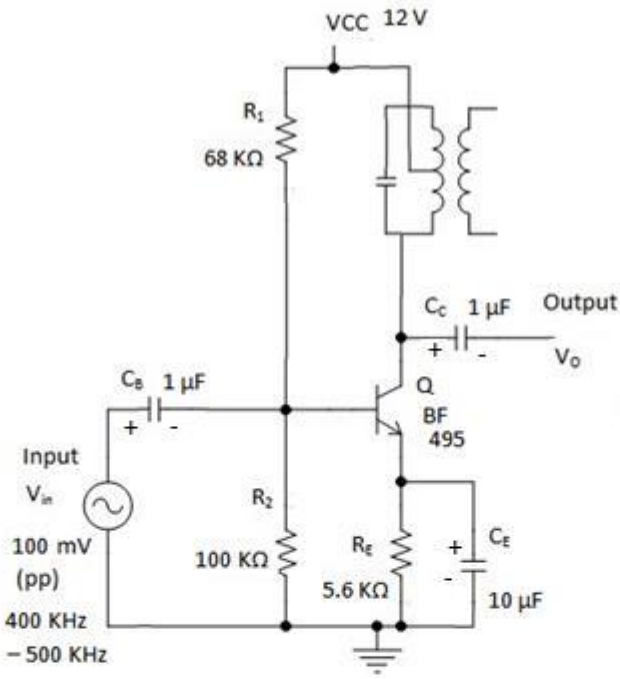
$$Q = \frac{\text{Resonant frequency}}{\text{Bandwidth}}$$

The ability of the tuned circuit to amplify a narrow band of frequencies makes it ideal for amplifying radio and TV signals. They are widely used as IF (Intermediate Frequency) amplifiers in radio and TV receivers. The IF Transformer used in this circuit is of AM radio receivers. It uses 455 KHz as standard IF. However resonant frequency can be varied beyond and above 455 KHz by adjusting the core of the transformer.

PROCEDURE

1. Test the components
2. Assemble the circuit on bread board
3. Check the DC biasing conditions of the transistor
4. Set 100mv sinusoidal signal as input
5. Vary the frequency of input from 400Khz to 500Khz in suitable steps
6. Measure the output voltage in each step
7. Calculate the gain in each step
8. Plot the frequency response in a graph sheet
9. Calculate resonant frequency, Bandwidth and Q factor

CIRCUIT DIAGRAM



OBSERVATIONS

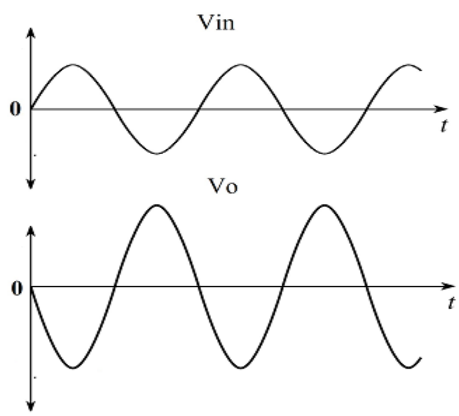
1. DC conditions

V_{CC} =

V_{BE} =

V_{CE} =

2. Input and output waveforms



3. Frequency response

V_{in} = 100 mV (pp), f = 400 KHz to 500 KHz

Frequency (f) in	Log f	V_O in Volt	Gain = $\frac{V_O}{V_{in}}$	Gain in dB

Resonant frequency, f_r =

f_H =

f_L =

RESULT:

For Office use only	Signature of Lab in charge	Remarks
Readiness to do experiment		
Completion of Experiment		

Exp No. 8 Date: D D - M M - Y Y

RC DIFFERENTIATOR

AIM

To design and construct RC differentiator circuit and study its pulse response.

EQUIPMENTS / COMPONENTS

Sl. no.	Name and specification	Quantit
1.	Capacitor 0.001 μF	1 no.
2.	Resistor 1 KΩ	1 no.
3.	Function generator 0 to 1 MHz	1 no.
4.	Oscilloscope 0 to 20 MHz	1 no.
5.	Multimeter	1 no.
6.	Breadboard	1 no.
7.	Connecting wires	

THEORY

An RC differentiator circuit is a wave shaping circuit. It consists a capacitor and a resistor. The time constant (R x C) of the circuit is very small in comparison with the period of the input signal. As the name shows the circuit does the mathematical operation 'differentiation' on the input signal. At the time of differentiation the voltage drop across R will be very small in comparison with the drop across C.

Differentiated output is proportional to the rate of change of input. When the input rises to maximum value, differentiated output follows it, because the sudden change of voltage is transferred to the output by the capacitor. Since the rate of change of voltage is positive, differentiated output is also positive. When the input remains maximum for a period of time the rate of change of voltage is zero ($\frac{d}{dt}$of constant = Zero). During this time input acts like a dc voltage and capacitor blocks it (At this time the charge stored in the capacitor previously, discharges through R). When input falls to zero, rate of change is negative. Thus the output also goes to negative.

For perfect differentiation RC < 0.0016T $\frac{1}{w}$

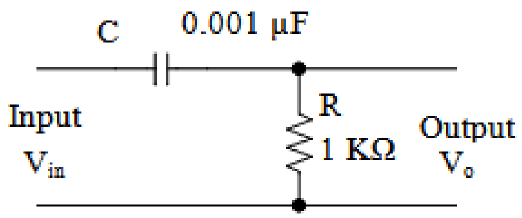
PROCEDURE

1) Test the components
2) Assemble the circuit on a breadboard
3) Connect the output of a function generator to the input of the differentiator circuit
4) Switch on the function generator and set the input at 5V, 1KHz pulse
5) Connect the output of the differentiator to an oscilloscope
6) Observe the output waveform and its amplitude for the following condition by varying the time period (T) of the input

   (i) RC << T (f = 1 KHz) that is RC << 0.0016T (ii) RC < T (f = 100 KHz)
   (iii) RC > T (f = 1 MHz)

7) Study the behavior of the circuit for different values of T
8) Plot all the input and output waveforms

CIRCUIT DIAGRAM



DESIGN

Let the input be a square pulse of 1 KHz

Then T = 1ms

For a differentiator RC ≤ 0.0016T

To avoid loading select R as 10 times the output impedance of the function generator

If it is 100 Ω, then R = 1KΩ

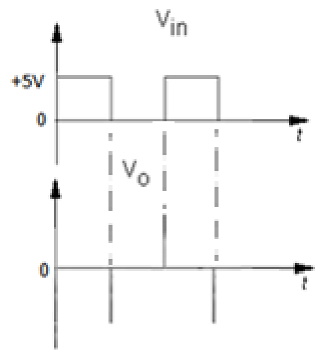
Substituting the values in the above expression, we get C = 0.0016µF

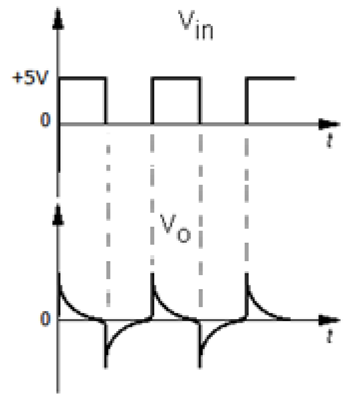
Take C = 0.001µF (Then RC value i.e. time constant of the above circuit is 1µs)

OBSERVATIONS

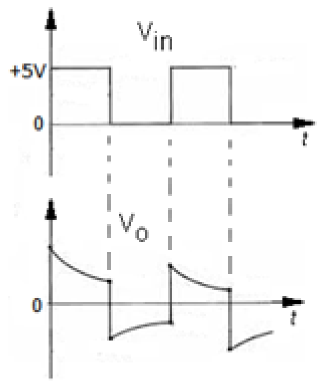
To observe the response of the circuit, you can change either the RC value of the circuit or T of the input. Here T of the input is changed.

1. f = 1 KHz, T = $\frac{1}{f}$ = 1ms, RC = 1μs (RC << T)





3. f = 1 MHz, T = $\frac{1}{f}$ = 1μs, RC = 1μs (RC ≥ T)



RESULT:

Exp No. 9 Date: D D - M M - Y Y

RC INTEGRATOR

AIM

To design and construct RC integratorcircuit and study its pulse response.

OBJECTIVES

On completion of the experiment students will be able to

- design integrator circuit for a given frequency
- understand the behavior of the circuit for various inputs

EQUIPMENTS / COMPONENTS

Sl. no.	Name and specification		Quantit
1.	Capacitor	22 µF	1 no.
2.	Resistor	1 KΩ	1 no.
3.	Function generator	0 to 1 MHz	1 no.
4.	Oscilloscope	0 to 20 MHz	1 no.
5.	Multimeter		1 no.
6.	Breadboard		1 no.
7.	Connecting wires		

PRINCIPLE

An RC integrator circuit is a wave shaping circuit. It constitutes a resistor in series and a capacitor in parallel to the output. As the name suggests it does the mathematical operation 'integration' on the input signal. The time constant RC of the circuit is very large in comparison with the time period of the input signal. Under this condition the voltage drop across C will be very small in comparison with the voltage drop across R. For satisfactory integration it is necessary that RC ≥ 16T, where T is time period of the input.

When pulse waveform is given at the input, capacitor charges through R and output voltage builds up slowly. Capacitor continues to charge as long as input voltage is present. When input falls to zero, capacitor discharges and output falls to zero slowly. As the value of RC >> T, the charging current is almost constant and the output become linear.

Hence a square pulse input provides a triangular output.

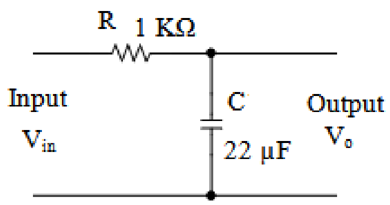
PROCEDURE

1) Test the components
2) Assemble the circuit on a breadboard3) Connect the output of a function generator to the input of the differentiator circuit
4) Switch on the function generator and set the output at 5V, 1KHz pulse
5) Connect the output of the differentiator to an oscilloscope
6) Observe the output waveform and its amplitude for the following condition by varying the time period (T) of the input

   (i) RC >> T (f = 1 KHz) that is RC >> 16T (ii) RC > T (f = 100 Hz)
   (iii) RC < T (f = 10 Hz) (iv) RC << T (f = 1 Hz)

7) Study the behavior of the circuit for different values of T
8) Plot all the input and output waveforms

CIRCUIT DIAGRAM



DESIGN

Let the input be a square pulse of 1 KHz

Then T = 1ms

For an integrator RC ≥ 16T

To avoid loading select R as 10 times the output impedance of the function generator

If it is 100 Ω, then R = 1KΩ

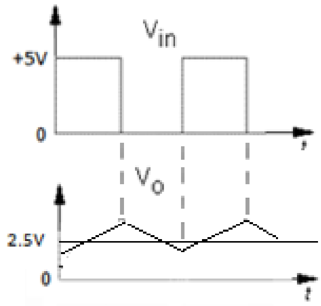
Substituting the value of R in the expression, RC = 16T,

we get C = 16µF Therefore C should be greater than 16µF. Hence choose C = 22µF

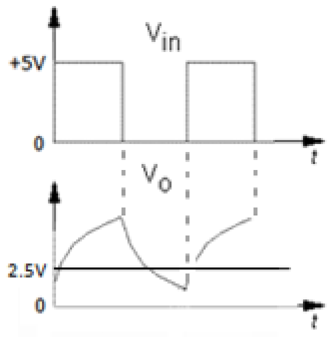
OBSERVATIONS

To observe the response of the circuit, you can change either the RC value of the circuit or T of the input. Here T of the input is changed.

1. f = 1 KHz, $T = \frac{1}{f}$ = 1ms, RC = 22ms (RC >> T)

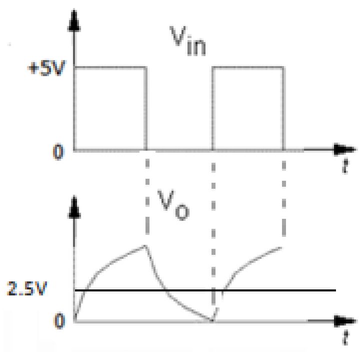


2. f = 100 KHz, $T = \frac{1}{f}$ = 10ms, RC = 22ms (RC > T)



RESULT:

INFERENCE:

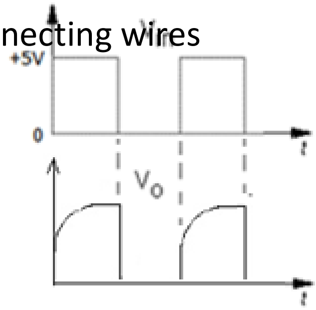


3. f = 10 Hz, T = $\frac{1}{f}$ = 100ms, RC = 22ms (RC < T)

4. f = 1 Hz, T = $\frac{1}{f}$ = 1s, RC = 22ms (RC << T)

8.	Connecting wires	

T
O



Exp No. 10 Date: D D - M M - Y Y

ASTABLE MULTIVIBRATOR

AIM

To construct a transistor Astable multivibrator circuit for 1 KHz and

(i) plot the collector and base waveforms
(ii) measure the frequency of oscillation

OBJECTIVES

On completion of the experiment students will be able to

(i) construct an astablemultivibrator for a given frequency
(ii) construct an LED flasher circuit
(iii) calculate the period and hence the frequency of an astablemultivibrator from its component values

EQUIPMENTS / COMPONENTS

Sl. no.	Name and	Quantity
1.	Capacitor 0.01 µF	2 nos.
2.	Resistor 2.2 KΩ 75 KΩ	2 nos. 2 nos.
3.	Transistor BC 548	2 nos.
4.	Power supply 5 V	1 no.
5.	Oscilloscope 0 to 20	1 no.
6.	Multimeter	1 no.
7.	Breadboard	1 no.
8.	Connecting wires	

PRINCIPLE

Astablemultivibrator is also called free running multivibrator and is used as a square wave oscillator. The transistors in the circuit do not have stable state. i.e. when V_{CC} is given, one transistor turns ON (goes to saturation region) and the other turns OFF (goes to cut off region). After sometime (determined by charging and discharging of the two capacitors in the circuit), the ON transistor is turns OFF and the OFF transistor turns ON. This cycle repeats as long as the supply is given.

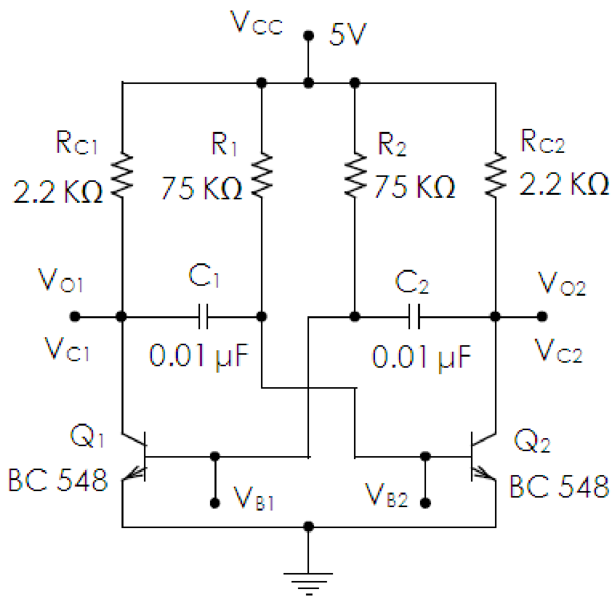
When the power supply is turned ON, one of the transistors is ON and the other is OFF due to transistor mismatch. When Q1 is ON, Q2 is OFF due to the cross coupling. Collector of Q1 is at V_{sat} (≈ 0) and collector of Q2 is at V_{CC}. Now the previously charged capacitor (when Q2 is ON) discharges through Q1 and after discharging completely it starts charging towards V_{CC}. But as one side of the capacitor reaches 0.7V, Q2 turns ON and its collector voltage falls to approximately 0V (V_{cesat}). This sudden change is coupled to the base of Q1 via C2. Thus Q1 turns OFF and the collector of Q1 reaches Vcc. Then C2 (which was charged when Q1 was ON), discharges through Q2 and when other side of C2 reaches 0.7V, Q1 turns ON. These actions continue. Thus OFF time of Q2 is determined by the values of R1 and C1 (T_{OFFQ2} = 0.693 R1 C1) while the OFF period of Q1 is determined by the values of R2 and C2 (T_{OFFQ1} = 0.693 R2 C2). If R1 = R2 = R and C1 = C2 = C, we get a square wave from collector of the transistors. The time period of the square wave, T = 0.693 R1 C1 + 0.693 R2 C2
= 1.38 R C and f = $\frac{1}{T}$.

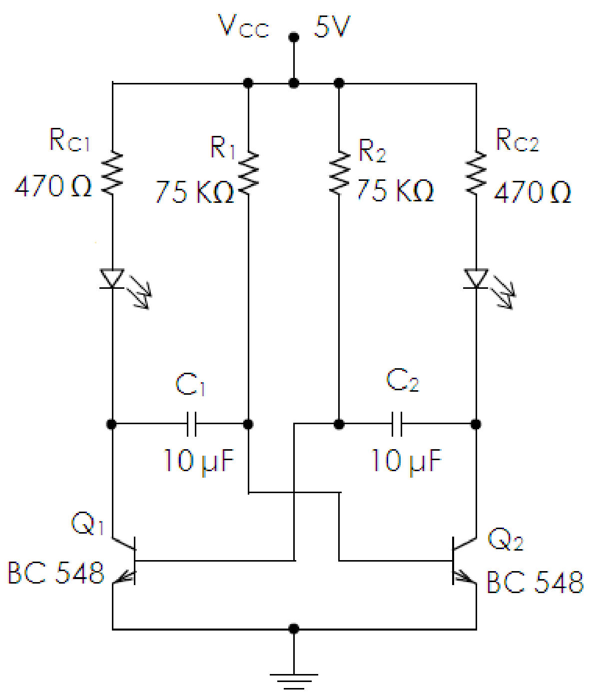
The second circuit is designed to get large ON and OFF periods for the transistors to visualize the ON and OFF action of transistors. For this LEDs are connected at the collector of the transistors. Here large value of C (10µF) is used to get T in seconds.

PROCEDURE

1) Test the components
2) Assemble the circuit in a breadboard
3) Switch ON the power supply
4) Connect the outputs of the circuit to an oscilloscope
5) Observe the collector and base waveforms of the two transistors
6) Measure the frequency and amplitude of the outputs
7) Plot all waveforms
8) Assemble the second circuit and visually verify the output

CIRCUIT DIAGRAM





DESIGN

1. For 1 KHz frequency

TOFFQ2 = 0.693 R C = 0.693 x 75 x 10^3 x C = 0.5ms

C = 0.01μF

TOFFQ1 = 0.693 R C = 0.693 x 75 x 10^3 x C = 0.5ms

C = 0.01μF

T = 1ms, f = $\frac{1}{T}$ = 1 KHz

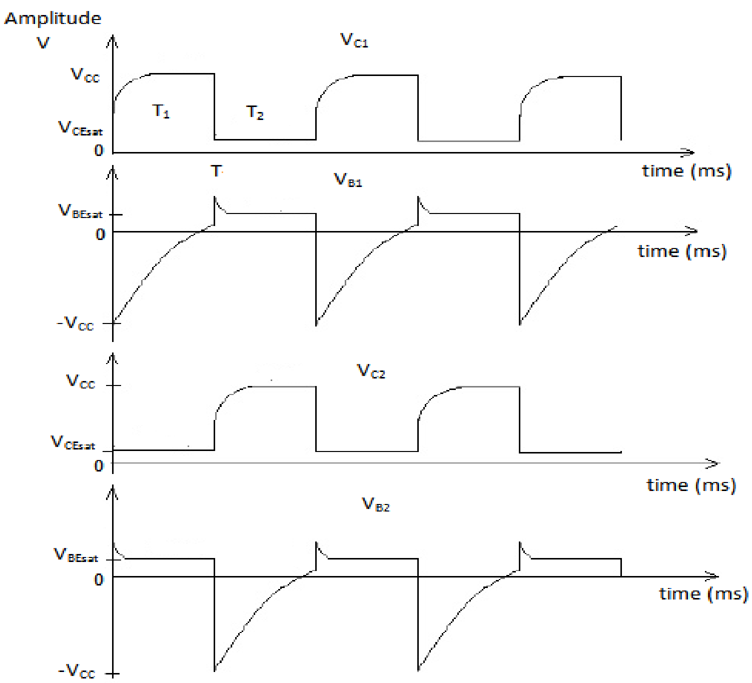
2. For 2 Hz frequency

ON / OFF time of LED = 0.693 R C = 0.693 x 75 x 10^3 x C = 0.5s

C = 10µF

OBSERVATIONS

1. For 1 KHz frequency astablemultivibrator circuit



ON time of Q1,

T1 = OFF time of

Q1, T2 =

Time period, T = T1 +

T2 = Frequency, f = $\frac{1}{T}$ =

2. For 2 Hz frequency astablemultivibrator circuit

Both LEDs turn ON and OFF with 0.5s delay

RESULT:

INFERENCE:

Exp No. 11 Date: D D - M M - Y Y

RC PHASE SHIFT OSCILLATOR

AIM

To setup RC phase shift oscillator for 1 KHz and

(i) plot the output waveform
(ii) measure the frequency of oscillation

OBJECTIVES

On completion of the experiment students will be able to construct an RC phase shift oscillator for a given frequency

EQUIPMENTS / COMPONENTS

Sl. no.	Name and specification		Quanti
1.	Capacitor µF	0.01 1 µF	3 nos.
2.	Resistor	470 Ω 1.8 KΩ 4.7 KΩ 10 KΩ	1 no. 1 no
3.	Variable resistor – Potentiometer (lin)	10 KΩ	1 n
4.	Transistor	BC 548	1 n
5.	Power supply	12 V	1 n
6.	Oscilloscope	0 to 20 MHz	1 n
7.	Multimeter		1 n
8.	Breadboard		1 n
9.	Connecting wires		

PRINCIPLE

An oscillator is an electronic circuit for generating ac signal voltage with a dc supply as the only input requirement. The frequency of the generated signal is decided by the circuit elements. An

oscillator requires an amplifier a frequency selective network and positive feedback from the output o the input. The Barkhausen criteria for sustained oscillator is Aβ = 1, where A is gain of the amplifier and β is the feedback factor.

If common emitter amplifier is used with resistive collector load, there is an

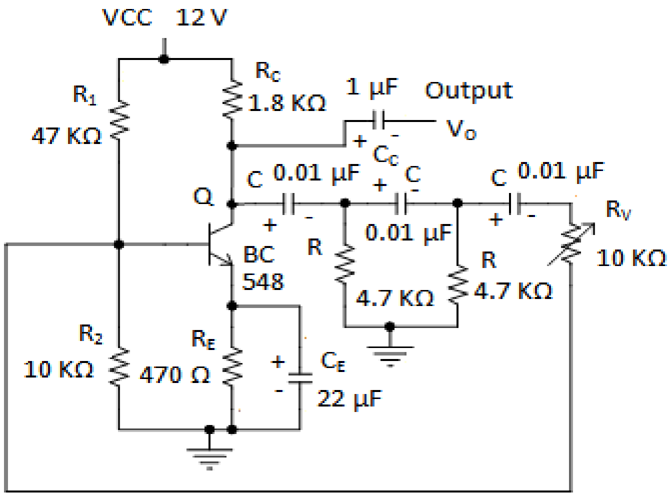
180^{o}phaseshift between input and output. The feedback network introduces an additional

180^{o}phaseshift at a particular frequency. The three section RC network offers 180^{o}phaseshift and the β of $\frac{1}{29}$. Hence for unity gain feedback, the gain of the amplifier should be 29. The phaseshift oscillator is particularly useful as audio frequency generator. The frequency of oscillation is given by $\frac{1}{2\pi\sqrt{6}RC}$.

PROCEDURE

1) Test the components
2) Assemble the amplifier part of the circuit in a breadboard
3) Connect the feedback network
4) Connect the output of the circuit to an oscilloscope
5) Adjust the 10 KΩ pot and observe the output
6) Measure the frequency and amplitude of the output
7) Plot output waveform

CIRCUIT DIAGRAM



From the given component values, the

frequency of oscillation f = $\frac{1}{2\pi\sqrt{6}RC}$ =

$\frac{1}{2\pi\sqrt{6} \times 4.7 \times 10^3 \times 0.01 \times 10^{-6}}$ =

OBSERVATIONS

1. DC conditions of amplifier section

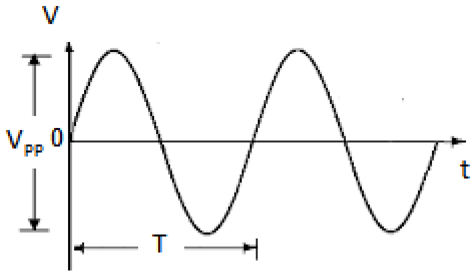
(i) VCC =

ii) VBE = (iii) VCE =

2. Output waveform

RESULT:

INFERENCE:



Time period, T =

$\frac{1}{T}$

Bandwidth = f_H-f_L =

Q factor = = $\frac{f_r}{bandwidth}$

Exp No. 12 Date: DD-MM-YY

SCHMITT TRIGGER

AIM

To setup a Schmitt trigger circuit using BJT

(i) plot the input and output waveforms
(ii) measure the UTP and LTP

OBJECTIVES

On completion of the experiment students will be able to

(i) construct an Schmitt trigger circuit using BJT (ii) know the application of Schmitt trigger

EQUIPMENTS / COMPONENTS

Sl. no.	Name and	Quantity
1.	Capacitor 330 pF	1 no.
2.	Resistor 1.5 KΩ 3.3 KΩ 4.7 KΩ 10KΩ 33 KΩ	1 no. 1 no. 1 no. 1
3.	Transistor BC 548	2 nos.
4.	Function generator 0 to 1	1 no.
4.	Power supply 8 V	1 no.
5.	Oscilloscope 0 to 20	1 no.
6.	Multimeter	1 no.
7.	Breadboard	1 no.
8.	Connecting wires	

PRINCIPLE

The Schmitt trigger is a emitter coupled multivibrator with no cross coupling. It is a comparator that is used to convert a periodical random analog wave to square wave having the same frequency of the analog wave. The Schmitt trigger is called a squaring circuit.

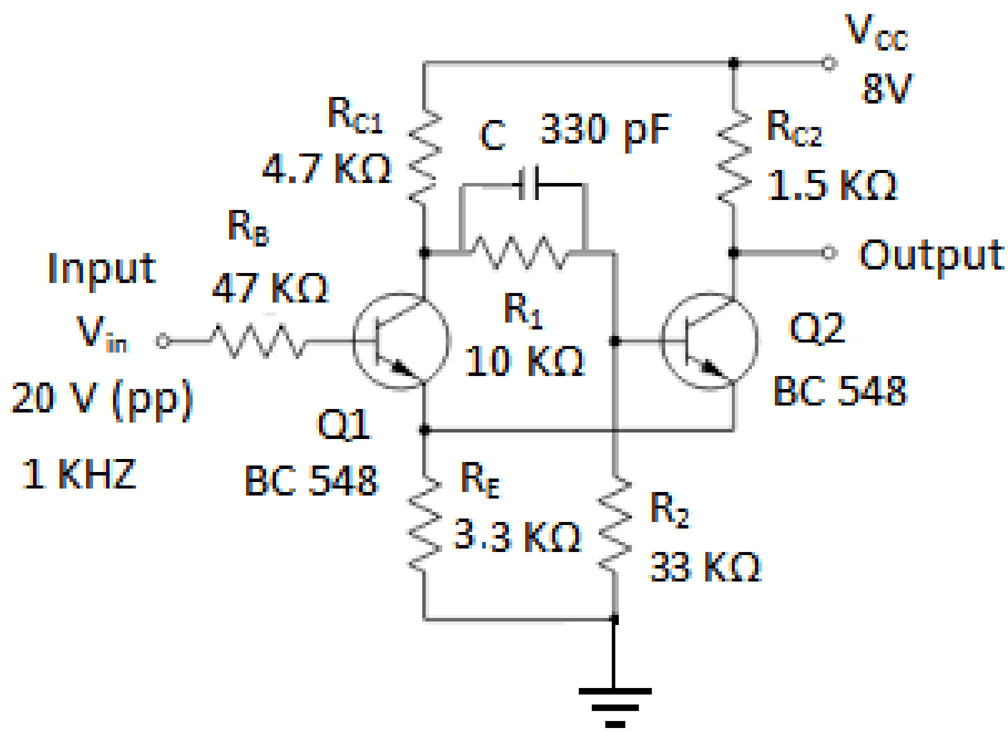
Without any input the transistor Q1 is in cut off state and Q2 is in saturation state. The emitter current of Q2 (I_{E2}) flows through common R_E causing a voltage drop across R_E (= I_{E2} x R_E). As the input voltage to Q1 reaches $I_{E2}R_E + V_{BE1}$ (base to emitter voltage of Q1), Q1 turns ON and Q2 turns OFF. This level of input is called upper triggering point (UTP). The output of Q2 rises to V_{CC}. Now I_{E2} becomes zero and I_{E1} starts flowing through R_E.

The minimum voltage required to hold transistor Q1 ON is equal to $I_{E1}R_E + V_{BE1}$. When the amplitude of the input sine wave becomes less than this Q1 turns OFF and Q2 turns ON. The output voltage then falls to a voltage called the lowering triggering point (LTP).

PROCEDURE

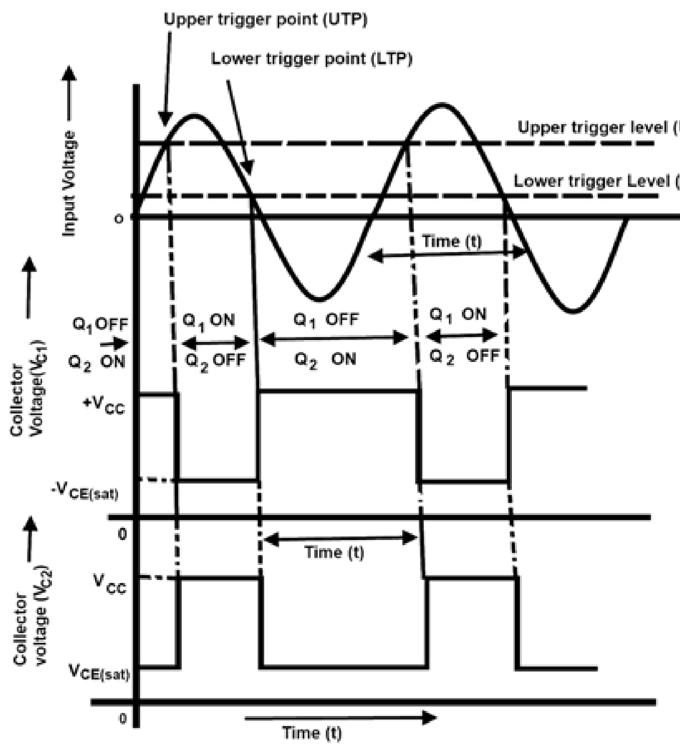
1) Test the components
2) Assemble the circuit in a breadboard
3) Connect the output of function generator to input of the circuit
4) Connect the output of the circuit to an oscilloscope
5) Switch ON the power supply
6) Observe the input and output waveforms
7) Measure the UTP and LTP of the output voltage
8) Plot the waveforms

CIRCUIT DIAGRAM



OBSERVATIONS

Output waveforms



UTP =

LTP =

RESULT:

INFERENCE:

Exp No. 13 Date: DD-MM-YY

HARTLEY OSCILLATOR

To set up a Hartley oscillator and

(i) Plot the output waveform
(ii) Measure the frequency of oscillation

OBJECTIVES

On completion of the experiment students will be able to

- Assemble Hartley oscillator
- Test and verify the DC conditions of the circuit
- Tune a resonant circuit for a desired frequency

EQUIPMENTS / COMPONENTS

Sl. no.	Name and Specification	Quantity
1.	Resistors 560 Ω 1.8 KΩ 10 KΩ 47 KΩ	1 no. 1 no. 1
2.	Capacitor 1µF	2 nos.
3.	Transistor BC 548	1 no.
4.	IFT	1 no.
5.	Oscilloscope 0 to 20 MHz	1 no.
6.	Multimeter	1 no.
7.	Breadboard	1 no.
8.	Connecting wires	

PRINCIPLE

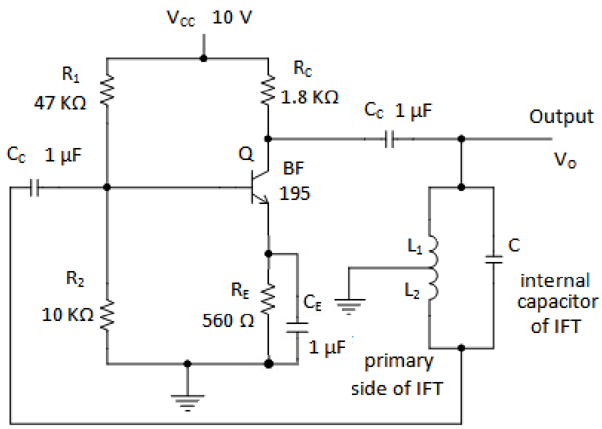
Hartley oscillator is an LC oscillator. It has LC tank circuit for frequency selection. LC oscillators are preferred for higher frequencies. Voltage divider bias is used for the amplifier in CE configuration. Amplifier section provides 180^{o} phase shift. The tank circuit provides another 180^{o} phase shift to satisfy Barkhausen criteria. R_E is bypassed by C_E to prevent ac signal feedback and thus to improve the gain of the amplifier.

Frequency of oscillation is determined by the resonant circuit consisting of capacitor C and inductors L_1 and L_2. It is given by $f = \frac{1}{2\pi\sqrt{Leq.C}}$ Hz. Where Leq = L_1+L_2, since L_1 is in series with L_2. The output voltage appears across L_1 and feedback voltage appears across L_2. So the feedback factor of the oscillator is given by $\beta = \frac{L_2}{L_1}$. This means that the gain of the amplifier section is $A = \frac{L_1}{L_2}$.

PROCEDURE

1. Test the components
2. Assemble the circuit on bread board
3. Switch ON the power supply
4. Measure and verify the DC biasing conditions of the transistor
5. Connect the output to oscilloscope
6. Observe and measure the amplitude and time period of the output
7. Calculate the frequency of oscillation
8. Adjust the core of IFT to get a desired frequency if necessary
9. Switch off the power supply and dismantle the circuit

CIRCUIT DIAGRAM



OBSERVATIONS

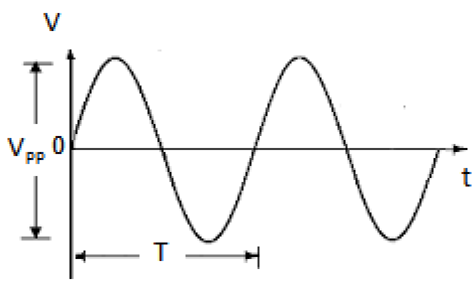
1. DC condition

VCC =

VBE =

VCE =

2. Output waveform



RESULT:

INFERENCE:

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