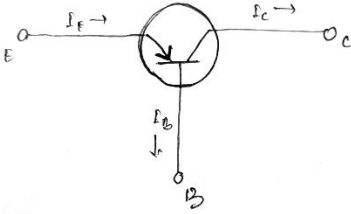
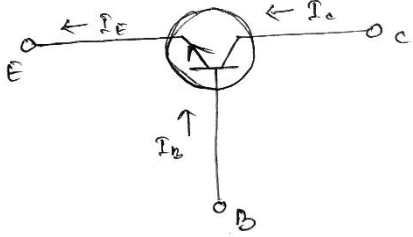


**APPLIED PHYSICS-II (2ND SEMESTER DIPLOMA ENGG STUDENTS
FROM SUMMER 2025 ONWARDS**

Unit-6 (Semiconductor Physics)

2 MARKS QUESTIONS & SOLUTIONS

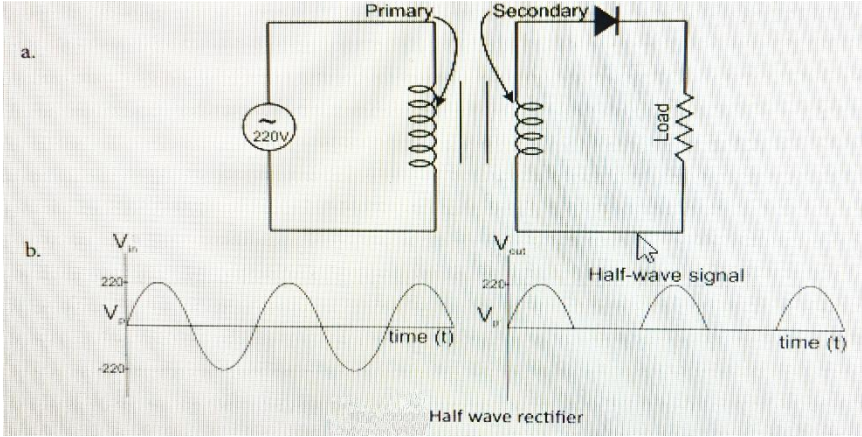
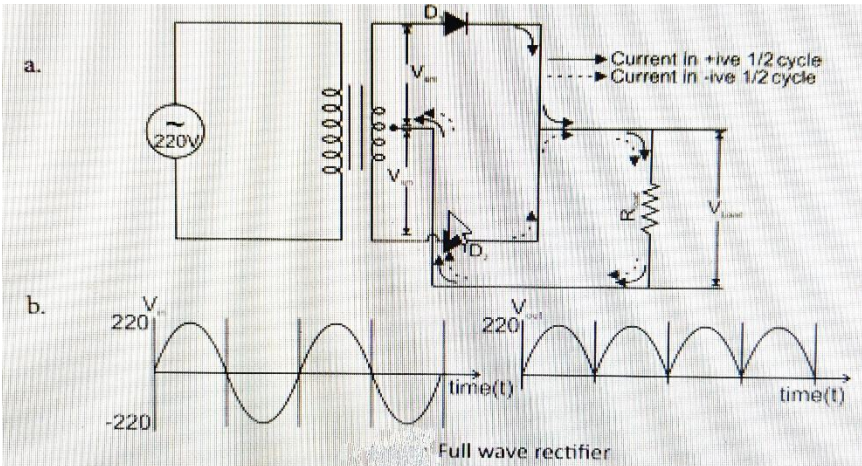
Q. No.	Question	Taxonomy Level	Marking Scheme
Q1.	Define Intrinsic Semiconductor.	L1	
Ans.	An intrinsic Semiconductor is a pure Semiconductor that is free of impurities.		2
Q2.	Define Extrinsic Semiconductor.	L1	
Ans.	Extrinsic Semiconductors are semiconductors that are doped with specific impurities.		2
Q3.	Define Doping	L2	
Ans.	The process of adding an impurity element in a pure semiconductor element is known as "Doping"		2
Q4.	Write down the types of Extrinsic Semiconductors.	L1	
Ans.	<ul style="list-style-type: none"> • p-type Semiconductor • n-type Semiconductor 		1 1
Q5.	Write down the types of materials based on conductivity.	L1	
Ans.	Based on conductivity, solids can be classified in three categories namely: <ul style="list-style-type: none"> • Conductor • Semiconductor • Insulator 		2
Q6.	Write two electronic applications of Transistor.	L1	
Ans.	Some of the electronic applications of transistor are: <ul style="list-style-type: none"> • Voltage Amplifier • Current Amplifier • As a Switch • For designing different types of logic gate circuits. • As basic building block of Operational Amplifier. 		1 1
Q7.	Write two applications of Solar cells in daily life.	L1	
Ans.	Series and parallel Combination of Solar cells are used for practical purposes and are known as Solar panels. Solar panels has numbers of engineering applications: <ul style="list-style-type: none"> • Power Generation • Water filtration plant • Solar Chargers 		1 1
Q8.	Write the names of any three Semiconducting materials.	L1	
Ans.	Silicon (Si), Germanium (Ge), Gallium Arsenide (GaAs)		2
Q9.	Give three examples of Tri-valent impurities.	L1	
Ans.	Aluminum (Al), Boron (B), Indium (In)		2
Q10.	Give three examples of Penta-valent impurities.	L1	

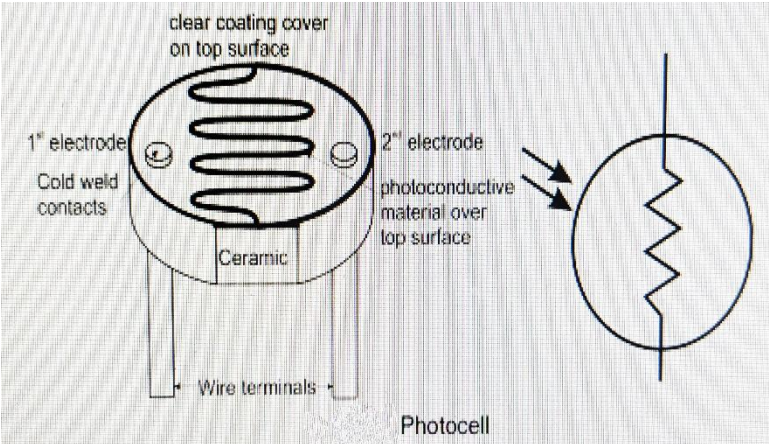
Ans.	Phosphorus (P), Arsenic (As), Antimony (Sb)		2
Q11.	Write down the types of transistors with symbol.	L2	
Ans.	<ul style="list-style-type: none"> • npn Transistor  <ul style="list-style-type: none"> • pnp Transistor 		1 1
Q12.	Define p-type Semiconductor.	L2	
Ans.	When a trivalent element is added as impurity in pure semiconductors, then the Semiconductor is known as p-type Semiconductor.		2
Q13.	Define n-type Semiconductor.	L2	
Ans.	When a pentavalent element is added as impurity in pure semiconductors, then the Semiconductor is known as n-type Semiconductor.		2
Q14.	Define Knee Voltage. Write the value of Knee Voltage for Si and Ge diode.	L2	
Ans.	Knee voltage is defined as the minimum voltage at which the diode begins to conduct and current flows through the diode in a forward biased state. The knee voltage of Si & Ge diode are 0.7 V and 0.3 V respectively.		1 1
Q15.	Write down the band gap of Si & Ge Semiconductors.	L1	
Ans.	The band gap of Si and Ge Semiconductors are 1.1 eV and 0.7 eV respectively.		1 1

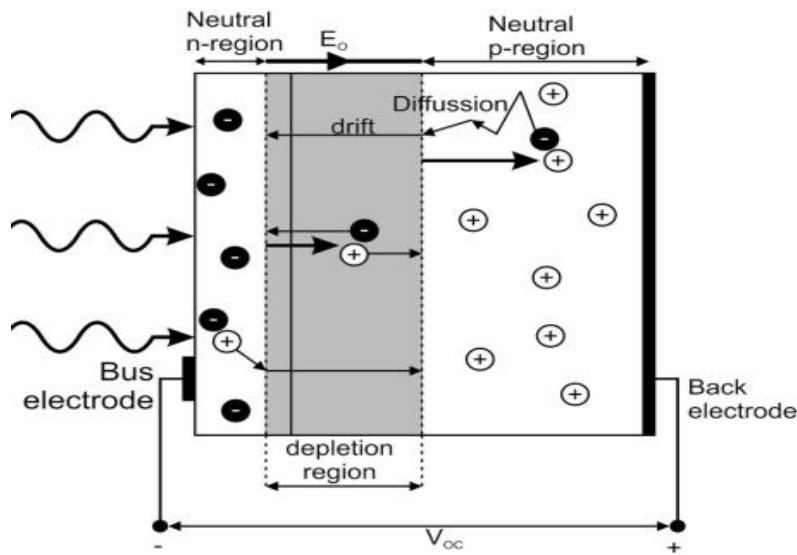
Unit-VI (5 MARKS QUESTIONS & SOLUTIONS)

Sl. No.	Question	Taxonomy Level	Marking Scheme
Q1.	Differentiate between p-type and n-type extrinsic Semiconductor	L4	
Ans.	p-type Semiconductor		1
	When a trivalent element is added as impurity in pure semiconductors, then the Semiconductor is known as p-type Semiconductor		1
	The elements of group III such as Aluminum, boron and indium are added as impurity for p type semiconductors		1
	In p-type Semiconductors, holes are majority charge carriers.		1
	Here electrons are minority charge carriers.		1
	Examples: <ul style="list-style-type: none"> • Si doped with P or As • Ge doped with P or As 		1
n-type Semiconductor			
When a pentavalent element is added as impurity in pure semiconductors, then the Semiconductor is known as n-type Semiconductor.			
The elements of group V such as phosphorous, Arsenic and Antimony are added as impurity for n type semiconductors.			
In n-type Semiconductors, electrons are majority charge carriers.			
Here holes are minority charge carriers.			
Examples: <ul style="list-style-type: none"> • Boron-doped Si • Alumium-doped Si 			
Q2.	Distinguish between Conductor, Semiconductor & Insulator (as per energy bands)	L4	

<p>Ans.</p>	<p>Conductors: -</p> <ul style="list-style-type: none"> (a) In metals the valence band and the conduction band overlaps. (b) The electron available in the valence band requires very less energy to transit from valence band to conduction band. In conductors large number of electrons are available in conduction band. (c) The conductivity in conductors decreases with increase in temperature as it increases the electron collisions. <p>Semiconductors: -</p> <ul style="list-style-type: none"> (a) In semiconductors there is a small energy gap between the valence band and the conduction band and it is of the order of 1eV. (b) The electron available in the valence band transits to the conduction band through thermal agitations. The numbers of electrons in the conduction band in semiconductors are less in comparison to conductors; hence the conductivity of semiconductors is less. (c) The conductivity in semiconductors increases with increase in temperature as it increases the number of electrons in the conduction band. <p>Insulators: -</p> <ul style="list-style-type: none"> (a) In insulators there is a large energy gap between the valence band and the conduction band of the order of 6eV. (b) No electrons are available in the conduction band and it requires a large amount of energy for the valence band electrons to transit in the conduction band. Hence the conductivity of the insulator is almost zero. <div data-bbox="316 1019 1161 1276" data-label="Figure"> </div> <p style="text-align: center;">(FIG-1)</p>	<p>[4]</p>	<p>[1]</p>
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3.	Draw Circuit Diagram of Half Wave Rectifier and explain it's working with input and output wave form.	L2	
Ans.	<p>In a Half wave rectifier, a step down transformer is used to scale down the AC voltage (say from 220 V to 12V), this AC signal is given to a circuit where a diode is connected in series with resistance (R). The diode will be in forward bias for one half cycle and in reverse bias in another half cycle. The voltage across the diode in forward bias is low (equal to knee voltage), then the total voltage will appear on Resistance R as per Kirchoff 's law. In reverse bias no current or very less current will flow, hence the voltage across resistance R is very low and all the voltage will appear on diode. Fig 2 (a) Shows the circuit of the Half wave rectifier. The input and output waveform is also displayed in Fig 2 (b). The voltage appearing on the R is variable DC voltage and further given to filter circuits to convert variable DC into constant DC.</p>  <p style="text-align: center;">(FIG-2)</p>		1 3 1
Q4.	Draw Circuit Diagram of Full Wave Rectifier (Centre Taped) and explain it's working with input and output wave form.	L2	
Ans.	<p>In a Half wave rectifier, only one-half cycle is used to convert AC signal to DC signal. If we use a center tapped step down transformer and two diodes then a full wave of AC can be rectified. In a full wave rectifier, the AC signal is given to a circuit with two diodes and one load resistance (R). In the first Half cycle, the first diode is in forward bias and the second diode is in reverse bias. The situation will be reversed In next half cycle. The voltage will appear across resistance R in both half cycles. Fig 3 (a) Shows the circuit of full wave rectifiers. The input and out waveform is also displayed in Fig 3 (b). The voltage appearing on the R is variable DC voltage and further given to filter circuits to convert variable DC into constant DC.</p>  <p style="text-align: center;">(FIG-3)</p>		1 3 1

<p>Q5.</p> <p>Ans.</p>	<p>Explain Working principle of Photoconductive Cell.</p> <p>Photoconductive materials are semiconductors whose conductivity increases in the presence of photons. The electron in the valence band absorbs photons and jump to the conduction band. As a result the number of electrons in the conduction band increases in the presence of photons or light. GaAs is an example of photoconductive materials.</p>  <p>(FIG-4)</p> <p>The diagram shows a cross-section of a photoconductive cell. It consists of a ceramic substrate with a thin layer of photoconductive material deposited on top. Two metal electrodes, labeled '1st electrode' and '2nd electrode', are connected to the photoconductive layer via 'Cold weld contacts'. A 'clear coating cover' is applied to the top surface. 'Wire terminals' are attached to the electrodes. To the right, a circuit symbol for a photoconductive cell is shown, represented by a circle with a zigzag line inside, indicating variable resistance.</p> <p>A photoconductive cell is a two terminal semiconductor device, the resistance between terminals varies with the intensity of light. The fig 4 shows the construction of a photocell. Photoconductive materials used in photocell are CdS and CdSe. The photocell does not have a junction like other junction devices such as photodiodes. A thin layer of the photoconductive material is deposited on a ceramic substrate. Two metal terminal are connected at the ends of thin layer to connect photoconductive cell in circuit. The resistance of a thin layer of material, typically is of the order of 100 kOhm and reduced to 100 Ohms when illuminated with light. It can be used for number of applications as follows:</p> <ul style="list-style-type: none"> • Automatic Headlight Dimmer • Night Light Control • Street Light Control 	<p>L2</p>	<p>[4+1]</p>
<p>Q6.</p> <p>Ans.</p>	<p>Explain working principle of Solar Cell with diagram.</p> <p>A solar cell is also a junction device, which is used to convert light energy into electrical energy. The schematic of the solar cell is given in Fig-5. The n region of the solar cell is thin as compared to the p region unlike normal p-n junction diodes. This junction is kept in light in a way that the n region is exposed to light. The valence band electron absorbs photons and moves into the conduction band. Due to this a large number of free electrons and holes are available in n region. As the n layer is very thin, the depletion layer electric field separates the holes and electrons and forces electrons to remain in the n region and diffuse the holes in the p region . A positive potential is developed at p and negative potential is developed at n terminal and current will flow when an external resistance is added between p and n terminal. The voltage developed across terminals without load is known as open circuit voltage (V_{oc}) is of the order of 0.5 V and the maximum load current also known as short circuit current (I_{sc}) is of the order of few mA, which increases as the intensity of light increases and absorption of photons in solar cell increases. The direction of current inside solar cell is from n to p, hence the V-I characteristics is drawn in IV quadrant.</p>	<p>L2</p>	<p>[4+1]</p>



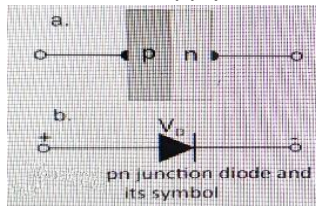
(FIG-5)

Q7. Explain the working of p-n junction diode and draw it's V-I characteristic.

L2

Ans. If we add two metallic terminals at two open ends of p-n junction through ohmic contact (no resistance between metallic wire and semiconductor), than this two terminal device, used in circuits is known as p-n junction diode. It is represented by symbol given in Fig.6 (b). When supply is not connected across the diode, no current flows through it. External biasing or supply is required to flow the current through the diode. There are two ways in which external DC supply can be connected to diode.

[3+2]



(FIG-6)

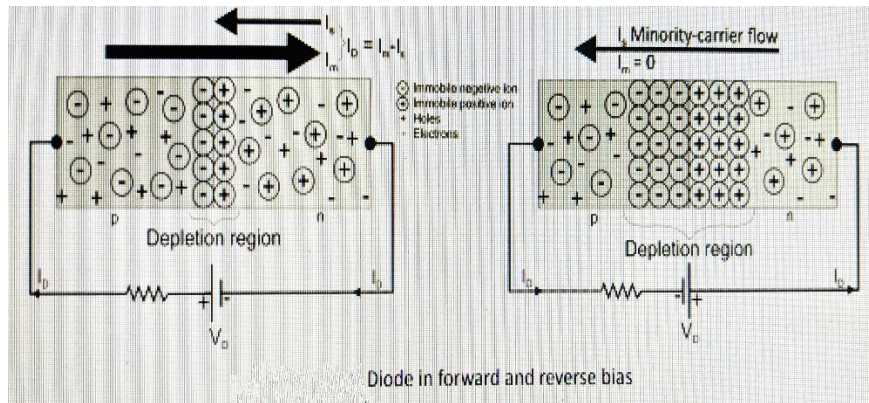
Forward biasing: When positive terminal of the battery or DC power supply is connected to p and negative terminal of battery or DC power supply is connected to n, then this biasing is known as forward biasing.

Note : A resistance should be connected in circuit to control the current.

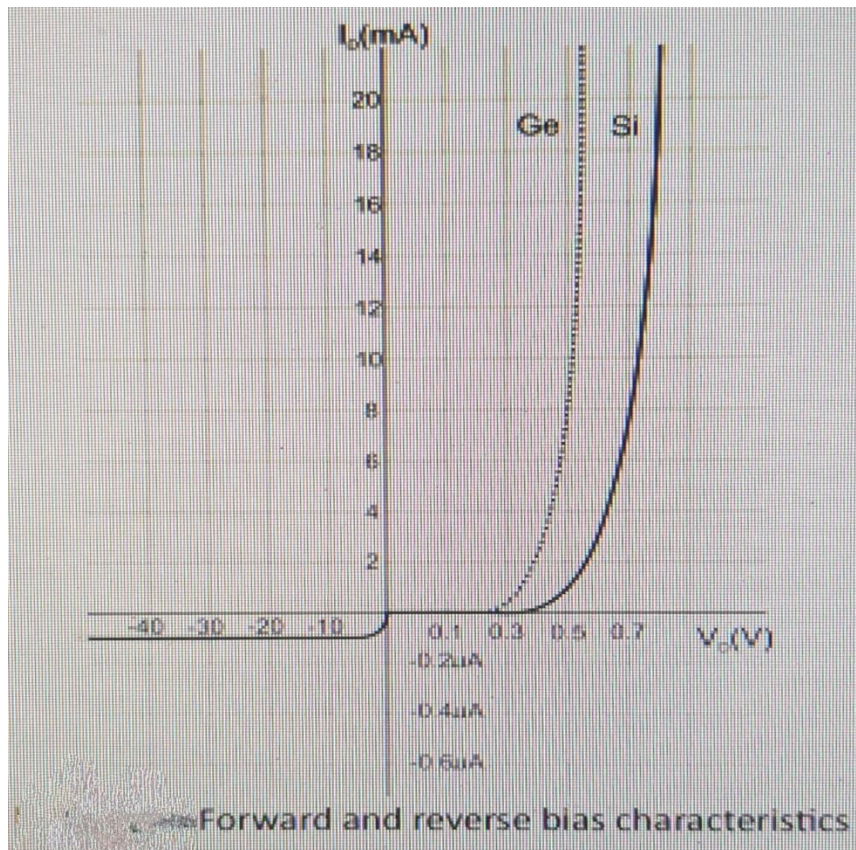
Reverse biasing: When positive terminal of the battery or DC power supply is connected to n and negative terminal of battery or DC power supply is connected to p. then this biasing is known as reverse biasing. In forward biasing, the electric field due to external supply is opposite to the field developed across the junction. When a diode is forward biased, it does not start conduction instantaneously, but after a particular forward voltage, current flows through diode and this particular voltage is known as knee voltage. The knee voltage of Si and Ge diode is 0.7 V and 0.3 V respectively. When a diode is in forward bias, the voltage across diode will be equal to its knee voltage. The current (I_D) flows in forward bias is of the order of milliampere. The direction of flow of current across diode in forward bias is from p to n. In reverse biasing, the electric field due to external supply is in the direction of the field that develops across the junction. Due to reverse bias voltage, height of potential barrier and width of depletion layer increases. Majority charge carrier cannot cross the junction but minority charge carrier i.e. holes in n type and electrons in p type can cross the junction and very small amount of current flows through diode. This current is of the order of micro ampere (10^{-6} Ampere) and its value does not increase or decrease with reverse bias voltage. This current is known as reverse saturation current (I_S).

The direction of current across diode in reverse bias is from n to p. Hence the reverse bias V-I characteristics is drawn in III quadrant.

Ideally the resistance of diodes in forward bias is zero and very high in reverse bias. The diode can be considered as short when used in forward bias and open when used in reverse bias.



(FIG-7)



(FIG-8)