Basic Electronics

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Q1-Part-B:-

The third approximation does the technician normally use when performing initial troubleshooting procedures because technicians usually satisfies the following equation;=

Ignore bulk: $RB < 0.0lRm$

This says to ignore the bulk resistance when it is less than 1/100 of the Thevenin resistance facing the diode. When this condition is satisfied, the error is less than 1-percent.

Part-C:-

The reasons for using a Thevenin circuit are:

a. the voltage across the load terminals when the load resistor is open is called Thevenin Voltage V_{TH}. Because of this, the Thevenin voltage is sometimes called the *open-circuit voltage.* As a defi nition:

Thevenin voltage: $V_{TH} = V_{OC}$

b. the resistance that an ohmmeter measures across the load terminals when all sources are reduced to zero and the load resistor is open. As a definition:

Thevenin resistance: $R_{TH} = R_{OC}$

The reasons for using a Norton circuit are:

a. the load current when the load resistor is shorted is called Norton current. Because of this, the **Norton current** is sometimes called *short- circuit c urrent.* As a defi nition:
   Norton current: $I_N = I_{SC}$
b. the resistance that an ohmmeter measures across the load terminals when all sources are reduced to zero and the load resistor is open is called Norton resistance. As a defi nition:
   Norton resistance: $R_N = R_{OC}$

Q2:

(a) : we discuss the effect of transformer turn ratio on the output voltage of full-wave rectifier.

- in one turn ratio the rectified peak voltage equal to the half value of input voltage at the primary side minus the voltage across a potential barrier.
- Due to double voltage at secondary side, half value of voltage will appear across the half part of the secondary winding and equal to the Vpri.
- To minimize the voltage drop across the potential barrier and to make an output voltage peak equal to the input voltage peak we used transformer having turn ratio 2.
- If the number of turns in primary windings and secondary windings is equal then the turn of ratio of a transformer will be one.

(b) : **center tapped rectifier:**

- Center tapped rectifier as the name suggest is requires a center tapped transformer (secondary winding).

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- The peak inverse voltage (PIV) of diode in center tapped full wave rectifier is twice the transformer secondary terminal voltage.
- Center tapped rectifier uses only two diodes in its circuit.
- Voltage drop across the two diodes of center tapped rectifier is less when compared to bridge rectifier.

Bridge rectifier:

- No center tapped transformer is required in bridged rectifier.
- Peak inverse voltage PIV of diode is equal to the transformer secondary voltage. Thus this type of rectifier can be used for high voltage application.
- Bridge rectifier uses four diodes in its circuit.
- The voltage drop across the 4 diodes of bridge rectifier is more than the voltage drop across center tapped rectifier.

(c): Advantages of RC filter;

An Rc filter allows the peak value of the rectified signal to pass through the load resister. The resister R is much greater than the Xc at the ripple frequency. Therefore the ripple is reduced before it reach to the load. Typically R is 10 times larger than Xc. Therefore at each section attenuates the ripple by a factor of 10.

Disadvantages of RC filter;

The disadvantage of anRC filter the loss of de voltage acroSs each *R.* Because ·of this, the *RC* filter is suitable only for very light loads (small load current or large load resistance).

Advantages of LC filter:

- The choke input (LC) filter has a high output D.C voltage.
- It has no loading effect on the rectifier and power transformer.
- The diode does not have to carry surge currents.
- It has a very low ripple factor as compared to series inductor filter and shunt capacitor filter.
- It has very good load regulation.

Disadvantages of LC filter:

- It cannot be used together with half wave rectifier.
- Due to inductor it produces the audible noise.
- It is not useful for very low load currents.
- There is a loss of power in the series inductor due to its DC resistance.
- It has low output D.C. voltage than that of π type filter.

Q3:

(a): The extremely small current **exist** in reverse biased diode because current is caused by the minority carriers in the n and p regions that are produced by thermally generated electrons-hole pairs. The small number of free minority electrons in the p region are “pushed” toward the pn junction by the negative bias voltage.

When these electrons reach the wide depletion region, they “fall down the energy hill” and combined with the minority holes in the n region as valance electrons and flow towards the positive bias voltage, creating a small hole current.

(B) Light emitting diodes produce light by the movement of electrons between the two terminals of diode, which occur by a process called electroluminescence. When a light emitting diode is electrically connected, electrons start moving at the junction of the N-type and P-type

semiconductors within the diode. When there is a jump over of electrons at the p-n junction, the electron loses a portion of its energy. In regular diodes this energy loss is in the form of heat. However, in LEDs the specific type of N and P conductors produce photons (light) instead of heat. The amount of energy lost defines the color of light produced

(c)

Step-by-step solution:

Step 1 of 5

In a pure silicon crystal, the thermal energy creates an equal number of free electrons and holes. The free electrons move randomly throughout the crystal. Occasionally, a free- electron will approach a hole, feel its attraction and fall into it. This is known as recombination. Because of this recombination energy is released.

The Following is the Figure showing the recombination of a free electron and a hole:

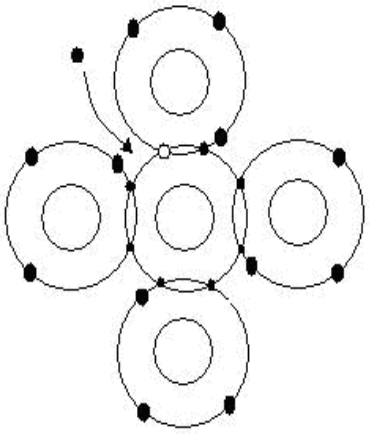

Figure 1: Recombination of free electron and hole.

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D) In the solid-state physics of semiconductors, carrier generation and carrier recombination are processes by which mobile charge carriers (electrons and electron holes) are created and eliminated. Carrier generation and recombination processes are fundamental to the operation of many optoelectronic semiconductor devices, such as photodiodes, light-emitting diodes and laser diodes. They are also critical to a full analysis of p-n junction devices such as bipolar junction transistors and p-n junction diodes.

E) Surface-leakage Current

Besides the thermally produced minority-carrier current, does any other current -

exist in a reverse-biased diode? Yes. A small current flows on the surface of the

crystal. Known as the surface .. Jeakage current, it is caused by Surface impurities

and imperfections in the crystal structure.