

Aim: Characteristics graph for PN Junction in forward bias connection

Apparatus:-

- (i) Bread Board.
- (ii) P-N Junction diode (Si)
- (iii) Resistor ( $1\text{ k}\Omega$ )
- (iv) DC power source (5V)
- (v) Connecting wires.

Theory: The P-N Junction supports uni-directional current flow. If +ve terminal of the input supply is connected to anode (P-side) and -ve terminal of the input supply is connected to cathode (N-side) then diode is ~~said~~ said to be forward biased. In this condition the height of the potential barrier at the junction is lowered by an amount equal to given forward biasing voltage. Both the holes from p-side and electrons from n-side cross the junction simultaneously and constitute a forward current (injected minority current - due to holes crossing the junction and entering N-side of the diode, due to electrons crossing the junction and entering P-side of the diode). Assuming current flowing through the diode to be very large, the diode can be approximated as short-circuited switch.

Procedure:- ① Connect the circuit using silicon PN Junction diode.

② Vary  $V_f$  gradually in steps of 0.1 Volts upto 5 volts and note down the corresponding Reading of  $I_f$ .

③ Step size is not fixed because of non-linear curve and vary the x-axis variable & if it is more, decrease input step size and vice versa.

④ Tabulate different forward currents obtained for different forward voltages.

Result:- The I-V characteristic curve of a p-n junction diode is not a straight line, therefore, diode is ~~not~~ non-ohmic in nature.

Precautions:- ① While doing the experiment do not exceed the rating of the diode. This may lead to damage the diode.

② Connect voltmeter and Ammeter in correct polarities as shown in the circuit diagram.

③ Do not Switch "ON" the power supply unless you have checked the circuit connections as per the circuit diagram.





Aim:- Designing of a Half wave Rectifier.

Apparates:-

- (i) Connecting wires.
- (ii) Silicon Diode (p-n junction)
- (iii) Voltage Source.
- (iv) Load (Resistance).
- (v) Transformer.

Theory:- A half-wave rectifier is defined as a type of rectifier that only allows one-half-cycle of an AC voltage waveform to pass, blocking other half cycle.

Half-wave rectifiers are used to convert AC voltage to DC voltage, and only require a single diode to construct.

Working Formula:-

- $V_{rms} = V_m / 2$  (rms voltage value (input)).
- $V_{dc} = V_m / \pi$  (Average value of input).
- $V_m = \text{peak value of output}$
- Ripple factor ( $r$ ) =  $V_{p,rms} / V_{dc}$ , where  $V_{p,rms}$  is rms value of the AC component.
- $V_{p,rms}^2 = V_{p,rms}^2 + V_{dc}^2$ , ripple factor.
- $r = \sqrt{(V_{rms} / V_{dc})^2 - 1}$
- $= 1.21$

•  $I_{rms} = I_m / 2$ , where  $I_{rms}$  is the RMS value of the load current for a half-wave rectifier.



- Peak Inverse Voltage (PIV) :  $V_m$
- Percentage Regulation :  $\left( \frac{V_{no\ load} - V_{full\ load}}{V_{full\ load}} \right) * 100$ ,  
where  $V_{no\ load} = V_m / \pi$ ,  $V_{full\ load} = \frac{V_m}{\pi} - I_{dc} \cdot R_f$   
 $= I_{dc} \cdot R_L$

- Transformer Utilization Factor (TUF) .  
 $= P_{dc} / P_{ac\ rated}$

- Rectification Efficiency :  $\eta = \frac{\text{power in the load}}{\text{input power}}$   
 $= \frac{P_{dc}}{P_{ac}}$

$$P_{dc} = I_{dc}^2 R_L / \pi^2, P_{ac} = (I_m^2 / 4) * (R_L + R_f)$$

$$\therefore \eta = \frac{4}{\pi^2} \left( \frac{R_L}{R_L + R_f} \right)$$



Aim:- Designing of Full wave Rectifier.

Apparatus:

- (i) Connecting wires
- (ii) Diodes
- (iii) Power source
- (iv) Resistors

Theory: A full-wave rectifier is exactly the same as the half-wave but, allows unidirectional current through the load during the entire sinusoidal cycle. A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Its output waveform is displayed in the diagram.

There are two types of full-wave rectifier:-

- a) Centre-Tapped full wave Rectifier.
- b) Bridge Full wave Rectifier.

Working Formula:-

- $I_m = V_m / (R_f + R_L)$  ;  $R_L \gg R_f$  (for every case)
- $I_{de} = 2 I_m / \pi$
- $V_{de} = I_{de} \cdot R_L = \frac{2 I_m}{\pi} \times R_L = \frac{2 V_m}{\pi}$  [Substituting value of  $I_m$ ]
- $I_{rms} = \frac{I_m}{\sqrt{2}} = V_m / \sqrt{2} (R_f + R_L)$  [Substituting value of  $I_m$ ]



- $V_{rms} = V_m / \sqrt{2}$
- $\eta = \text{power in the load} / \text{input power} = P_{de} / P_{ac}$   
 $= \frac{8}{\pi^2} \left( 1 + \frac{R_F}{R_L} \right)$   
 $= 0.812 / (1 + R_F/R_L)$
- $\therefore \eta = 81.2 / (1 + R_F/R_L)$
- Ripple Factor ( $r$ ) = rms value of ac component / dc component in the output.  
 $= \sqrt{(I_{rms} / I_{dc})^2 - 1}$   
 $= \sqrt{(I_m / 2\sqrt{2} / (2I_m / \pi))^2 - 1} = 0.48$
- Peak Inverse Voltage (PIV) =  $2V_m$
- % Regulation =  $(V_{no load} - V_{full load} / V_{full load}) * 100$ ,  
 where,  $V_{no load} = 2V_m / \pi$        $V_{full load} = \frac{2V_m}{\pi} - I_{dc} \cdot R_F$
- TUF = dc power delivered to the load / ac rating of transformer.  
 $= P_{de} / P_{ac \text{ rated}}, \text{ where } .$   
 $P_{de} = I_{dc}^2 R_L$        $P_{ac \text{ rated}} = V_{ac(rms)} \cdot I_{rms}$   
 $= (V_m / \sqrt{2}) * (I_m / \sqrt{2})$   
 $\therefore TUF = \frac{\left( \frac{2V_m}{\pi} \right)^2 R_L}{\frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}}}$   
 $= 0.812 .$



Aim:- Design Positive and Negative clipper Circuit (Series & Parallel) and draw the graph for that.

Apparatus:

- (i) Connecting Wires
- (ii) Resistor.
- (iii) Diode.
- (iv) AC Voltage Source (for power).

Theory: A clipping circuit or a clipper is a device. used to clip the input voltage to prevent it from attaining a value larger than predefined value. The basic component required for a clipping circuit are - an ideal diode and a resistor.

Positive Diode clipper:-

In a positive clipper, the positive half cycles of the input voltage will be removed. The circuit arrangement are illustrated in the diagram.

Negative Diode clipper:- The negative clipping circuit is almost the same as the positive clipping circuit, with only one difference. If the diode is reconnected with reversed polarity, the circuit will become for a negative series clipper and is illustrated in the diagram.



In this experiment, both the positive clipper circuit and negative clipper circuit are illustrated in series and parallel circuit form.

Result: The result of all the circuits, either in series connection or parallel is illustrated in the diagram.

Precautions:-

- (i) Properly connect the devices to prevent an accidental loss.
- (ii) Do not keep the power on when building the circuit.

Aim: Design Positive and Negative clamper circuit (both ideal and practical case).

Apparatus:

- (i) Capacitor.
- (ii) Diode
- (iii) DC battery (power supply) (if needed).
- (iv) AC power supply.
- (v) Resistor.

Theory: A Clamper circuit can be defined as the circuit that consists of a diode, a resistor and a capacitor that shifts the waveform to a defined DC level without changing the actual appearance of the applied signal.  
It is also called level shifter.

Positive Clamper: A clamping circuit restores the DC level. When a negative peak of the signal is raised above to the zero level, then the signal is said to be positively clamped.

It consists of a diode, a resistor and a capacitor and that shifts the output signal to be positively clamped.

It consists of a diode, a resistor and ~~and~~ a capacitor and that shifts the output signal to the positive portion of the input signal.



A Negative clamper:- A Negative clamper is one that consists of a diode, a resistor and a capacitor and that shifts the output signal to the negative portion of the input signal.

Result: During Positive Half cycle.

During the interval of  $0 - T/2$ , the network will appear with the diode in the ON state effectively "shorting out" the effect of the resistor  $R$ .

During Negative Half cycle:-

The diode will now be in the open state condition. Applying KVL around the input loop to get the result.



Aim: Design Half Wave Capacitor Filter.

Apparatus:

- (i) AC Voltage supply.
- (ii) Diode.
- (iii) Capacitor.
- (iv) Resistor.
- (v) Connecting wires.

Theory: The main function of half wave rectifier is to change the AC (Alternating Current) into DC. However, the acquired output DC. This DC is not constant and varies with time. Whenever this changing DC is given to any type of electronics device, then it may not function correctly, and that may get damaged. Due to this reason, it will be applicable in most of the applications.

Precautions: (i) The primary and secondary side of the transformer should be carefully identified.

(ii) Polarities of all diodes should be carefully identified.

(iii) All connections should be proper and clean.



Expt No - 07

Aim:- Implementation of Series & Shunt Regulator.

Apparatus:

- (i) Connecting wires.
- (ii) DC voltage supply
- (iii) Resistors.
- (iv) Zener Diode.
- (v) Transistor.

Theory:- Regulator is a circuit used to produce a constant dc output voltage by reducing the ripple to negligible amount. One part of power supply.

Fundamentally there are two basic types of linear regulator are the series regulator and shunt regulator.

Series Regulator circuit:-

- Control element in series with load between input and output.
- Output sample circuit senses a change in output voltage.

### Shunt Regulator circuit :-

- The unregulated input voltage provides current to the load.
- Some of the current is pulled away by the control element.

### Precautions:-

- All the connections should be proper, neat and clean.
- Polarity of devices should be checked.
- Power should be turned off while construction of circuit is in progress.



Aim: To find the bias point of a Si BJT with  $\beta = 200$

Apparatus:

- (i) Resistor.
- (ii) Capacitor.
- (iii) Transistor
- (iv) Analog voltage source.
- (v) Connecting wires.
- (vi) Multisim softwares.
- (vii) Windows and labs.

Theory: Q point or the operating point of a device also known as a bias point or a quiescent point is the steady state DC voltage or current at a specified terminal of an active device such as diode or transistor, with no input signal applied.

Result: The bias point of a Si Pjt with  $\beta = 200$  is

$$Q \text{ Point} = (V_{CE}, I_C)$$

$$Q \text{ Point} = (4.75V, 3.81mA)$$

Conclusion: The bias point or Q point of a Si BJT has been when  $\beta = 200$  and Q Point has been studied.

Precaution-

- All connection must be made tight.
- Wires must be cleaned with sand paper before making connections.