ElCoM

ELECTRICAL COMPUTER MECHATRONICS

# تقارير مختبر الكترونيات

إرادة - ثقة - تغيير

19/26

# Electronics Lab
## Lab Session 1: Diode Characteristics

| Students Names | ID |
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**Part one:**

1.Construct the circuit shown below, measure the forward voltage *VF, VR1*, and compute *IF*.

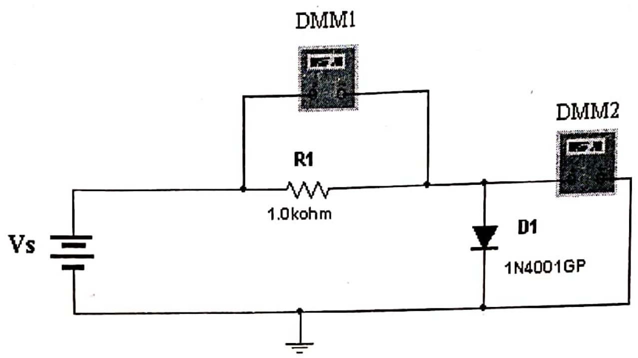
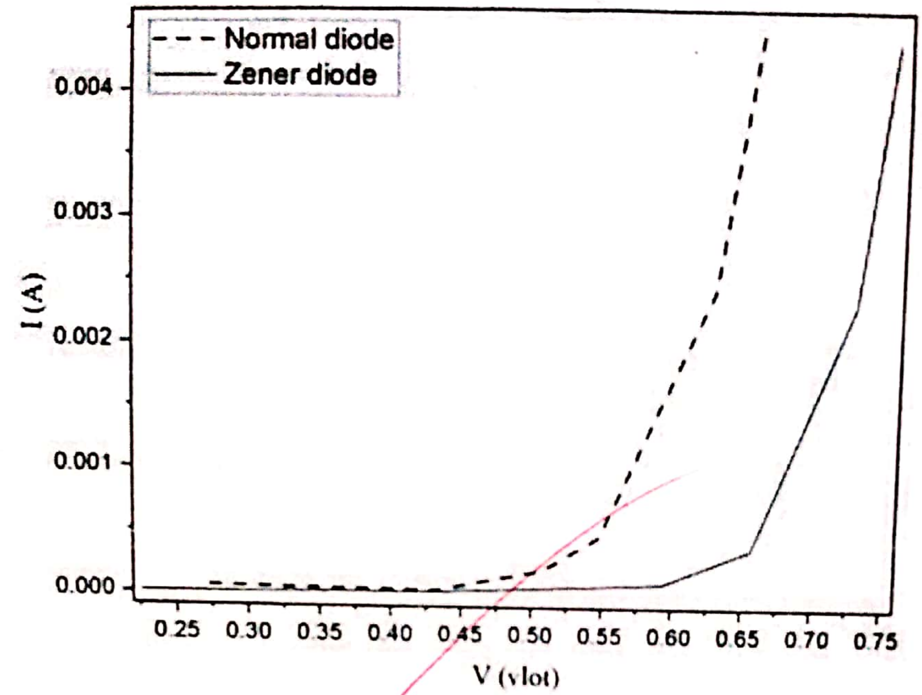



Table2: Diode Forward Currents and Voltages

| $V_s$ | $V_{R1}$ Normal | $V_D$ Normal | $I_D=V_R/R$ Normal |
|---|---|---|---|
| 0.2 | 0.58 mv | 273.1mv | 58 µV |
| 0.4 | 36.95mv | 431.7mv | 36.95µV |
| 0.6 | 206.1mv | 507.1mv | 206.1µV |
| 1.0 | 486.6mv | 547.3mv | 486.6µV |
| 3.0 | 2.46v | 627.4mv | 2460 µV |
| 5.0 | 4.45v | 657.4mv | 4450 µV |

| $V_s$ | $V_{R1}$ Zener | $V_D$ Zener | $I_D=V_R/R$ Zener |
|---|---|---|---|
| 0.2 | 0.30 mv | 226.1mv | 3 µV |
| 0.4 | 23.9 mv | 435.1mv | 23.9 µV |
| 0.6 | 99.8 mv | 593.3mv | 99.8 µV |
| 1.0 | 392.7 mv | 656.4mv | 392.7 µV |
| 3.0 | 2.36 v | 727.2mv | 2360 µV |
| 5.0 | 4.39 v | 751.4mv | 4390 µV |

2.Use your results from Table 2 to plot the *IF* versus *VF* curve for both diodes in the figure below




3.Graphically determine the dynamic resistance of the normal diode at 3.

$$RD = \frac{\Delta V}{\Delta I} = \frac{657.4\text{mv} - 547.3\text{mv}}{4450\ \mu\text{V} - 486.6\mu\text{V}} = 27.779\ ohm$$

4. Determine the static resistance of the normal diode at 1.

$$R = \frac{Vd}{Id} = \frac{547.3\text{mv}}{486.6\mu\text{V}} = 1124.7\ ohm$$

**Part Two :**

5.Construct the circuit shown below, Measure the voltage across the zener diode, and record this values

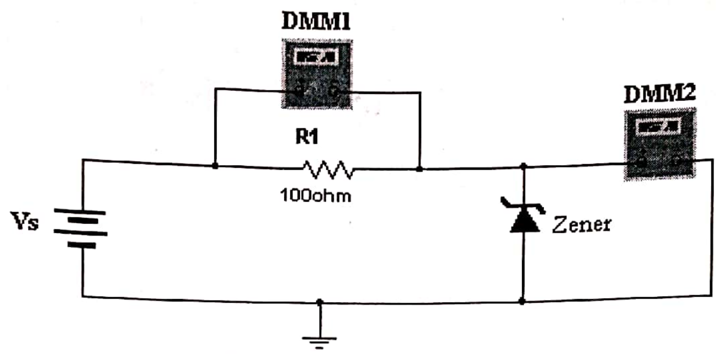
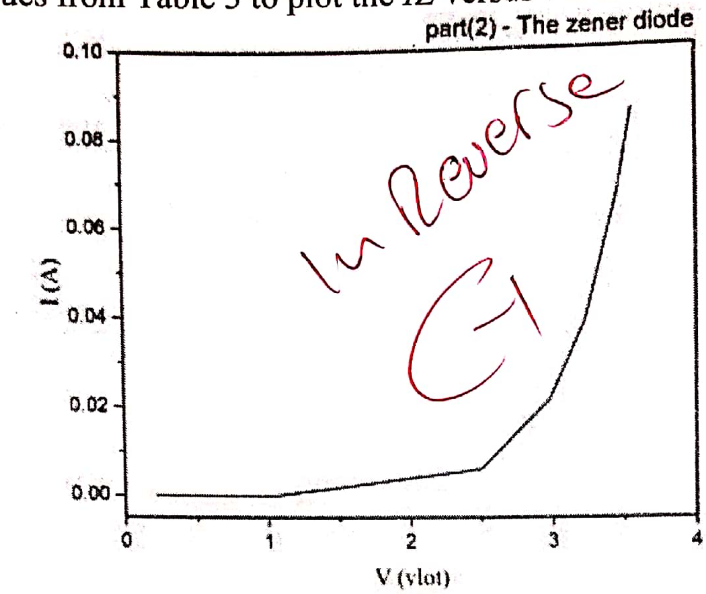



Table.3: Measurement of $V_{R1}$ and Vz

| VS (volt) | VR1 (volt) | Vz (volt) | IZ =VR1 / R1 (mA) |
|---|---|---|---|
| 0.2 | 0.06mv | 217.6 mv | 0.0006 |
| 0.6 | 0.22mv | 703.7 mv | 0.0022 |
| 1.0 | 1.41mv | 1040.3 mv | 0.0141 |
| 3.0 | 600.5mv | 2.497v | 6.005 |
| 5.0 | 2.14v | 2.98v | 21.4 |
| 7.0 | 3.93v | 3.233v | 39.3 |
| 10.0 | 6.77v | 3.46v | 67.7 |
| 12.0 | 8.6v | 3.56v | 86.0 |
| Vz=3v | | | |

6.Use the values from Table 3 to plot the *IZ* versus *VZ* curve in Figure 3.




## Conclusions

- If vd greater than specific Vα, then the diode is (on), and the voltage on it is equal to battery voltage = Vα.
- If vd smaller than specific Vα, then the voltage of the diode equal to Vs and the circuit will be open circuit.
- If Vz greater than or equal to specific Vz, so the voltage of the Zener act like a battery with Vz value.
- If Vz smaller than Vz the circuit acts as open circuit and the voltage equal Vs.

CamScanner

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**Electronics Lab**
**Lab Session 2: Diode Applications**

| Students Names | ID# |
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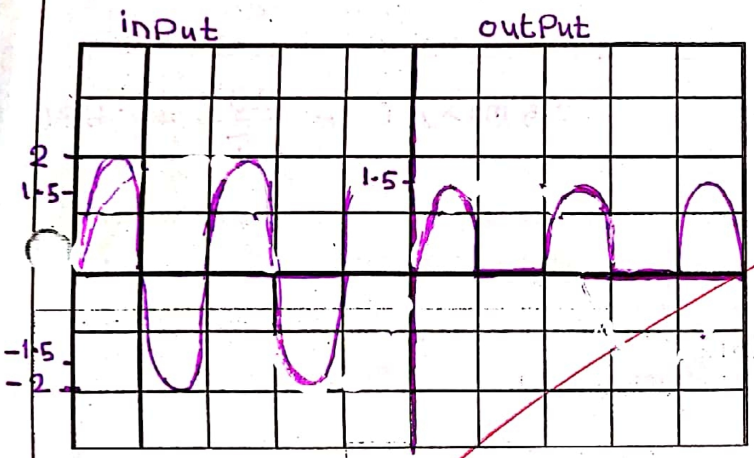
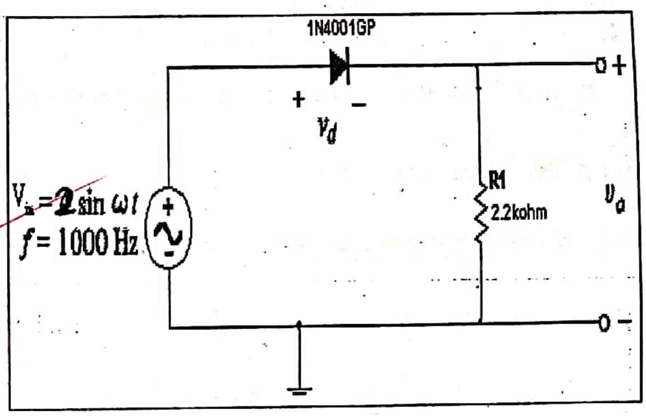
## Part 1: Half-Wave Rectification

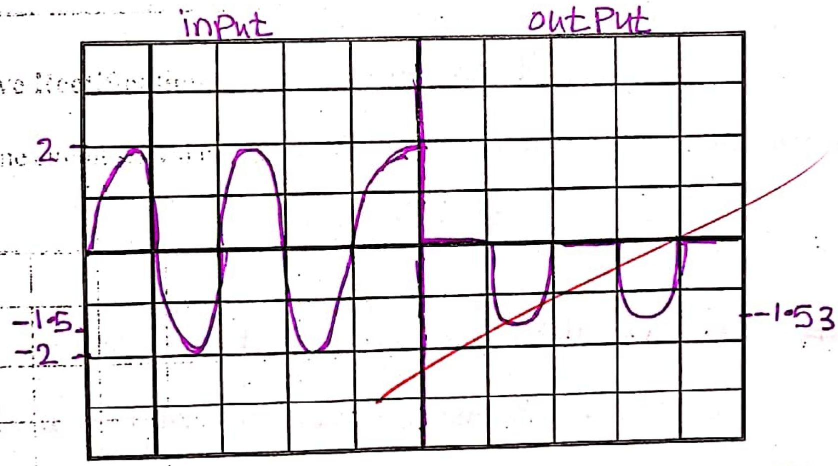
1) Construct the circuit shown below and draw the input and output signal.




2) Measure the DC value of $V_O$ using the DC scale in the DMM. $V_{ODC}$=......399.2 mV......

3) **Reverse** the diode and draw the input and output signal.




4) Measure the DC value of $V_O$ using the DC scale in the DMM. **VODC** =......-406.8 mV......

5) For step 1, and 3, Calculate the DC level of the output waveform.

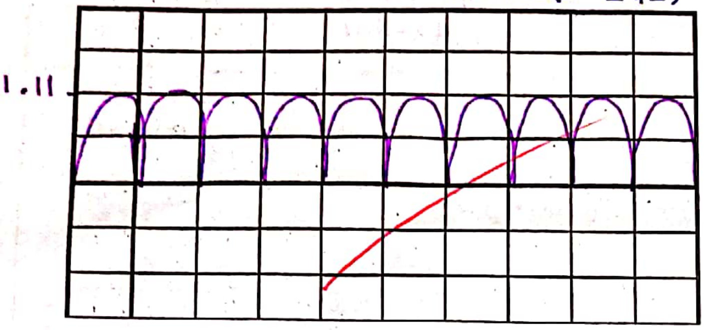
**Vavg1=** ......$V_m/\pi = 1.5/\pi = 0.477$......

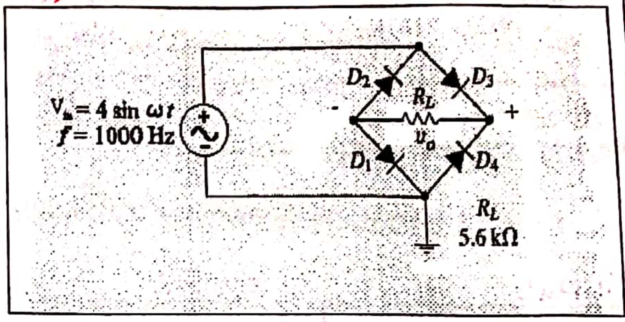
**Vavg4=**......$V_m/\pi = -1.5/\pi = -0.477$......

**Part 2: Full-Wave Rectification**

6) Construct the circuit shown below. Draw the output waveforms. Then, measure the DC load voltage using DMM. $V_{ODC}$ =............................................ = 0.45 v

0.2142 − (0.242) =

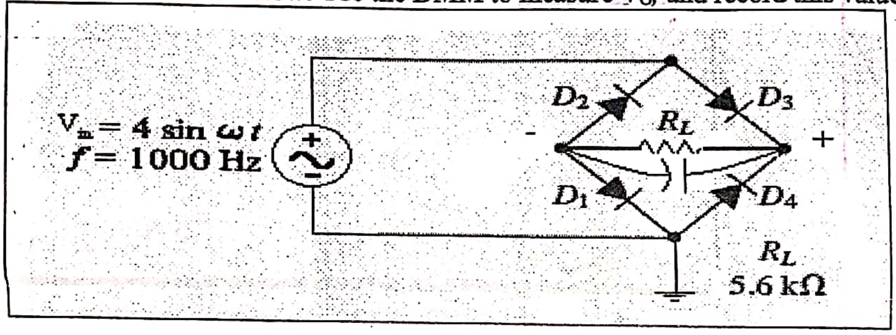



7) Calculate the DC level of the output waveform Vo. $V_{avg}$ = ...2Vmax/π...=...$\frac{2(1)}{\pi}$... = 0.636

**Part 3: Rectifier Filtering**

8) Construct the circuit shown below. Use the DMM to measure $V_O$, and record this value.




9) Use the oscilloscope to observe and measure the ripple voltage using **1 µF**.

Vr =.........146.4 mV...................

10) Use the oscilloscope to observe and measure the ripple voltage using **22 µF**.

Vr=..............61 mV.....................

***Conclusion***

the rectifier is used to convert Ac voltage to DC, it uses one or more diode in its cct, which is (H.W or F.W). the Benifits of filter [capacter with F.W] is to reduce the ripple in the signal, and when the capacter ↑ the ripple ↓.

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**Electronics Lab**
**Lab Session 2.b: Diode Applications**

| Students Names | ID# |
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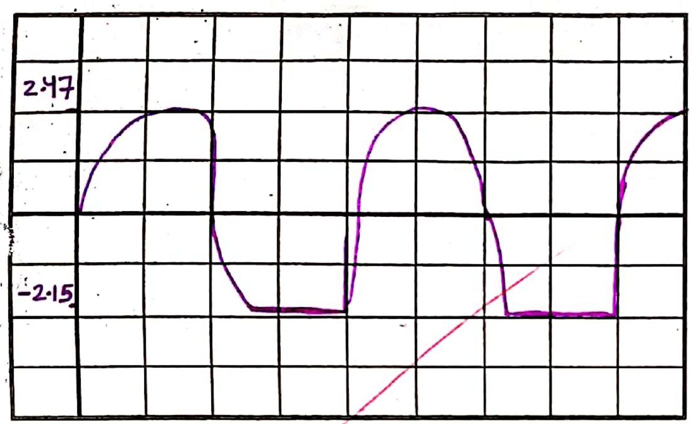
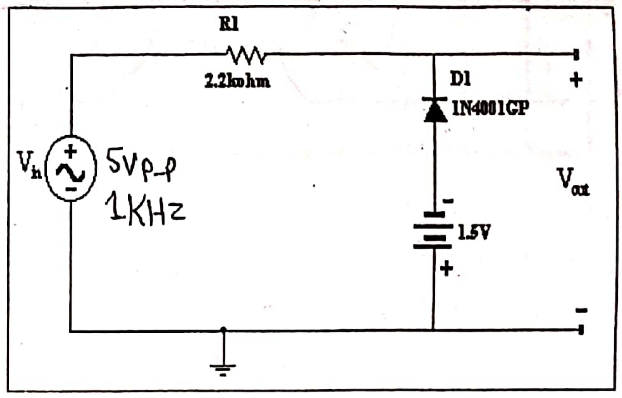
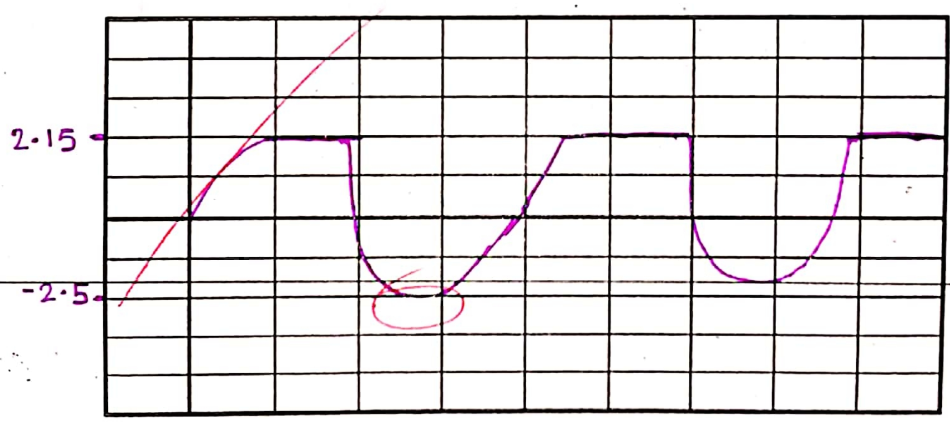
## Part 1: *The Shunt Clipper with a DC Battery*

1. Construct the circuit shown below. The input signal is 5 $V_{p-p}$ sine wave at a frequency of 1KHz.
2. Draw the output signal.



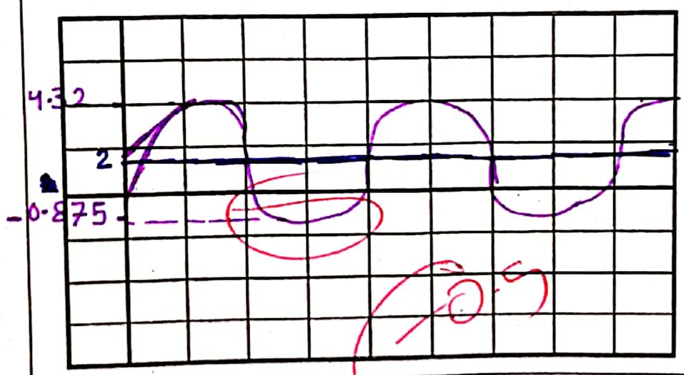



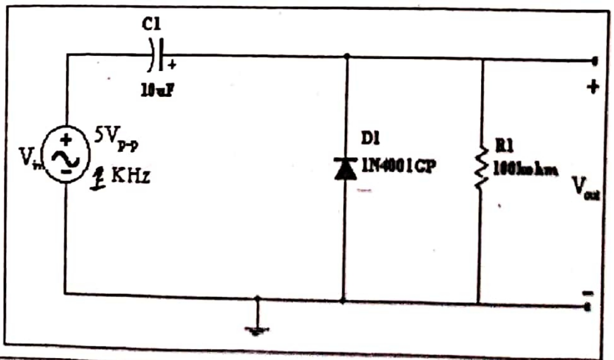

3. Reverse the polarity of the diode and the power supply then draw the output.




## Part 2: *The Clamper circuit*

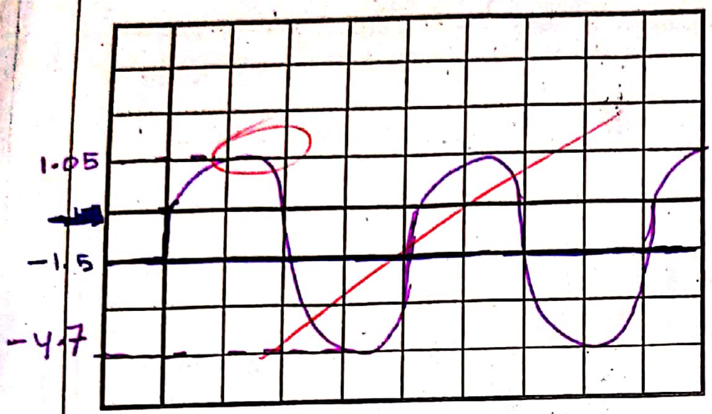
4. Construct the circuit shown in below. The input signal is 5 $V_{p-p}$ sine wave at a frequency of 1 KHz.
5. Draw the output signal.

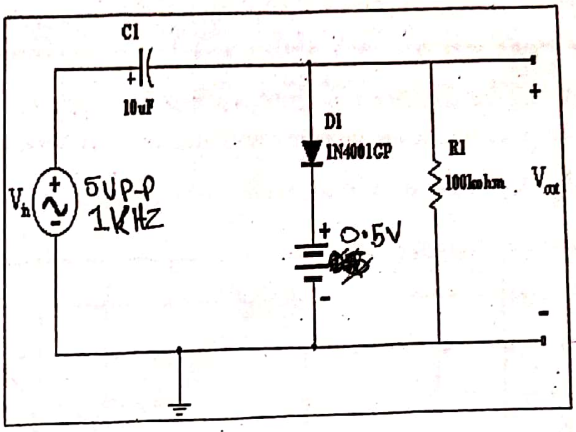


*Part 3: the Clamper circuit with DC Battery*

**6. Construct the circuit shown in the figure and Set the function generator to a 1 KHz, ~~10~~ 5 $V_{p-p}$ sine wave. Then sketch the output signal**




***Conclusions***

* clipping is a process of cutting a portion of the Ac input signal to certain specification level., the cct which performs clliping is called "clipper" and it contains diodes which represents the main element in the cct.

* otherwise, the clamper is changing the D.c level of the Ac input signal to a certain specified level., types of clamping are +ve, -ve, the type of the clamping depends on the diode direction, and the clamping level (D.c level) depends on value and polarity of the DC source connected with diode (if any).

* the difference between clipper and clamper is the capacitor.

**Electronics Lab**

**Lab Session 3: BJT Characteristics and DC Biasing**

20/26

| Students Names | ID# |
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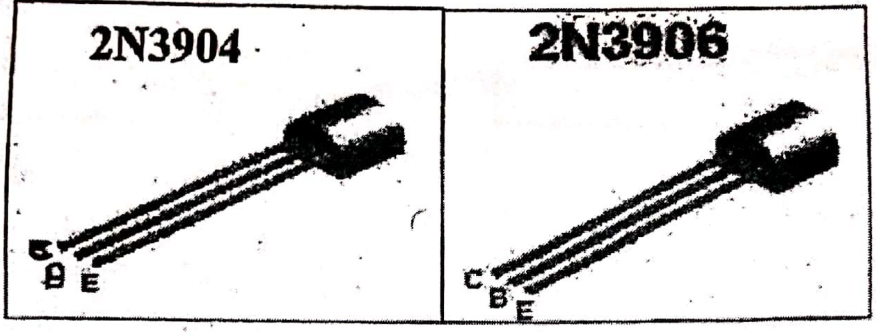
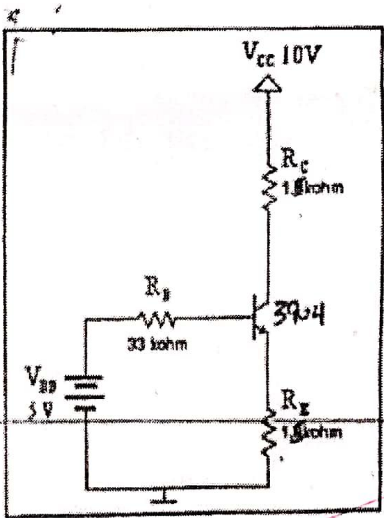
## Part 1: Checking Transistors



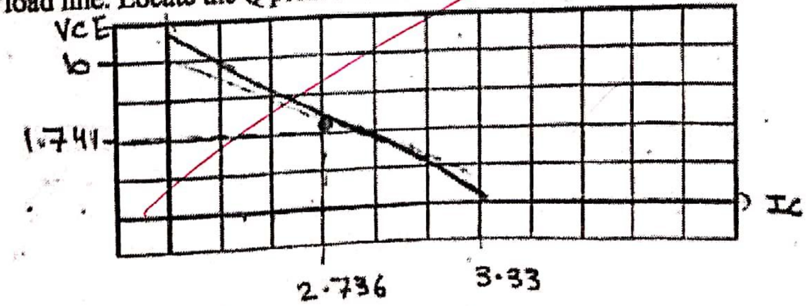

## Part 2: Determining Transistor Parameters and the DC Load Line

1. Connect the circuit as shown in Figure 8 in the lab manual using NPN transistor and fill the following table:

| Parameter | Measured |
|---|---|
| $V_C$ | 5.895 |
| $V_B$ | 4.878 |
| $V_E$ | 4.235 |
| $V_{CEQ}$ | 1.741 |
| $V_{BEQ}$ | 0.6583 |
| $I_{BQ}$ | 0.087 |
| $I_{EQ}$ | 2.823 |
| $I_{CQ}$ | 2.736 |
| $\beta$ | 31.44 |
| $\alpha$ | 0.969 |




3. Determine the saturation ($I_{C(short)}$) and cutoff ($V_{CE(off)}$) points on the DC load line for this circuit, then plot the DC load line. Locate the Q point based on the measured values of $I_{CQ}$ and $V_{CEQ}$.



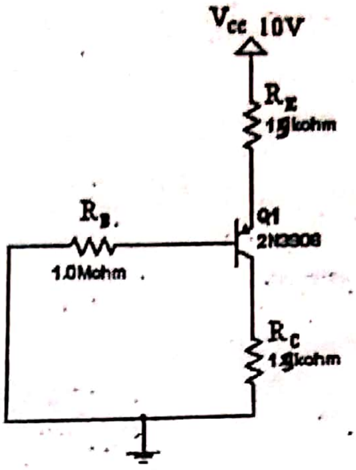

when $I_C = 0 \rightarrow \boxed{V_{CE} = 10}$

when $V_{CE} = 0 \rightarrow I_C = \frac{V_{CC}}{R_C + R_E} = \frac{10}{3}$

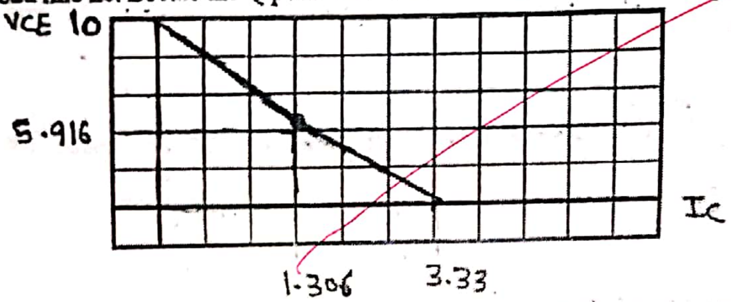
$\boxed{I_C = 3.33}$

4. **Connect the circuit as shown in Figure 9 in the lab manual using PNP transistor and fill the following table:**

| Parameter | Measured |
|---|---|
| $V_C$ | 1.159 |
| $V_B$ | 7.226 |
| $V_E$ | 8.026 |
| $V_{CEQ}$ | +5.916 |
| $V_{BEQ}$ | +0.6697 |
| ~~ ~~ | ~~ ~~ |
| $I_{CQ}$ | 1.306 |
| $I_{BQ}$ | 0.01 |
| $I_{EQ}$ | 1.316 |
| ~~ ~~ | ~~ ~~ |
| $\beta$ | 130.6 |
| $\alpha$ | 0.992 |




5. Determine the saturation ($I_{C(short)}$) and cutoff ($V_{CE(off)}$) points on the DC load line for this circuit, then plot the DC load line ne. Locate the Q point based on the measured values of $I_{CQ}$ and $V_{CEQ}$.




when $I_C = 0 \Rightarrow -10 + V_{EE} = 0$

$\boxed{V_{CE} = 10}$

when $V_{CE} = 0 \rightarrow I_C = \frac{V_{EE}}{R_C + R_E}$

$= \frac{10}{3}$

$\boxed{I_C = 3.33}$

**Calculations (PART1 and PART2) calculate All Currents using the Measured Values**

$I_C = \frac{V_{CC} - V_C}{R_C} = \frac{10 - 5.895}{1.5} = 2.736$

$I_E = \frac{V_E}{R_E} = \frac{4.235}{1.5} = 2.823$

$I_B = I_E - I_C = 2.736 + {}^{-}2.823 = 0.87$

$\beta = I_C / I_B = 2.736 / 0.87 = 31.44$

$\alpha = \beta / \beta + 1 = 31.44 / 32.44 = 0.969$

$\boxed{\text{Part (1)}}$

$I_E = \frac{V_{EE} - V_E}{R_E} = \frac{10 - 8.026}{1.5} = 1.316$

$I_C = \frac{V_C}{R_C} = \frac{1.959}{1.5} = 1.306$

$I_B = I_E - I_C = 1.316 - 1.306 = 0.01$

$\beta = I_C / I_B = 1.306 / 0.01 = 130.6$

$\alpha = \beta / \beta + 1 = 130.6 / 131.6 = 0.96$

$\boxed{\text{Part (2)}}$

# Electronics Lab
## Lab Session 4: The Common Emitter Amplifier

| Student Names | ID# |
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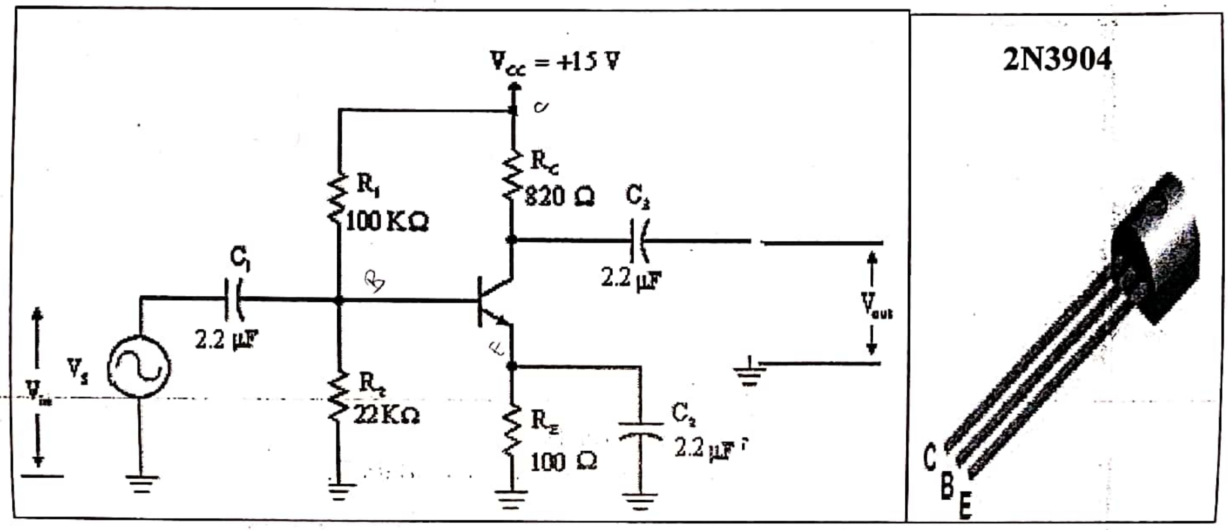
1) Construct the circuit shown below and Measure and record the DC voltages listed in Table 1.




| DC Parameter | Measured Value |
|---|---|
| $V_B$ | 2 V |
| $V_E$ | 1.36 V |
| $V_C$ | 4.22 V |
| $V_{CE}$ | 2.83 V |
| $V_{BE}$ | 686 mV |
| Ic | 13.14 mA |
| $I_B$ | 0.46 mA |
| $I_E$ | 13.6 mA |
| β | 28.565 |
| α | 0.966176 |

Table.1: DC Parameters of CE Amplifier

**Calculations**

$I_C = \frac{V_{cc} - V_c}{R_c} = \frac{15 - 4.22}{820} = 13.14\text{ mA}$ // $I_E = \frac{V_E}{R_E} = \frac{1.36}{100} = 13.6\text{ mA}$

$I_B = I_E - I_C = 0.46\text{ mA}$ // $\beta = \frac{I_C}{I_B} = 28.565$

$\alpha = \frac{\beta}{1+\beta} = 0.966176$

2) Connect the AC circuit with **Vs= 150 mVp-p** sine wave at 1.0 kHz. Fill Table2.

| | |
|---|---|
| $v_b = V_{in}$ | 150 m Vpp |
| $r_e = 26mv/I_E$ | 1.91176 Ω |
| $v_C = V_{out}$ | 3.6 Vpp |
| $A_V = V_{out}/V_{in}$ | 24 |

Table.2: AC Parameters of CE Amplifier

5) Remove $C_2$ from the circuit and fill Table3.

| | |
|---|---|
| $v_b = V_{in}$ | 150 m Vpp |
| $r_e = 26mv/I_E$ | 1.91176 Ω |
| $v_C = V_{out}$ | 1.25 Vpp |
| $A_V = V_{out}/V_{in}$ | 8.33333 |

Table3: AC Parameters of CE Amplifier

3) Use *20kΩ* pot. to measurer the $R_{in}$. $R_{in}$ =......11.3 KΩ......

4) Use *20kΩ* pot. to measurer the $R_{out}$. $R_{out}$ =......800Ω......

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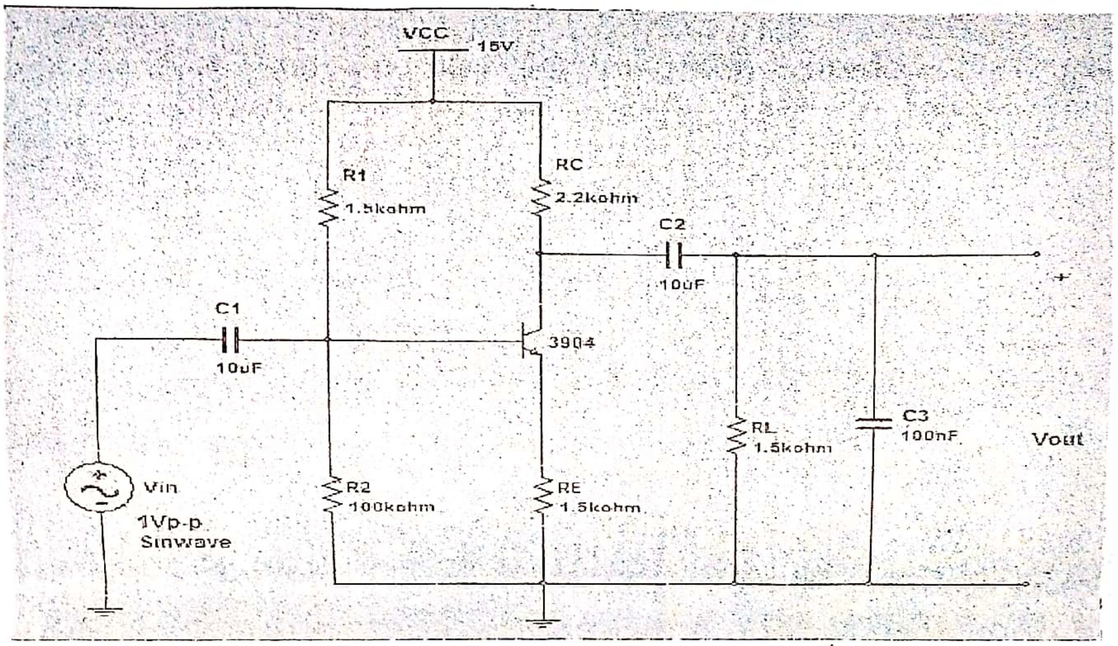
# Electronics Lab

## Lab Session 6: Frequency response

**Student Name:**
**Section No:**

**Registration No.:**
**Date:**

**a) Assemble the circuit shown in the figure then fill the table below.**




| | F | 20 H | 40 H | 50 H | 100 H | 200 H | 1 KH | 7 KH | 10 KH | 50K H | 100 KH | 200 KH | 500 KH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mV | $V_{out}$ | 330 | 559 | 625 | 760 | 812 | 880 | 840 | 820 | 320 | 180 | 120 | 80 |
| m | Av | 330 | 559 | 625 | 760 | 812 | 880 | 840 | 820 | 320 | 180 | 120 | 80 |

**Note: always check the input voltage**

**b) Determine the followings.**

1. The lower cut off frequency (FL) = $\frac{Av_m}{\sqrt{2}} = \frac{880}{\sqrt{2}} = 0.62 \Rightarrow \boxed{50\,H}$

2. The upper cut off frequency (FH) = $\boxed{20KH}$

3. The bandwidth of the amplifier = $20 * 10^3 - 50 = 20000 - 50 = 19950$ H

4. The midband gain of the amplifie= 880 m

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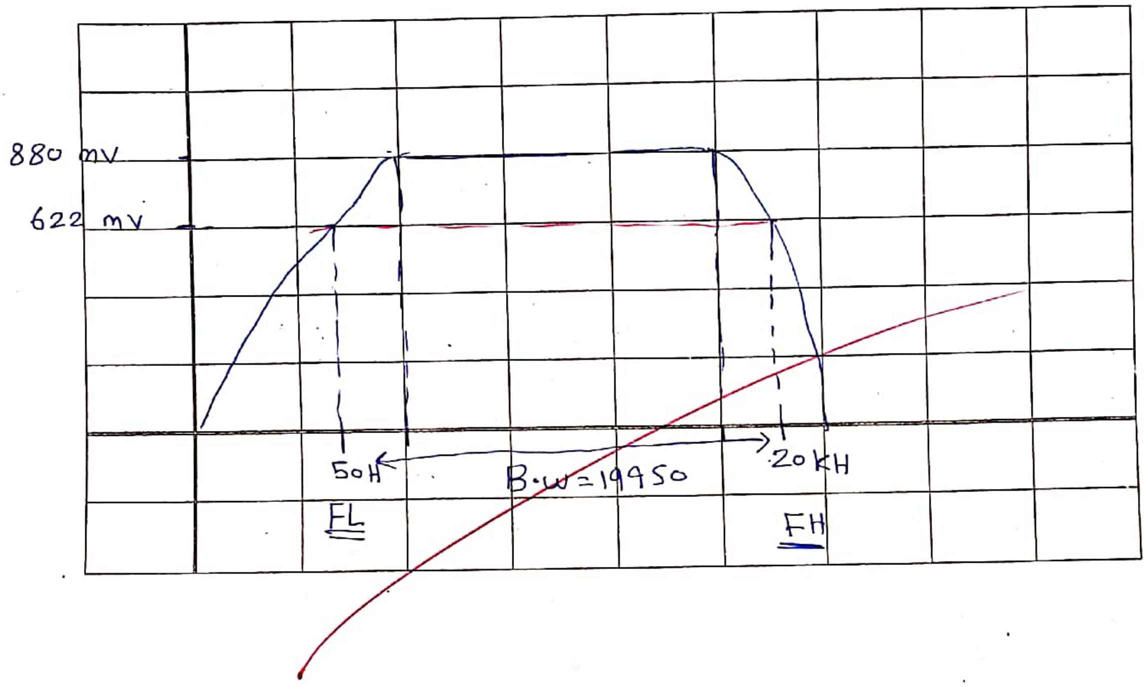
5. **Plot** the resulting frequency response (Av against F or Av(dB) against F) showing clearly the results found in 1 through 4.



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**Electronics Lab**
**Lab Session 6: Operational Amplifier**

| Students Names | ID# |
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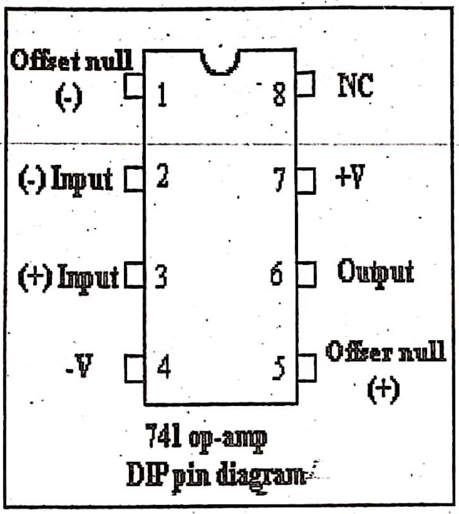
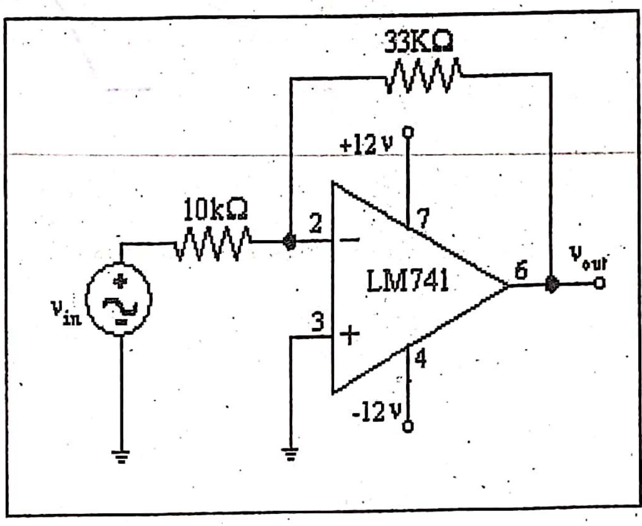
## *Part 1: Inverting Amplifier*

1. Construct the circuit shown Connect a 500 Hz, 1 $V_{p\text{-}p}$ sine wave.



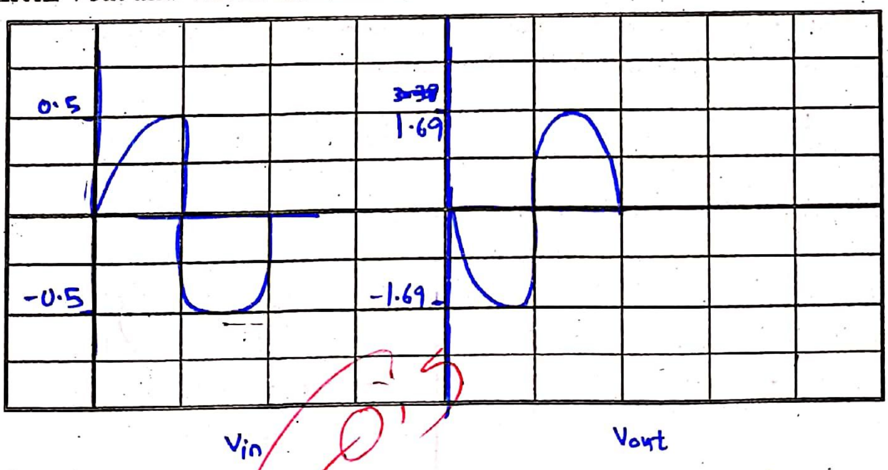
741 op-amp DIP pin diagram




2. **Measure the peak-to-peak values of the input and output Waveforms .**

**Vin=**....1.......... **Vo=**..-3.38..... **Phase Shift**...180..... **AV=**....$\frac{V_o}{V_i}$ = $\frac{3.38}{1}$ = -3.38

3. **Sketch Vout and Vin on the same sheet**

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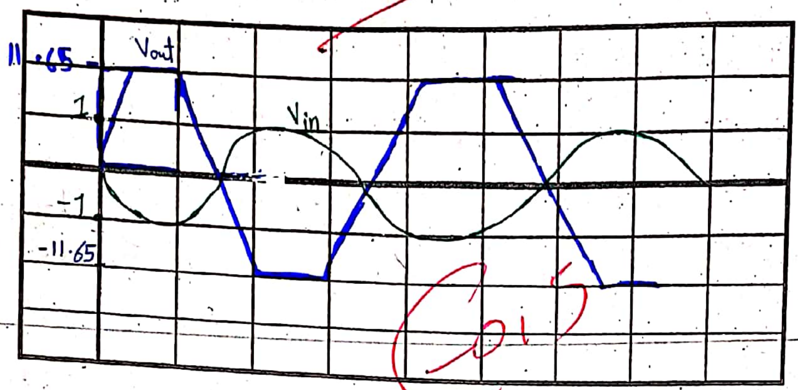
مع بعض !!

4. Increase Vin to be 2 Vp-p and replace $R_f$ =33KΩ with 1MΩ, Measure the peak-to-peak values of the input and outpu. Then, sketch both waveforms.

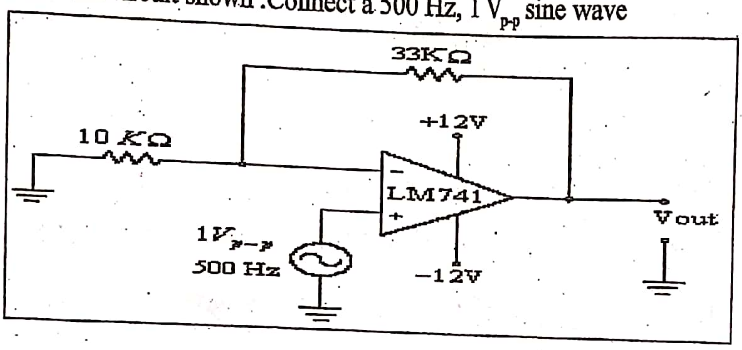
Vin=....2.................. Vo=....-23.3............ AV=....$\frac{V_o}{V_i}$ = -11.65............

لازم توضح
التباعد بين
1 و 11.65 ن




## Part 2: Non-inverting Amplifier

1. Construct the circuit shown .Connect a 500 Hz, 1 $V_{p-p}$ sine wave




2. Measure the peak-to-peak values of the input and output waveforms, and record their values. Then, sketch both waveforms.

Vin=........1........ Vo=......4.5..... Phase Shift....0...... AV=.....4.5......

3. Sketch Vout and Vin on the same sheet

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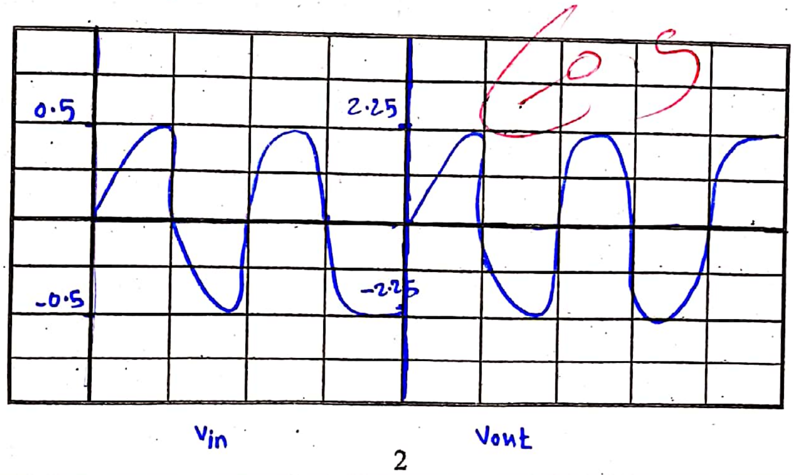

## Part3: Summing Amplifier [redacted]

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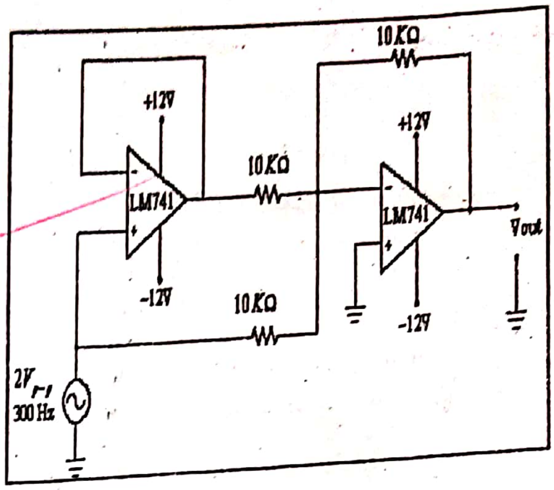
1. For the circuit shown, calculate Vo

$V_{in} = 2$ [$V_{in}$ the same for both op Am]

$V_o = -\left(\frac{R_F}{R_1} V_{in_2} + \frac{R_F}{R_2} V_{in}\right)$

$= -\left(\frac{10K}{10K} \cdot 2 + \frac{10K}{10K} \cdot 2\right)$

$= -4$




### Conclusions

- Regarding the Ic, pin (1, 5, 8) → we don't connect those pins
- The wiers shouldn't be touching, if happen the cct will be shorted
- The op-Am gives max output = +Vcc, -Vcc

if we connect a circuit that gives output larger then (+Vcc, -Vcc) The output signal is going to be clipped to the max Value as I mention before at (+Vcc, -Vcc)

- Inverting Amp: have 180° phase shift between The input and the output
- NoN-inverting Amp: have zero phase shift between the input and the output
- Av can be controlled by changing the Resistor values.

**Electronics Lab**
**Lab Session 7: Operational Amplifier**

| Students Names | ID# |
|---|---|
| | |
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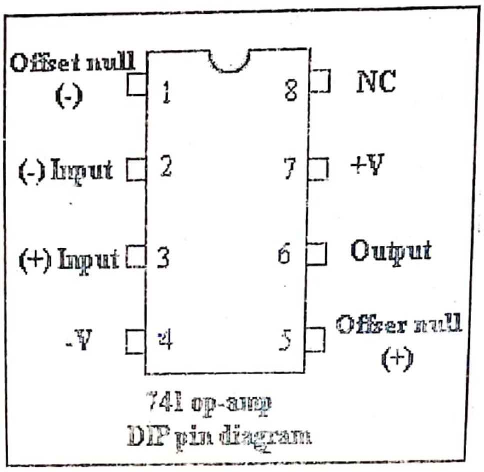
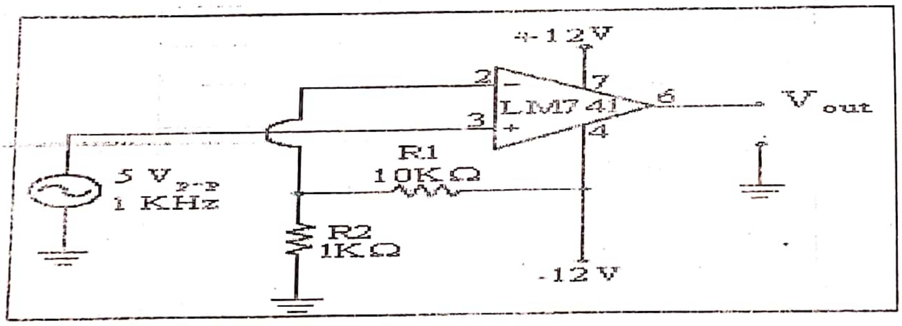
| | |
| | |



741 op-amp
DIP pin diagram

***Part1: Comparator with 741 IC Used as a Level Detector***

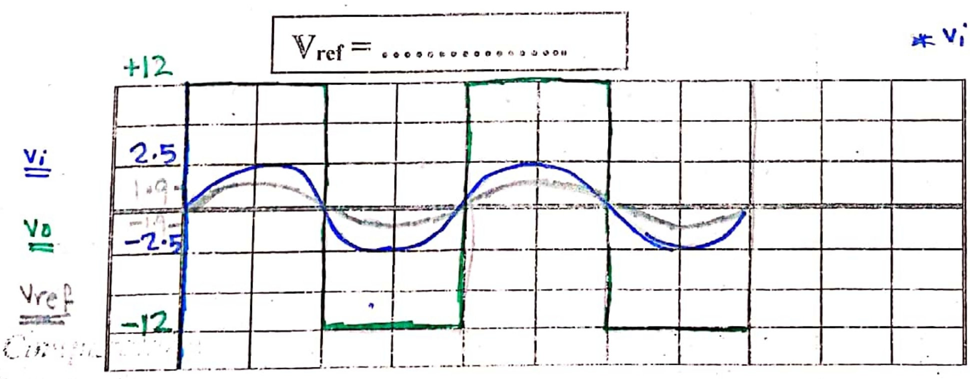
1. Construct the circuit shown below, connect a 500 Hz., 5-$V_{p-p}$ to the input. Sketch the input SIGNAL, Vref and the output signal on the same graph,




$$* \ V_{ref} = \frac{-12 * 1}{1+10} = -1.09$$

$* \ V_i < V_{ref} \Rightarrow V_o = -12$

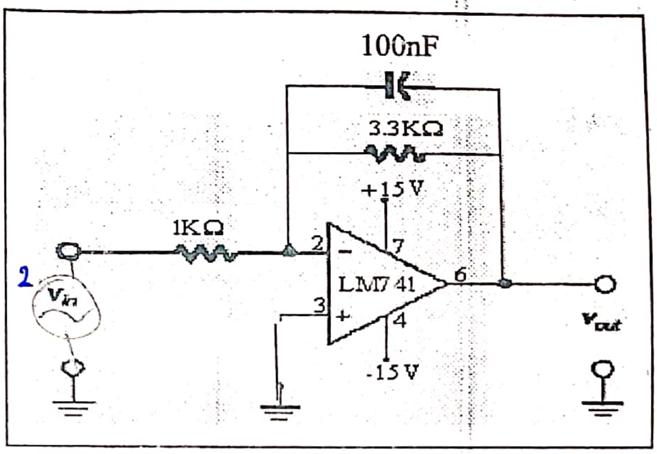
$* \ V_i > V_{ref} \Rightarrow V_o = 12$

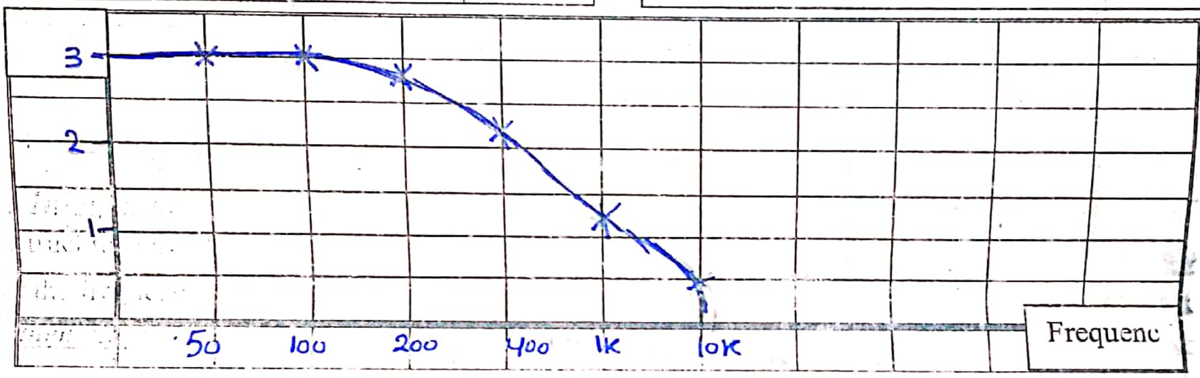


## Part 4: Integrator

1. Construct the circuit shown below, apply a 2 $V_{p-p}$ of 200Hz sine wave.
2. Vary the frequency of $V_{in}$ frown 200Hz to 50KHz. Calculate the gain. And record the results in the Table 1, ***and then plot the gain vs. frequency on semi-log graph paper.***

| Frequency (Hz) | $V_{in}$ (Volt) | $V_{out}$ (Volt) | Av |
|---|---|---|---|
| 50 | 2 | 6.2 | 3.1 |
| 100 | 2 | 6 | 3 |
| 200 | 2 | 5.5 | 2.75 |
| 400 | 2 | 4.6 | 2.3 |
| 1K | 2 | 2.6 | 1.3 |
| 10K | 2 | 900 m | 0.45 |
| 15K | 2 | | |



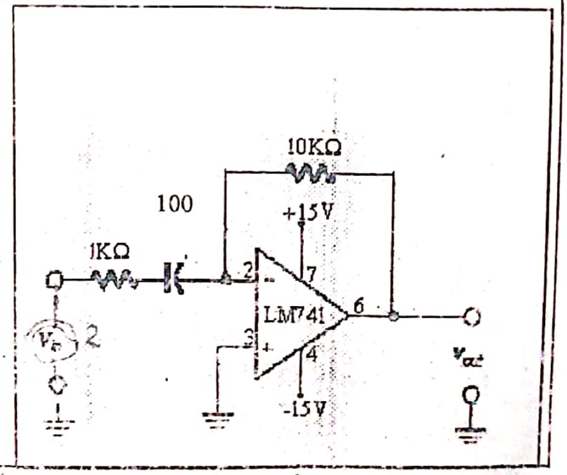

*The Break Frequency of the Integrator circuit FB* = $\frac{1}{2\pi C_F R_F} = \frac{1}{2\pi\ 100\times10^{-9} \times 3.3\times10^{3}}$

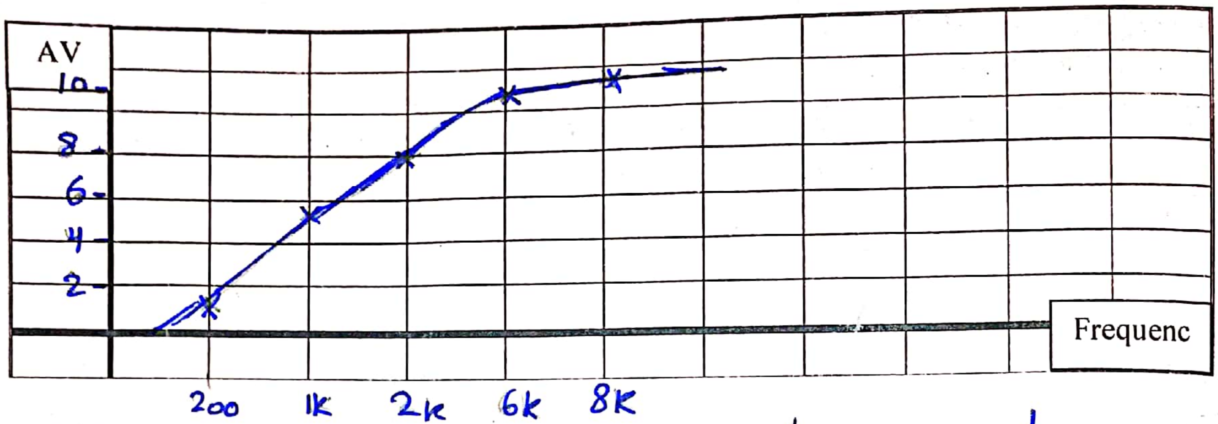
= 482.53

## Part5: Differentiator

1. Connect the circuit shown. Apply a 2 $V_{p-p}$ sine wave at 200 Hz sine wave.
2. Vary the frequency of $V_{in}$ as shown in the Table 2 and record the results.
3. Calculate the gain ***and then plot the gain vs. frequency on semi-log graph paper.***

| Frequency(Hz) | $V_{in}$ (Volt) | $V_{out}$ (Volt) | Av |
|---|---|---|---|
| 200 | 2 | 2.85 | 1.425 |
| 1K | 2 | 11.5 | 5.75 |
| 2K | 2 | 15.9 | 7.95 |
| 6K | 2 | 18.4 | 9.45 |
| 8K | 2 | 19.3 | 9.65 |






*The Break Frequency of the differentiator circuit FB* = $\frac{1}{2\pi C R_1} = \frac{1}{2\pi \; 100*10^{-9} * 1*10^{3}}$

$= 1592.35$

*Conclusions*

* we use the comparator to compare between 2 signals (vin and vref) [between DC signal and ~~sinu~~ sinusoidal signal].

if $V_{in} > V_{ref} \rightarrow V_{out} = +V_{cc}$

if $V_{in} < V_{ref} \rightarrow V_{out} = -V_{cc}$, the output is a square wave.

* the integrator work as a low pass filter → pass low frequency at hight frequency, which depends on the value of the cutoff frequency.

* Differentiater work as hight pass filter, pass hight frequency and atten- low frequency, which depends on the value of the cut off frequency. (fB).

before (fB), it works as diffretiator.

after (fB), it works as invertor with constant gain.

the gain become constant with increasing the frequency.