DIODE CLIPPING CIRCUITS

Aim: To design and test diode clipping circuits for peak clipping and peak detection.

Components required:

-Power Supply

-Diodes IN4007or BY127

-Resistors

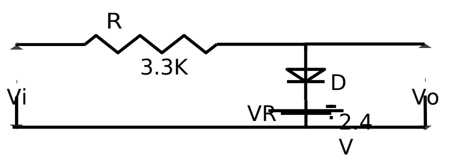
Procedure:

- Make the Connections as shown in the circuit diagram
- Apply sinusoidal input Vi of 1 KHz and of amplitude 8V P-P to the circuit.
- Observe the output signal in the CRO and verify it with given waveforms.
- Apply Vi and Vo to the X and Y channel of CRO and observe the transfer characteristic waveform and verify it.

I) Positive Clipping

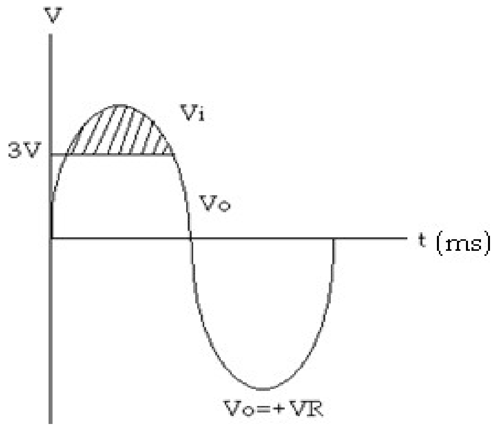
Circuit: Circuit

Diagram:

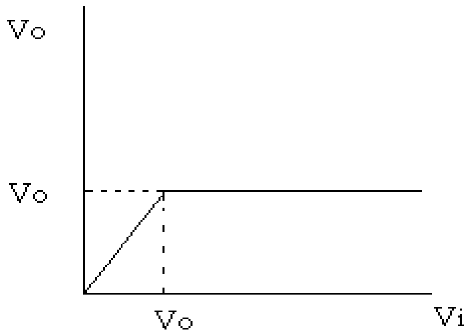


8Vp-p

Waveforms:


V
Vi
3V
Vo
t (ms)
Vo=+VR

Transfer Characteristics:



To find the value of R:

Given: R_f =100Ω, R_r =100KΩ

R_f - Diode forward resistance R_r - Diode reverse resistance

R=$\sqrt{R_f R_r} = \sqrt{100 \times 100 \times 10^3}$ =3.16KΩ

Choose R as 10 KΩ

Let the output voltage be clipped at +3V

∴ V_{omax} =3V

From the circuit diagram,

$V_{omax} = V_r + V_{ref}$

Where V_r is the diode drop = 0.6V

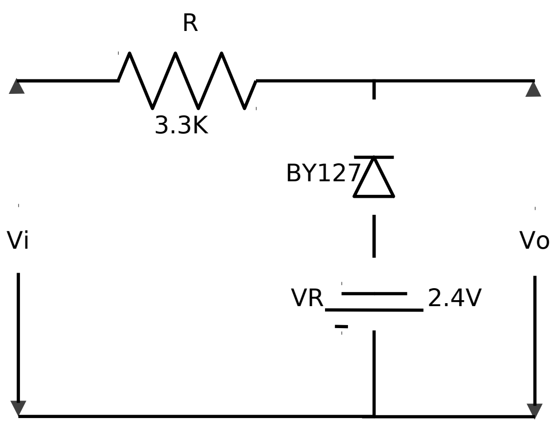
∴ $V_{ref} = V_{omax} - V_r$

=3 - 0.7

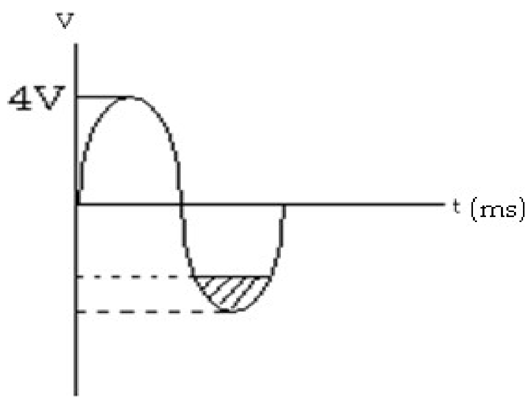
V_{ref} = 2.3 V

II) Negative Clipping

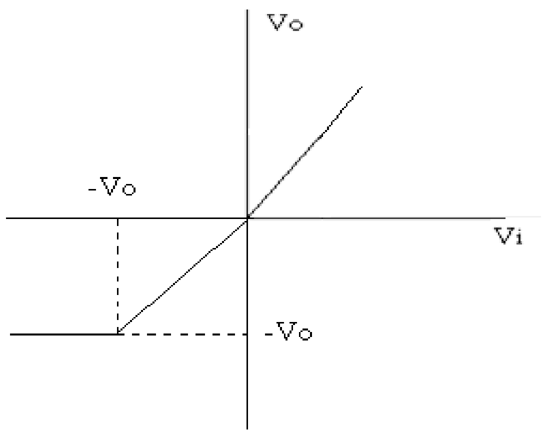
Circuit: Circuit Diagram:



Waveforms:



Transfer Characteristics:



Let the output voltage be clipped at

-3V V_{omin} = -3V

$V_{omin} = -V_r + V_{ref}$

$V_{ref} = V_{omin+}V_r = -3 + 0.7$

$V_{ref} = -2.3V$

CLAMPING CIRCUITS

Aim: Design and test positive and negative clamping circuit for a given reference voltage.

Components required:

- Power Supply
- CRO
- Signal Generator
- Diode BY 127
- Resistors
- Capacitor

Design:

R_f – Diode forward resistance = 100Ω Rr – Diode Reverse resistance = 1M Ω R = $\sqrt{R_f R_r}$ = 10KΩ

$RC \gg T$ let T = 1ms

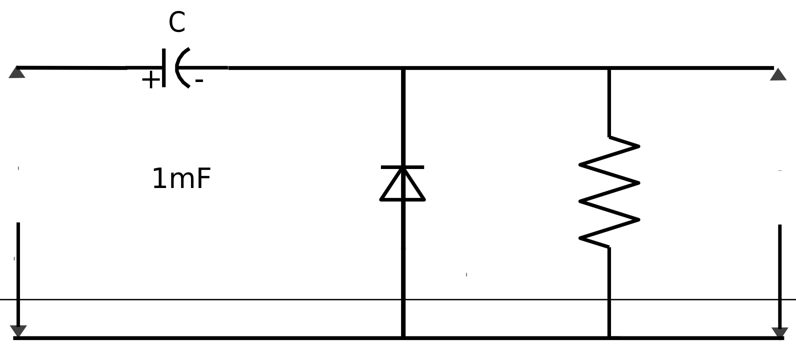
f(1KHz) Let RC = 10T

RC = 10ms

C = 1µF

R = 10KΩ

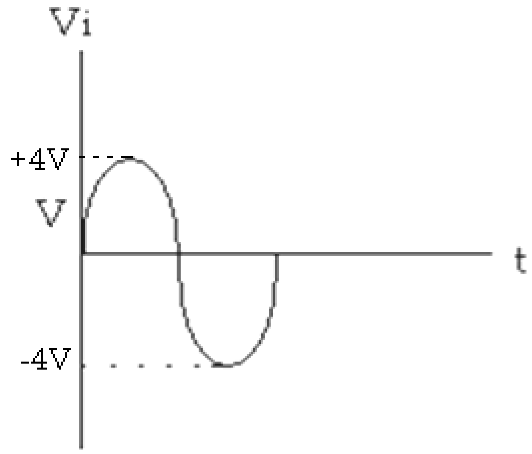
I) Positive Clamping Circuits: Circuit Diagram:

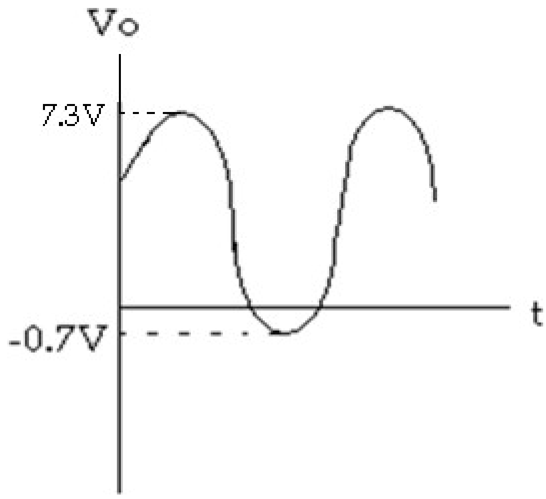


D BY127 R 10K Vo

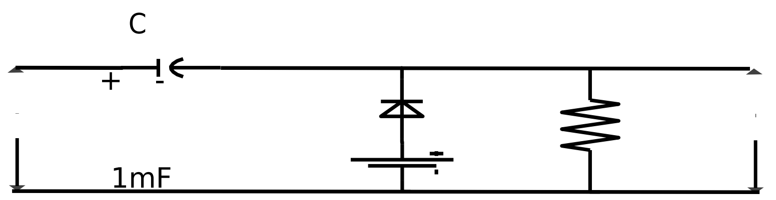
8Vp-p Vi

Waveforms:

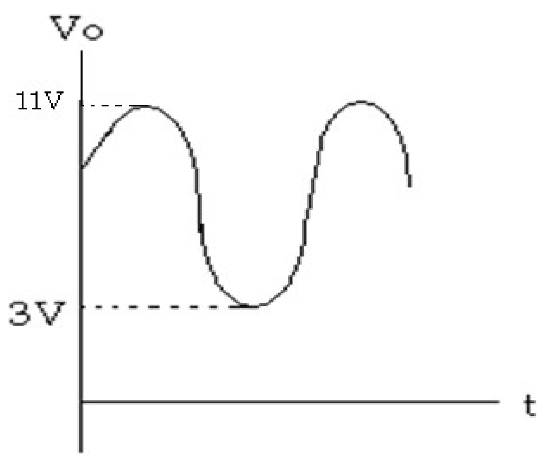




II) Design a Clamping Circuit to Clamp Negative Peak at +3V:



Waveforms:



$V_o = V_\vartheta +$

V_{ref} 3 = -0.7

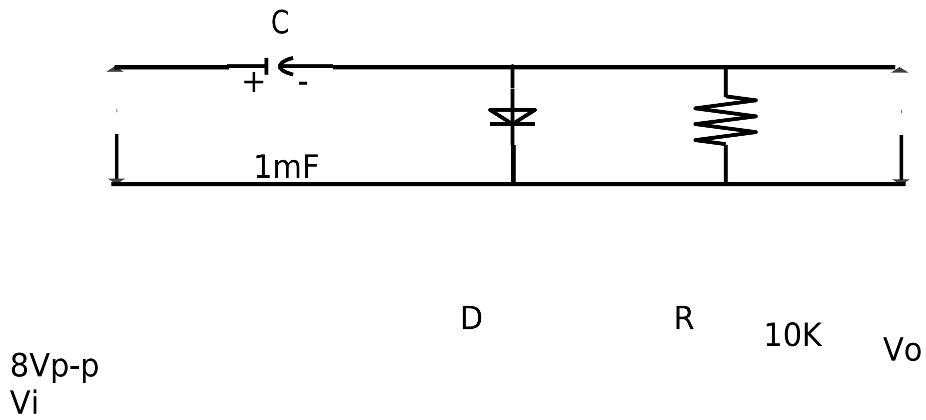
+ V_{ref}

V_{ref} = 3.7

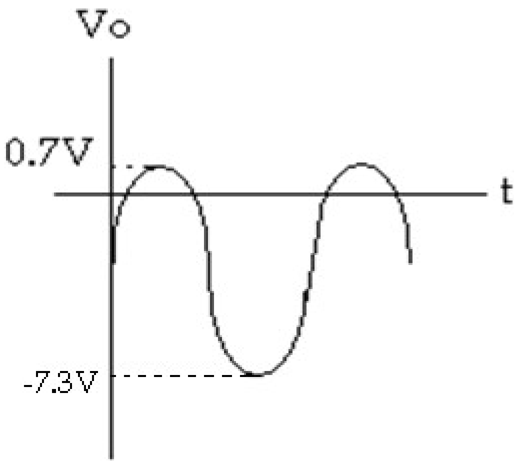
III) Negative Clamping

Circuit: Circuit

Diagram:



Waveforms:



RECTIFIER CIRCUITS

Aim: To design and test Half wave, Full wave, Bridge Rectifier circuits with & without capacitor filter and determine the Ripple factor, Regulation & Efficiency.

Components required:

- Resistors
- Diodes
- 12-0-12V Transformer
- Capacitor

Calculations:

Assume R_L = 4.7KΩ, C = 220μF

I) Half wave Rectifier:

1. Ripple Factor without Filter (Theoretical) = 1.21
2. Percentage Regulation = $\frac{R_f}{R_L} \times 100$ (R_f = Diode forward resistance)
3. Rectifier Efficiency η = $\frac{0.406}{1+\frac{R_f}{R_L}} \simeq$ 40.6 %
4. γ Ripple Factor without Filter = $\frac{1}{2\sqrt{3}\, f R_L C}$ (f = frequency = 50Hz)

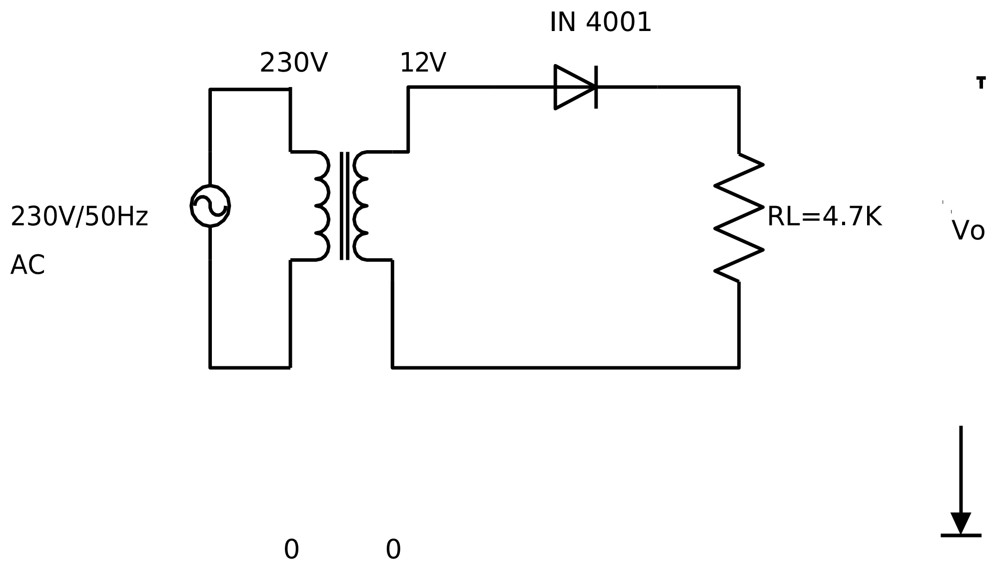
II) Full wave Rectifier:

1. Ripple Factor without Filter = 0.48
2. Percentage Regulation = $\frac{R_f}{R_L} \times 100$
3. Rectifier Efficiency η = $\frac{0.81}{1+\frac{R_f}{R_L}} =$ **81 %**
4. γ Ripple Factor without Filter = $\frac{1}{4\sqrt{3}\, f C R_L}$

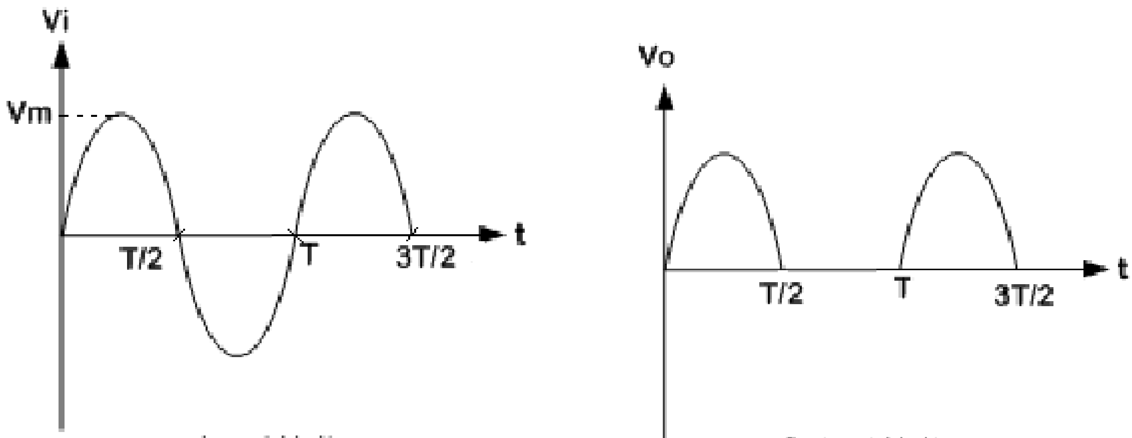
III) Bridge Rectifier:

1. Ripple Factor without Filter = 0.48
2. Percentage Regulation = $\frac{R_f}{R_L} \times 100$
3. Rectifier Efficiency η = $\frac{0.81}{1+\frac{R_f}{R_L}} =$ 81 %

I) Half wave Rectifier without Filter: Circuit Diagram:



Waveforms:



Input Voltage   Output Voltage

Peak output voltage

$V_m = V_{dc} = \frac{Vm}{\pi} =$

$V_{rms} = \frac{Vm}{2} =$

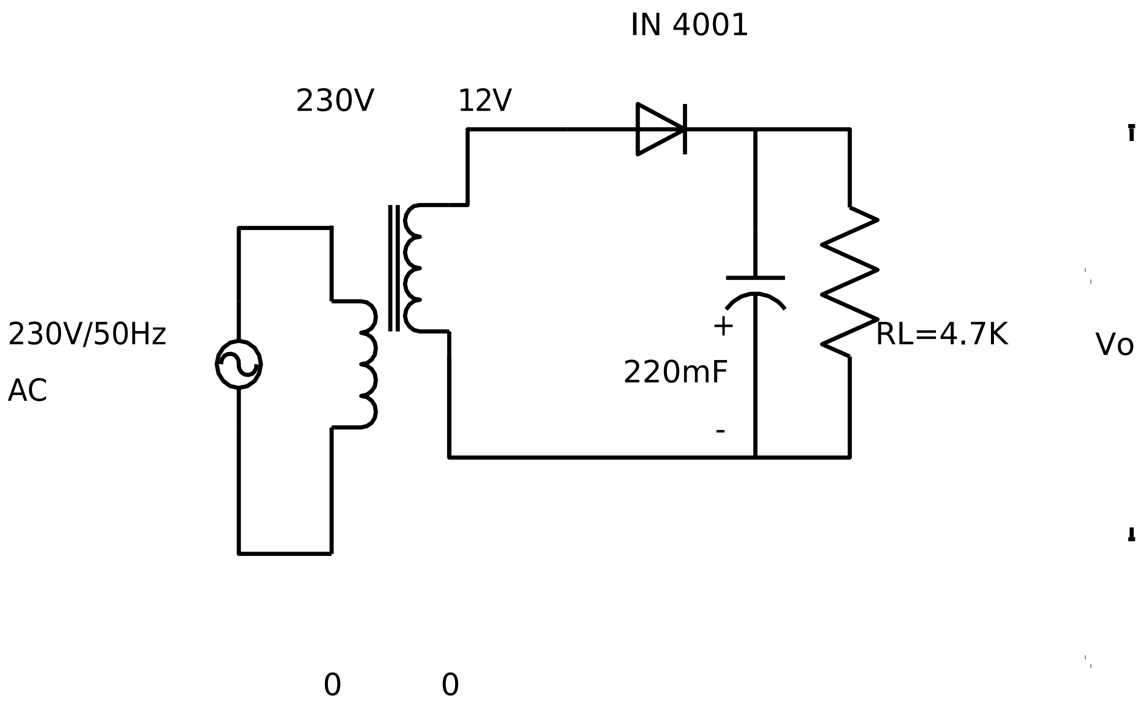
$V_{ac} = \sqrt{V_{rms^2}} - V_{dc^2} =$

Ripple Factor $\Upsilon = \frac{V_{ac}}{V_{dc}} =$

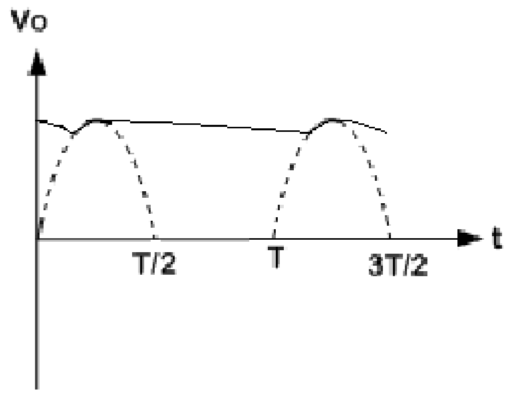
Rectifier efficiency η = $\frac{P_{dc}}{P_{ac}}$ = $\frac{V_{dc}{}^2}{V_{rms}{}^2}$ =

% Regulation = $\frac{V_{dc(NL)} - V_{dc\,(FL)}}{V_{dc\,(FL)}} \times 100 =$

Half wave Rectifier with Filter:



Waveforms:



Peak output Voltage

V_m = Ripple Factor =

$\frac{V_{ac}}{V_{dc}} =$

$V_{dc} = \frac{V_m}{1+\frac{1}{2fR_LC}} =$

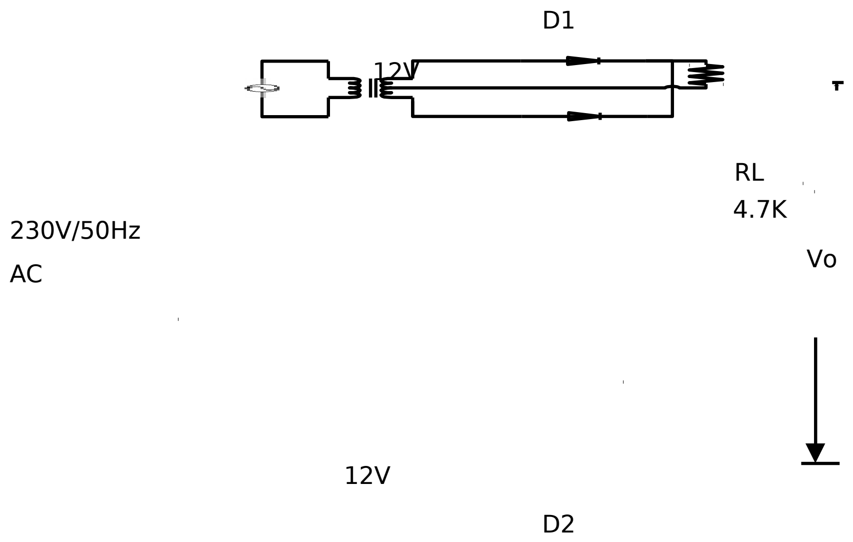
$V_{ac} = \frac{V_{rp-p}}{2} =$

$V_{rms} = \sqrt{V_{dc^2} + V_{ac^2}} =$

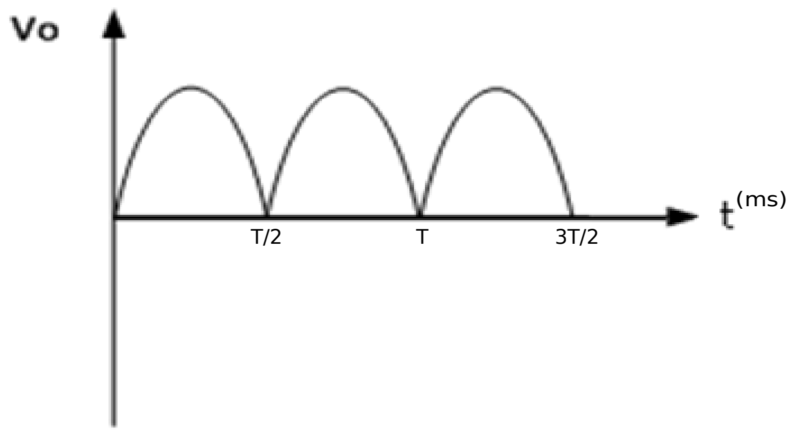
Rectifier efficiency $\eta = \frac{P_{dc}}{P_{ac}} = \left[\frac{V_{dc}}{V_{rms}}\right]^2 =$

% Regulation = $\frac{V_{dc(NL)} - V_{dc\,(FL)}}{V_{dc\,(FL)}} \times 100 =$

II) Full wave Rectifier without Filter: Circuit Diagram:



Waveforms:



$$V_{dc} = \frac{2Vm}{\pi} =$$

$$V_{rms} = \frac{V_m}{\sqrt{2}} =$$

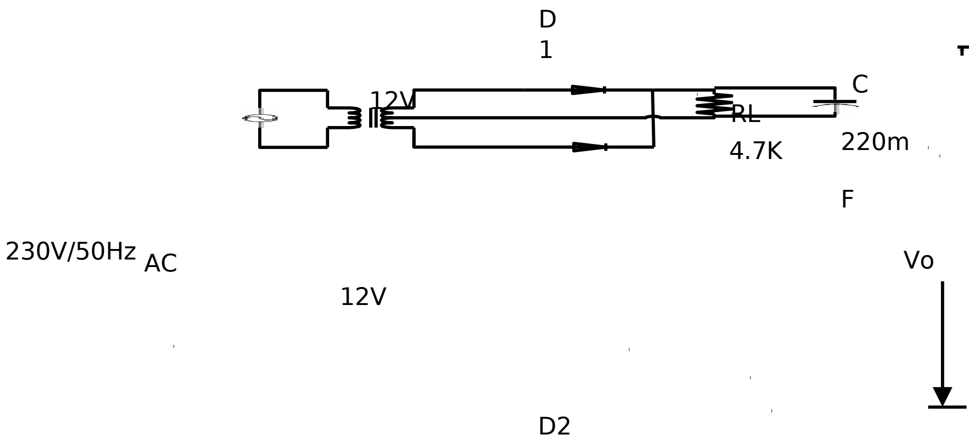
$$V_{ac} = \sqrt{V_{rms}^2 - V_{dc}^2} =$$

$$\Upsilon = \frac{V_{ac}}{V_{dc}} =$$

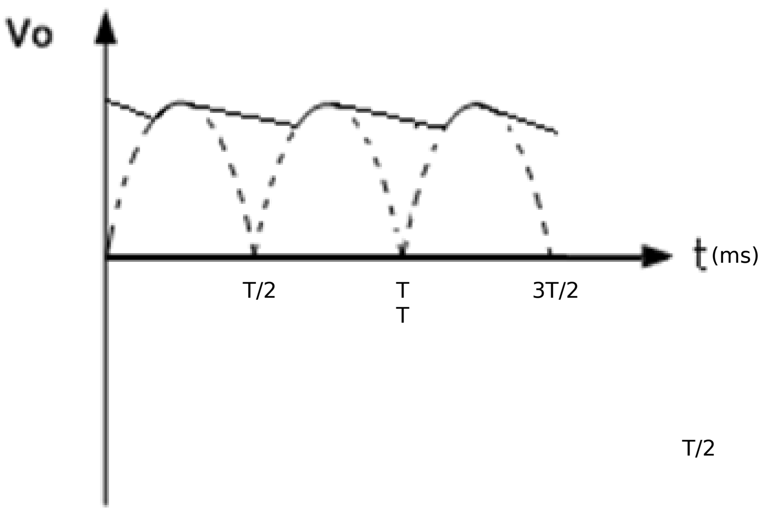
$$\eta = \frac{P_{dc}}{P_{ac}} = \left[\frac{V_{dc}}{V_{rms}}\right]^2 =$$

$$\% \text{ Regulation} = \frac{V_{dc(NL)} - V_{dc\,(FL)}}{V_{dc\,(FL)}} \times 100 =$$

III) Full wave Rectifier with Filter: Circuit Diagram:



Waveforms:



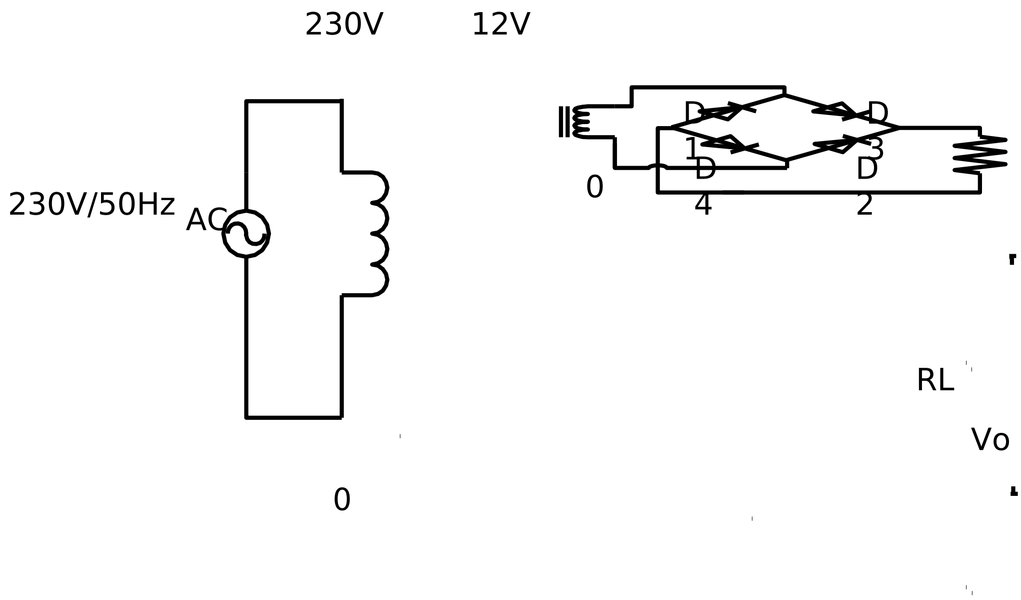
$$V_{dc} = \frac{V_m}{1+\frac{1}{4fR_LC}} =$$

$$\Upsilon = \frac{V_{ac}}{V_{dc}}$$

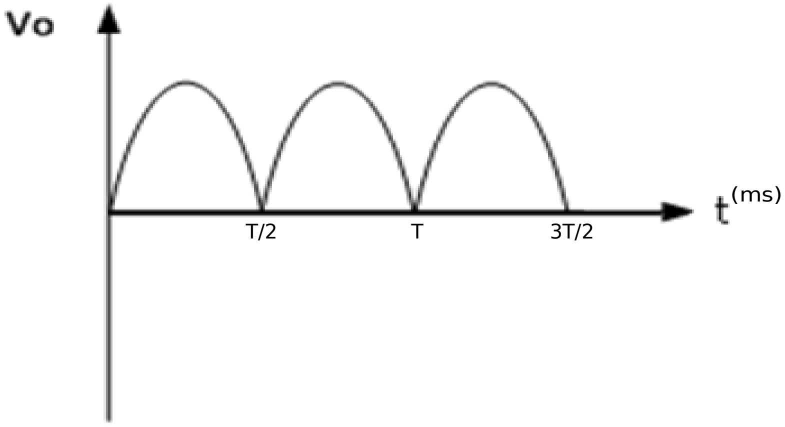
$$V_{ac} = \frac{V_{r-(p-p)}}{2\sqrt{3}} = V_{rms} = \sqrt{V_{dc}^2 + V_{ac}^2} =$$

$$\eta = \frac{P_{dc}}{P_{ac}} = \left[\frac{V_{dc}}{V_{rms}}\right]^2 =$$

Bridge Rectifier without Filter: Circuit Diagram:



Waveforms:



$V_{dc} = \frac{2Vm}{\pi} =$

$V_{rms} = \frac{V_m}{\sqrt{2}} =$

$V_{ac} = \sqrt{V_{rms}{}^2 - V_{dc}{}^2} =$

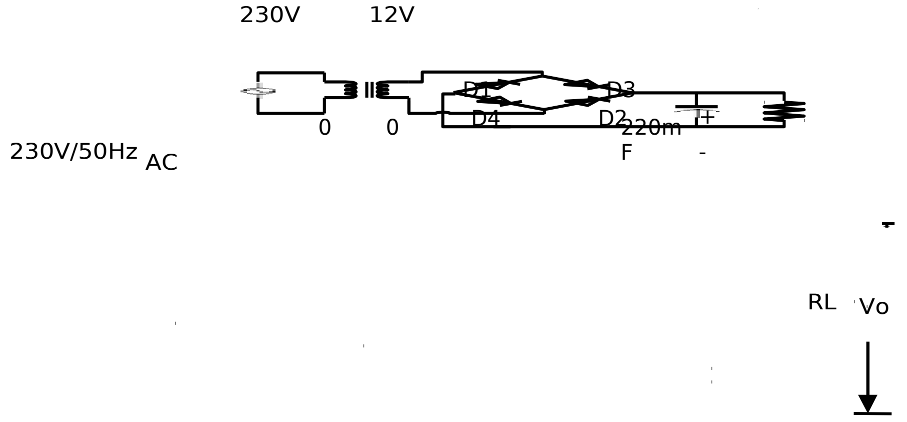
$\gamma = \frac{V_{ac}}{V_{dc}} =$

$\eta = \frac{P_{dc}}{P_{ac}} = \left[\frac{V_{dc}}{V_{rms}}\right]^2 =$

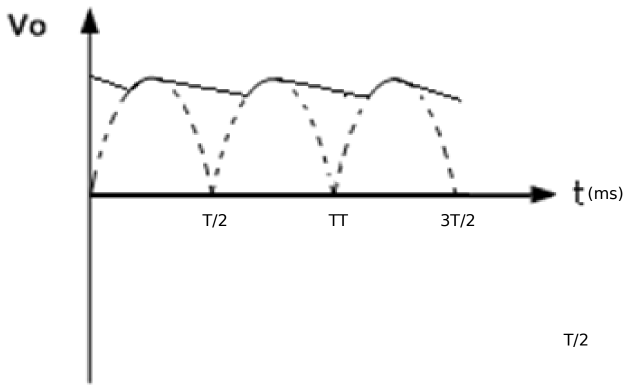
% Regulation = $\frac{V_{dc(NL)} - V_{dc\,(FL)}}{V_{dc\,(FL)}} \times 100 =$

Bridge Rectifier with

Filter: Circuit Diagram:



Waveforms:



$V_{dc} = \frac{V_m}{1+\frac{1}{4fR_LC}} =$

$V_{ac} = \frac{V_{r-(p-p)}}{2\sqrt{3}} =$

$\Upsilon = \frac{V_{ac}}{V_{dc}} =$

$V_{rms} = \sqrt{V_{dc^2} + V_{ac^2}} =$

$\eta = \frac{P_{dc}}{P_{ac}} = \left[\frac{V_{dc}}{V_{rms}}\right]2 =$

Procedure:

- Make the Connections as shown in the circuit diagram
- Apply 230V AC supply from the power mains to the primary of the transformer
- Observe the voltage across secondary to get V_m , the peak value in CRO
- Use relevant formula to find V_{dc} and V_{rms} of both Full wave and Half wave rectifier & draw the waveforms
- Find out the Ripple factor, Regulation and Efficiency by using the formula.

Conclusions:

EXP-4

R.C.PHASE SHIFT OSCILLATOR

Aim: To design and test the RC Phase shift Oscillator for the frequency of 1KHz.

Components required:

-Transistor (BC 107)

- Resistors
- CRO
- Capacitors

Design:

V_{CC} = 12V I_C = 2mA

V_{RC} = 40% V_{CC} = 4.8V V_{RE} = 10% V_{CC} = 1.2V V_{CE} = 50% V_{CC} = 6V

To find R_C, R_1, R_E & R_2

We Have,

V_{RC} = $I_C R_C$=4.8V R_C = 2.4KΩ

Choose R_C = 2.2KΩ

V_{RE} = $I_E R_E$=1.2V R_E = 600Ω

Choose R_E = 680Ω

h_{fe} = 100 (For BC

107) $I_B = \frac{I_C}{h_{fe}} =$

20mA

Assume current through R_1 = 10 I_B & through R_2 = 9 I_B $VR_1 = V_{CC} - V_{R2}$

= 10V

Also, $VR_1 = 10 I_B R_1 = 10.1V$

R_1= 50KΩ

Choose R_1= 47KΩ

$VR_2 = V_{BE+}V_{RE}$

= 0.7+1.2

= 1.9V

Also, VR_2 =9 I_B

R_2=1.9V R_2=

10.6KΩ

Choose R_1= 12KΩ

To find C_C & C_E

$X_{CE} = \frac{1}{2\pi C_E} = \frac{1}{10} R_E = \frac{680}{10} = 68\Omega$

For ϑ =

20Hz C_E=

117 μF

Choose C_E = 220 μF

$X_{CC} = \frac{1}{2\pi C_C} = \frac{R_C}{10} = 220\Omega$

For ϑ = 20Hz

Choose C_C =

47 μF

Design of ϑ Selective Circuit:

Required ϑ of oscillations f = 1KHz

$$f = \frac{1}{2\pi R_{C\sqrt{6}+\frac{4R_C}{R}}}$$

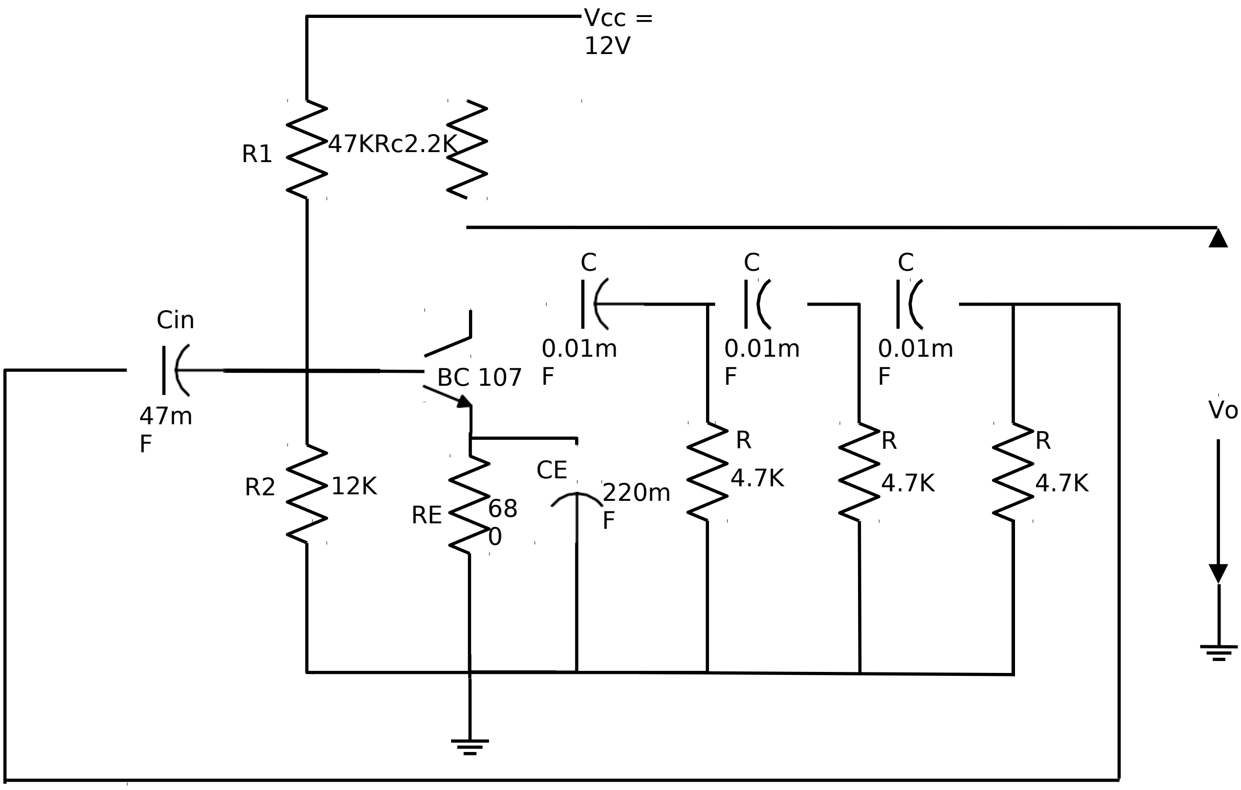
Take R= 4.7KΩ & C=0.01μF

Procedure:

- Rig up the circuit as shown in the figure
- Observe the sinusoidal output voltage.

- Measure the frequency and compare with the theoretical values.

Circuit Diagram:



Result:

Frequency

Theoretical: 1KHz

Practical: __________

EXP-5

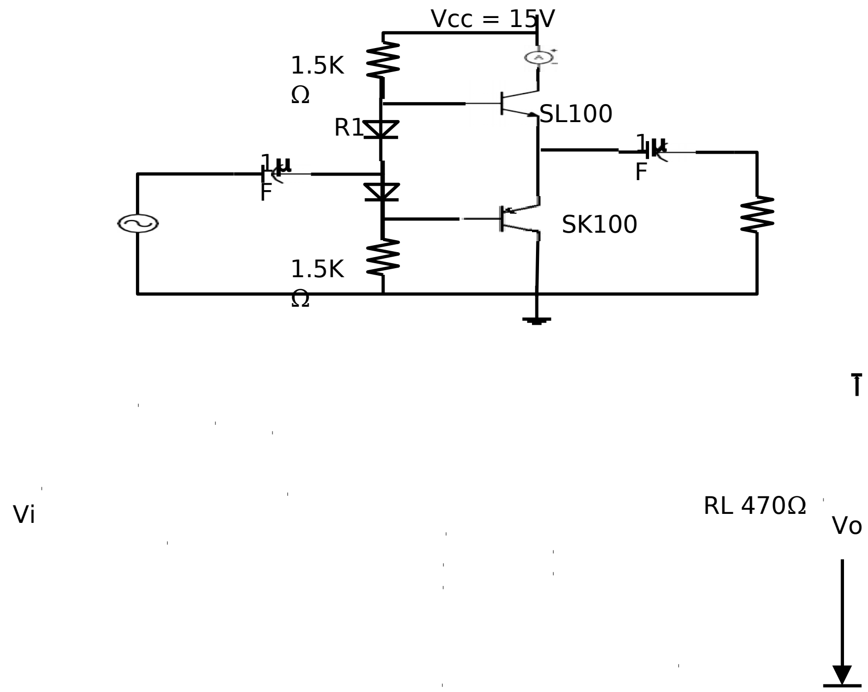
CLASS 'B' PUSH-PULL AMPLIFIER

Aim: To design and test the performance of transformer less Class 'B' Push-Pull Amplifier and to determine its conversion efficiency.

Components Required:

- Diodes IN 4001
- Transistor SL100, SK100
- Resistors
- Capacitors

Circuit Diagram:



Design:

Given $V_{CC} = 15V$, $R_L = 470\Omega$

$V_{CE1} = V_{CE2} = \frac{V_{CC}}{2} = 7.5V$

$V_{B1} = V_{CE2} + V_{BE1} = 7.5 + 0.7 = 8.2V$

Assume $I_1 = 5mA$

$R_1 = \frac{V_{CC}-}{I} = 1.36 K\Omega$

$R_2 = \frac{V_{R2}}{I_1} = \frac{V_{B1}-}{}$

$1.36 K\Omega$

Choose $R_1 = R_2 = 1.5 K\Omega$

Choose $C_i = C_2 = 1\mu F$

$P_i(dc) = V_{CC} I_{dc}$

$P_o(ac) = \frac{V_m{}^2}{2R_L}$

Efficiency η =

$\frac{P_{O(ac)}}{P_{i(dc)}}$

Procedure:

- Connect the circuit as shown in the circuit diagram.
- Apply the input voltage $V_i = 5V$
- Keeping the voltage constant, vary the frequency from 100Hz to 1MHz in regular steps and note down the output voltage in each case.
- Plot the gain Vs Frequency graph.
- Note down the dc current I_{dc}
- Calculate the efficiency.

Observations:

$V_i = 5V$

Freq. in Hz	V_o	Gain=	Gain in dB = 20 log $^{Vo}/_{Vi}$
50 Hz 100 Hz 200 Hz 500 Hz 1 KHz 2 KHz 3 KHz 5 KHz 10 KHz . . .			

. 1MHz 2 MHz			

Result:

Efficiency η =

AIM: To check the following applications of OP-AMP.

a) Inverting Amplifier. b) Non inverting amplifier.

APPARATUS:

S.No	Name	Range / Value	Quantity
1.	Fixed power supply	[- 15V – 0V – +15V]	1
2.	OP-AMP	µA741C	1
3.	Resistors	1KΩ, 4.7KΩ, 10KΩ, 33KΩ	Each 1
4.	Function generator	--	1
5.	CRO	--	1

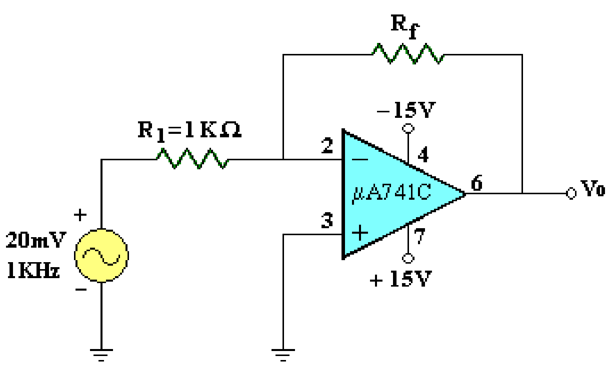
PROCEDURE:

INVERTING & NON - INVERTING AMPLIFIER:

1. Connect the circuit as shown in the figure -1
2. Switch on the power supply and signal generator.
3. Apply a sinusoidal signal with peak to peak amplitude of 20mV at a frequency of 1KHz.
4. Note down the amplitude of O/P signal in the C.R.O.
5. Repeat the above steps for different values of R_f.
6. Repeat the above steps for the circuit of fig –2.
7. Tabulate the readings.

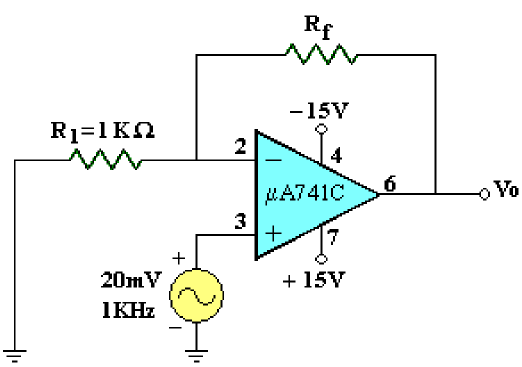
CIRCUIT DIAGRAM:

<u>Inverting Amplifier:</u>



Inverting Amplifier

<u>Non - inverting Amplifier:</u>



Non-Inverting Amplifier

INVERTING AMPLIFIER:

V_i = 20mV

S.NO	R_f (Ω)	R_1(Ω)	V_0 (mV)	Gain = V_0 / V_i	Theoretical Gain = ($-R_f/R_1$)
1	4.7K	1K			
2	10K	1K			
3	33K	1K			

NON-INVERTING AMPLIFIER:

V_i = 20mV

S.NO	R_f (Ω)	R_1(Ω)	V_0 (mV)	Gain= V_0 / V_i	Theoretical Gain = ($1+R_f/R_1$)
1	4.7K	1K			
2	10K	1K			
3	33K	1K			

RESULT-

EXP-7

COLPITTS OSCILLATOR

AIM: To determine the frequency of oscillations of a given Colpitts Oscillator.

APPARATUS:

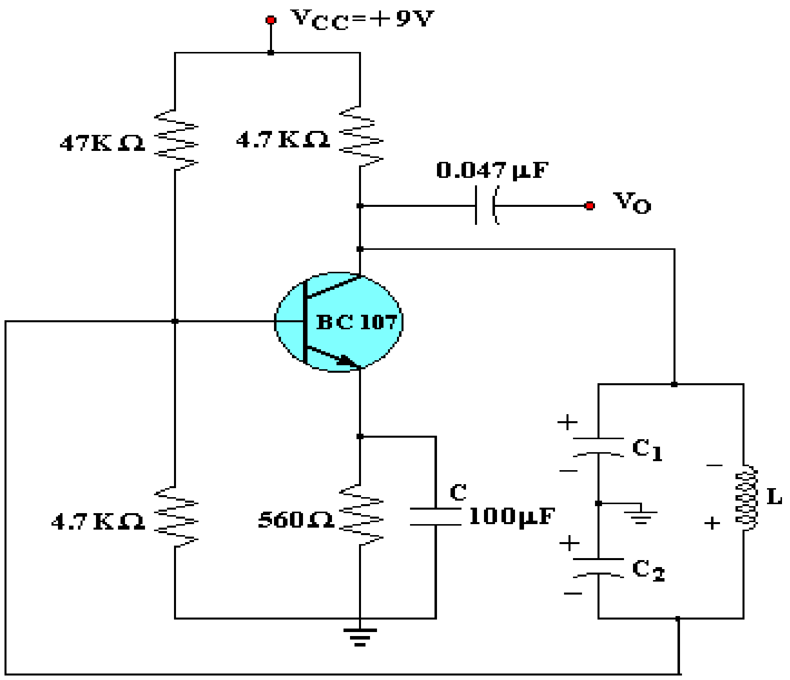
S.No	Name	Range / Value	Quantity
1.	DC Regulated Power Supply	(0-30V)	1
2.	Resistors	560Ω, 47 KΩ	Each 1
4.	Resistors	4.7 KΩ	2
5.	Capacitors	100μF, 0.047μF	Each 1
6.	Decade Inductance Box	--	1
7.	Decade Capacitance Box	--	2
8.	CRO	--	1

PROCEDURE:

1. Connect the circuit diagram as shown in the figure.
2. Switch on the power supply.
3. Connect the out put terminals to CRO.
4. Adjust the capacitances until a sinusoidal wave form is observed on the CRO.
5. Measure the time period of the sinusoidal wave form (T) and determine the Frequency (1/T).
6. Repeat the above steps for different values of L, C_1 & C_2.

7. Tabulate the readings and compare with theoretical values

CIRCUIT DIAGRAM



Colpitts Oscillator

TABULAR FORM:

S.NO.	L (mH)	C (µF)		Practical frequency (Hz)	Theoretical Frequency (Hz)
		C_1	C_2		
1					
2					
3					

CALCULATIONS:

f_0 (practical) =1/T Hz.

f_0 (theoretical) $f_0 = \frac{1}{2\pi\sqrt{LC_{eq}}}$. [Where $C_{eq} = \frac{C_1 C_2}{C1 + C2}$]

WEIN BRIDGE OSCILLATOR

AIM: To determine the frequency of oscillations of a given Wein Bridge oscillator and compare it with the theoretical value.

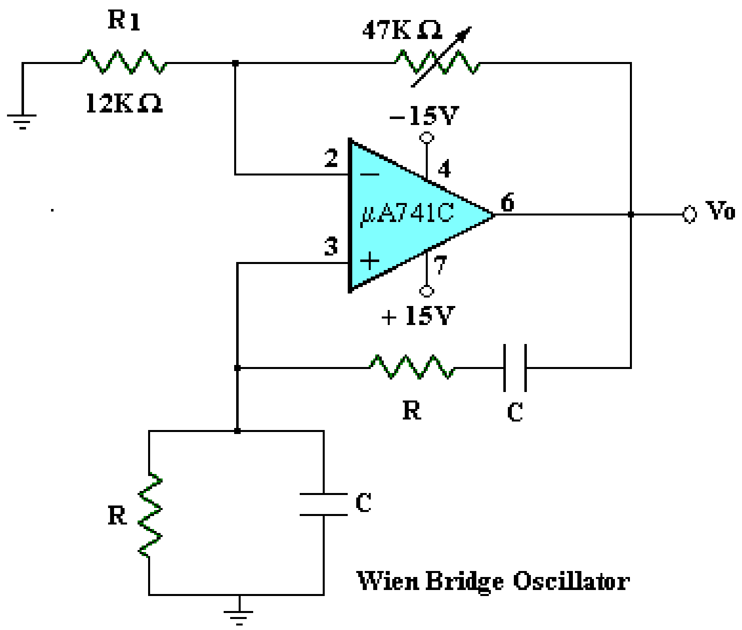
APPARATUS:

S.No	Name	Range / Value	Quantity
1.	Fixed Power Supply	[- 15V – 0V – +15V]	1
2.	OP-AMP	μ A741C	1
3.	Potentiometer	47 K Ω	1
4.	Resistors	3.3 K Ω, 220Ω	Each 2
5.	Resistors	12 KΩ	1
6.	Capacitors	0.047μ F, 0.33μ F	Each 2
7.	CRO.	--	1

PROCEDURE:

1. Connect the circuit as shown in the figure.
2. Connect 0.047 μ F, and 3.3 K Ω in place of C and R.
3. Connect the O/P to the C.R.O and observe the sinusoidal signal and measure its frequency.
4. Connect 0.33 μ F, and 220 Ω in places of C and R.
5. Observe the sinusoidal signal and measure its frequency.
6. Tabulate the readings and Compare it with theoretical values

CIRCUIT DIAGRAM:



TABULAR FORM:

S.No	Capacitance C (μ F)	Resistance R (Ω)	Theoretical Frequency = 1/2π RC (Hz)	Practical Frequency= 1/T (Hz)
1	0.047	3.3 K		
2	0.33	220		

FORMULAS:

Practical Frequency =Fo=1/T

Theoretical Frequency=1/2ΠRC

EXP-9

HARTLEY OSCILLATOR

AIM: To Determine the frequency of oscillations of a Hartley Oscillator and compare it with the theoretical values.

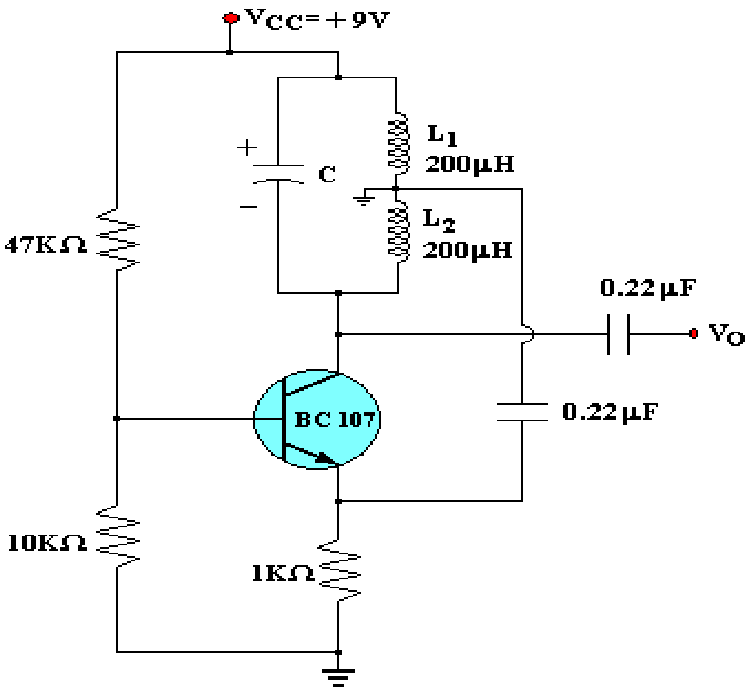
APPARATUS:

S.No	Name	Range / Value	Quantity
1.	D.C Regulated Power Supply	(0 – 30V)	1
2.	Resistors	1KΩ, 10kΩ, 47KΩ	Each 1
3.	Capacitors	0.22μF	2
4.	Decade Capacitance Box	--	1
5.	Decade Inductance Box	--	2
6.	CRO	--	1

PROCEDURE:

1. Connect the circuit as shown in the figure.
2. Connect the O / P of the oscillator to the C.R.O.
3. Adjust the Capacitance and Inductance Boxes until a sinusoidal signal is observed in the CRO.
4. Determine the frequency of the wave form.
5. Determine the frequency by varying the capacitance in convenient steps.
6. Tabulate the readings and compare the readings with the theoretical values.

CKT DIA.



Hartley Oscillator

TABULAR FORM:

Capacitance C (µ F)	Inductance (m H)		Practical Frequency (Hz)	Theoretical Frequency (Hz)
	L_1	L_2		

FORMULAS:

Theoretical Frequency $f_0 = 1/2\Pi\sqrt{LC}$

Practical Frequency F =1/T