ID :14269

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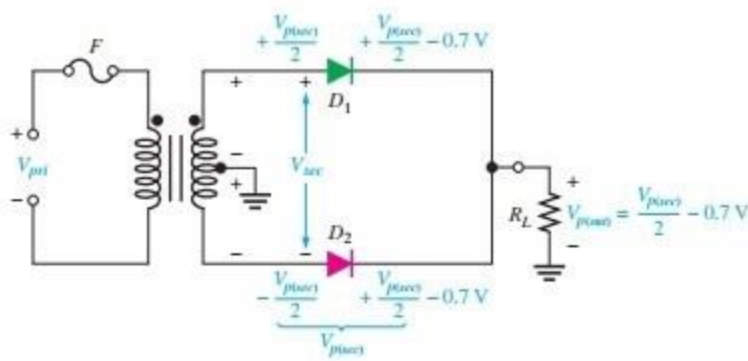
DEP:BS(SE)

Note: Attempt all Questions

Q1:

a. Explain how the transformer turns ratio affects the rectified output voltage of full wave rectifier?
The output voltage of a center-tapped full-wave rectifier is always one-half of the total secondary voltage less the diode drop, no matter what the turns ratio.

$$V_{out} = \frac{V_{sec}}{2} - 0.7\ \text{V}$$

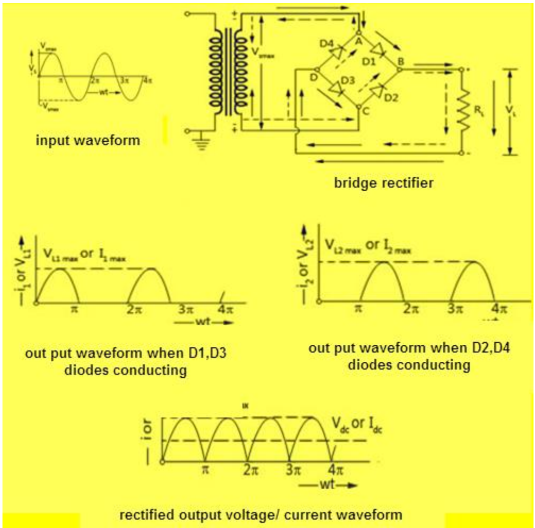


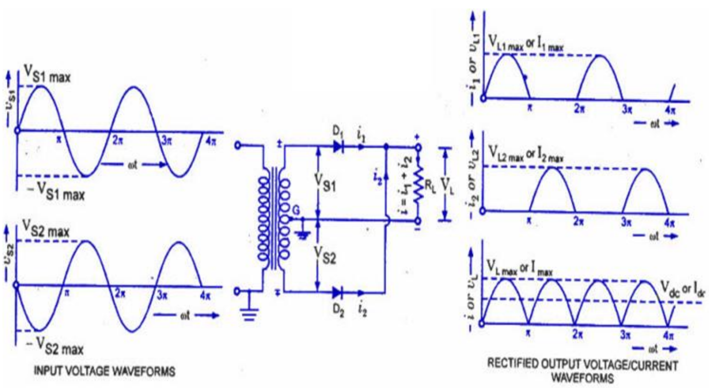
Each diode in the full-wave rectifier is continuously changing from forward-biased and then reverse-biased. The maximum reverse voltage that a diode can handle is the peak secondary voltage Vp(sec). The peak inverse voltage across either diode in a full-wave center tapped rectifier is:

$$\text{PIV} = 2V_{p(out)} + 0.7\ \text{V}$$

b. Compare the center-tapped rectifier and the bridge rectifier?

The crucial thing which differentiates Centre Tapped and Bridge Rectifier is the design architecture. Centre tapped Rectifier consists of two diodes which are connected to the center tapped secondary winding of the transformer as well as with the load resistor. Bridge rectifier comprises of 4 diodes which are connected in the form of Wheat stone bridge and thus provide full wave rectification.





The advantage of using Bridge rectifier is that no centre tapping is required. Thus, we can eliminate the transformer from the circuit, if the step-down voltage is not required. Although, Bridge rectifier also possesses some drawbacks, among which one of the drawbacks is the voltage drop across four diodes.

Bridge Rectifier needs four diodes which makes the circuit complex, as well as the voltage drop in this scenario, will be two times more than the voltage drop in Centre-Tap Rectifier. This is because Centre-Tap rectifier includes only two diodes in its circuit.

PARAMETERS	CENTRE TAPPED RECTIFIER	BRIDGE RECTIFIER
Definition	A full wave rectifier which uses two diode.	A full wave rectifier which uses four diodes connected together in the architecture resembling wheatstone bridge.
Peak Inverse Voltage	2 Vs max	Vs max
Transformer Utilization Factor	0.692	0.812
Voltage Regulation	Better	Good
Peak Load Current	Vs max/ (RL + RF) where RL (Load resistance) & RF (diode forward resistance)	Vs max/(RL + 2RF)
Transformer Requirement	Mandatory for Centre Tapping	Discretionary or not essential
Voltage Drop across diode	Low	High due to presence of four diode
Number of diodes	2	4

PARAMETERS	CENTRE TAPPED RECTIFIER	BRIDGE RECTIFIER
Circuit Complexity	less	More

c. List the advantages and disadvantages of the RC filter and LC filter?

RC filters	LC filters
The RC filter is only useful for small load currents.	The LC filters are useful for heavy load currents.
More power dissipated in RC filter.	Less power dissipated in LC filter.
It has poor voltage regulation.	It has good voltage regulation.
It is cheaper.	It is costlier.
It also requires ventilation to conduct away the heat produced in the resistor.	It does not require any ventilation because the heat is not produced in the inductor.
It has high ripple factor.	It has low ripple factor.
RC is fine for filtering low power signals.	LC is fine for filtering high power signals.

Q2:

a. What would be an advantage of a 50 Ω voltage source compared to a 600 Ω voltage source?

For the 50 Ohm voltage source, maximum power transfer will occur when the load has a appears as a resistance of 50 Ohms. Similarly, 600 Ohms is required for max power transfer into an impedance that presents itself as 600 Ohms. You need to maintain the integrity of the impedance at all points if you are to avoid reflections down the line and damaging the output PA.

So, if you had an antenna rated at 50 Ohms connected to a 50 Ohm feed then all things being equal min SWR etc you be better with 50 Ohms source. Some configurations of antenna may be "seen" as presenting an impedance of say 580 Ohms in which case the 600 ohm may be the closest and best alternative. However, the loads need not be in radio engineering.

If they both have the same EMF then the 50 Ohm Voltage source is capable of supplying up to 12 times as much power as the 600 Ohm Voltage source.

Maximum power transfer from any Voltage source occurs when the load impedance is selected such that it is equal to the internal resistance of the Voltage source. Assuming both Voltage sources have the same EMF then;

Maximum available power to the load from the 600 Ohm Voltage source = [(EMF/2)^2]/(600 Ohm)

Maximum available power to the load from the 50 Ohm Voltage source = [(EMF/2)^2]/(50 Ohm)

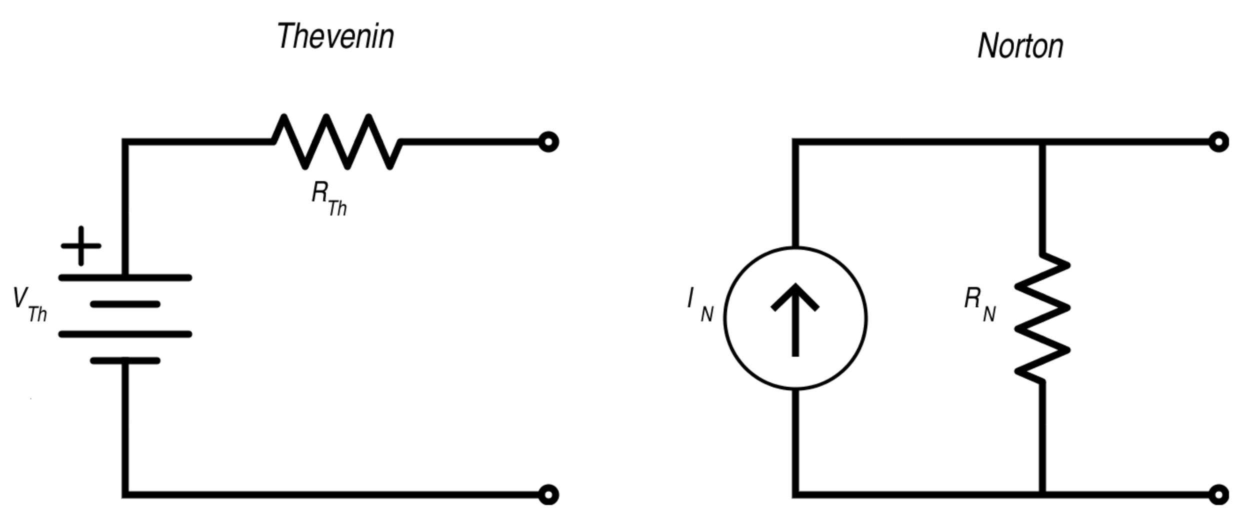
(Power of 50 Ohm Voltage source)/(power of 600 Ohm Voltage source) = [(1)/(50)] / [(1/(600)] = 600/50 = 12.

b. Which approximation does the technician normally use when performing initial troubleshooting procedures? Why?
The third approximation is rarely used by technicians because circuit designers usually satisfy. The equivalent circuit for the third approximation is a switch in series With a bainer potential of OJ V and a resistance of R8 When the diode voltage is larger than 0.7 V, the diode conducts. During conduction, the total voltage across the diode is:

Vd=0.7v+IdRb

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

c. What are some of the reasons for using a Thevenin or Norton circuit?
Thevenin's theorem states that any circuit composed of linear elements can be simplified to a single voltage source and a single series resistance (or series impedance for AC analysis). Norton's theorem is the same except that the voltage source and series resistance are replaced by a current source and parallel resistance. The reason for Thevenin's theorem is that the voltage-plus-series-resistance model is more intuitive and more applicable to real-life circuit design. Furthermore, it is easy to convert a Thevenin equivalent to a Norton equivalent and vice versa



The biggest reason for doing this is that circuits are easier to deal with when they are divided into digestible portions. No one would ever dream of designing a microprocessor by starting with a billion transistors and wiring them together one by one; likewise, even a relatively simple mixed-signal design is best analyzed as a collection of interconnected blocks.

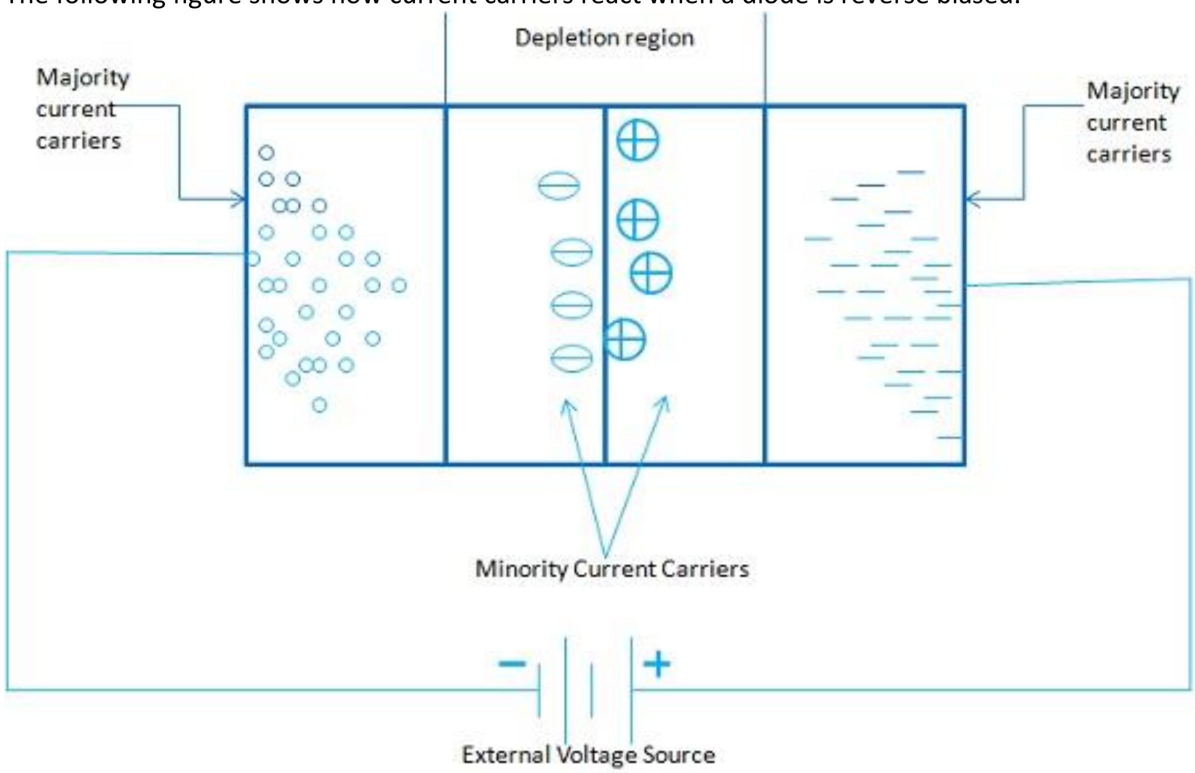
Q3:

a. Tell me why a very small current exists in a reverse-biased diode?

   An important conduction limitation of PN junction diode is leakage current. When a diode is reverse biased, the width of the depletion region increases. Generally, this condition is required to restrict the current carrier accumulation near the junction. Majority current carriers are primarily negated in the depletion region and hence the depletion region acts as an insulator. Normally, current carriers do not pass through an insulator.

   It is seen that in a reverse-biased diode, some current flows through the depletion region. This current is called leakage current. Leakage current is dependent on minority current carriers. As we know that the minority carriers are electrons in the P type material and holes in the N type material.

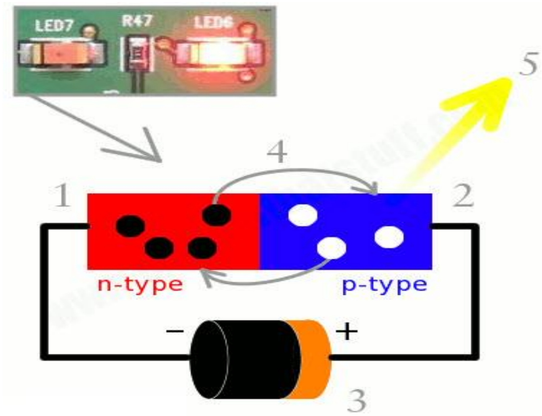
   The following figure shows how current carriers react when a diode is reverse biased.



   Minority carriers of each material are pushed through the depletion zone to the junction. This action causes a very small leakage current to occur. Generally, leakage current is so small that it can be considered as negligible.

b. I want to know why a light emitting diode produces light. Tell me about it.

The light emitting diode simply, we know as a diode. When the diode is forward biased, then the electrons & holes are moving fast across the junction and they are combining constantly, removing one another out. Soon after the electrons are moving from the n-type to the p-type silicon, it combines with the holes, then it disappears. Hence it makes the complete atom & more stable and it gives the little burst of energy in the form of a tiny packet or photon of light.



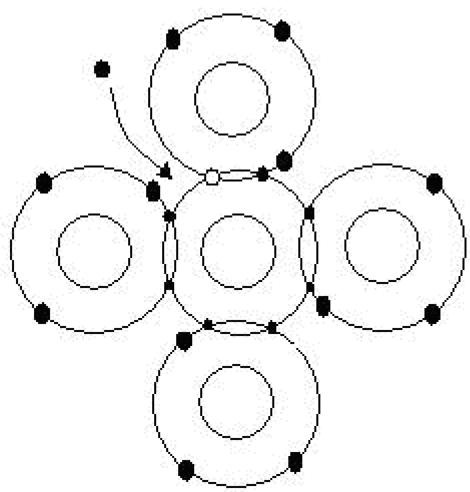
c. Do holes flow in a conductor? Why or why not? What happens to holes when they reach the end of a semiconductor?

Holes does not flow in a conductor. Semiconductors are characterized by two types of mobile carriers, electrons in the conduction band and holes in the valence band. Both bands are separated by the energy gap. This energy gap is about 1.1 eV in silicon. There is a continuous transition of electrons between the two bands. When an electron falls from the conduction band into the valence band, into a hole, a recombination process occurs and an electron hole pair disappears.

d. Why is recombination important in a diode?

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.

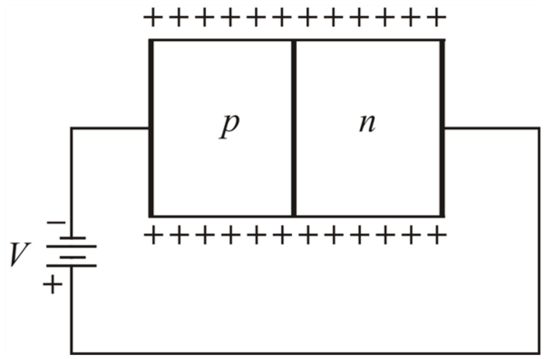
The Following is the Figure showing the recombination of a free electron and a hole:



e. What is surface leakage current?

surface leakage current:

There is some current which flows on the surface of the crystal because of surface imperfection and impurities in the crystal structure. This current is known as surface- leakage current. It actually flows when the diode is in reverse bias. What actually happen is, the atoms that are on the top and bottom surface of the crystal does not have any neighbors, they have six valence electrons in the valence orbit implying two holes in each surface atom. Visualize these holes along the surface of the crystal shown in Figure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