ANALOG ELECTRONICS
LAB MANUAL

DEPARTMENT OF
ELECTRONICS & COMMUNICATION
ENGINEERING

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

Components required:

- Power Supply
- Diodes IN4007 or 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.

1) Positive Clipping Circuit:

Circuit Diagram:

Waveforms:
To find the value of R:

Given: \( R_f = 100\Omega, R_r = 100\,\text{K}\Omega \)

\( R_f \) - Diode forward resistance

\( R_r \) - Diode reverse resistance

\[ R = \sqrt{R_f R_r} = \sqrt{100 \times 100 \times 10^3} = 3.16\,\text{K}\Omega \]

Choose R as 10 K\Omega

Let the output voltage be clipped at +3V

\( \therefore V_{\text{omax}} = 3\text{V} \)

From the circuit diagram,

\[ V_{\text{omax}} = V_r + V_{\text{ref}} \]

Where \( V_r \) is the diode drop = 0.6V

\( \therefore V_{\text{ref}} = V_{\text{omax}} - V_r \)

\[ = 3 \text{V} - 0.7 \]

\( V_{\text{ref}} = 2.3\,\text{V} \)
II) Negative Clipping Circuit:

Circuit Diagram:

Waveforms:

Transfer Characteristics:

Let the output voltage be clipped at -3V

\[ V_{\text{omin}} = -3V \]

\[ V_{\text{omin}} = -V_r + V_{\text{ref}} \]

\[ V_{\text{ref}} = V_{\text{omin}} + V_r = -3 + 0.7 \]

\[ V_{\text{ref}} = -2.3V \]
III) Diode Series Clipping / Positive Peak Clipper:

**Circuit Diagram:**

```
8Vp-p
Vi
BY127

R
3.3K

VR
2V

Vo
```

**Waveforms:**

Let the output voltage be clipped at 2V

\[ V_{\text{omax}} = V_{\text{ref}} = 2V \]
IV) Negative Peak Clipper:

Circuit Diagram:

Waveforms:

Transfer Characteristics:

Let the output voltage be clipped at -2V

\[ V_{omin} = V_{ref} = -2V \]
V) Clipping at two independent levels:

**Circuit Diagram:**

![Circuit Diagram](image)

**Waveforms:**

![Waveforms](image)

**Transfer Characteristics:**

![Transfer Characteristics](image)

Let $V_{\text{omax}} = 6V$ and $V_{\text{omin}} = 3V$

$\therefore V_{\text{omax}} = V_{r1} + V_r$

$V_{r1} = V_{\text{omax}} - V_r = 6 - 0.7 = 5.3V$

$V_{\text{omin}} = V_{r2} - V_r$

$V_{r2} = V_{\text{omin}} + V_r = 3 + 0.7 = 3.7V$
VI) Double ended clipper to generate a symmetric square wave:

**Circuit Diagram:**

![Circuit Diagram](image)

**Waveforms:**

![Waveforms](image)

**Transfer Characteristics:**

![Transfer Characteristics](image)

Let $V_{R1} = V_{R2} = V_R$, $V_{omax} = 4V$

$V_{omax} = V_R + V_t$

$V_R = V_{omax} - V_t = 4 - 0.7$

$V_R = 3.3V$
VII) To Clip a sine wave between +2V and -3V level:

**Circuit Diagram:**

![Circuit Diagram](image)

**Transfer Characteristics:**

![Transfer Characteristics](image)

To Clip a sine wave between +2V and -3V level

\[ V_o = V_1 + V_r \]

\[ V_1 = V_o - V_r = 2 - 0.7 \]

\[ V_1 = 1.4V \]

\[ V_o = V_2 - V_r \]

\[ -3 = V_2 - 0.7 \]

\[ V_2 = -3 + 0.7 \]

\[ V_2 = -2.3V \]
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:**

\[ R_f \text{ – Diode forward resistance} = 100\Omega \]
\[ R_r \text{ – Diode Reverse resistance} = 1M \Omega \]
\[ R = \sqrt{R_f R_r} = 10K\Omega \]

\[ RC \gg T \text{ let } T = 1ms \]
\[ f(1KHz) \]

Let \[ RC = 10T \]
\[ RC = 10ms \]
\[ C = 1\mu F \]
\[ R = 10K\Omega \]

1) **Positive Clamping Circuits:**

**Circuit Diagram:**

![Circuit Diagram](image)
Waveforms:

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

![Circuit Diagram]

Waveforms:

\[ V_o = V_\theta + V_{\text{ref}} \]

\[ 3 = -0.7 + V_{\text{ref}} \]

\[ V_{\text{ref}} = 3.7 \]
III) Negative Clamping Circuit:

Circuit Diagram:

Waveforms:
IV) Design a Clamping Circuit to clamp Positive Peak at -3V:

Circuit Diagram:

Waveforms:

\[ V_o = V_\phi - V_{ref} \]

\[ V_{ref} = - V_o + V_\phi \]

\[ = +3+0.7 \]

\[ V_{ref} = 3.7 \]
V) Design a Clamping Circuit to Clamp Negative Peak at -3V:

Circuit Diagram:

![Circuit Diagram](image)

Waveforms:

\[
V_o = -(V_{\phi} + V_{ref})
\]

\[
V_{\phi} = V_o - V_{\phi}
\]

\[
= -0.7 - (-3)
\]

\[
V_{ref} = +2.3V
\]
VI) Design a Clamping Circuit to clamp Positive Peak at +3V:

Circuit Diagram:

Waveforms:

\[ V_o = V_{\theta} + V_{\text{ref}} \]

\[ V_{\text{ref}} = V_o - V_{\theta} \]

\[ V_{\text{ref}} = 2.7V \]

Procedure:

- Rig up the circuit.
- Apply sinusoidal input signal of 8V P-P from signal generator.
- Observe the output waveform in the CRO.
- Note down the readings from the CRO and compare it with the expected values.
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 $R_L = 4.7K\Omega$, $C = 220\mu F$

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 $\eta = \frac{0.406}{1 + \frac{R_f}{R_L}} \approx 40.6\%$
4. Ripple Factor without Filter $\gamma = \frac{1}{2\sqrt{3}fR_L C}$ (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 $\eta = \frac{0.81}{1 + \frac{R_f}{R_L}} = 81\%$
4. Ripple Factor without Filter $\gamma = \frac{1}{4\sqrt{3}fCR_L}$

III) Bridge Rectifier:
1. Ripple Factor without Filter = 0.48
2. Percentage Regulation $= \frac{R_f}{R_L} \times 100$
3. Rectifier Efficiency $\eta = \frac{0.81}{1 + \frac{R_f}{R_L}} = 81\%$
4. Ripple Factor without Filter

\[ Y = \frac{1}{4\sqrt{3} f R_L} \]

I) Half wave Rectifier without Filter:

Circuit Diagram:

![Circuit Diagram](image)

Waveforms:

![Waveforms](image)

Peak output voltage \( V_m = \)

\[ V_{dc} = \frac{V_m}{\pi} = \]

\[ V_{rms} = \frac{V_m}{2} = \]

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

Ripple Factor \( Y = \frac{V_{ac}}{V_{dc}} = \)

Rectifier efficiency \( \eta = \frac{P_{dc}}{P_{ac}} = \frac{V_{dc}^2}{V_{rms}^2} = \)
% Regulation = \frac{V_{dc}^{NL} - V_{dc}(FL)}{V_{dc}(FL)} \times 100 =

II) Half wave Rectifier with Filter:

\[ \text{Waveforms:} \]

Peak output Voltage \( V_m = \)

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

\[ V_{dc} = \frac{V_m}{1 + \frac{1}{2fRLC}} = \]

\[ V_{ac} = \frac{V_{RP} - V}{2} = \]

\[ V_{rms} = \sqrt{V_{ac}^2 + V_{ac}^2} = \]

Rectifier efficiency \( \eta = \frac{P_{dc}}{P_{ac}} = \left[ \frac{V_{dc}}{V_{rms}} \right]^2 = \)
% Regulation = \frac{V_{d_c^{(NL)}} - V_{d_c^{(FL)}}}{V_{d_c^{(FL)}}} \times 100 =

III) Full wave Rectifier without Filter:

**Circuit Diagram:**

![Circuit Diagram]

**Waveforms:**

![Waveforms]

\[ V_{d_c} = \frac{2V_m}{\pi} = \]
\[ V_{rms} = \frac{V_m}{\sqrt{2}} = \]
\[ V_{ac} = \sqrt{V_{rms}^2 - V_{d_c}^2} = \]
\[ Y = \frac{V_{ac}}{V_{d_c}} = \]
IV) **Full wave Rectifier with Filter:**

**Circuit Diagram:**

![Circuit Diagram](image)

**Waveforms:**

![Waveforms](image)

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

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

\[
V_{dc} = \frac{V_m}{1 + \frac{1}{4 f R L C}}
\]

\[
V_{ac} = \frac{V_r - (p - p)}{2 \sqrt{3}}
\]

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

V) Bridge Rectifier without Filter:

**Circuit Diagram:**

![Bridge Rectifier Circuit Diagram](image)

**Waveforms:**

![Bridge Rectifier Waveforms](image)

\[ V_{dc} = \frac{2V_m}{\pi} = \]
\[ V_{rms} = \frac{V_m}{\sqrt{2}} = \]
\[ V_{ac} = \sqrt{V_{rms}^2 - V_{dc}^2} = \]
\[ Y = \frac{V_{ac}}{V_{dc}} = \]
\[ \eta = \frac{P_{dc}}{P_{ac}} = \left[ \frac{V_{dc}}{V_{rms}} \right]^2 = \]
% Regulation = \frac{V_{dc(NL)} - V_{dc(LED)}}{V_{dc(LED)}} \times 100 = 

VI) Bridge Rectifier with Filter:

Circuit Diagram:

Waveforms:

\[
V_{dc} = \frac{V_m}{1 + \frac{1}{4fR_LC}} \\
V_{ac} = \frac{V_T - (p-p)}{2\sqrt{3}} = \frac{V_{dc}}{V_{ac}} \\
Y = \frac{V_{ac}}{V_{dc}} \\
V_{rms} = \sqrt{V_{dc}^2 + V_{ac}^2} = \left[\frac{V_{dc}}{V_{rms}}\right]^2 \\
\eta = \frac{P_{dc}}{P_{ac}} = \left[\frac{V_{dc}}{V_{rms}}\right]^2
\]
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:
**RC-COUPLED AMPLIFIER**

**Aim:** To design and setup an RC Coupled amplifier using BJT & to find the input and output impedance of the RC-Coupled amplifier.

**Components Required:**
- Transistor
- Capacitor
- Resistors
- Signal Generator
- CRO

**Design:**

Let $V_{cc} = 10V$

$I_c = 5mA$

$\beta = 100$

To find $R_E$:

$V_{RE} = \frac{V_{cc}}{10} = \frac{10}{10} = 1V$

i.e. $I_E R_E = 1V$

$R_E = \frac{1V}{I_{E}} = \frac{1V}{I_{C}} = \frac{1V}{5mA} = 200\Omega$

Select $R_E = 220\Omega$

To find $R_C$:

$V_{CE} = \frac{V_{cc}}{2} = \frac{10}{2} = 5V$

Apply KVL to CE loop,

$V_{CC} - I_C R_C - V_{CE} - V_{BE} = 0$

$10 - 5R_C - 5 - 1 = 0$

$R_C = 800\Omega$

Select $R_C$ as 820 $\Omega$

To find $R_1$:

From the above biasing circuit,

$V_B = V_{BE} + V_{RE} = 0.7 + 1 = 1.7V$
Assume 10 $I_B$ flows through $R_1$

$$R_1 = \frac{V_{cc} - V_B}{10 I_B} = \frac{10 - 1.7}{10 \times 0.050} = 16.6\, \text{K}\Omega$$

Select $R_1$ as 18KΩ

Assume 9 $I_B$ flows through $R_2$

$$R_2 = \frac{V_B - 9 I_B}{9 I_B} = \frac{1.7}{9 \times 0.050} = 3.7\, \text{K}\Omega$$

Select $R_2$ as 3.9KΩ

Bypass capacitor $C_E$ and coupling Capacitor $C_{C1}$ and $C_{C2}$

Let $X_{CE} = \frac{1}{10} R_E$ at $f = 100\, \text{Hz}$

i.e. $\frac{1}{2\pi f C_E} = \frac{R_E}{10}$

$$C_E = \frac{10}{2\pi \times 100 \times 220} = 72.3\, \mu\text{F}$$

Select $C_E$ as 100μF

Also use $C_{C1} = C_{C2} = 0.47\, \mu\text{F}$

**Procedure:**

- Rig up the circuit
- Apply the sinusoidal input of 50m(P-P) and observe the input and output waveforms simultaneously on the CRO screen
- By varying the frequency of the input from Hz to maximum value and note down the output voltages
- Plot the frequency response (gain in dB vs log f) and determine the bandwidth from the graph
Circuit Diagram:

Waveforms:

Tabular Column:

<table>
<thead>
<tr>
<th>Freq. in Hz</th>
<th>Vo p-p</th>
<th>AU = Vo/V1</th>
<th>Gain in dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1KHz</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.2 KHz  
.  
2 KHz  
3 KHz  
4 KHz  
.  
200 KHz  
300 KHz  
.  
2 MHz

To measure input impedance and output impedance:

I) Input impedance (Ri):

Procedure:

- Connect the circuit as shown
- Set the DRB to a minimum value
- Set the output to a convenient level and note down the output voltage
- Increase the DRB value till $V_o$ becomes half of the maximum amplitude
- The corresponding DRB value gives input impedance

![RC Coupled Amplifier Diagram]

II) Output impedance ($R_o$):

Procedure:

- Connect the circuit as shown
- Set the DRB to a maximum value
- Set the output to a convenient level and note down the output voltage
- Increase the DRB value till $V_o$ becomes half of the maximum amplitude
- The corresponding DRB value gives input impedance
Result:

Bandwidth: ________ Hz
Input Impedance: ________ Ω
Output Impedance: ________ Ω
**Aim:** To determine a BJT Darlington Emitter Follower and determine the Gain, Input and Output impedances.

**Components required:**
- Transistor (SL100)
- Resistors
- Signal Generator
- CRO
- Capacitors

**Biasing Circuit:**

\[
\begin{align*}
\text{V}_{cc} &= +12\text{V} \\
R_1 &= 10\text{ }\text{I}_{B1} \\
R_2 &= 9\text{ }\text{I}_{B1} \\
B &= Q1 \\
C &= Q1 \\
P &= Q2 \\
Q &= Q2 \\
R &= 3.3\text{K} \\
I_{E1} &= I_{E2} \\
I_{C1} &= \text{I}_{C2} \\
V_o &= \text{I}_{C2} \times R_3
\end{align*}
\]

**Design:**

Let \( V_{cc} = 12\text{V} \)

\( I_{C2} = 2\text{mA} \)

\( \beta = 100 \)

From Biasing Circuit,

\( V_{B1} = 2V_{BE} + V_{RE} \)

\( V_{B1} = 1.4 + 6 \)

\( V_{B1} = 7.4\text{V} \)
Let \( V_{B2} = \frac{V_{CC}}{2} = \frac{12}{2} = 6V \)

\[ I_{E2}R_E = 6V \]

\[ R_E = \frac{6}{2m} = 3K\Omega \]

Select \( R_E = 3.3K\Omega \)

\[ I_{B2} = \frac{I_{C2}}{\beta} = \frac{2m}{100} = 0.02mA \]

\[ I_{B1} = \frac{I_{C1}}{\beta} \times \frac{I_{B2}}{100} = 0.0002mA \]

Assume 10 \( I_B \) flows through \( R_1 \)

\[ R_1 = \frac{V_{CC} - V_{B1}}{10I_B} = \frac{12 - 7.4}{10 \times 0.0002m} = \frac{4.6}{2 \times 10^{-3} \times 10^{-3}} = 2.3M\Omega \]

Assume 9 \( I_B \) flows through \( R_2 \)

\[ R_2 = \frac{V_B}{9I_B} = \frac{7.4}{9 \times 0.0002m} = \frac{7.4}{1.8 \times 10^{-3} \times 10^{-3}} = 4.1M\Omega \]

Choose the coupling capacitor \( C_{C1} \) and \( C_{C2} \) as 0.47\( \mu \)F

**Procedure:**

- Connect the circuit as shown in the circuit diagram.
- Set the Signal generator amplitude as 1V peak to peak and observe the input and output waveforms simultaneously on the CRO.
- By varying the frequency of the input from Hz range to MHz range and note the frequency range of the signal and corresponding voltage.
- The output voltage remains constant in mid frequency range.
- Tabulate the readings in tabular column.
- Plot the graph with frequency along X-axis and gain in dB along Y-axis.
- From the graph determine the bandwidth.
**Circuit Diagram:**

![Circuit Diagram]

**Tabular Column:**

<table>
<thead>
<tr>
<th>Freq. in Hz</th>
<th>$V_o$ p-p</th>
<th>$A_V = \frac{V_o}{V_1}$</th>
<th>Gain in dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Hz</td>
<td></td>
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</tr>
<tr>
<td>100 Hz</td>
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<td>200 Hz</td>
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<tr>
<td>500 Hz</td>
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<td>1kHz</td>
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<td>2kHz</td>
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<td>3kHz</td>
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<td>200kHz</td>
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<td>300kHz</td>
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<tr>
<td>3 MHz</td>
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</tbody>
</table>
To measure input impedance and output impedance:

I) **Input impedance (R\textsubscript{i})**:

Procedure:

- Connect the circuit as shown
- Set the DRB to a minimum value
- Set the output to a convenient level and note down the output voltage
- Increase the DRB value till V\textsubscript{o} becomes half of the maximum amplitude
- The corresponding DRB value gives input impedance

[Diagram]

II) **Output impedance (R\textsubscript{o})**:

Procedure:

- Connect the circuit as shown
- Set the DRB to a maximum value
- Set the output to a convenient level and note down the output voltage
- Increase the DRB value till V\textsubscript{o} becomes half of the maximum amplitude
- The corresponding DRB value gives input impedance

[Diagram]

**Result:**

Bandwidth: __________Hz
Input Impedance: __________Ω
Output Impedance: __________Ω
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,

\[ V_{RC} = I_CR_C=4.8V \]
\[ R_C = 2.4K\Omega \]
Choose \( R_C = 2.2K\Omega \)

\[ V_{RE} = I_ER_E=1.2V \]
\[ R_E = 600\Omega \]
Choose \( R_E = 680\Omega \)
\[ h_{fe} = 100 \ (\text{For BC 107}) \]
\[ I_B= \frac{I_C}{h_{fe}} = 20mA \]

Assume current through \( R_1 = 10 I_B \) \& through \( R_2 = 9 I_B \)
\[ VR_1 = V_{CC}-V_{R2} \]
\[ = 10V \]
Also, \( VR_1 = 10 I_B R_1 = 10.1V \)
\[ R_1 = 50\,\Omega \]

Choose \( R_1 = 47\,\Omega \)

\[ VR_2 = V_{BE} + V_{RE} \]
\[ = 0.7 + 1.2 \]
\[ = 1.9\,V \]

Also, \( VR_2 = 9 \, I_B \) \( R_2 = 1.9\,V \)

\( R_2 = 10.6\,\Omega \)

Choose \( R_1 = 12\,\Omega \)

**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 \( \theta = 20\,Hz \)

\( C_E = 117\,\mu F \)

Choose \( C_E = 220\,\mu F \)

\[ X_{CC} = \frac{1}{2\pi C_C} = \frac{R_C}{10} = 220\,\Omega \]

For \( \theta = 20\,Hz \)

Choose \( C_C = 47\,\mu F \)

**Design of \( \theta \) Selective Circuit:**

Required \( \theta \) of oscillations \( f = 1\,KH \)

\[ f = \frac{1}{2\pi R} \frac{\sqrt{C}}{\sqrt{R}} \]

Take \( R = 4.7\,\Omega \) & \( C = 0.01\,\mu F \)

**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:**

![Circuit Diagram](image)

**Result:**

Frequency

Theoretical: 1KHz

Practical: ________
**VERIFICATION OF NETWORK THEOREMS**

**Aim:** To verify Thevenin’s & Maximum power transfer theorem for DC Circuits.

**Components Required:**
- Resistor
- DRB
- Ammeter (DC)
- Multimeter

1) **Thevenin’s Theorem:**

   **Circuit Diagram:**

   a) **Given Resistor Network:**

   ![Circuit Diagram](image)

   b) **Thevenin’s Voltage – Experimental Setup:**

   ![Experimental Setup Diagram](image)

   c) **Thevenin’s Resistance – Experimental Setup:**

   ![Resistance Diagram](image)
Calculations:

Assume $V_i = 10V$, $R_1=10\,\Omega$, $R_2=4.7\,\Omega$, $R_3=10\,\Omega$, $R_4=4.7\,\Omega$, $R_L=10\,\Omega$

At node 1:

\[
\frac{V_2 - 10}{10\,\Omega} + \frac{V_1 - V_2}{4.7\,\Omega} + \frac{V_4}{10\,\Omega} = 0
\]

\[
V_1 \left[ \frac{1}{10\,\Omega} + \frac{1}{4.7\,\Omega} + \frac{1}{10\,\Omega} \right] - \frac{V_2}{4.7\,\Omega} = \frac{1}{1K}
\]

\[
4.128 \times 10^{-4} V_1 - 2.128 \times 10^{-4} V_2 = 1\,\text{m} \quad -------(1)
\]

At node 2:

\[
\frac{V_2 - V_1}{4.7\,\Omega} + \frac{V_2}{4.7\,\Omega} = 0
\]

\[
4.26 \times 10^{-4} V_2 - 2.128 \times 10^{-4} V_1 = 0 \quad -------(2)
\]

From (1) & (2)

\[
V_1 = 3.27V
\]

\[
V_2 = V_{th} = V_m = 1.635V
\]

\[
R_{th} = ((10 \parallel 10) + 4.7) \parallel 4.7)\,\Omega
\]

\[
= \left(\frac{10 \times 10}{20} \right) \times 4.7 \parallel 4.7)\,\Omega
\]

\[
= (5+4.7) \parallel 4.7)\,\Omega
\]

\[
= (9.7 \parallel 4.7)\,\Omega
\]

\[
R_{th} = 3.16\,\Omega
\]

\[
I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{1.63}{3.16\Omega + 10\,\Omega} = 0.124\,\text{mA}
\]

\[
I_L = 0.124\,\text{mA}
\]
\[ V_{O1} = I_L \times R_L \]
\[ = 0.1238m \times 10K = 1.24V \]
\[ V_{O1} = 1.24V \]

**Procedure:**

- Rig up the circuit as shown in the Fig I(a), measure the voltage across load \( R_L \) using DC Voltmeter. Note voltage as \( V_O \).
- Connect the circuit as in Fig I(b), measure the voltage across terminals AB. Note down the voltage reading as \( V_{OC} \).
- Rig up the circuit as shown in the Fig I(c), switch of the DC voltage source. The resistance \( 'r' \), represents internal resistance of the voltage source.
- Measure resistance across terminals AB using multimeter. Note down the resistance value as \( R_O \).
- Now rig up the circuit as shown in the Fig I(d), switch on the power supply and measure the voltage drop across the load resistance \( R_L \) using the multimeter, note down voltage as \( V_{O1} \).
- Compare the voltages \( V_O \) and \( V_{O1} \), they must agree each other, which verifies Thevenins theorem.

**Observations:**

Voltage across load \( R_L \) in the circuit Fig I(a), \( V_O = \)

Current through load \( R_L \) in the circuit Fig I(a), \( I_O = \)

Thevenins Voltage in Fig I(b), \( V_{OC} = \)

Thevenins Resistance in Fig I(c), \( R_O = \)

Voltage across load \( R_L \) in Thevenins equivalent circuit in Fig I(d), \( V_{O1} = \)

II) **Maximum Power Transfer Theorem:**

**Circuit Diagrams:**

![Circuit Diagram](image)
Calculations:
Choose \( R_N = 4.7\, \text{K}\Omega \)

\[-5 + 4.7K \, I_L + R_L \, I_L = 0\]

\[9.4K \, I_L = 5\]

\[I_L = 0.53\, \text{mA}\]

Maximum Power:
\[P = I_L^2 \, R_L\]
\[= 1.32\, \text{mw}\]

Procedure:
- Rig up the circuit as shown in the Fig II
- Set the input Dc voltage \( V_i = 5\, \text{V} \)
- Vary the resistance \( R_L \) using DRB in regular steps and note down the corresponding voltmeter and ammeter readings.
- Plot the graph of power Vs Resistance \( R_L \).
- Determine the resistance \( R_L \) at which power is maximum (From the Graph)

Tabular Column:

<table>
<thead>
<tr>
<th>( R_L ) (( \Omega ))</th>
<th>( I_L ) (mA)</th>
<th>( V_L ) (volts)</th>
<th>( P_L = V_L I_L ) (watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 K</td>
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</tr>
<tr>
<td>2 K</td>
<td></td>
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<tr>
<td>3 K</td>
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<tr>
<td>4 K</td>
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<tr>
<td>4.1 K</td>
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<tr>
<td>4.2 K</td>
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<td>5 K</td>
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<tr>
<td>6 K</td>
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<tr>
<td>10 K</td>
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</tbody>
</table>

Specimen Graph:
SERIES AND PARALLEL RESONANCE CIRCUITS

Aim: To test and verify the working/functioning of Series and Parallel resonance circuits and plots its response

Components Required:
- Resistor, Decade Resistance Box
- Decade Capacitance Box
- Decade Inductance Box
- Function Generator
- AC Voltmeter, Ammeter

I) Series Resonance:

Circuit Diagram:

![Series Resonance Circuit Diagram]

Procedure:
- Set up the circuit as in Fig
- Set input voltage $V_m = 5\text{v}$ using signal generator and vary the frequency from 100Hz to 1MHz in regular steps.
- Note down the corresponding voltage and current.
- Plot the graph of Frequency Vs Current
- Find Resonance Frequency, Quality Factor and Bandwidth from the graph obtained and compare with the theoretical values.

Calculations:

Take $R = 100\Omega$, $L = 10\text{mH}$, $C = 0.1\mu\text{F}$

Resonance Frequency $f_o = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{100\Omega} = \frac{1}{10\text{mH}} = \frac{1}{0.1\mu\text{F}}$

Quality factor of Series Resonance Circuit $Q_o = \frac{W_o L}{R} = \frac{1}{W_o C R}$
Bandwidth $B_W = \frac{\omega_0}{Q_0} =$

**Observations:**

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Total Current $i_T$ (mA)</th>
<th>$X_C$ (Ω)</th>
<th>$X_L$ (Ω)</th>
<th>$Z = \frac{v}{i_T}$ (Ω)</th>
<th>$Z = \sqrt{R^2 + (X_L - X_C)^2}$ (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 KHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2 KHz</td>
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<td>3 KHz</td>
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<tr>
<td>4 KHz</td>
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<tr>
<td>10 KHz</td>
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</tbody>
</table>

**Model Graph:**

From the Graph,

Resonance Frequency $f_0 =$

Bandwidth $BW = f_2 - f_1 =$
II) **Parallel Resonance:**

**Circuit Diagram:**

![Circuit Diagram](image)

**Procedure:**

- Set up the circuit as in Fig
- Set input voltage $V_m = 5v$ using signal generator and vary the frequency from 100Hz to 1MHz in regular steps.
- Note down the corresponding voltage and current readings and calculate impedance $Z = \frac{V_T}{I_T}$
- Plot the graph of Frequency Vs Impedance.
- Find Resonance Frequency, Quality Factor and Bandwidth from the graph obtained and compare with the theoretical values.

**Calculations:**

Take $R_L = 4.7K\Omega$, $R_C = 4.7K\Omega$, $L = 10mH$, $C = 0.1\mu F$

Resonance Frequency $f_0 = \frac{1}{2\pi\sqrt{LC}}$, if $R_L = R_C$

Quality factor of Series Resonance Circuit $Q_o = \frac{R}{W_o L} = W_o RC$

Bandwidth $B_W = \ldots$

**Observations:**

$V_m = 5V$

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Total Current $I_T$(mA)</th>
<th>$X_C$ (Ω)</th>
<th>$X_L$ (Ω)</th>
<th>$Z = \frac{V}{I_T}$ (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 KHz</td>
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<tr>
<td>2 KHz</td>
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<tr>
<td>3 KHz</td>
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<tr>
<td>4 KHz</td>
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<td>5 KHz</td>
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<td>7 KHz</td>
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<td>8 KHz</td>
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<td>9 KHz</td>
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<tr>
<td>10 KHz</td>
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</tbody>
</table>
Specimen Graph:

From the Graph,

Resonance Frequency \( f_0 = \)

Bandwidth \( BW = f_2 - f_1 = \)

Results:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Series Resonance</th>
<th>Parallel Resonance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonance Frequency</td>
<td>Theoretical</td>
<td></td>
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<tr>
<td></td>
<td>Observed</td>
<td></td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Theoretical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observed</td>
<td></td>
</tr>
<tr>
<td>Quality Factor</td>
<td>Theoretical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observed</td>
<td></td>
</tr>
</tbody>
</table>
**VOLTAGE SERIES FEEDBACK AMPLIFIER**

**Aim:** Design of a FET Voltage series feedback amplifier and determine the gain, frequency response, input and output impedances with and without feedback.

**Components required:**
- Power supply
- Multimeter
- CRO
- Function Generator
- AC mill voltimeters
- FET BW 10/11
- Resistors
- Capacitors

**Circuit Diagram:**

![Circuit Diagram](image)

**Design:**

\[ I_{DSS} = 10mA \]
\[ V_P = -3V \text{ (From Data Sheet)} \]

Given, Q condition is \( I_D = 2mA, V_{DS} = 5V = \frac{V_{DD}}{2} \)

\[ I_D = I_{DSS}\left[1-\left(\frac{V_{GS}}{V_P}\right)^2\right] \]
We Know that,
\[
\left[ \frac{I_D}{DSS} \right]^{1/2} = 1 - \frac{V_{GS}}{V_P}
\]
\[
1 - 0.44 = \frac{V_{GS}}{3}
\]

Rs:
\[
V_{GS} = -0.55 \times 3 = -1.65V
\]
\[
I_D R_S = |V_{GS}|
\]
Choose \( R_S = 1K\Omega \)

R_D:
\[
V_{DD} = V_{DS} + I_D (R_S + R_D)
\]
\[
5 = 2 \times 10^3 [1K + R_D]
\]
Choose \( R_D = 1.5K\Omega \)

R_G:
\[
I_{gs} = 1000nA \text{ (From Data Sheet)}
\]
Before conduction, minority carriers have to be drained out, for this \( R_G \) would be usually very large. Further input impedance of the amplifier would be equal to \( R_G \) itself.

Thus,
\[
I_{gs} R_G = V_{gs}
\]
\[
R_G = \frac{V_{gs}}{I_{gs}} = 1.65M\Omega
\]
Choose \( R_G = 2M\Omega \)

C_S:
Should act as a short circuit at lowest frequency of interest
\[
X_{C_S} = \frac{1}{100}R_S = 10\Omega \text{ 1t 500Hz (say)}
\]
\[
\therefore \ C_S = \frac{1}{2\pi f X_{C_S}} \Rightarrow C_S = 33\mu F
\]
Choose \( C_S = 33 \text{ or } 47\mu F \)

Theoretically gain \( A_V \) without feedback is calculated as
\[
A_V = -gm R_D
\]
For the above circuit,
\[
g_m \text{ is computed as bellow,}
\]
We have, \( I_D = I_{DSS}(1 - \frac{V_{GS}}{V_P})^2 \)

Differentiating with respect to \( V_{gs} \)

\[
\left| \frac{\partial I_D}{\partial V_{GS}} \right| = 2I_{DSS}(1 + \frac{V_{GS}}{V_P}) \left( \frac{1}{V_P} \right)
\]

\[
\frac{\partial I_D}{\partial V_{GS}} = g_m \quad \therefore \quad g_m = 2(10)(1 + \frac{1.65}{3})\left( \frac{1}{3} \right)
\]

\[ g_m = 10 \text{ mA/V} \]

\[
\therefore |A_V| = g_m \times R_D = 10 \times 1.5 = 15
\]

To Design feedback circuit \((R_1, R_2)\)

Let us Assume gain with feedback desired is 2

i.e. \( A_{Vf} = 2 \)

Then \( A_{Vf} = \frac{A_V}{1 + A_V \beta} \) where \( \beta = \frac{R_2}{R_1 + R_2} \)

(Practically we may not get \( A_V = 15; \)

It is better to measure \( A_V \) practically & design \( R_1 & R_2 \))

E.g: Say \( A_V = 4.8 \) (Practical Value)

\[
\therefore A_{Vf} = \frac{4.8}{1 + 4.8 \beta}
\]

\[
\frac{2}{4.8} = \frac{1}{1 + 4.8 \beta}
\]

\[ R_1 = 2.4 \ \Omega \]

Choose \( R_2 = 68K\Omega, R_1 = 165K\Omega \ (150K\Omega + 15K\Omega) \)

**Procedure:**

- Rig up the circuit as shown in the circuit diagram.
- Check Q conditions i.e., measure \( V_{DS} \) and \( V_{GS} \).
- Set \( V_i = 1V \) or \( 2V \) at 10 KHz on Audio signal Generator and measure gain \( A_V \) without feedback.
- Disconnect short of Green and Black terminal of signal generator to avoid grounding problem or isolate ground of signal generator.
- Measure \( V_O \) with feedback & find \( A_{Vf} \) the gain with feedback. Note \( A_{Vf} \) is less than \( A_V \)
- To plot freq response, note output voltage with and without feedback from 100Hz to 10MHz
Frequency response:

Here one can observe that effect of feedback is gain decreases but Bandwidth increases.

To measure input impedance and output impedance:

I) Input impedance (Zi):

Procedure:

- Connect the circuit as shown
- Set all knobs of DRB to 0Ω
- Apply input sinusoidal wave (20 to 40 mVp-p)
- Fix input frequency in mid freq range (say 15 KHz) and measure output voltage \( V_O \).
- Increase resistance on DRB, till \( V_O \) reduces to half the value this gives \( V_{O1} = \frac{V_O}{2} \). The DRB values now gives input impedance \( Z_i \) of amplifier.
II) **Output impedance (R\textsubscript{O}):**

**Procedure:**

- Connect the circuit as shown
- Set all knobs of DRB to maximum value.
- Apply input sinusoidal wave (20 to 40 mV)
- Fix input frequency 15 KHz and measure output voltage.
- Decrease resistance on DRB, till output voltage reduces to half the value of V\textsubscript{O}. Now \( V\textsubscript{O2} = \frac{V\textsubscript{O}}{2} \). The DRB values now gives output impedance Z\textsubscript{O} of amplifier.

![Circuit Diagram]

**Observation:**

Gain with feedback : ________
Gain without feedback : ________

<table>
<thead>
<tr>
<th>Frequency</th>
<th>V\textsubscript{O}</th>
<th>A\textsubscript{V}</th>
<th>A\textsubscript{VF}</th>
<th>Z\textsubscript{i}</th>
<th>Z\textsubscript{O}</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz</td>
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<tr>
<td>200 Hz</td>
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<tr>
<td>1 kHz</td>
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<td>2 KHz</td>
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</tr>
<tr>
<td>100 KHz</td>
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</tbody>
</table>
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:**

![Circuit Diagram](image)

**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 $I_1 = 5mA$

$R_1 = \frac{V_{CC} - V_{B1}}{I_1} = 1.36K\Omega$

$R_2 = \frac{V_{R2}}{I_1} = \frac{V_{B1} - V_{D1} - V_{D2}}{I_1} = 1.36K\Omega$

Choose $R_1 = R_2 = 1.5K\Omega$
Choose \( C_1 = C_2 = 1 \mu F \)

\[
P_i(\text{dc}) = V_{CC}I_{dc} \\

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

\text{Efficiency } \eta = \frac{P_o(\text{ac})}{P_i(\text{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:**

\( V_i = 5V \)

<table>
<thead>
<tr>
<th>Freq. in Hz</th>
<th>( V_o )</th>
<th>Gain = ( \frac{V_o}{V_i} )</th>
<th>Gain in dB = ( 20 \log \frac{V_o}{V_i} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Hz</td>
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<tr>
<td>100 Hz</td>
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<td>200 Hz</td>
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<tr>
<td>500 Hz</td>
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<td>1 KHz</td>
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<td>2 KHz</td>
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<td>10 KHz</td>
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<tr>
<td>1 MHz</td>
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<tr>
<td>2 MHz</td>
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</tbody>
</table>

**Result:**

\[
\text{Efficiency } \eta = 
\]
CRYSTAL OSCILLATOR

Aim: To design and test the performance of BJT - Crystal Oscillator for $f_0 > 100$ KHz.

Components Required:
- Crystal 2MHz
- Transistor SL100
- Resistors
- Capacitors

Circuit Diagram:

![Circuit Diagram]

Design:

Given $V_{cc} = 10V$, $\beta = 200$, $I_c = 2mA$

To find $R_E$:

$$V_{RE} = \frac{V_{cc}}{10} = \frac{10}{10} = 1V$$

$$I_E R_E = 1, I_E \approx I_C$$

$$R_E = \frac{V_{RE}}{I_C} = \frac{V_{RE}}{I_C} = \frac{1}{2 \times 10^{-3}} = 500\Omega$$

Choose $R_E = 470\Omega$

To find $R_C$:

Applying KVL
\[ V_{CC} - I_C R_C - V_{CE} - V_{RE} = 0 \quad [V_{CE} = \frac{V_{CC}}{2}] \]

\[ 10 - 2 \times 10^{-3} R_C - 5 - 1 = 0 \]

\[ 4 - 2 \times 10^{-3} R_C = 0 \]

\[ R_C = 2K\Omega \]

Choose \( R_C = 2.2K\Omega \)

From the biasing circuit

\[ V_B = V_{BE} + V_{RE} \]

\[ = 0.7 + 1 \]

\[ = 1.7V \]

To find \( I_B \):

\[ I_B = \frac{I_C}{I_b} = \frac{2 \times 10^{-3}}{200} = 0.01mA \]

Assume 10 \( I_B \) flows through \( R_1 \)

\[ R_1 = \frac{V_{CC} - V_B}{10 I_B} = \frac{10 - 1.7}{10 \times 0.01mA} = 83\Omega \]

Choose \( R_1 = 82K\Omega \)

Assume 9 \( I_B \) flows through \( R_2 \)

\[ R_2 = \frac{V_B}{9 I_B} = \frac{1.7}{9 \times 0.01mA} = 18\ K\Omega \]

Choose \( R_2 = 18K\Omega \)

Assume coupling capacitor \( C_{C1} \) and \( C_{C2} \) as 0.47\( \mu \)F

Procedue:

- Make the connections as shown in circuit diagram.
- Vary 1\( K\Omega \) potentiometer so as to get an undistorted sine wave at the output.
- Note down the frequency of the output wave and compare it with the theoretical frequency of oscillation.

Result:

Frequency: Theoretical: 2MHz Practical:
FET HARTLEY & COLPITTS OSCILLATOR

Aim: To design Hartley & Colpitts Oscillator for given frequency using FET.

Components Required:

- FET (BFW11)
- Resistors
- Capacitors
- CRO

Biasing Circuit:

$$V_{cc} = 10V$$

Design:

$$V_{DD} = 10V, \quad V_{DS} = \frac{V_{DD}}{2} = 5V$$

For FET, $$I_{DSS} = 11.5mA$$

$$V_P = -3V$$

$$V_{GS} = -1.7V$$

$$I_D = I_{DSS} \left[ 1 - \frac{V_{GS}}{V_P} \right]^2$$

$$I_D = 11.5 \times 10^{-3} \left[ 1 - \frac{1.7}{3} \right]^2$$

$$I_D = 2mA$$

Applying KVL to the outer loop
\[ V_{DD} = I_D (R_D + R_S) + V_{DS} \]

\[ R_D + R_S = \frac{V_{DD} - V_{DS}}{I_D} = \frac{10 - 5}{2m} = 2.1K\Omega \]

Let \( R_D = 1K\Omega \) & \( R_S = 1.5K\Omega \)

Use 1K pot in series with 1.5K\( \Omega \) for \( R_S \)

\[ \frac{V_{DD} R_2}{R_1 + R_2} = V_{GS} + V_{RS} \]

\[ \frac{R_2}{R_1 + R_2} = \frac{V_{GS} + I_D R_S}{V_{DD}} = \frac{-1.7 + (2 \times 10^{-3}) \times 1.5K}{10} \]

\[ \frac{R_2}{R_1 + R_2} = 0.13 \]

\[ R_2 = 0.13R_1 + 0.13R_2 \]

\[ 0.87R_2 = 0.13R_1 \]

\[ \frac{R_2}{R_1} = \frac{0.13}{0.87} = 0.149 \]

\[ R_1 = 1M\Omega \]

\[ R_2 = 0.149 \times 1M\Omega \approx 150K\Omega \] (Choose \( R_2 \) as 82K\( \Omega \))

**Hartley Oscillator:**

**Tank Circuit Design:**

\[ f_O = \frac{1}{2\pi \sqrt{LC}} \] Where \( L = L_1 + L_2 \)

\[ f_O = 100KHz \]

\[ L = \frac{1}{4\pi^2 f_O^2 C} \] let \( C = 330pF \)

\[ L = \frac{1}{4 \times (3.14)^2 \times (100 \times 10^{-2})^2 \times 330 \times 10^{-12}} \]

\[ L = 7.68mH \]

\[ L_1 = 5mH \]

\[ L_2 = 2.6mH \]
Circuit Diagram:

Colpitts Oscillator:

\[ f_0 = \frac{1}{2\pi \sqrt{LC_{eq}}} \]

\[ C = C_1 C_2 \frac{C_1 + C_2}{C_1 C_2} \]

\[ f_0 = 100 \text{ KHz} \]

\[ C = \frac{1000 \times 2200 \times 10^{-24}}{(1000 + 2200) \times 10^{-12}} \]

\[ C = 687.5 \text{ pF} \]

\[ L = \frac{1}{4\pi^2 f_0^2 C} = \frac{1}{4 \times (3.14)^2 \times (100 \times 10^3)^2 \times 687.5 \times 10^{-12}} \]

\[ L = 3.6 \text{ mH} \]
Circuit Diagram:

Procedure:

- Make the connections as shown in circuit diagram.
- Observe the sinusoidal output voltage.
- Measure the frequency and compare with the theoretical values.

Result:

**Hartley Oscillator:**

- Theoretical Frequency: 100KHz
- Practical Frequency: 
- Amplitude of the sine wave: 

**Colpitts Oscillator:**

- Theoretical Frequency: 100KHz
- Practical Frequency: 
- Amplitude of the sine wave: 

VDD = 10V

VDD = 10V

R1 1MΩ

RD 1K Ω

Cc1

0.1µF/0.47µF

RG 82KΩ

Cs 47µF

Cc2

0.1µF/0.47µF

G

S

D

1KΩ Pot

Rs 1.5KΩ

Vo

C1

C2

1000pF

2200pF

3.6mH

L

C
VIVA-VOCE QUESTIONS

[2] Name different types of semiconductors.
[3] What are intrinsic semiconductors and extrinsic semiconductors?
[4] How do you get P-type and N-type semiconductors?
[6] Name different types of Dopants.
[7] What do you understand by Donor and acceptor atoms?
[8] What is the other name for p-type and N-type semiconductors?
[9] What are majority carriers and minority carriers?
[10] What is the effect of temperature on semiconductors?
[12] What is depletion region or space charge region?
[13] What is junction potential or potential barrier in PN junction?
[14] What is a diode? Name different types of diodes and name its applications
[15] What is biasing? Name different types w.r.t. Diode biasing
[16] How does a diode behave in its forward and reverse biased conditions?
[17] What is static and dynamic resistance of diode?
[18] Why the current in the forward biased diode takes exponential path?
[19] What do you understand by Avalanche breakdown and zener breakdown?
[21] What is PIV of a diode
[22] What is knee voltage or cut-in voltage?
[23] What do you mean by transition capacitance or space charge capacitor?
[24] What do you mean by diffusion capacitance or storage capacitance?
[25] What is a transistor? Why is it called so?
[26] Name different types of transistors.
[27] Name different configurations in which the transistor is operated
[28] Mention the applications of transistor. Explain how transistor is used as switch
[29] What is transistor biasing? Why is it necessary?
[30] What are the three different regions in which the transistor works?
[31] Why transistor is called current controlled device?
[32] What is FET? Why it is called so?
[33] What are the parameters of FET?
[34] What are the characteristics of FET?
[35] Why FET is known as voltage controlled device?
[36] What are the differences between BJT and FET?
[37] Mention applications of FET. What is pinch off voltage.
[38] What is an amplifier? What is the need for an amplifier circuit?
[39] How do you classify amplifiers?
[40] What is faithful amplification? How do you achieve this?
[41] What is coupling? Name different types of coupling
[42] What is operating point or quiescent point?
[43] What do you mean by frequency response of an amplifier?
What are gain, Bandwidth, lower cutoff frequency and upper cutoff frequency?

What is the figure of merit of an amplifier circuit?

What are the advantages of RC coupled amplifier?

Why a 3db point is taken to calculate Bandwidth?

What is semi-log graph sheet? Why it is used to plot frequency response?

How do you test a diode, transistor, FET?

How do you identify the terminals of Diode, Transistor & FET?

Mention the type number of the devices used in your lab.

Describe the operation of NPN transistor. Define reverse saturation current.

Explain Doping w.r.t. Three regions of transistor

Explain the terms hie/hib, hoe/hob, hre/hrb, hre/hfb.

Explain thermal runaway. How it can be prevented.

Define FET parameters and write the relation between them.

What are Drain Characteristics and transfer characteristics?

Explain the construction and working of FET

What is feedback? Name different types.

What is the effect of negative feedback on the characteristics of an amplifier?

Why common collector amplifier is known as emitter follower circuit?

What is the application of emitter follower ckt?

What is cascading and cascoding? Why do you cascade the amplifier ckt.s?

How do you determine the value of capacitor?

Write down the diode current equation.

Write symbols of various passive and active components

How do you determine the value of resistor by color code method?

What is tolerance and power rating of resistor?

Name different types of resistors.

How do you classify resistors?

Name different types of capacitors.

What are clipping circuits? Classify them.

Mention the application of clipping circuits.

What are clamping circuits? Classify them

What is the other name of clamping circuits?

Mention the applications of clamping circuits.

What is Darlington emitter follower circuit?

Can we increase the number of transistors in Darlington emitter follower circuit?

Name different types of Emitter follower circuits.

What is an Oscillator? Classify them.

What are damped & Un-damped Oscillations?

What are Barkhausen's criteria?

What type of oscillator has got more frequency stability?

What is the disadvantage of Hartley & Colpit's Oscillator?

Why RC tank Circuit Oscillator is used for AF range?

Why LC tank Circuit Oscillator is used for RF range?

What type of feedback is used in Oscillator circuit?

In a Transistor type No. SL 100 and in Diode BY 127, what does SL and BY stands for?

Classify Amplifiers based on: operating point selection.
[88] What is the efficiency of Class B push pull amplifier?
[89] What is the drawback of Class B push pull Amplifier? How it is eliminated.
[90] What is the advantage of having complimentary symmetry push pull amplifier?
[91] What is Bootstrapping? What is the advantage of bootstrapping?
[92] State Thevenin's Theorem and Maximum power transfer theorem.
[93] What is the figure of merit of resonance circuit?
[94] What is the application of resonant circuit?
[96] What is the efficiency of half wave and full wave rectifier?
[97] What is the advantage of Bridge rectifier of Centre tapped type FWR.
[98] What is the different between Darlington emitter follower circuit & Voltage follower circuit using Op-Amp. Which is better.

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