MAHA BARATHI ENGINEERING COLLEGE

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Even Semester

(Regulation 2021)

II Year/ IV Semester

EC3462-Linear Integrated Circuits Laboratory

(As per the Anna University Syllabus, Chennai)

TABLE OF CONTENT

S.No	Date	Nameof theExperiment	PageNo	Marks	Signature

Ex.No:1(a)	DESIGN AN DANA LYSIS OF CURRENT SERIES FEEDBACK AMPLIFIER
Date:	

AIM:

To designandanalyzethecurrentseriesfeedbackamplifierandcalculatetheBandwidth,Input impedanceandOutputimpedance forwith&withoutfeedbackamplifier.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	56KΩ,2.2KΩ,12KΩ,470Ω	Eachone
3	Capacitor	22µF,2.2µF,47µF	Eachone
4	CRO	(0-30)MHz	1
5	RPS	(0-30)V	1
6	FunctionGenerator	(0–3)MHz	1
7	Breadboard	-	1
8	Connectingwires	-	Asrequired

THEORY:

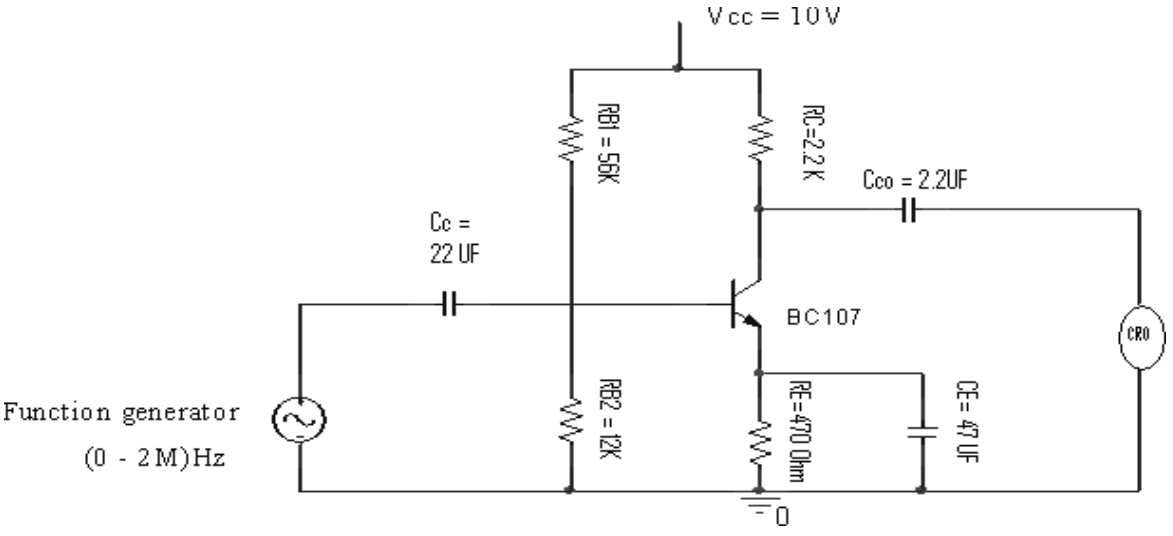
A portion of the output signal is taken from the output of the amplifier and is combined with thenormal input signal and thereby feedback is accomplished. There are two types of feedback, positivefeedbackandnegativefeedback.Feedbackincreasesthestabilityofanamplifier,increasesthebandwidthandreducesthedistortionandnoise.Thepropertyofpositivefeedbackisutilizedinoscillators.Theseriesconnection at the output increases the output resistance. Common emitter amplifier is an exampleforcurrentseries feedback amplifier.

Parameter	Withfeedback
InputImpedance	Increases
OutputImpedance	Increases
Gain	Decreases
Bandwidth	Increases

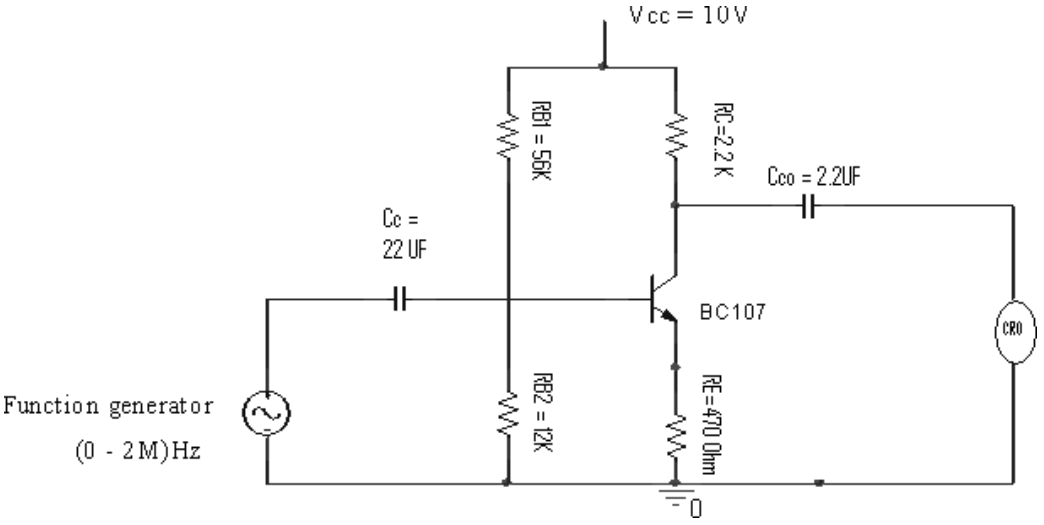
PROCEDURE:

1. Designthecurrentseriesfeedbackamplifier.
2. Theconnectionsaremadeas perthecircuit diagram.
3. Set the input voltage to a fixed value. Measure the output voltages for the various inputfrequencies.Calculate thevoltagegain indBforeachinput frequency.
4. Plotthegraph:FrequencyinHzVsGainindBfortheamplifierwithfeedback.
5. ThenthecapacitorC$_E$isincludedinparallel withR$_E$togettheamplifierwithoutfeedback.
6. Thesteps (2,3, and4)arerepeated foran amplifier withoutfeedback.
7. Calculatetheinputimpedance and outputimpedancevalues.

CIRCUIT DIAGRAM:WITHOUTFEEDBACK



WITHFEEDBACK



DESIGNPROCEDURE:

Assumptions: V_{CC}=10v,V_E=V_{CC}/10=1V,V_{CE}=V_{CC}/2=5;R_L=100ohms ,F_L=1KHz SinceI$_B$isverysmallcomparewithIc,I_E~Ic=2mAA$_V$=30;h_{fe}=120,S=5,h_{ie} =1.56KΩ,R_{leff} =234Ω, R_{B1}=56KΩ,R_{B2}=12KΩ,D=29

1. Calculation of R_E:

R_E=V_E/I_E=470Ω

V_B= V_{CC}.R_{B1}/R_{B1}+$R_{B2}$$V_B$

=1.3V

2. Calculation of R_C:

V_{cc}=$I_c$$R_c$+$V_{CE}$+$I_E$$R_E$$I_C$

≅I_E

R_c=2.2K Ω

3. Calculation of R_B:

R_B=R_{B1}||R_{B2}R

$_{B1}$=56K

ΩR_{B2}=12KΩ

R_B=9.88K Ω

4. CalculationofInputimpedanceZ_i:

Z_I = h_{ie} ||

$R_B$$Z_I$=1.34K

Ω

5. CalculationofOutputimpedance Z_0:

Z_0=R_c=2KΩ

Parameter	Withoutfeedback	WithFeedback
InputImpedance	Z_i=R_B//hie=1.34KΩ	Z_{if}=Z_iD=25.23KΩ
OutputImpedance	Z_O=R_C//R_L=2KΩ	Z_{Of}=Z_OD=58KΩ

TABULATION:WITHO

UTFEEDBACK:

Vin=

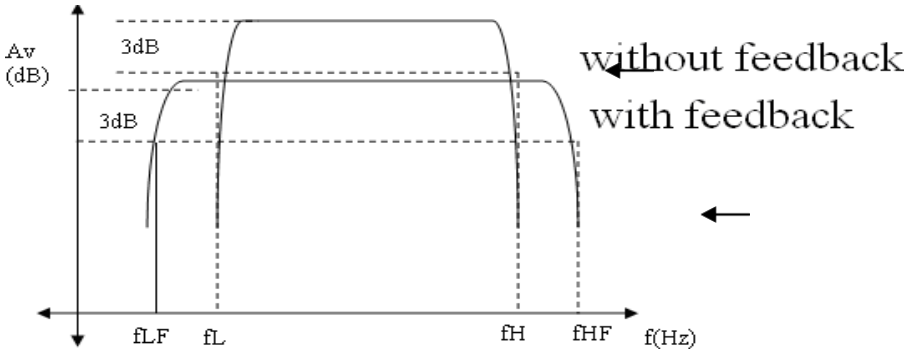
S.NO	FrequencyinHz	OutputvoltageinVolts	Voltagegain	Voltagegain in dB

WITHFEEDBACK:

Vin=

S.NO	FrequencyinHz	OutputvoltageinVolts	Voltagegain	Voltagegain in dB

MODELGRAPH:



RESULT:

Thusthecurrentseriesfeedbackamplifierisdesignedforwithout andwithfeedback.

The circuit is analyzed to get the frequency response and measured the following

parametersLowercutoffFrequency$f_{L:}$

UppercutoffFrequencyf_H :

Bandwidth :

Inputimpedance :

Outputimpedance :

Ex.No:1(b)	DESIGNANDANALYSISOFVOLTAGESHUNTFEEDBACK AMPLIFIER
Date:	

AIM

Todesignandanalyzethevoltageshuntfeedbackamplifierandcalculatethe Bandwidth,Input impedanceandOutputimpedanceforwith&withoutfeedbackamplifier.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	56KΩ,2.2KΩ,12KΩ,470Ω,1KΩ	Eachone
3	Capacitor	22µF,2.2µF,47µF, 0.1µF	Eachone
4	CRO	(0-30)MHz	1
5	RPS	(0-30)V	1
6	FunctionGenerator	(0–3)MHz	1
7	Breadboard	-	1
8	Connectingwires	-	Asrequired

THEORY:

A portion of the output signal is taken from the output of the amplifier and is combinedwith the normal input signal and thereby feedback is accomplished. There are two types of feedback,positive feedback and negative feedback. Feedback increases the stability of an amplifier, increases

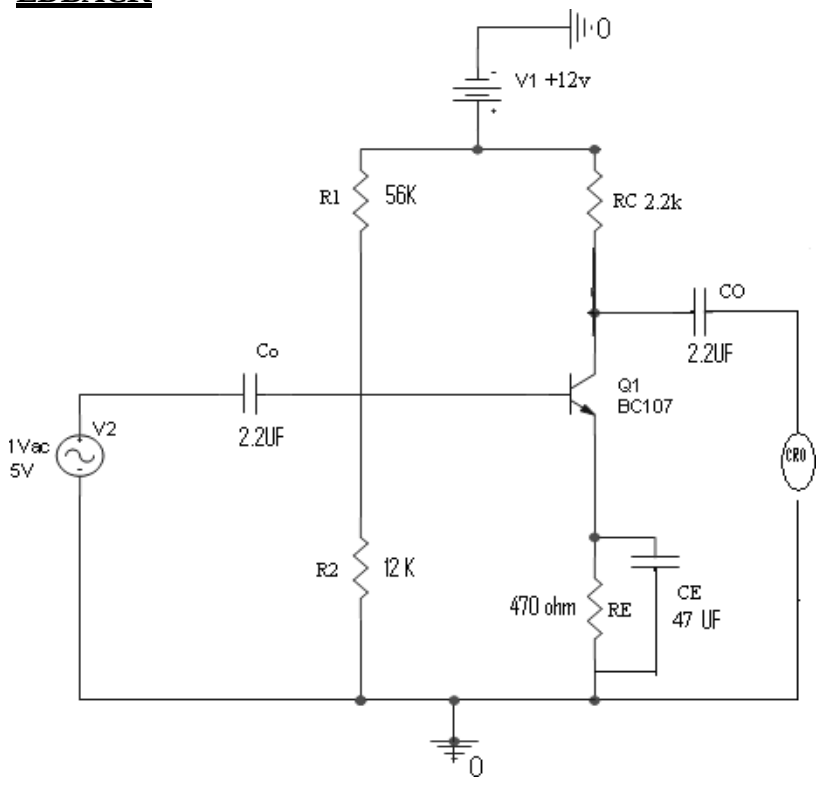
thebandwidthandreducesthedistortionandnoise.Thepropertyofpositivefeedbackisutilizedinoscillators.The shunt connection at the output decreases the output resistance. Common emitter amplifierwith aresistivefeedback fromcollectortobaseisanexample forvoltageshuntfeedbackamplifier.

Parameter	Withfeedback
InputImpedance	Decreases
OutputImpedance	Decreases
Gain	Decreases
Bandwidth	Increases

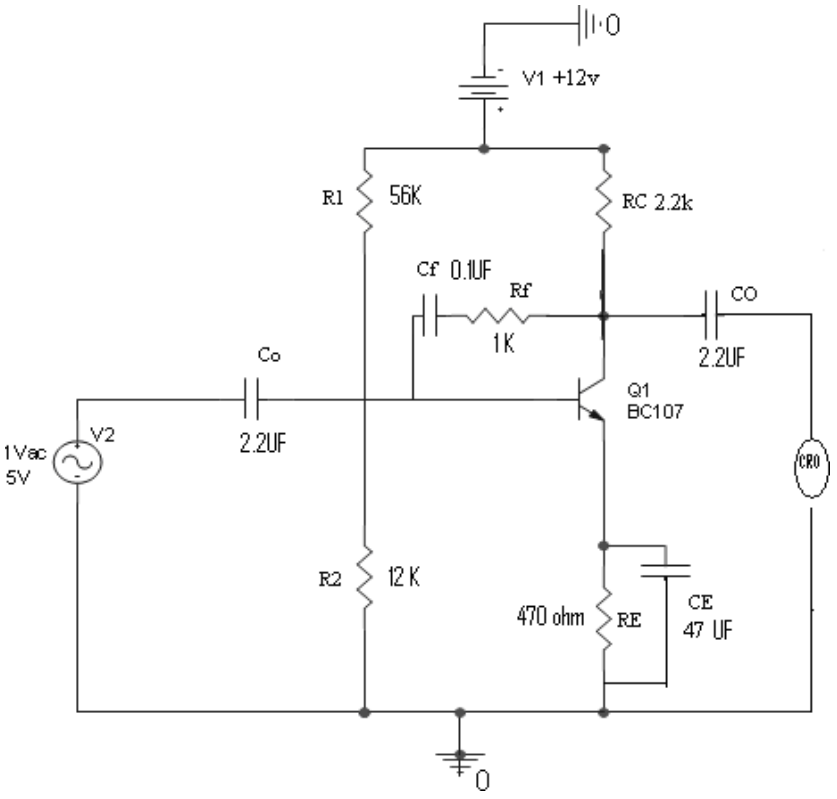
PROCEDURE:

1. Designthevoltageshuntfeedbackamplifier.
2. Theconnectionsaremadeas perthecircuit diagram.
3. Set the input voltage to a fixed value. Measure the output voltages for the various inputfrequencies.Calculate thevoltagegain indBforeachinput frequency.
4. Plotthegraph:FrequencyinHzVsGainindBfortheamplifierwithfeedback.
5. ThenthecapacitorC$_f$andresistanceR$_f$isremovedfromthefeedbacktogettheamplifierwithoutfeedback.
6. Thesteps (2,3, and4)arerepeated foran amplifier withoutfeedback.
7. Calculatetheinputimpedance and outputimpedancevalues.

CIRCUIT DIAGRAM:WITHOUTFEEDBACK



WITHFEEDBACK:



DESIGNPROCEDURE:

Assumptions:V_{CC}=12v,AV=30f_L=1KHz,S=2,I_E=1.2mA,R_L=4.7KΩ,β=0.4;

1. Calculationofh_{ie}:

r_e=26mV/$I_{E\,2}$

$h_{ie}=h_{fe}r_e$

2.CaluclationofA$_{Vf}$

$$A_v=\frac{h_{fe}R_c||R_L}{hie}$$

$V_E=V_{CC}/10,V_{CE}=V_{CC}/2$

3. Calculationof R_C:

$V_{cc}=I_cR_c+V_{CE}+I_ER_E$

$R_C=(V_{cc}-V_{CE}-I_ER_E)/I_cI_C\cong I_E$

$V_B=V_{CC}.R_2/R_1+R_2$

4. Calculationof R_E:

$R_E=V_E/I_E$

5. Calculationof R_B:

$R_B=R_1||R_2$

6. CalculationofInputimpedanceZ$_i$:

$R_I=h_{ie}||R_B||R_F$

7. CalculationofInputimpedanceZ$_0$:

$R_0=R_c||R_F$

8. CalculationofCouplingCapacitors:

$X_{ci}=R_i/10$

$X_{c0}=R_c||R_L$

WITH

FEEDBACKD=1+A

$\beta A_{VF}=A_v/D$

$R_{if}=R_i/DR_{of}$

$=R_0/D$

Parameter	Withoutfeedback	WithFeedback
InputImpedance	$R_I=h_{ie}\|\|R_B\|\|R_F$	$R_{if}=R_i/D$
OutputImpedance	$R_0=R_c\|\|R_F$	$R_{of}=R_0/D$
Gain	$A_v=\frac{hfeR_c\|\|R_L}{Hie}$	$A_{VF}=A_v/D$

TABULATION:WITHO

UTFEEDBACK:

Vin=

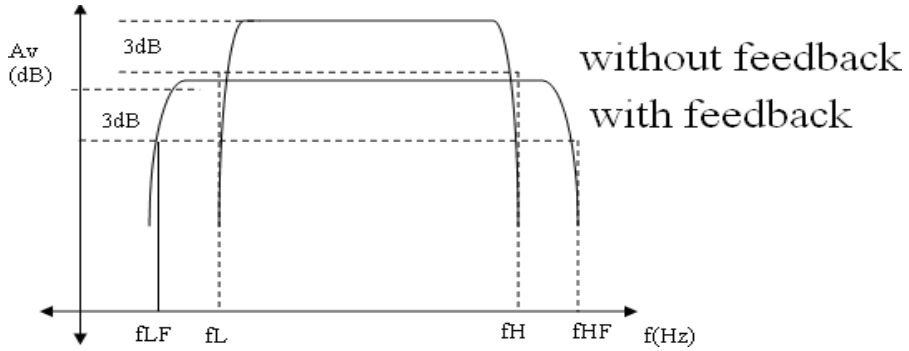
S.NO	FrequencyinHz	Amplitudein Volts	Voltagegain	Voltagegain in dB

WITHFEEDBACK:

Vin=

S.NO	FrequencyinHz	Amplitudein Volts	Voltagegain	Voltagegain in dB

MODELGRAPH:



RESULT:

Thus the voltage shunt feedback amplifier is designed for without and with feedback. The circuit isanalyzed toget thefrequencyresponseand measured the followingparameters

Lower cutoff Frequency f_L

:Upper cutoff Frequency

f_H:Bandwidth :

Inputimpedance :

Outputimpedance :

Ex.No:2(a)	DESIGNANDANALYSISOFRCPHASESHIFTOSCILLATOR
Date:	

AIM:

Todesignandanalyzea RC phaseshiftoscillatorforagivenfrequencyandtesttheresult withthedesign.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	56K,12KΩ,470Ω,2.2KΩ	Each1
3	Resistor		Each3
4	Capacitor	0.01µF	3
5	CRO	(0-30)MHz	1
6	RPS	(0-30)V	1
7	Breadboard	-	1
8	Connectingwires	-	Asrequired

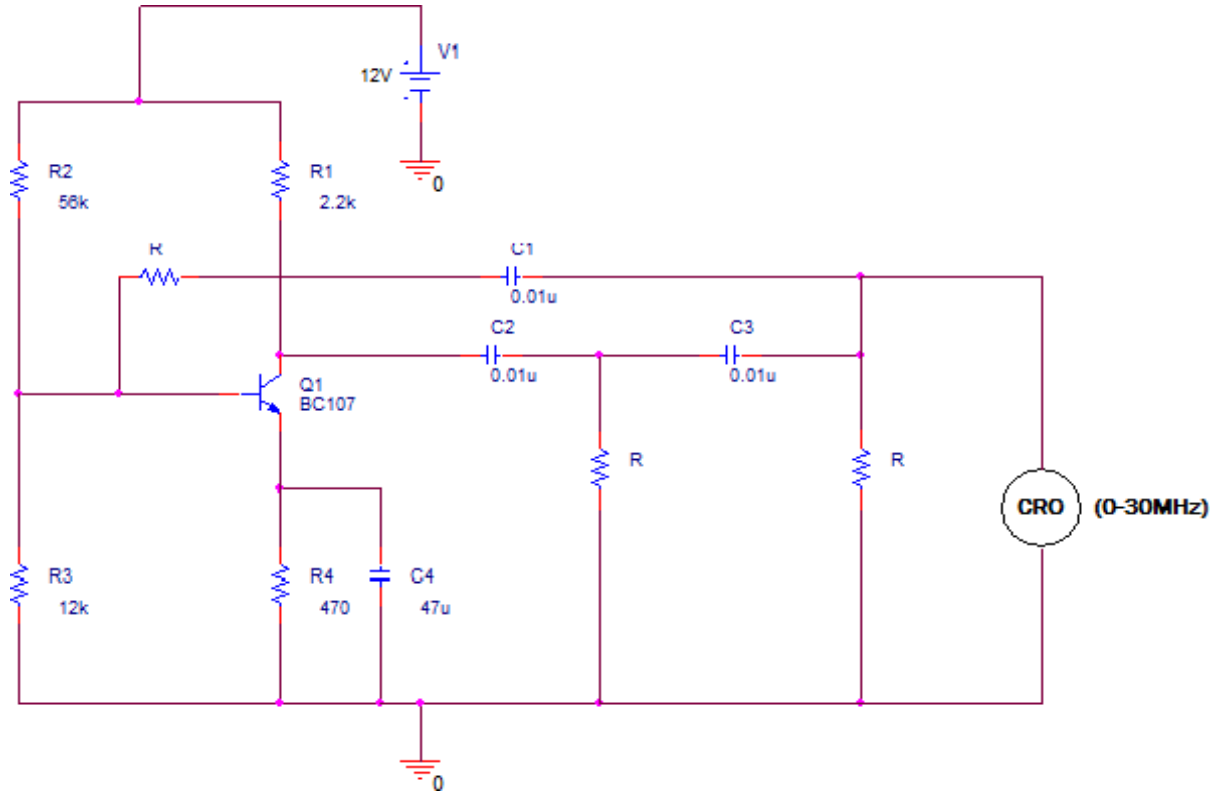
THEORY:

Acommonemitteramplifierfollowedbythreesectionsof RCphaseshiftnetwork,theoutputofthelastsectionbeingreturnedtotheinputformaRCphaseshiftoscillator.InpracticethevalueofRisadjustedsuchthatthephaseanglebecomes60.IfthevaluesofRandCarechosensothatforthegivenfrequencythephase shift of each RC section is 60. Thus such a RC ladder network produces a total phase shift of 180betweenitsinputandoutputvoltagesforonlythegivenfrequencythetotalphaseshiftfromthebaseofthe transistor around the circuit and back to the base will be exactly 360 or 0, thereby satisfying Barkhausancondition for oscillation. The RC phase shift oscillator is suitable for audio frequencies only.Its maindrawbacks are that the three capacitors and resistors should be changed simultaneously to changethefrequency of oscillation and it is difficult to control the amplitude of oscillation without affecting thefrequencyofoscillation.Itis mainlyused inaudio frequencytransmitterfor generatingcarriersignals.

PROCEDURE:

1. DesigntheRC phaseshiftoscillator.
2. Theconnectionsaremadeas perthecircuit diagram.
3. Measuretheoutput sinewaveformusingCRO.
4. Thevalueoffrequencyiscalculatedandcomparedwith thedesign.

CIRCUITDIAGRAM:



DESIGNPROCEDURE:

Design ofaTransistorcircuit:

V_{CC} = 10V, Ic = 2mA, β =

100I_B=I_C/ β =0.02mA

V_{CE}=V_{CC}/ 2 =5V

V_{BE}=10%ofV_{CC}=1.0V

V_B=V_{RE}+V_{BE}=1.0+0.7 =1.7V

R_E = V_{RE} / I_E = 1.0 / (2.02*10^-3) = 495Ω = 470

ΩR2=V_B/ (10*I_B) =8.5KΩ=12KΩ

R1=[V_{CC}/(10*I_B)]–R_2=50K

Ω=56KΩRC=(V_{CC}–V_{CE}– $I_E$$R_E$)/$I_C$=2.2KΩ

X_{CE}mustbeequal toonetenth ofvalueof$R_E$atthelowestoperatingfrequency.X_{CE}=RE /

10 =47,ω=2πf, f=75Hz

⇨ 1/(ωC_E) =47

⇨ C_E = 56μF =

47μFChoosecouplingcapacitor=0.0

1μF

Design ofTankcircuit:

Given frequency = 1KHZ and assume C =

0.01µFDesignEquation: Frequencyf

$=1/(2\pi RC\sqrt{4K+6})$

$=>R=6.8K\Omega$

BarkhausenCriterion:

K =Rc/ R

=2.4K/ 6.5K

=0.32

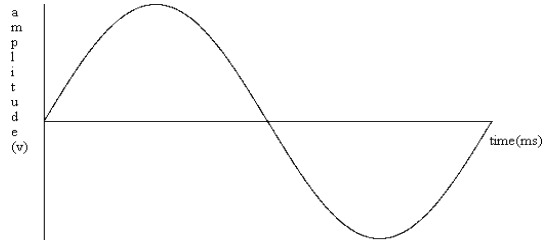
h_{fe}=4K+23+29 / K

=114.99

TABULATION:

S.No	Capacitor	Resistor	Theoreticalfrequency inKHz	Amplitude inVolts	Timeperiod inms	Observedfrequency inKHz
1	0.01uF		1K			
2	0.01uF		1.5K			
3	0.01uF		2K			
4	0.01uF		2.5K			

MODELGRAPH:



RESULT:

ThustheRCphaseshift oscillatorisdesignedandanalyzedasperthedesign.

Designed frequency

=Obtainedfrequency

=

Ex.No:2(b)	DESIGNANDANALYSISOFWEINBRIDGEOSCILLATOR.
Date:	

AIM:

Todesignandanalyze a weinbridgeoscillatorforagivenfrequencyandtest theresultwiththe design.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	470 Ω	1
3	Resistor	56KΩ,12KΩ,1KΩ,1.5KΩ 1KΩ	Each2
4	Resistor	4KΩ	1
5	Capacitor	0.1µF,10µF	Each2
6	CRO	(0-30)MHz	1
7	RPS	(0-30)V	1
8	Breadboard	-	1
9	Connectingwires	-	Asrequired

THEORY:

Wein bridge oscillator is an audio frequency RC oscillator. The amplifier used in wein bridgeoscillator is non inverting type. Here two common emitter amplifier is cascaded to produce a phase

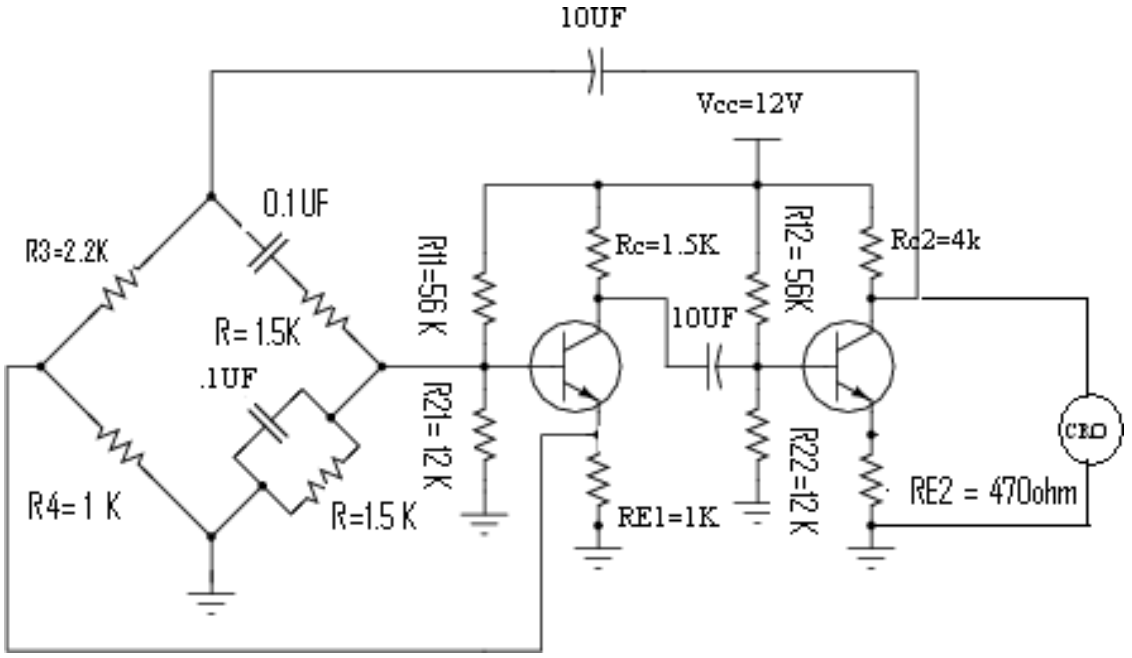
shiftof0.ThereforethefeedbacknetworkneednotprovideanyphaseshiftBychangingthevalueofRandCin frequency sensitive arm we can change the output signal frequency. To generate low frequency audiosignal wein bridgeoscillators is usedin signalgenerators.

Frequencyofoscillation=1/ (2πRC√6)

PROCEDURE:

1. Designtheweinbridgeoscillatorasperthedesign.
2. Theconnectionsaremadeas perthecircuit diagram.
3. Measuretheoutput sinewaveformusingCRO.
4. Thevalueoffrequencyiscalculatedandcomparedwiththedesign

CIRCUITDIAGRAM:



DESIGNPROCEDURE:

DesignofaTransistorcircuit1:

AssumeV_{cc}=12V,I_c=4mA = I_E,V_{CE}=V_{CC}/2=6V,V_E =V_{CC}/10, R_{11}=56KΩ

Z parallel =R_C / X_C = =

9.42ΩZ series = R + X_C ==

1.6KΩZ_f=1.61KΩ

To find R_{E1}:

R_{E1}=V_E /$_{IE}$=**1K**Ω

To find R_{C1}

R_{C1}=V_{CC}/ 2I_C=**1.5K**Ω

To find R_{12}

R_{11}||R_{12}>10Z_F**R_{12}= 56K**Ω

DesignofaTransistorcircuit2:

Assume V_{CC} =12V,I_C =1.5mA =I_E,V_{CE}=V_{CC}/ 2 =6V,V_E=VCC/10=1.2V, R_{22} =12K

To find R_{E2}

$R_{E2}=V_E/I_E=470\Omega$

To find R_{C2}

$R_{C2}= V_{CC}/2I_C= 4K\Omega$

$V_B= V_{BE}+V_E=1.9V$ $V_B= V_{CC}(R_{B2}/R_{22}+R_{21})$

To find R_{21}

$R_{21}+R_{22}>10Z_F$ $R_{21}=12K\Omega$

Design of Tank circuit:

Assume: f =1 KHz, C =0.1μf

$F=1/2\pi RCR$

$=1.5K\Omega$

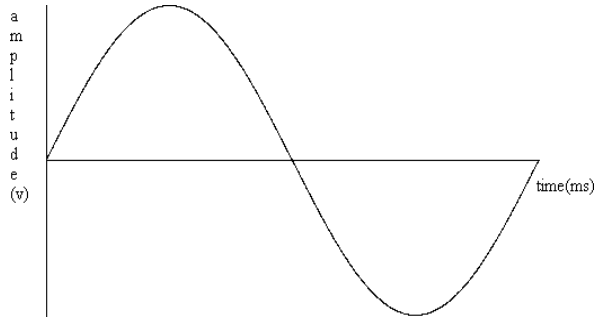
Barkhausen Criterion:

Assume $R_4=1K\Omega$ $R_3/R_4=2; R_3=2K\Omega$

TABULATION:

S.No	Amplitude in Volts	Time period in ms	Theoretical frequency in KHz	Observed frequency in KHz

MODEL GRAPH:



RESULT:

ThustheWein bridgeoscillatorisdesignedandanalyzedasperthedesign.

Designed frequency

=Obtainedfrequency=

Ex.No:3(a)	DESIGNANDANALYSISOFHARTLEYOSCILLATOR
Date:	

AIM:

Todesignandanalyze a Hartleyoscillatorfora givenfrequencyandtesttheresult withthe design.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	56KΩ,2.2KΩ,12KΩ,470Ω	Eachone
3	Capacitor	22µF,2.2µF,47µF,0.01µF	Eachone
4	Inductor	mH	2
5	CRO	(0-30)MHz	1
6	RPS	(0-30)V	1
7	Breadboard	-	1
8	Connectingwires	-	Asrequired

THEORY:

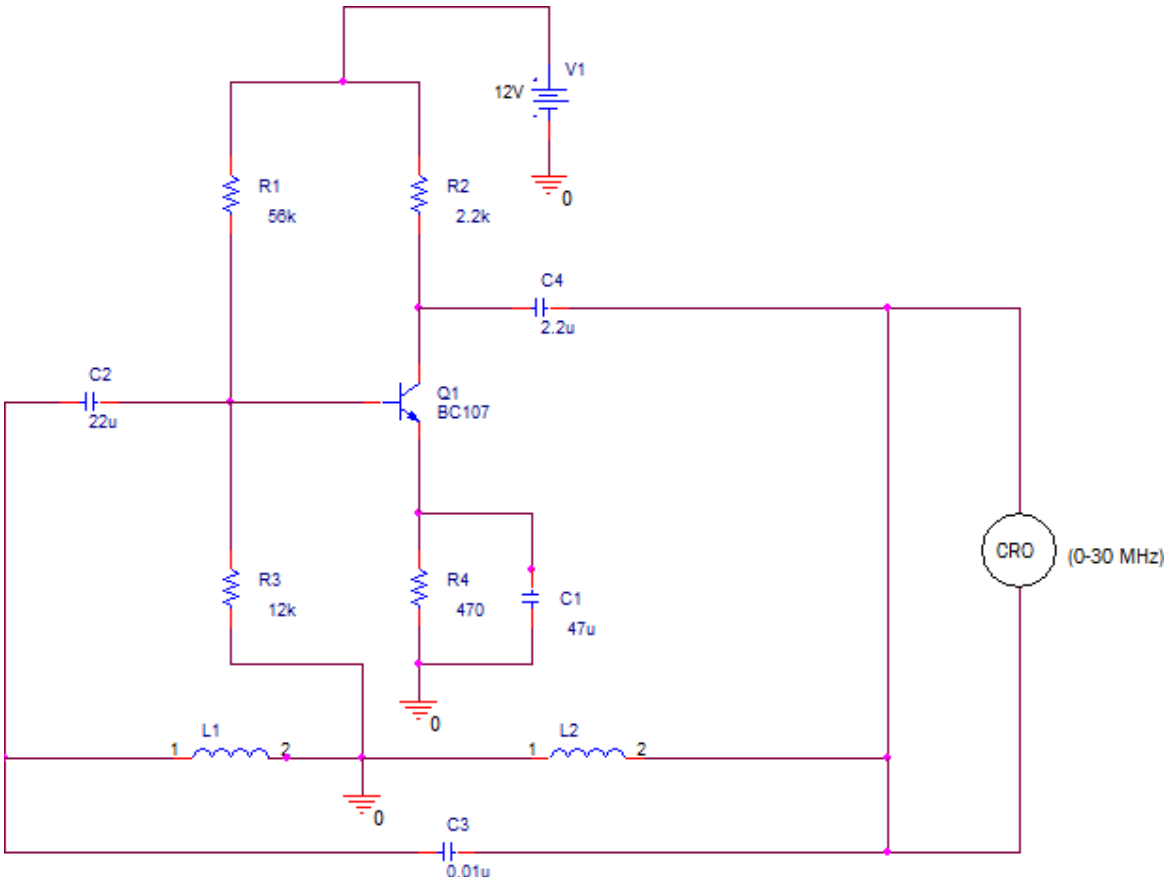
Whenthesupplyvoltage+Vccisswitchedon,atransientcurrentisproducedinthetank circuitandconsequentlydampedharmonicoscillationsaresetupinthecircuit.Theoscillatorycurrentinthetankcircuitproducesacvoltagesacross L1andL2.Asterminal3isearthedit willbeatzeropotential.Ifterminal1is atpositivepotentialwithrespectto3atanyinstant,terminal2willbeanegativepotentialwithrespectto3atthesameinstant.Thusthephasedifferencebetweentheterminals1and2isalways

180. In the CE mode, the transistor provides the phase difference of 180 between the input and output.Thereforethetotalphaseshiftis360.Thusatthefrequencydeterminantforthetankcircuit,thenecessaryconditionforsustainedoscillationsissatisfied.Ifthefeedbackisadjustedsothattheloopgain Aβ=1,thecircuit acts as an oscillator. In radio frequency transmitter to generate high frequency carriersignals LCoscillatorsareused.

PROCEDURE:

1. DesigntheHartleyoscillatoras perthedesignprocedure.
2. Theconnectionsaremadeas perthecircuitdiagram.
3. Measuretheoutput sinewaveformusingCRO.
4. Thevalueoffrequencyiscalculatedand comparedwiththedesign

CIRCUITDIAGRAM:



DESIGNPROCEDURE:

Design ofTransistorcircuit:

Assume V_{cc}= 10V,I_c = 4mA = I_E,V_{CE} = V_{CC}/2 = 5V, V_E = V_{CC}/10,R_E=V_E / I_E =470Ω

R_C=V_{CC} -V_{CE}-V_E

.....=

2.2KΩI_C

V_2=V_{BE}+V_E=1.7VV_{CC}=V

1+V_2=10.1VR_1

=V_1/10*I_B=56KΩR_2=

V_2/9*I_B=12KΩ

R_B=R_1‖R_2=20.78KΩF_O=

10KHz

X_{CE}=R_E/10=47

C_E=10/2*F_O*R_E=47µF

Design ofTankcircuit:

Assumef =30KHzandC=0.01μFFrequencyofoscillationf=1/(2π√LC)ThenL=6mH;

$L=L1+L_2$

Let$L_1=L_2$ $L_1= L/ 2=3mH$ $L_1=L_2=3mH$

BarkhausenCriterion:

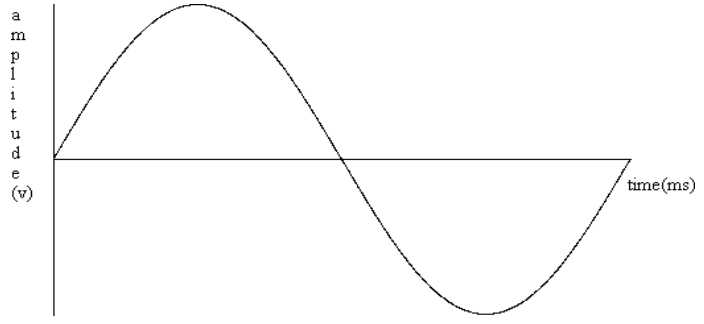
$h_{fe}=L1/L_2$

=3 mH /3 mH=1

TABULATION:

S.No	Capacitor	Inductor ($L_1=L_2$)	Theoreticalfrequency inKHz	Amplitude inVolts	Timeperiod inms	Observedfrequency inKHz
1	0.01uF		40K			
2	0.01uF		10K			
3	0.01uF		20K			
4	0.01uF		30K			

MODELGRAPH:



RESULT:

ThustheHartleyoscillatorisdesignedand analyzedasperthedesign.

Designed frequency

=Obtainedfrequency=

Ex.No:3(b)	DESIGNANDANALYSISOFCOLPITTSOSCILLATOR
Date:	

AIM:

TodesignandconstructaColpittsoscillator foragivenfrequencyandtesttheresultwiththe design.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Transistor	BC107	1
2	Resistor	56KΩ,2.2KΩ,12KΩ,470Ω	Eachone
3	Capacitor	22µF,2.2µF,47µF,0.01µF	2.2µF-1, 22µF-1, 0.01µF-247µF– 1
4	Inductor	mH	1
5	CRO	(0-30)MHz	1
6	RPS	(0-30)V	1
7	Breadboard	-	1
8	Connectingwires	-	Asrequired

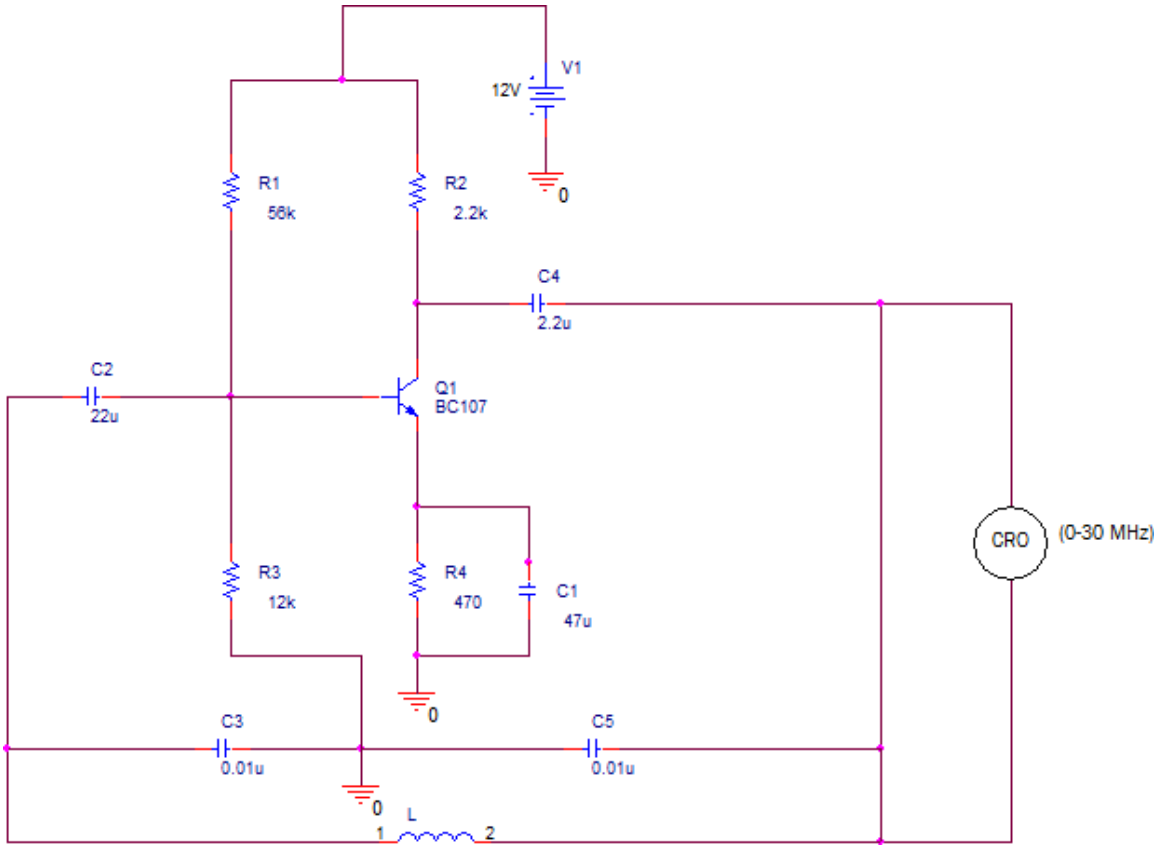
THEORY:

ThefeedbacknetworkconsistingofinductorsLandcapacitorC1andC_2determinesthefrequencyofthe oscillator.Whenthesupplyvoltage+Vccisswitchedon,atransientcurrentisproducedinthetankcircuitandcons equentlydampedharmonicoscillationsaresetupinthecircuit.Theoscillatorycurrent in the tank circuit produces ac voltages across C1 and C2. As terminal 3 is earthed it will be atzero potential. If terminal 1 is at positive potential with respect to 3 at any instant, terminal 2 will be anegative potential with respect to 3 at the same instant. Thus the phase difference between the terminals1 and 2 is always 180. In the CE mode, the transistor provides the phase difference of 180 between theinput and output. Therefore the total phase shift is 360. Thus at the frequency determinant for the tankcircuit, the necessary condition for sustained oscillations is satisfied. If the feedback is adjusted so thatthe loop gain $A\beta = 1$ the circuit acts as an oscillator. In radio frequency transmitter to generate highfrequencycarrier signalsLC oscillators areused.

PROCEDURE:

1. DesigntheColpittsoscillatorasperthedesignprocedure.
2. Theconnectionsaremadeas perthecircuitdiagram.
3. Measuretheoutput sinewaveformusingCRO.
4. Thevalueoffrequencyiscalculated andcomparedwiththedesign.

CIRCUITDIAGRAM:



DESIGNPROCEDURE:

Assume f = 30 KHz and L = 5mH,

C=5.6nFFrequencyof oscillationf=1 /(2π√LC)

And C = C_1C_2 / (C_1+

C_2)LetC_1=0.01µF

⇨ C2=0.01µF

BarkhausenCriterion:

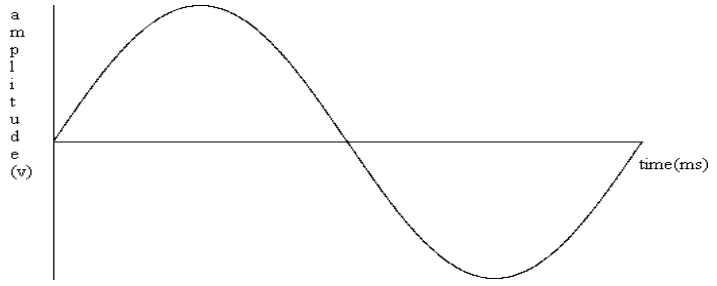
$h_{fe}=C_1/C_2$

=0.01µF/ 0.01µF=1

TABULATION:

S.No	Capacitor (C_1=C_2)	Inductor L	Theoretical frequency inKHz	Amplitude inVolts	Time period inms	Observed frequency inKHz
1	0.01uF		40K			
2	0.01uF		10K			
3	0.01uF		20K			
4	0.01uF		30K			

MODELGRAPH:



RESULT:

ThustheColpittsoscillatorisdesignedandanalyzedasperthedesign.

Designed frequency

=Obtainedfrequency=

Ex.No:4	**DESIGNANDANALYSISOFRCINTEGRATOR &DIFFERENTIATOR**
Date:	

AIM:

TodesignandanalyzetheRCintegrator,differentiatorscircuits.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Resistor	1KΩ	1
2	Capacitor	0.1uF	1
3	CRO	(0-30)MHz	1
4	Functiongenerator	(0-3)MHz	1
5	Breadboard	-	1
6	Connectingwires	-	Asrequired

THEORY:

INTEGRATOR:

ForalowpassRCcircuit,ifthetimeconstantisverylargeascomparedtothetimerequired bytheinputsignaltomakeanappreciablechange,thecircuitactsasanintegrator.Underthiscase,thedropacross Cisnegligible comparedtodrop acrossR.ThustheentireinputVi(t)canbeassumedto be appearing across R. Then the current i is given by, $V_r = V_i = iR$; $i = V_i / R$**DIFFERENTIATOR:**

ForahighpassRCcircuit,iftimeconstantisverysmallascomparedtothetimerequiredbythe inputsignalto makean appreciablechangethe circuit actsasadifferentiator.

i = C (dVc

/dt)i=C(dVi

/

dt)Vo=i

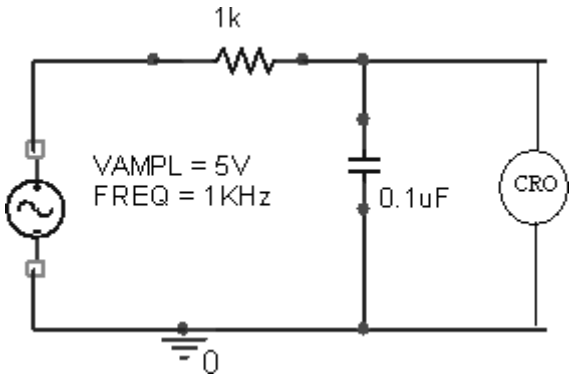
R

Vo=RC (dVi/dt)

PROCEDURE:

1. Thecircuit connectionsaremadeasperthecircuitdiagramIntegrator.
2. Applythesquarewaveas ainputsignaltothecircuit.
3. The time period and amplitude of the output wave is noted from CRO and the waveform isdrawn in agraph.
4. InterchangetheresistorandcapacitorpositiontogetDifferentiatorcircuit,thenPerformthesteps1,2, 3.

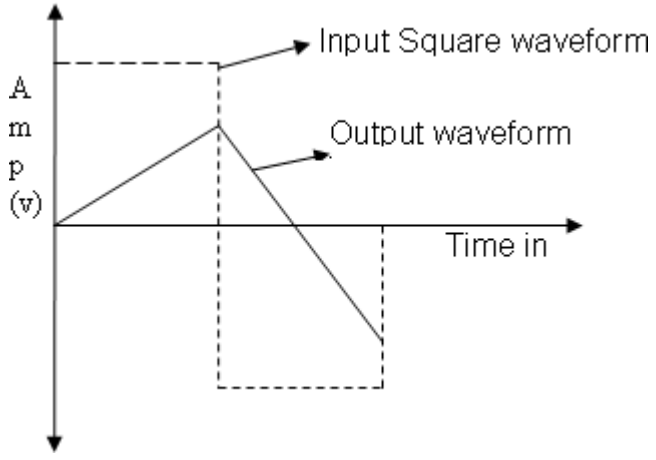
INTEGRATOR:



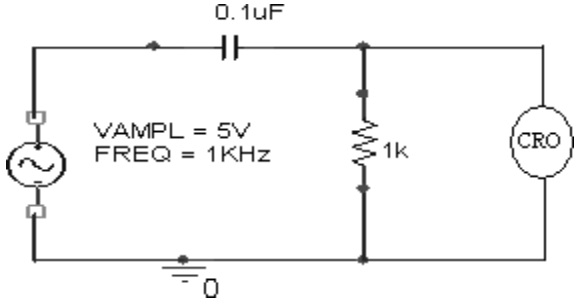
TABULATION:

S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:



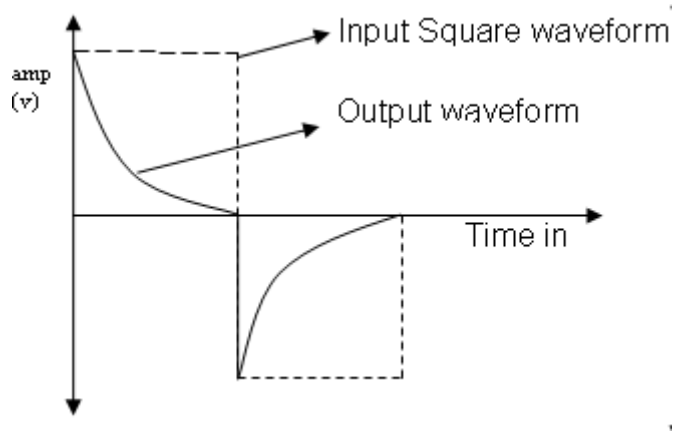
DIFFERENTIATOR:



TABULATION:

S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:



RESULT:

Ex.No:5	DESIGNANDANALYSISOFCLIPPERS&CLAMPERS
Date:	

AIM:

Todesignandanalyzetheclippers, clamperscircuits.

EQUIPMENTSREQUIRED:

S.NO	EQUIPMENTS	RANGE	QUANTITY
1	Diode	IN4007	1
2	Resistor	1K	1
3	Capacitor	0.1uF	1
4	CRO	(0-30)MHz	1
5	RPS	(0-30)V	1
6	Breadboard	-	1
7	Connectingwires	-	Asrequired

THEORY:

CLIPPER:

Clipper is a circuit which is used to clip off unwanted portion of the waveform, withoutdistorting the remaining part of the waveform. When the diode is connected in series with the load,such a circuit is called a series clipper. The clipper level is determined by the reference voltage V_{ref}andcouldbeobtainedbythesupplyvoltage.

Whenthesupplyvoltageispositive,thecircuitissaidtobepositivereferenceclipper.

CLAMPER:

The clamper which is used to add a dc level as per the requirements to the ac output signal iscalledclampers.Thecapacitor,diodeandresistorsarethe3basicelementsofaclampercircuit. Theyare also called as dc inserter circuits or dc resonators. They are positive and negative clampersdependingonwhetherpositivedcornegativedcshiftisintroduced.Apositiveclamperaddsapositiv eleveltotheacoutput.Duringthepositivehalfcycleof Vi,thediodeisreversebiasedandthecapacitorstarts discharge. During the negative half cycle, the diode gets forward biased and the capacitorchargesto maximum levelVm. A negativeclamperaddsanegativelevel tothe acoutput.

PROCEDURE:

1. Thecircuitconnectionsaremadeasperthecircuitdiagram.
2. Applythe sinewaveasan input signalto thecircuit.

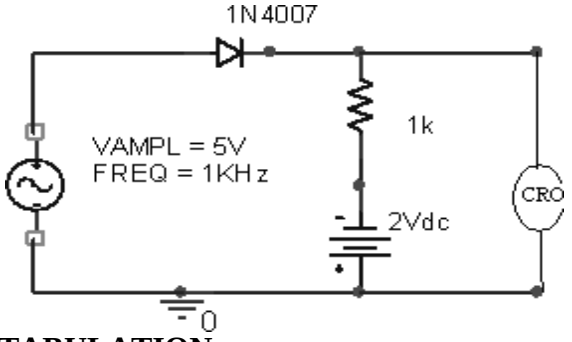
3. The time period and amplitude of the output wave is noted from CRO and the waveformisdrawninagraph.
4. Repeattheaboveproceduresforallthecircuit diagram.

drawninagraph.

5. Repeattheaboveproceduresforallthecircuit diagram.

SERIESCLIPPERS:

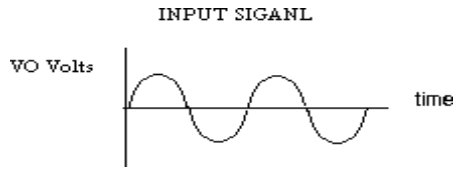
Negativeclipperwithnegativereference:

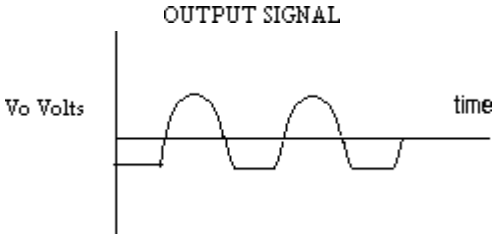


TABULATION:

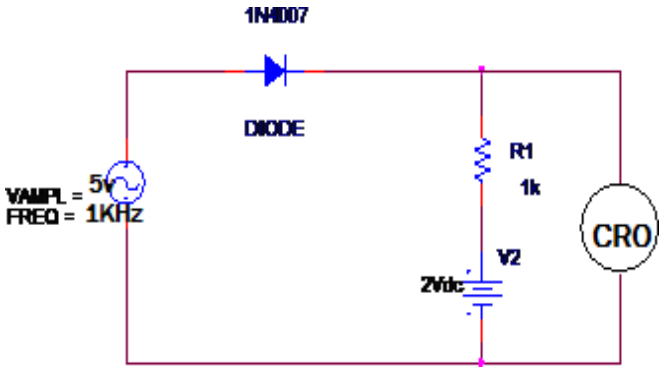
S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:





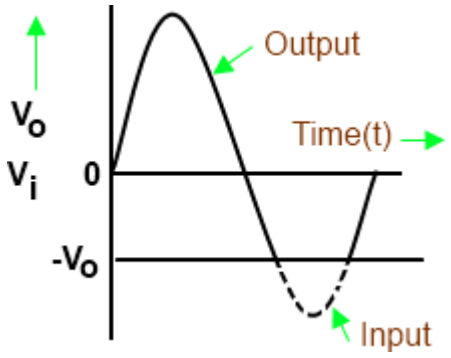
Negativeclipperwithpositivereference



TABULATION:

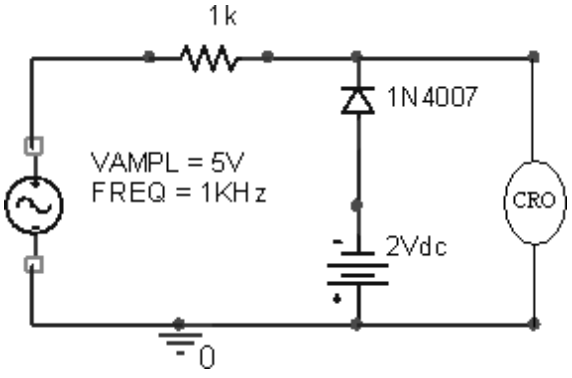
S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:



PARALLELCLIPPERS:

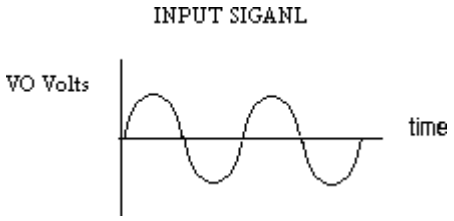
Negativeclipperwithnegativereference:

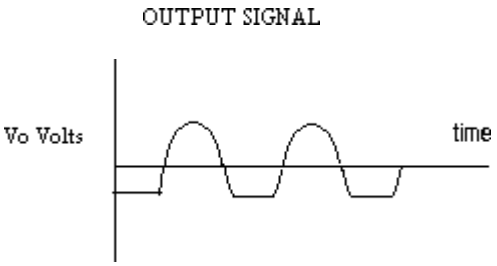


TABULATION:

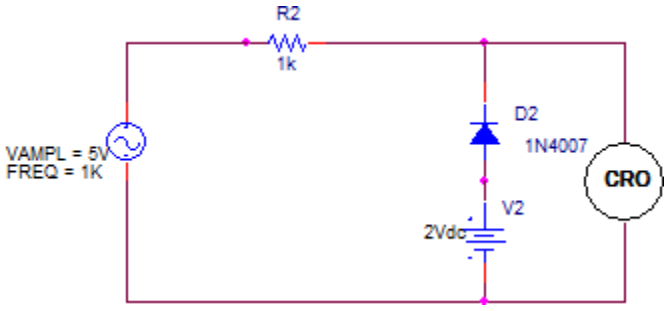
S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:





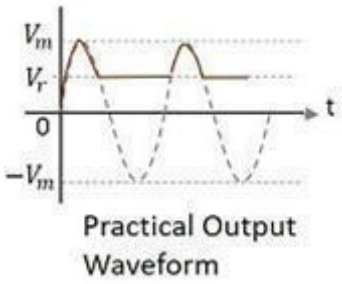
Negativeclipperwithpositivereference:



TABULATION:

S.No	Amplitudein V	Timeperiod in ms

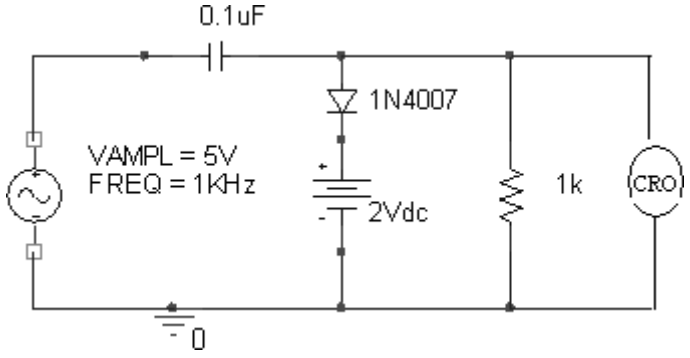
MODELGRAPH



Practical Output Waveform

CLAMPER:

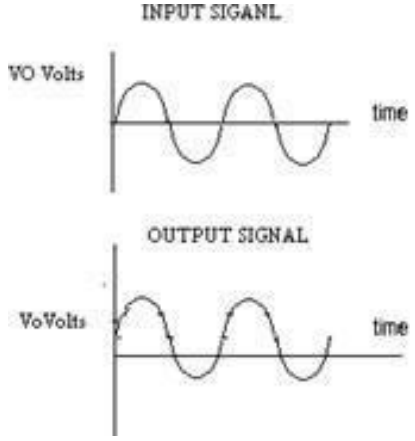
Positiveclamper:



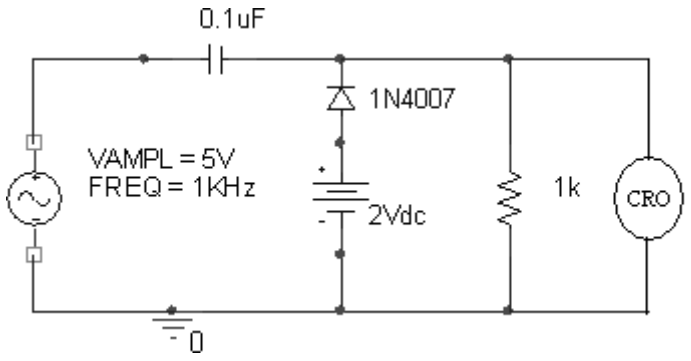
TABULATION:

S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:



NegativeClamper:

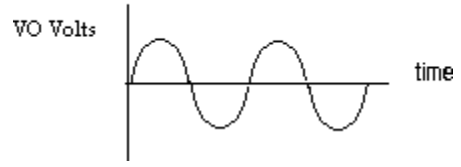


TABULATION:

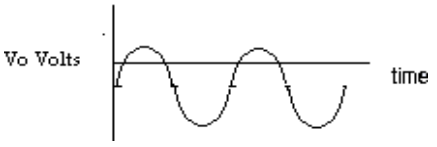
S.No	Amplitudein V	Timeperiod in ms

MODELGRAPH:

INPUT SIGANL



OUTPUT SIGNAL



RESULT:

Exp.No:6 **InstrumentationAmplifier**

Date:

Aim: Todesignaninstrumentationamplifierandobtaintheoutputforvariousgain.

ApparatusRequired:

S.NO.	COMPONENTSNAME	SPECIFICATION &RANGE	QUANTITY
1.	Bread board	-	1
2.	Opamp	IC741	3
3.	Functiongenerator	3MHz	2
4.	CRO	30MHz	1
5.	Dualpowersupply	+12/-12V	1
6.	Resistors		Each 1
7.	Connectingwires	Singlestrand	Asrequired

Theory:

Instrumentationamplifierisakindofdifferentialamplifierwith additionalinputbufferstages.Theadditionofinputbuffer stages makes it easy to match (impedance matching) the amplifier with the preceding stage. Instrumentation arecommonly used in industrial test and measurement application. Theinstrumentationamplifieralsohassomeuseful featureslikelowoffset voltage, highCMRR(Commonmoderejectionratio),highinputresistance,highgainetc.

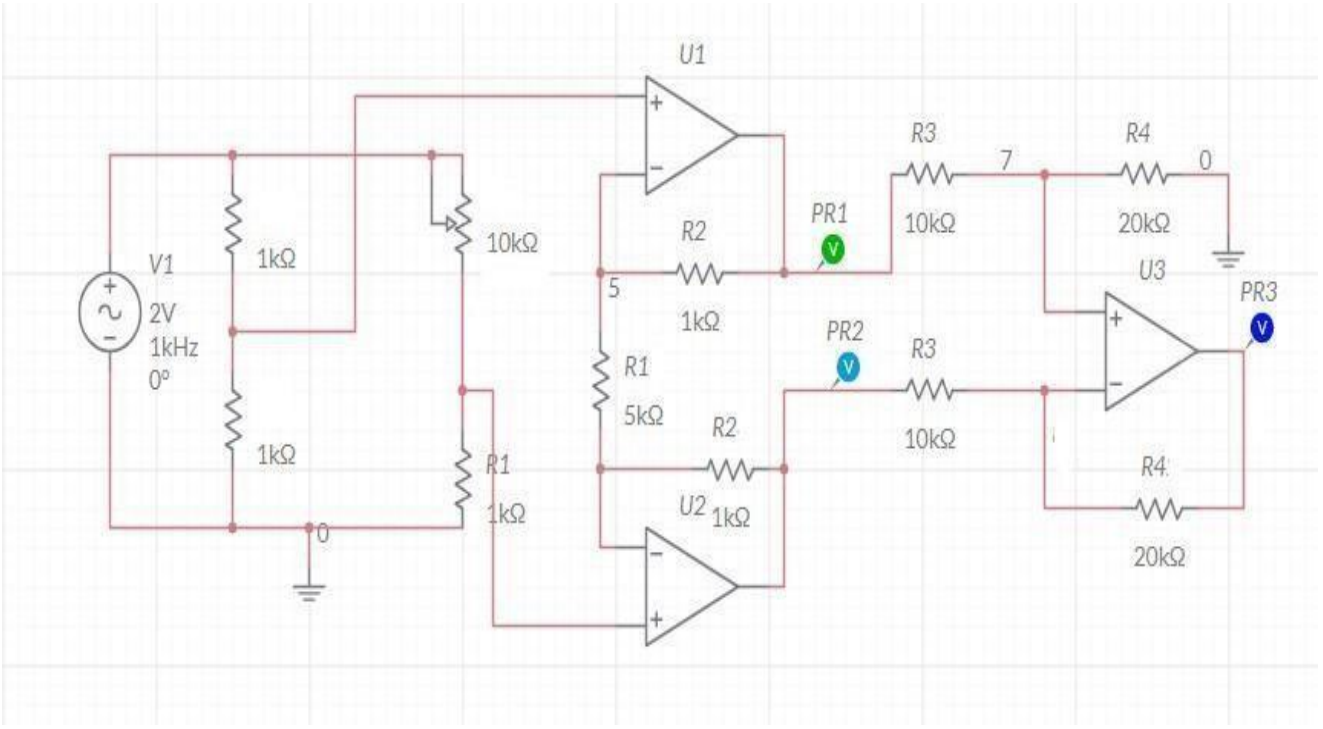
The two non-inverting amplifiers form a differential input stage acting as buffer amplifiers with a gain of 1 + 2R2/R1for differential input signals and unity gain for common mode input signals. Since amplifiers A1 and A2 are closed loopnegative feedback amplifiers, we can expect the voltage at Va tobe equal to the input voltage V1. Likewise, the voltage atVbtobeequaltothevalueatV2.

As the op-amps take no current at their input terminals (virtual earth), the same current must flow through thethreeresistornetworkofR2,R1andR2connectedacrosstheop-ampoutputs.Thismeansthenthatthevoltageontheupper end ofR1willbeequaltoV1andthevoltageat thelowerendofR1tobeequaltoV2.

The voltage output from the differential op-amp A3 acting as a subtractor, is simply the difference between its twoinputs(V2–V1)andwhichisamplifiedbythegainofA3whichmay beone,unity,(assumingthatR3=R4).Thenwehaveageneral expression for overallvoltagegainoftheinstrumentationamplifier circuitas:

$$V_{out} = (V_2 - V_1)\left[1+\frac{2R_2}{R_1}\right]\frac{R_4}{R_3}$$

InstrumentationAmplifierCircuit:



Procedure:

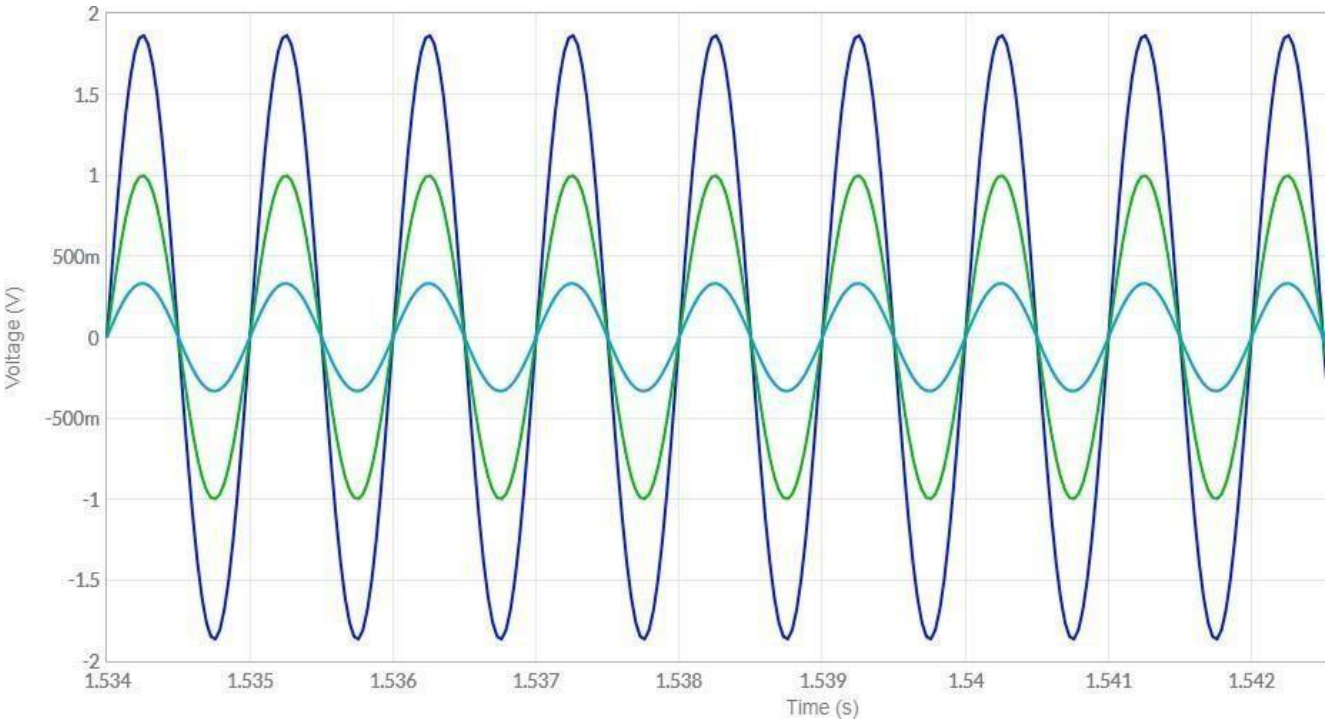
1. Connectionsaregivenas perthecircuitdiagram.
2. Inputsignalisconnected tothecircuitfromthesignalgenerator.
3. The input and output signals of the circuit observed from the dual channels 1 and 2 of theCRO.
4. Suitablevoltagesensitivityandtime-baseonCROisselected.
5. Changethegain settingresistor valueandobserve theoutput.

Design:

Tabulation:

Input /Output	Theoretical			Practical		
	Amplitude	Time				
Input						
Output	V1	V2	Vo	V1	V2	Vo

Output:



Result:

ThustheInstrumentationamplifierwasdesignedandverified.

Exp.No:7 ActiveLowPass,HighPassandBandPassFilters

Date:

Aim:

To design Low pass, High pass and Band pass active filters using Op-amp and obtain frequencyresponse.

ApparatusRequired:

S.NO.	COMPONENTSNAME	SPECIFICATION &RANGE	QUANTITY
1.	Bread board	-	1
2.	Op-amp	IC741	1
3.	CRO	30MHz	1
4.	DualPowersupply	+12/-12V	1
5.	Capacitor		Each1
6.	Resistors		Each1
7.	Functiongenerator	3 MHz	1
8.	Connectingwires	Singlestrand	As required

Theory:

A filter is often used in electronic circuits to block (or allow) a selectfrequency to thecircuit. Anop-ampisusedtodesignafilters,soitiscalledActivefilters.ThereareFourtypesactivefilterslikeLowpass, High pass, band pass and band stop . A low pass filter is used in circuits that only allow lowfrequenciestopassthrough(belowtheCutofffrequency).ItisoftenusedtoblockhighfrequenciesandAC current in a circuit.A high pass filter is used in circuits that only require high frequencies to operate(above the cut off frequency). It blocks most low frequencies & DC component.A band pass filter is acombination of a high pass anda low pass filter. It allows only a select range of frequenciesto passthrough.Itisdesignedsuchawaythatthecutofffrequencyofthelowpassfilterishigher thanthecutoff frequency of the high pass filter, hence allowing only a select range of the frequenciesto passthrough.

Procedure:

1. Connectionsaregivenas perthecircuitdiagram.
2. Inputsignalisconnected tothecircuitfromthesignalgenerator.
3. Theinputandoutput signals ofthefilterchannels1and2oftheCROareconnected.
4. SuitablevoltagesensitivityandtimeбaseonCROisselected.
5. Thecorrectpolarityis checked.
6. Theabovestepsarerepeated forsecondorderfilter.

DesignLowPassFilter:

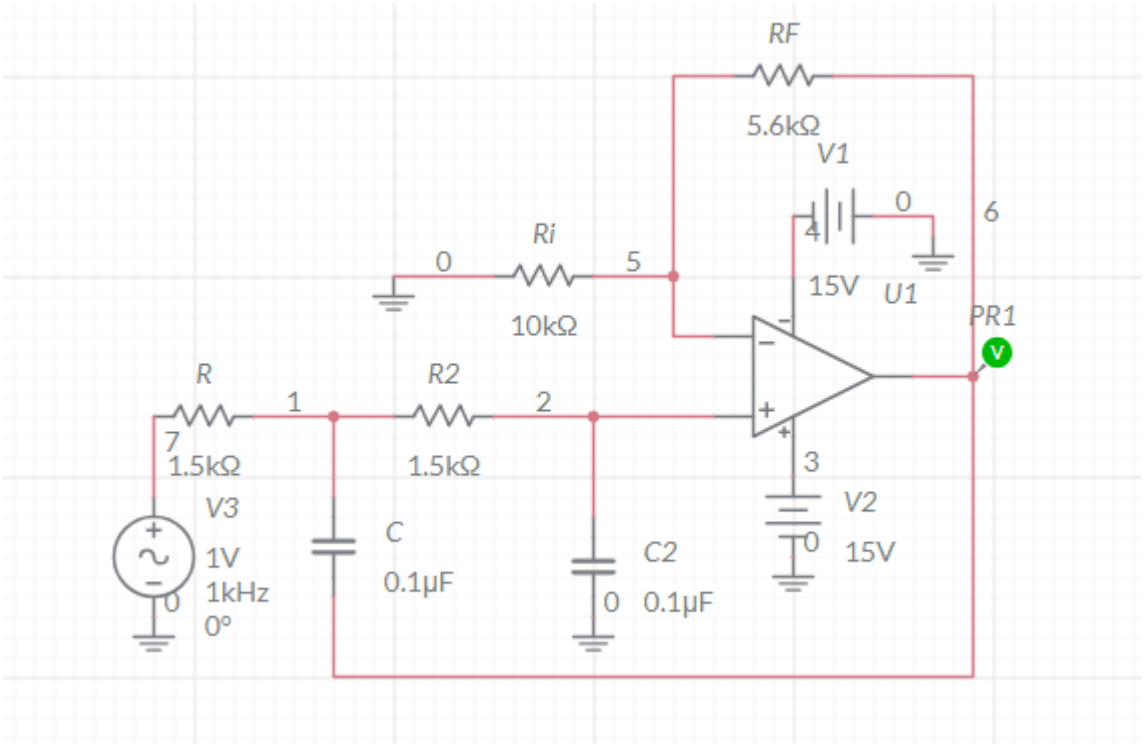
Design Second order Butterworth LowPassfilter havinguppercutofffrequency 1KHz anddetermineitsfrequencyresponse.

Thefollowingstepsareused forthedesignofactiveLPF.

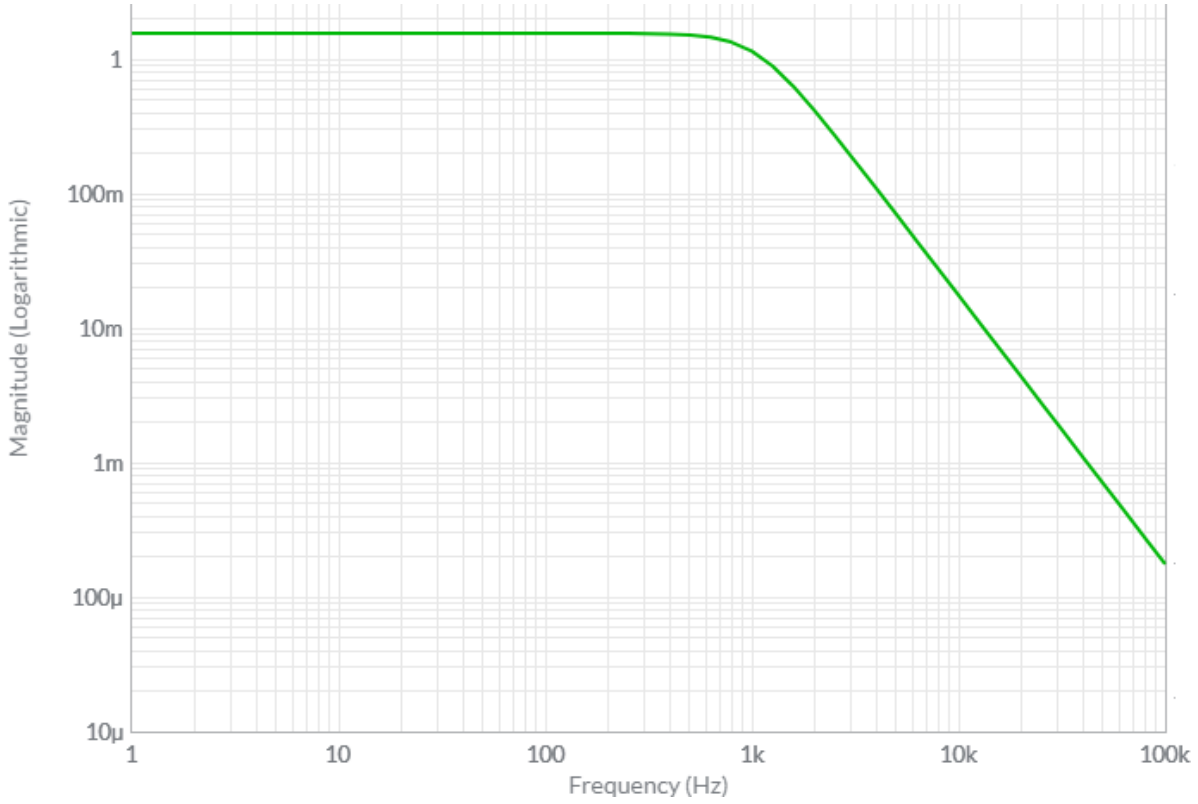
1. Thevalueofhighcut off frequency$f_H$ischosen.
2. ThevalueofcapacitorCisselectedsuchthatitsvalueis≤1μF.
3. Byknowingthe valuesof$f_H$and C, thevalueofR canbecalculated using $f_H = \frac{1}{2\pi RC}$
4. Finallythevalues of$R_1$and $R_f$areselected dependingon the designedpassband gain by using $A = 1 + \left(\frac{R_f}{R_1}\right)$

CircuitDiagram:-

LowPassfilterCircuit:



Output:



LowPassFilterTabulation:

S.No	Frequency(Hz)	O/pvoltage(v)	Gain=Vo/Vin	Gain=20log(Vo/Vin)

SecondorderHighPassFilter:

The high pass filter is the complement of the low pass filter. Thus the high pass filter can beobtainedbyinterchangingRandCinthecircuitoflowpassconfiguration.Ahighpassfilterallowsonlyfrequenciesaboveacertainbreadpointtopassthroughandatterminatesthelowfrequencycomponents.Therangeoffrequenciesbeyond its lowercutofffrequency$f_L$is called stopband.

Design:-

$$f_L = 1\mathbf{K}HZ, C = 0.1\mu F, Gain, Av = 2$$

$$f_L = \frac{1}{2\pi\sqrt{R_2 R_3 C_2 C_3}}$$

$$Let R_2 = R_3 = R C_2 = C_3 = C$$

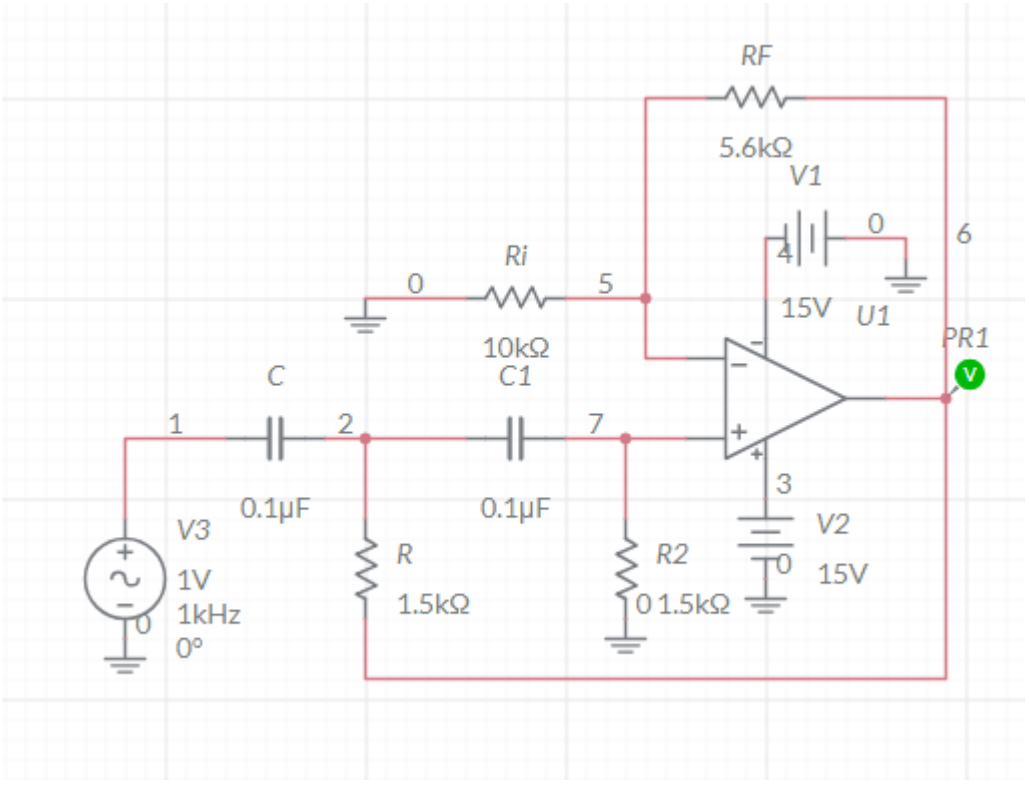
$$R_2 = R_3 = \frac{1}{2\pi f L C}$$

$$R_2 = R_3 = 1.5k\Omega$$

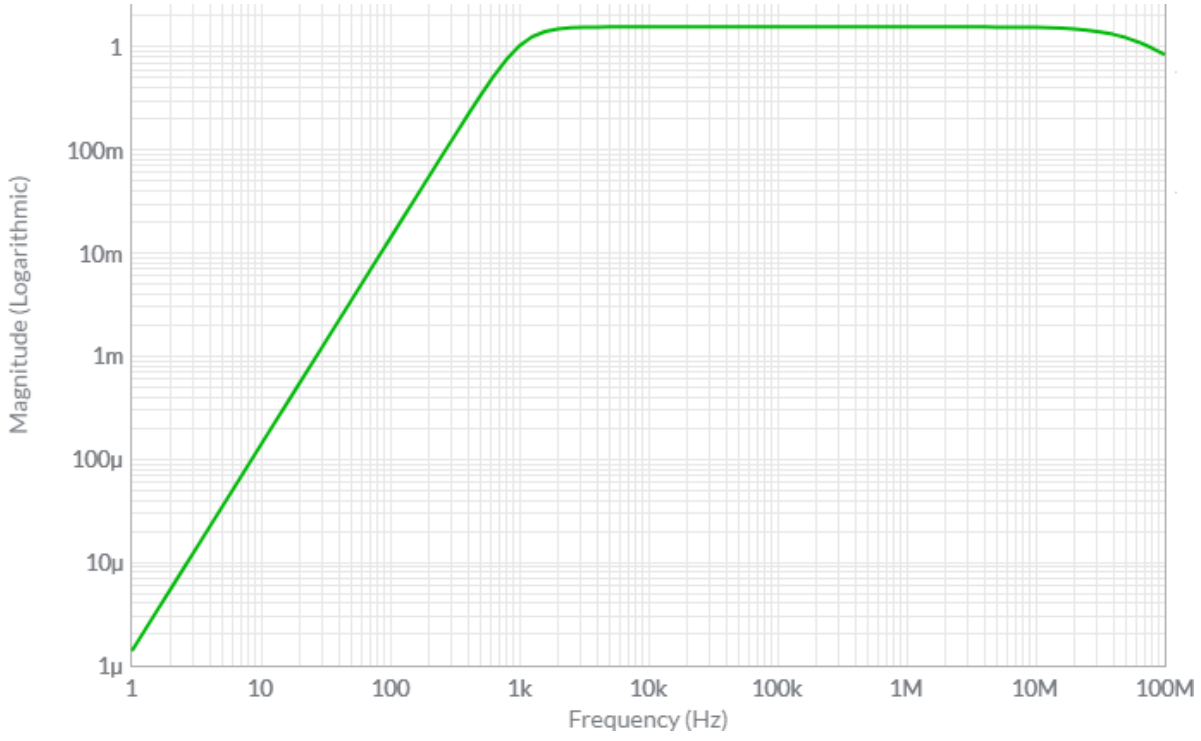
$$A = 1 + \frac{R_f}{R_1} = 2$$

$$\therefore R_f = R_1 = 10k\Omega(given)$$

SecondorderHighPassFilterCircuit:



Output:



HighPassFilterTabulation:

S.No	Frequency(Hz)	O/pvoltage(v)	Gain=Vo/Vin	Gain=20log(Vo/Vin)

BPF:-

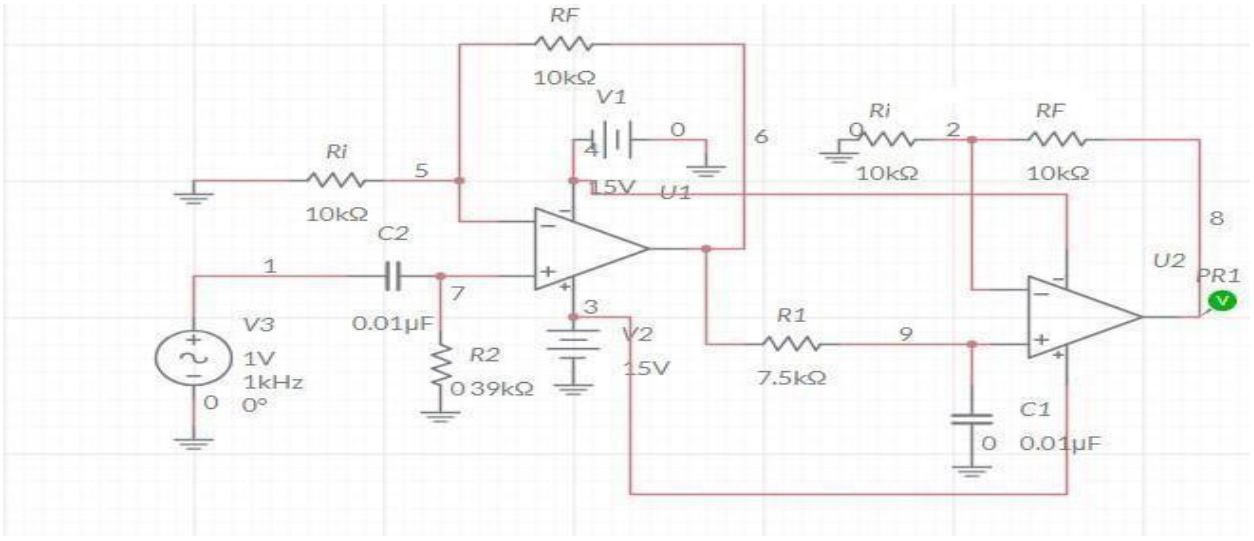
The BPF is the combination of high and low pass filters and this allows a specified range of frequencies to pass through. It has two stop bands in range of frequencies between 0 to f_L and beyond f_H. The band b/w f_L and f_H is called pass band. Hence its bandwidth is (f_L-f_H). This filter has a maximum gain at the resonant frequency(f_r) which is defined as

$$f_r = \sqrt{f_H f_L}$$

The figure of merit (or) quality factor Q is given by

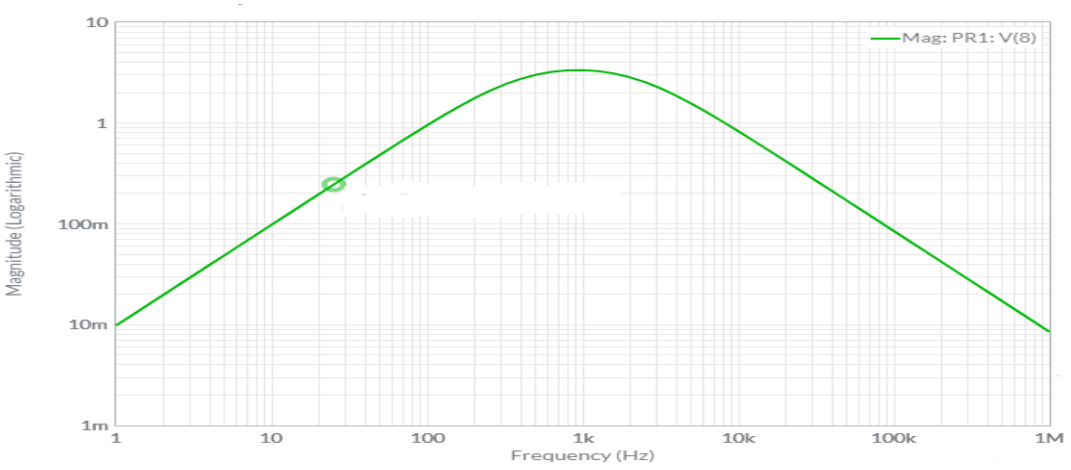
$$Q = \frac{f_r}{f_r f_H - f_L} = \frac{}{BW}$$

BandPassFilterCircuit:



HPF **LPF**

Output:



Result:

Thecircuitwasdesignedandtheirfrequencyresponseswereplotted.

Lowpassfilter:

Theuppercutofffrequency (Designed)= KHz.

Theuppercutofffrequency(Obtained)= KHz.

Highpassfilter:

Thelowercutofffrequency(Designed)= KHz.

Thelowercutofffrequency(Obtained)= KHz.

Bandpassfilter:

CentreFrequency = KHz.

Quality Factor =

Ex.No: 8

PLLcharacteristicsanditsuseasFrequencyMultiplier,Clocksynchronization.Dat

e:

Aim:

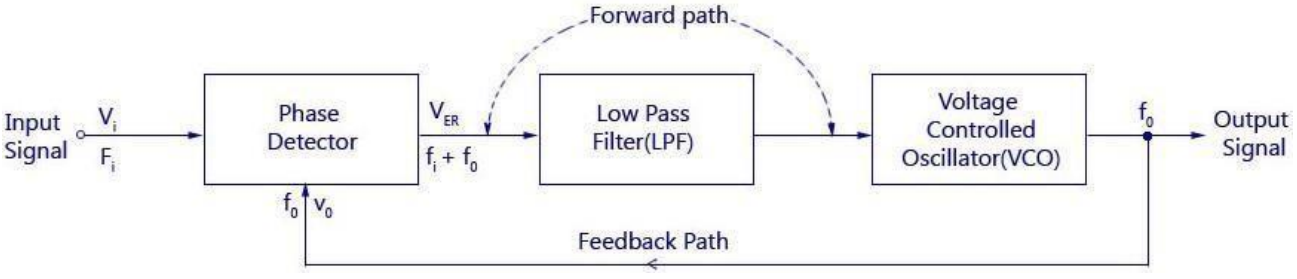
1. **TostudythePLLcharacteristics.**
2. **TousePLLasfrequencymultiplierandclocksynchronization.**

ApparatusRequired:

S.NO.	EQUIPMENTS& COMPONENTS	SPECIFICATION	QUANTITY
1.	Bread board	-	1
2.	IC	IC565,IC7490	1
3.	Resistors	20K,2K,10K,4.7K	Each1
	Capacitor	0.001µF,10µF,0.01µF	Each1
4.	Functiongenerator	3 MHz	1
5.	CRO	30MHz	1
6.	Dualpowersupply	+6/-6V	1
7.	Connectingwires	Singlestrand	10wires

Theory:

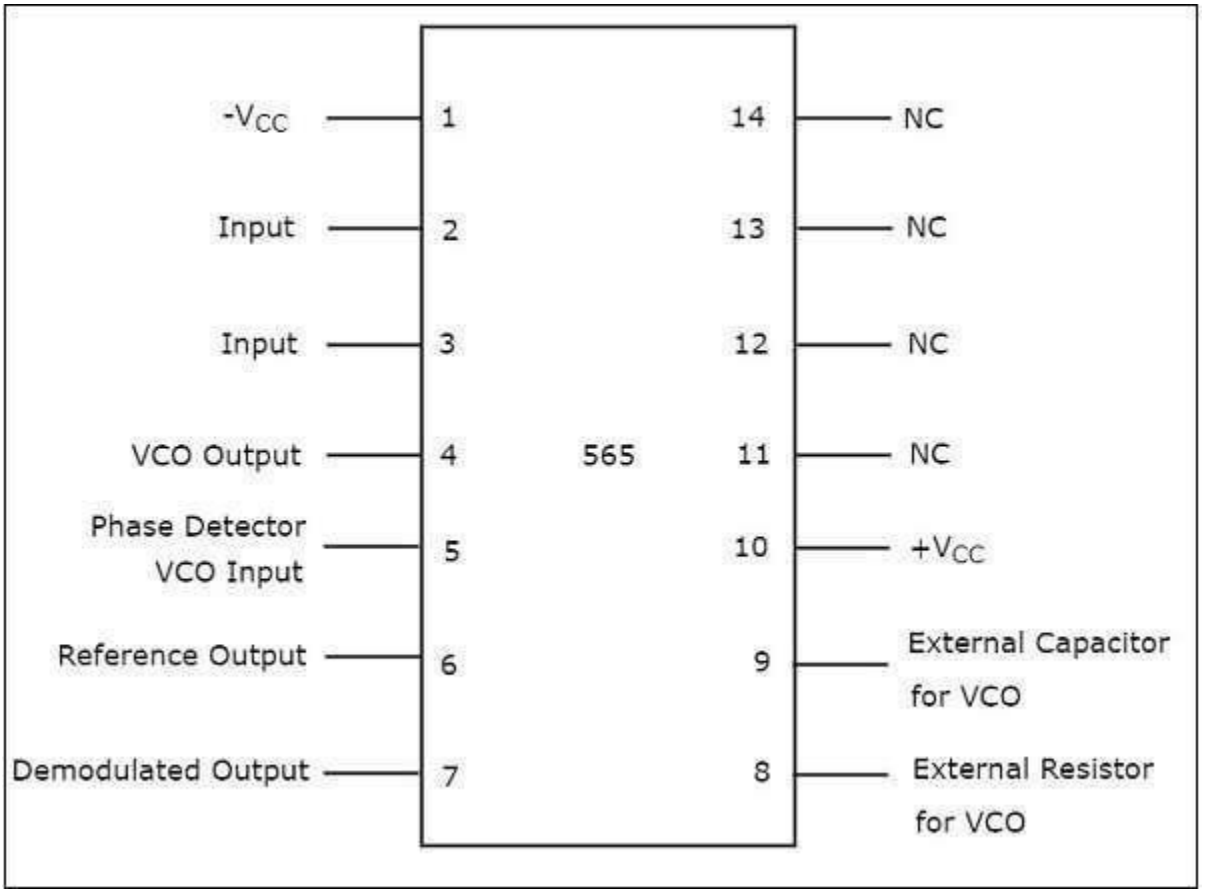
The PLL IC 565 is usable over the frequency range 0.1 Hz to 500 kHz. It has highly stable centrefrequencyandisabletoachieveaverylinearFMdetection.Theoutput ofVCOiscapableofproducingTTL compatible square wave. The dual supply is in the range of ±6V to ±12V. The IC can also beoperated from singlesupplyin therange12V to 24V.



The phase locked loop consists of a phase detector, a voltage control oscillator and, in between them,alow pass filter is fixed. The input signal „Vi" with an input frequency „Fi" is conceded by a phasedetector.Basicallythephasedetectorisacomparatorwhichcomparestheinputfrequencyfithroughthe

feedback frequency fo. The output of the phase detector is (fi+fo) which isa DC voltage.The outofthephasedetector,i.e.,DCvoltageisinputtothelowpassfilter(LPF);itremovesthehighfrequencynoisean dproducesasteadyDClevel,i.e., Fi-Fo.TheVfisalso adynamiccharacteristicofthePLL.

Thefollowingfigureshowsthepin-outandtheinternalblockschematicof PLLICLM565.



Design:

Centerfrequencyor VCOfrequency

$$f_{out} = \frac{1.2}{4R_1C_1} \text{ Hz}$$

$$Lock in range = f = \pm 8 \frac{f_o}{V} \quad ; \quad V = V^+ - (V^-)$$

$$Capture range = f = \pm \left[\frac{f_L}{2\pi \times 3.6 \times 10^3 \times C_2} \right]^{-1}$$

PLLusedasFrequencyMultiplier:

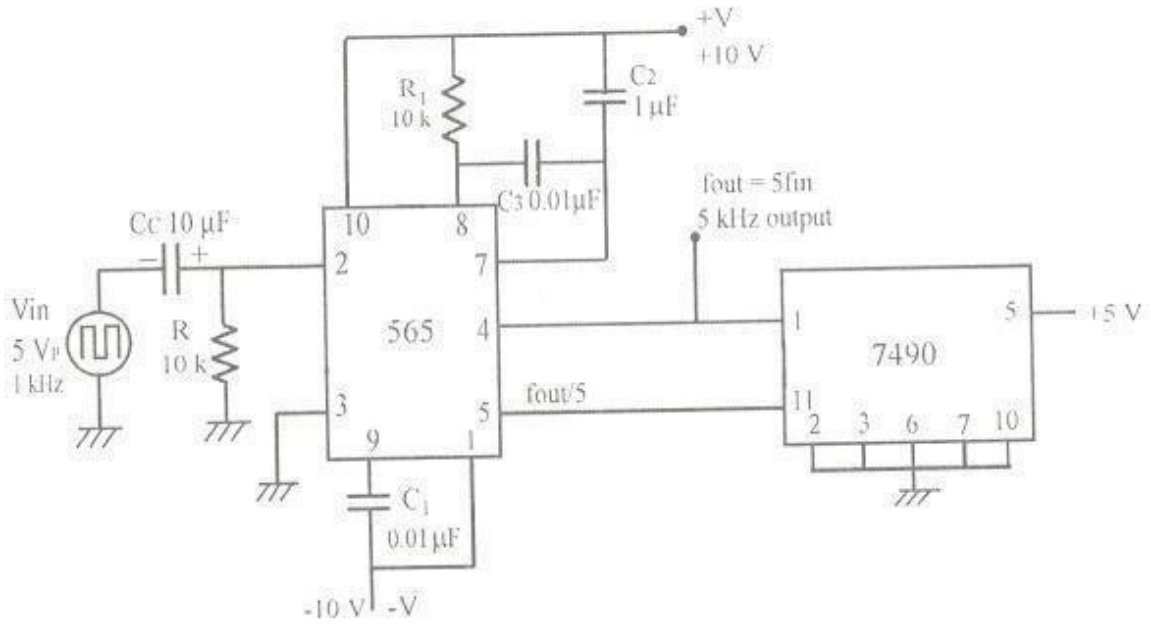
Design:

LetV+=10VandV-=-10

Lettheinputfrequencybe1Khz,andtheoutputfrequency5Khz,VCOshouldr unat5Khzfrequency,fo=(1.2/4*R1*C1)=5Khz

TakeC1=0.01μFThenR1=6KTake C2=10μFandC3=0.001μF

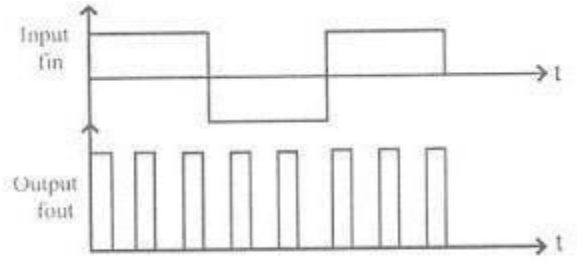
useCc=10μFandR=10kforaccouplingofinputsignal



Procedure:

- Checkthecomponentusingmultimeter
- setupthecircuit stagebystage onthebreadboard
- verifytheworkingofcircuitseparately.
- completethecircuitandapply5Vp-p,1Khzsquarewave
- observethemultipliedfrequencyoutputontheCRO
- plottheoutputwaveformonthegraphsheet

Outputwaveform:



Result:

Thus,thePLLcircuitwasassembledsuccessfully.

Ex.No:9 **R-2RLadderTypeD-AConverter using Op-amp.**

Date:

Aim:

TodesignR-2RLadderTypeD-AConverterusingOp-ampandobservetheoutput.

Apparatusrequired:

S.NO.	EQUIPMENTS& COMPONENTS	SPECIFICATION	QUANTITY
1.	Bread board	-	1
2.	Op-amp	IC741	1
3.	Resistors	2.5K	5
4.	Functiongenerator	3 MHz	1
5.	CRO	30MHz	1
6.	Dualpowersupply	+6/-6V	1
7.	Connectingwires	Singlestrand	10wires

Theory:

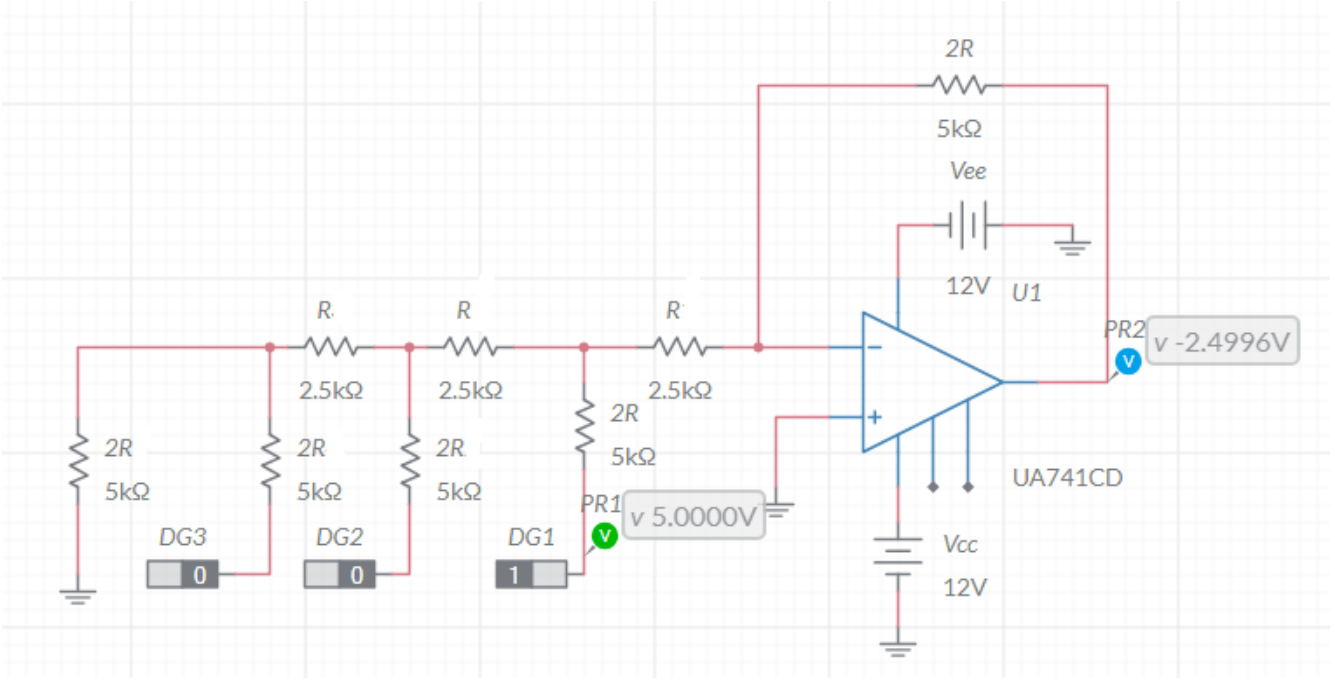
Adigital-to-analogconverter(DAC,D/A,D2AorD-to-A)isacircuitthatconvertsdigitaldata(usually binary) into an analog signal (current or voltage). One important specification of a DAC isits resolution. It can be defined by the numbers of bits or its step size. Wide range of resistors usedWeighted Resistor type DAC. This can be avoided by using R-2R ladder type DAC where only twovaluesofresistorsare required.

BasicBlockdiagramofDAC.

TheoutputvoltageofDAC;

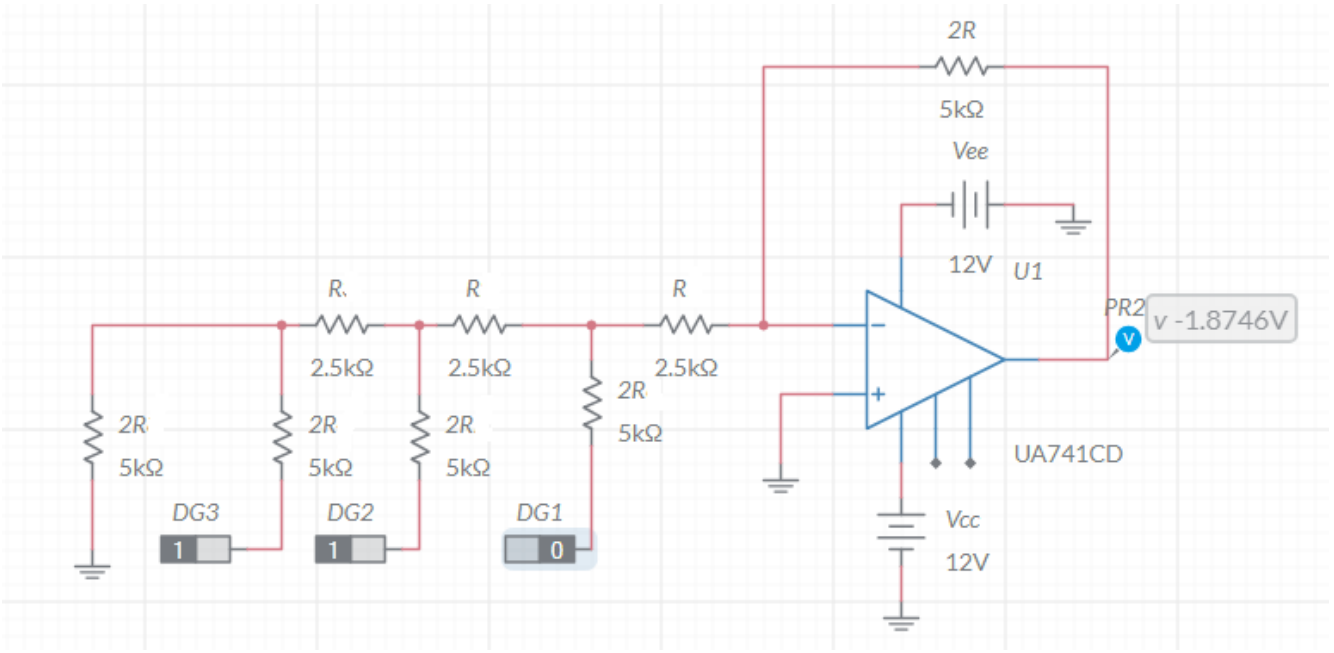
$$V_0=(d_1 2^{-1}+d_2 2^{-2}+\cdots+d_n 2^{-n})$$

To design 3 bit R-2R Digital to Analog converter to convert analog voltageofbinarybit100.



TheoreticalCalculation:

Ifbinary bit011 :



Tabulation:

Vref = -5V

d1	d2	d3	Theoretical V0	Practical V0
0	0	0		
0	0	1		
0	1	1		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Procedure:

- Checkthecomponentusingmultimeter.
- Setupthe circuitstagebystageonthe breadboard
- Verifytheworkingofcircuitseparately.
- Completethecircuitandapply-5Vref ifbit=1.
- Observetheoutput usingmultimeter.
- Plottheoutputwaveform onthegraphsheet.

Result:

ThustheR-2RLaddertypeusingop-ampwere designed anditsoutputwaveformwereplotted

Ex.No:1	TUNEDCOLLECTOROSCILLATOR
Date:	

AIM

Toconstructand simulatetheTuned collectoroscillatorbyusingpspice.

SOFTWAREUSED

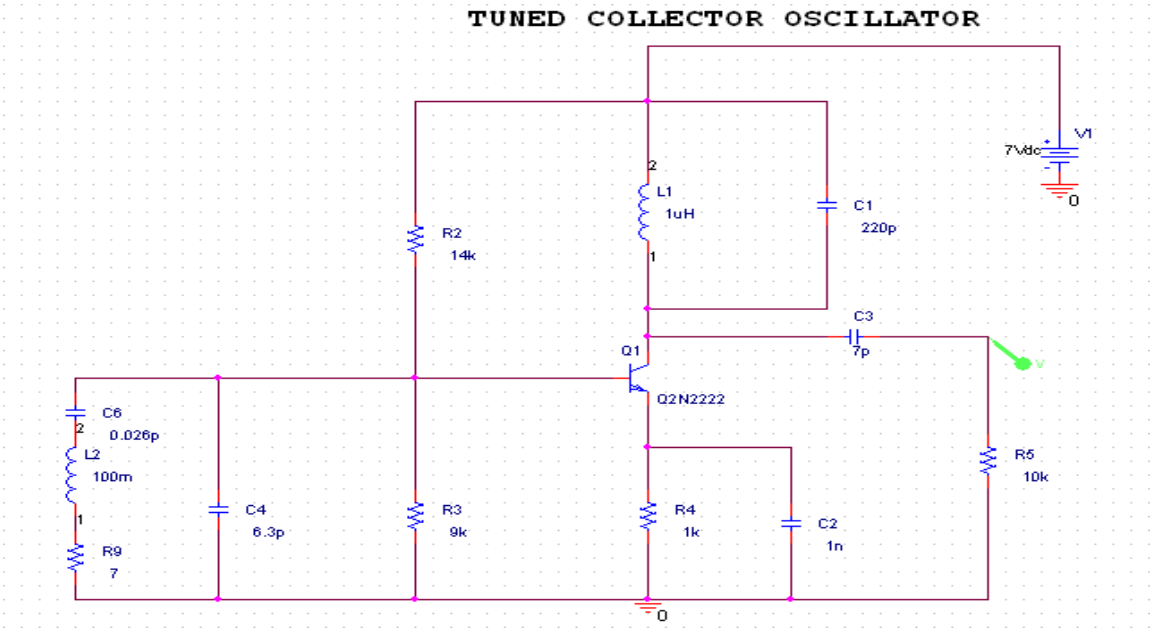
ORCAD16.0

PROCEDURE

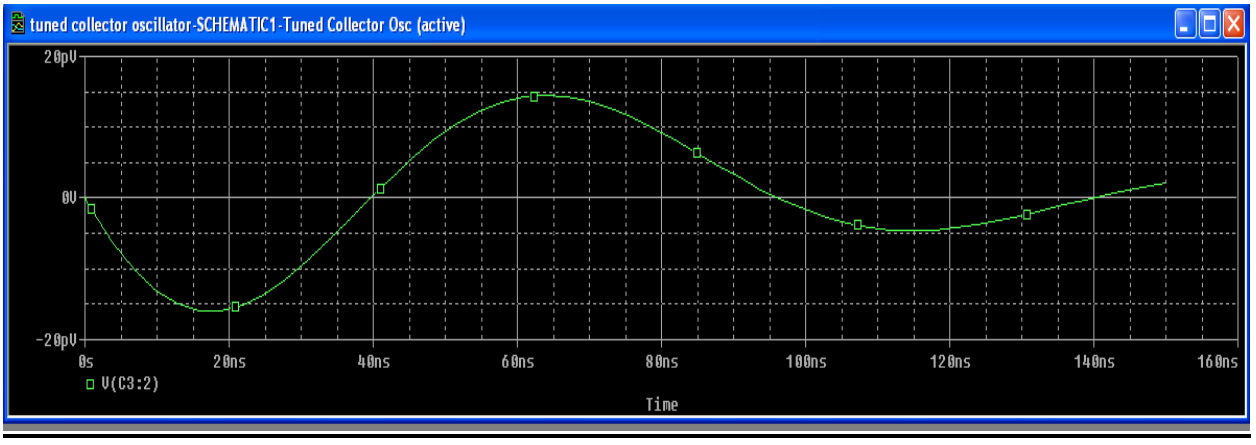
1. ORCAD-capture
2. Maximizethesessionlog.
3. Infile,openanewprojectandgivethenametotheprojectandchooseanalogormixedA/Bandspecifythe location sayD:/ECEII
4. Createablankproject.
5. Clickinsidethewindowonceand thetool barappears.
6. Chooseplacepart-addlibrary-selectacomponentinthe libraryandselectallthecomponents -clickopen toaddall thecomponents.
7. Choosethecomponents fromthelibraryandplaceintheworksheet.
8. Giveconnection usingwireand properlygroundthecircuit.
9. Savetheproject andsimulateit.
10. Placethemarkerat thepoints whereverthewaveformsareto beviewed.
11. ClicktheoptionRUNandtheoutput willbedisplayed.
12. Iftherareerrors,correctandsimulateit.
13. Toviewthewaveformseparatelyinplot–addplottowindow–cutandpastetherequiredwaveforms.
14. Therequiredinput andoutputwaveformsaretakenprintout.

CIRCUITDAIGRAM:

TUNEDCOLLECTOROSCILLATOR



OUTPUTWAVEFORM:



RESULT:

Ex.No:2	TWIN-TOSCILLATOR/WEINBRIDGEOSCILLATOR
Date:	

AIM

ToconstructandstimulateaTwin-Toscillatorand Weinbridgeoscillatorusingpspice.

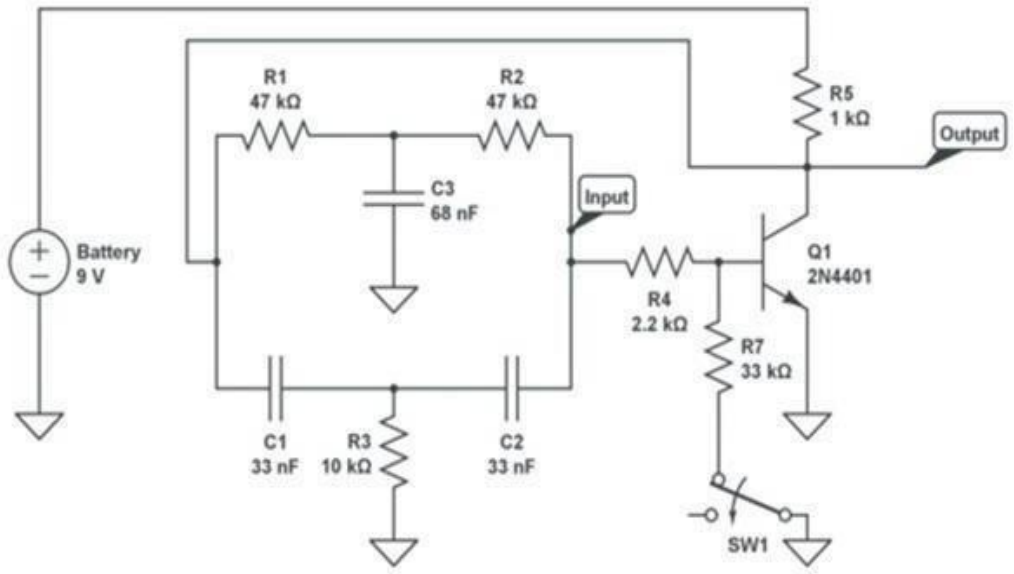
SOFTWAREUSED

ORCAD16.0

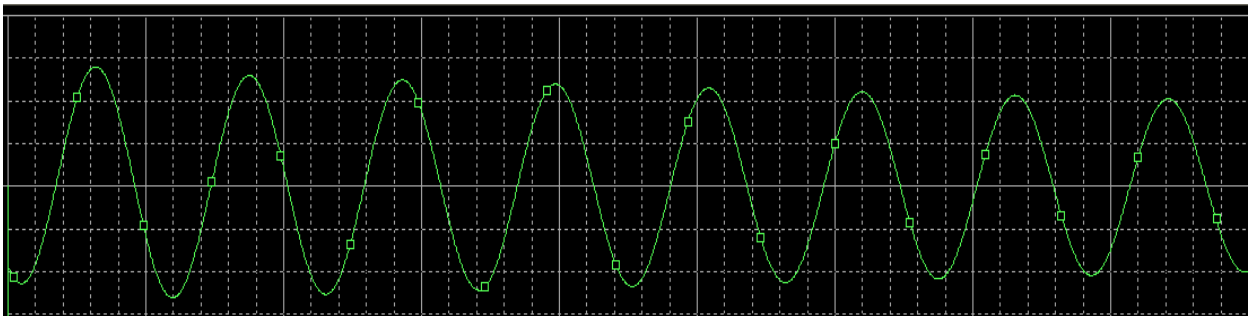
PROCEDURE

1. ORCAD-capture
2. Maximizethesessionlog.
3. Infile, opena new project andgive the name tothe project andchooseanalog or mixed A/Bandspecifythe location sayD:/ECEII
4. Createablankproject.
5. Clickinsidethewindowonceand thetool barappears.
6. Chooseplacepart-addlibrary- selectacomponentinthelibraryandselectallthecomponents -clickopen toaddall thecomponents.
7. Choosethecomponents fromthelibraryandplaceintheworksheet.
8. Giveconnection usingwireand properlygroundthecircuit.
9. Savetheproject andsimulateit.
10. Placethemarkerat thepointswhereverthewaveforms aretobeviewed.
11. ClicktheoptionRUNandtheoutput willbedisplayed.
12. Iftherareerrors,correctandsimulateit.
13. Toviewthewaveformseparatelyinplot–addplottowindow–cutandpastetherequiredwaveforms.
14. Therequired inputand output waveforms aretaken printout.

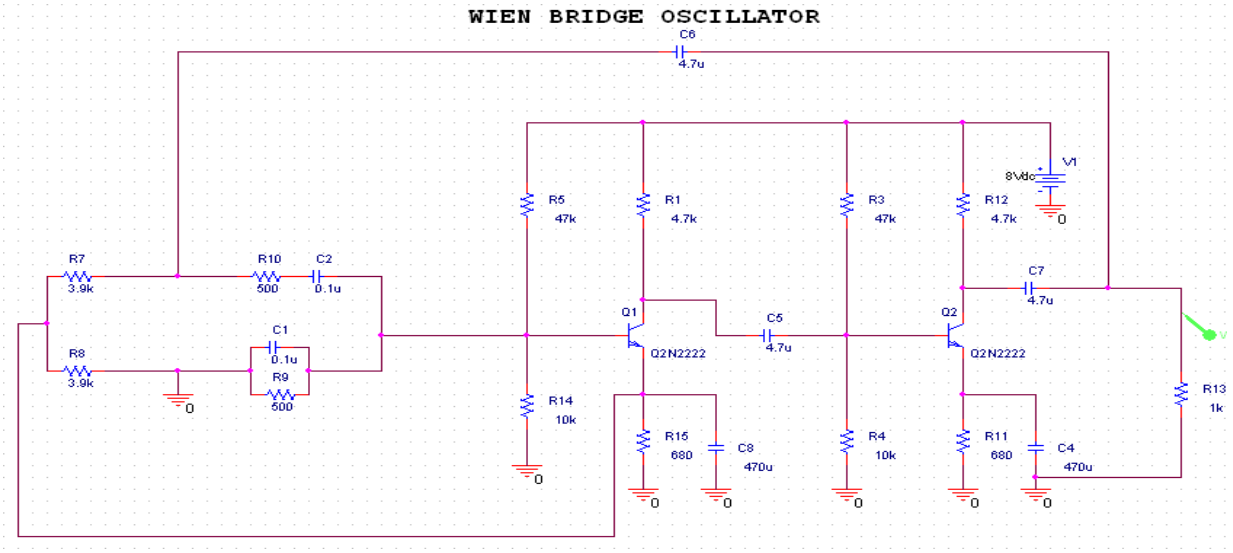
CIRCUITDIAGRAM:



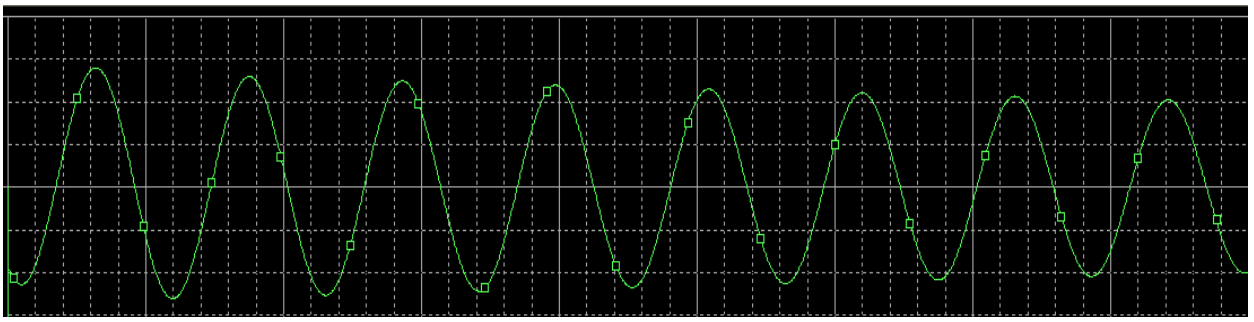
MODELGRAPH:



CIRCUITDIAGRAM:



MODELGRAPH:



RESULT:

Ex.No:3	DOUBLEANDSTAGGERTUNEDAMPLIFIERS
Date:	

AIM

ToconstructandstimulateaDoubleandStaggertunedamplifiersusingpspice.

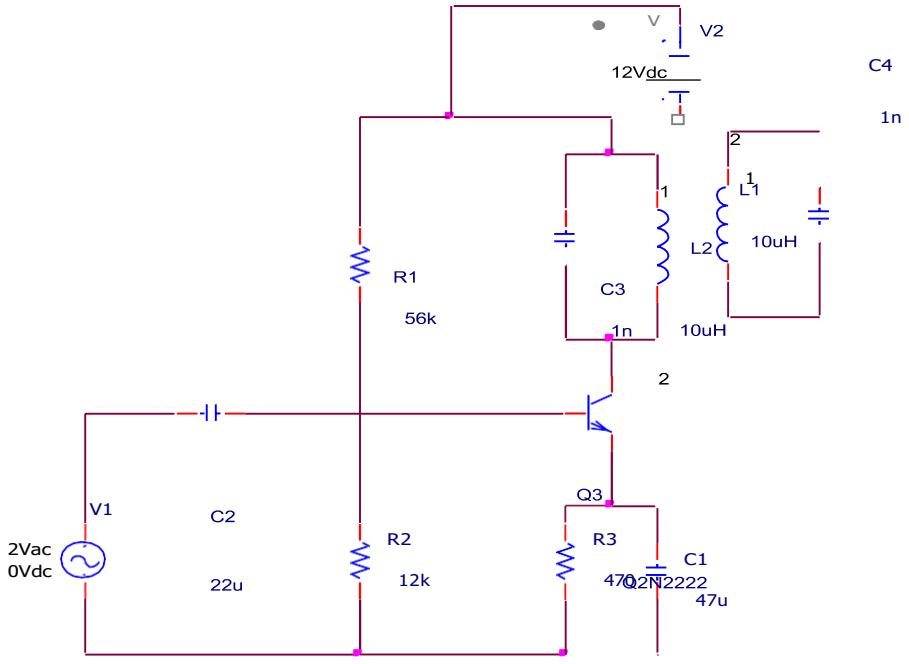
SOFTWAREUSED

ORCAD16.0

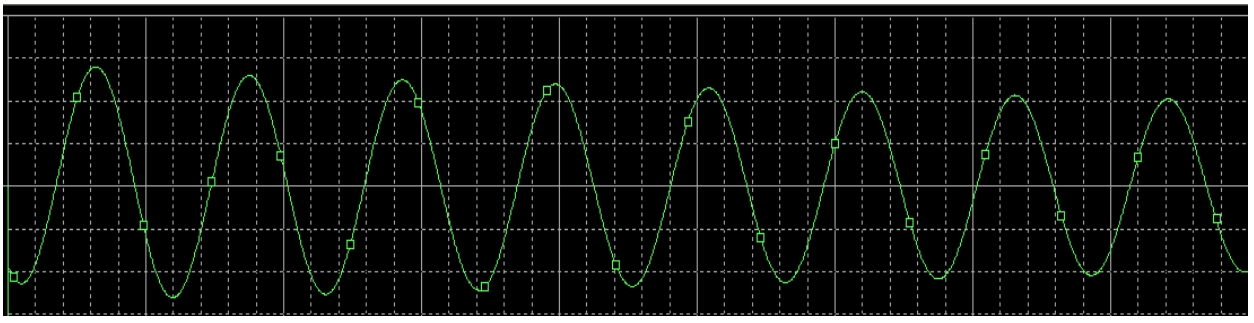
PROCEDURE:

1. ORCAD-capture
2. Maximizethesessionlog.
3. Infile,openanewprojectandgivethenametotheprojectandchooseanalogormixedA/Bandspecifythe location sayD:/ECEII
4. Createablankproject.
5. Clickinsidethewindowonceand thetool barappears.
6. Chooseplacepart-addlibrary- selectacomponentinthelibraryandselectallthecomponents -clickopen toaddall thecomponents.
7. Choosethecomponents fromthelibraryandplaceintheworksheet.
8. Giveconnection usingwireand properlygroundthecircuit.
9. Savetheproject andsimulateit.
10. Placethemarkerat thepoints whereverthewaveformsareto beviewed.
11. ClicktheoptionRUNandtheoutput willbedisplayed.
12. Iftherareerrors,correctandsimulateit.
13. Toviewthewaveformseparatelyinplot–addplottowindow–cutandpastetherequiredwaveforms.
14. Therequired inputand output waveforms aretaken printout.

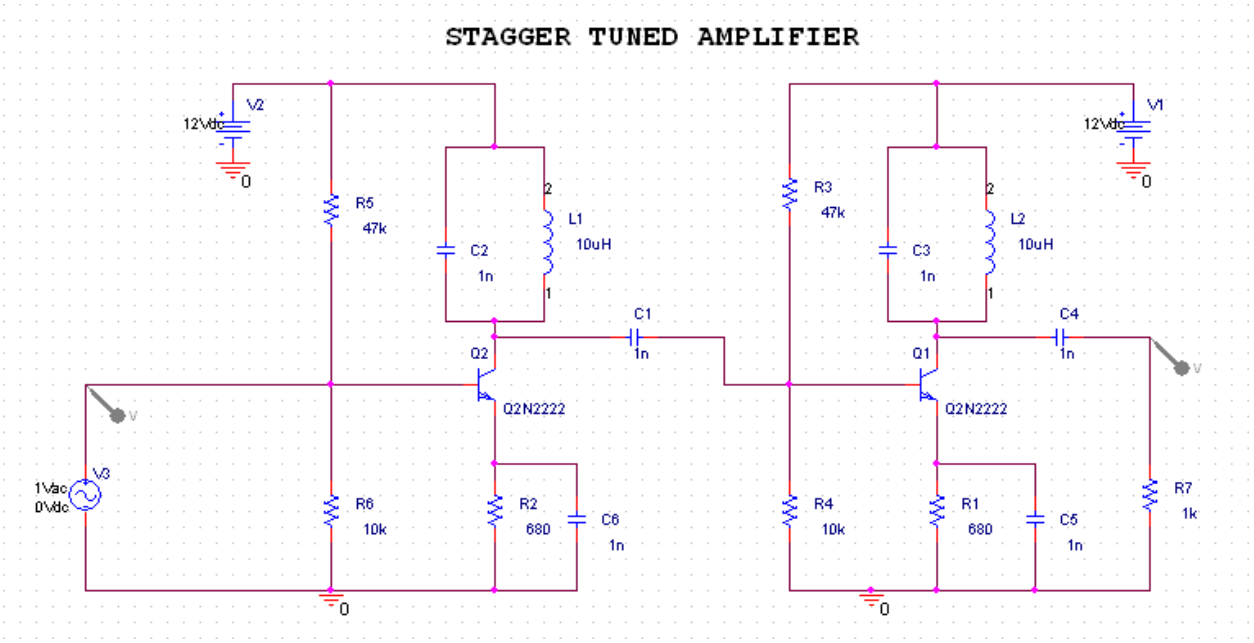
DOUBLETUNEDAMPLIFIER



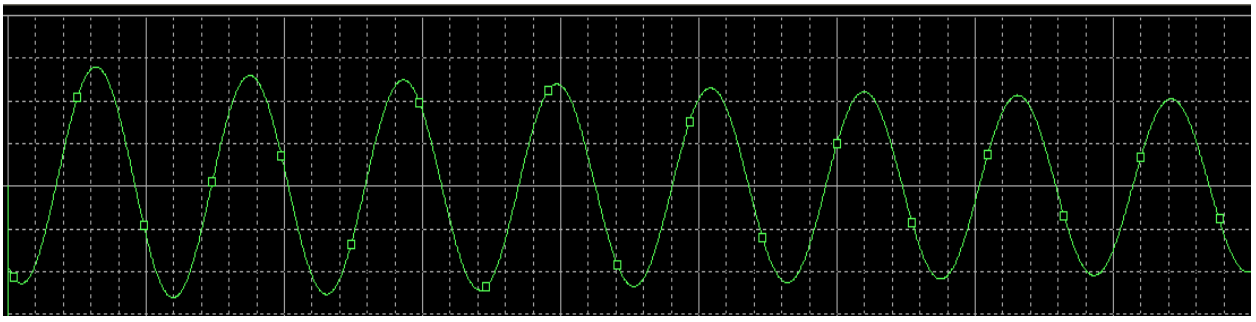
OUTPUTWAVEFORM



CIRCUITDIAGRAM:



OUTPUTWAVEFORM:



RESULT:

Ex.No:4	BISTABLEMULTIVIBRATOR
Date:	

AIM

Toconstruct andsimulate theBistablemultivibrator byusingpspice.

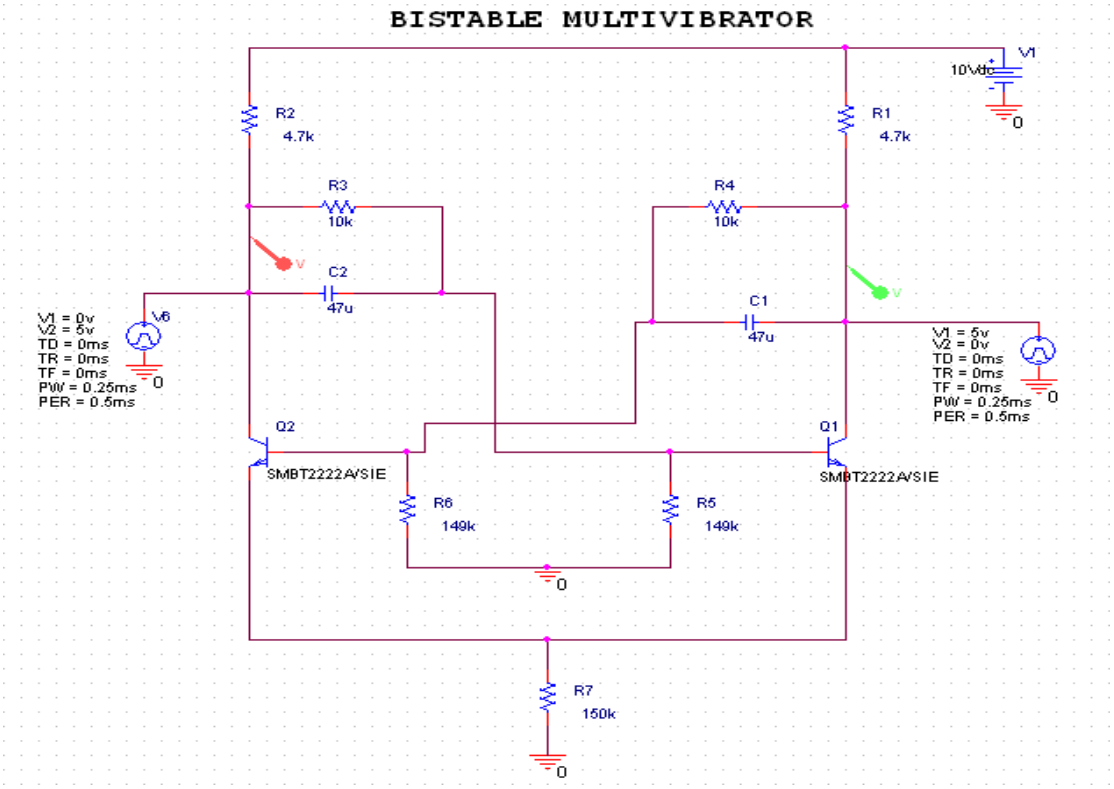
SOFTWAREUSED

ORCAD16.0

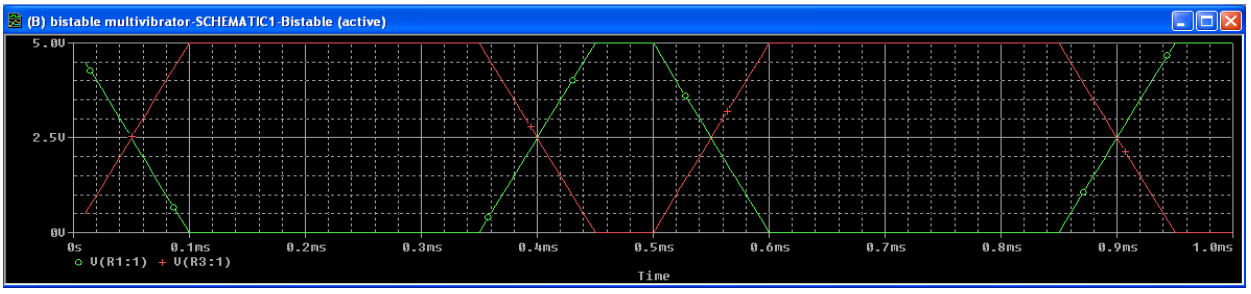
PROCEDURE

1. ORCAD-capture
2. Maximizethesessionlog.
3. Infile,openanewprojectandgivethenametotheprojectandchooseanalogormixedA/Bandspecifythe location sayD:/ECEII
4. Createablankproject.
5. Clickinsidethewindowonceand thetool barappears.
6. Chooseplacepart-addlibrary- selectacomponentinthelibraryandselectallthecomponents -clickopen toaddall thecomponents.
7. Choosethecomponents fromthelibraryandplaceintheworksheet.
8. Giveconnection usingwireandproperlygroundthecircuit.
9. Savetheproject andsimulateit.
10. Placethemarkerat thepoints whereverthewaveformsareto beviewed.
11. ClicktheoptionRUNandtheoutput willbedisplayed.
12. Iftherareerrors,correctandsimulateit.
13. Toviewthewaveformseparatelyinplot–addplottowindow–cutandpastetherequiredwaveforms.
14. Therequiredinput andoutputwaveformsaretakenprintout.

CIRCUITDIAGRAM:



OUTPUTWAVEFORM:



RESULT:

Ex.No:5	**SCHMITTTRIGGERCIRCUITWITHPREDICTABLEH YSTERESIS**
Date:	

AIM

Toconstruct andsimulateSchmitttriggercircuitbyusingpspice.

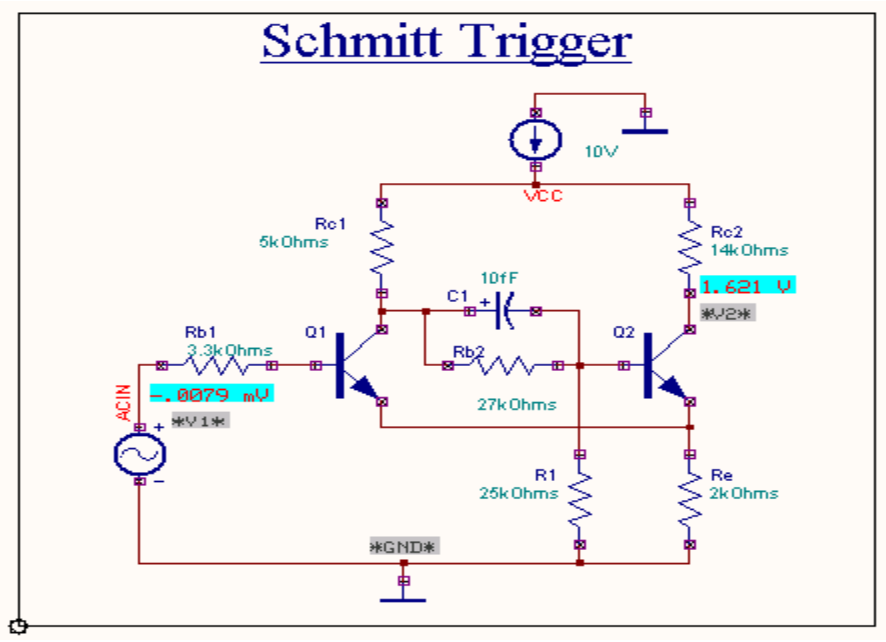
SOFTWAREUSED

ORCAD16.0

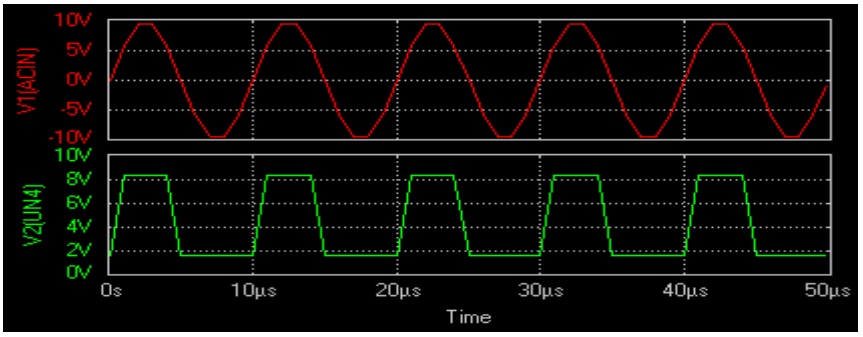
PROCEDURE

1. ORCAD-capture
2. Maximizethesessionlog.
3. Infile,openanewprojectandgivethenametotheprojectandchooseanalogormixedA/Bandspecifythe location sayD:/ECEII
4. Createablankproject.
5. Clickinsidethewindowonceand thetool barappears.
6. Chooseplacepart-addlibrary-selectacomponentinthelibraryandselectallthecomponents -clickopen toaddall thecomponents.
7. Choosethecomponentsfrom thelibraryand place intheworksheet.
8. Giveconnectionusingwireand properlyground thecircuit.
9. Savetheproject andsimulateit.
10. Placethemarkerat thepoints whereverthewaveformsareto beviewed.
11. ClicktheoptionRUNandtheoutput willbedisplayed.
12. Iftherareerrors,correctandsimulateit.
13. Toviewthewaveformseparatelyinplot–addplottowindow–cutandpastetherequiredwaveforms.
14. Therequiredinput andoutputwaveformsaretakenprintout.

CIRCUITDIAGRAM



OUTPUTWAVEFORM



RESULT:

Ex.No:6	ANALYSISOFPOWERAMPLIFIERS
Date:	

ANALYSISOFPOWERAMPLIFIERS

AIM

Toconstruct andsimulatepoweramplifiercircuitbyusingpspice.

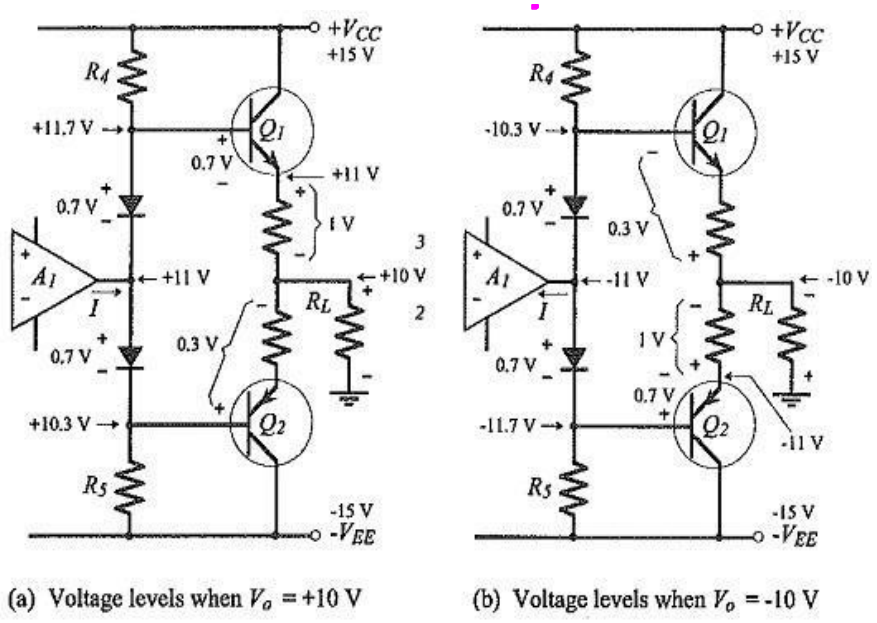
SOFTWAREUSED

ORCAD16.0

PROCEDURE

1. ORCAD-capture
2. Maximizethesessionlog.
3. Infile,openanewprojectandgivethenametotheprojectandchooseanalogormixedA/Bandspecifythel ocation sayD:/ECEII
4. Createablankproject.
5. Clickinsidethewindowonceand thetool barappears.
6. Chooseplacepart-addlibrary-selectacomponentinthelibraryandselectallthecomponents -clickopen toaddall thecomponents.
7. Choosethecomponentsfrom thelibraryand place intheworksheet.
8. Giveconnection usingwireand properlygroundthecircuit.
9. Savetheproject andsimulateit.
10. Placethemarkerat thepoints whereverthewaveformsareto beviewed.
11. ClicktheoptionRUNandtheoutputwillbedisplayed.
12. Iftherareerrors,correctandsimulateit.
13. Toviewthewaveformseparatelyinplot–addplottowindow–cutandpastetherequiredwaveforms.
14. Therequiredinput andoutputwaveformsaretakenprintout.

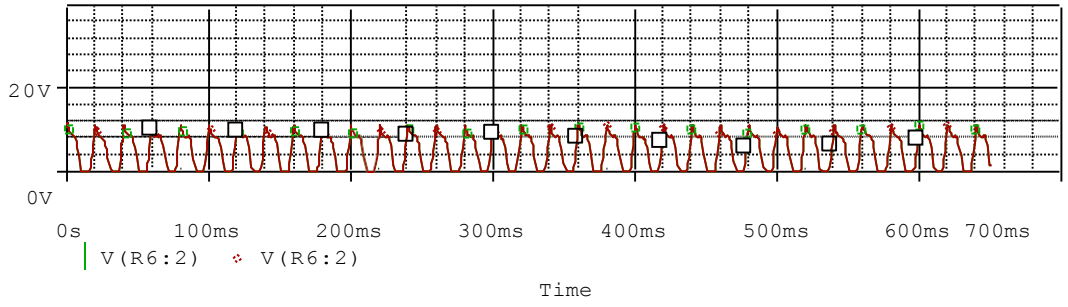
CIRCUITDIAGRAM



(a) Voltage levels when $V_o = +10$ V (b) Voltage levels when $V_o = -10$ V

Figure 18-40
Output stage voltage levels for peak output voltages of ±10 V.

OUTPUTWAVEFORM



RESULT: