1. Details of unit revision and its structure

Subject Name	Physics
Course Name	Physics 04 (Physics Part-2, Class XII)
Title	Revision Unit-09_Study Guide
Pre-requisites	Content of Unit 09: Semiconductor devices
Objectives	After going through this study guide, the learners will be able to: • How to consolidate the unit? • How to prepare notes?
Keywords	Semiconductors, conductors, energy bands, diodes, transistor

2. Development Team

Role	Name	Affiliation
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Study Guide

Unit 9: Semiconductor Devices

Electronic Devices

Chapter 14: semiconductor electronic material, devices and simple circuits.

Energy-bands in conductors, semiconductors and insulators (qualitative only)

Semiconductors: intrinsic and extrinsic

Semiconductor diode: I-V characteristics in forward and reverse bias, application of diode as a rectifier

Special purpose p-n diodes: LED, photodiode, solar cell and Zener diode and their characteristics, Zener diode as a voltage regulator

Junction transistor: transistor action, characteristics of a transistor and transistor as amplifier common emitter configuration

Basic idea of analog and digital signal, logic gates OR, AND, NOR, NOT, NAND

Dear learner,

This unit is full of new concepts and very new vocabulary. The reason, for its inclusion in the physics syllabus is that it will familiarise you to new and fast developing application of semiconductors.

The unit helps you to understand the behaviour of semiconductors, and hence their use in electronic circuitry.

We do not study special circuits but learn the use in logic gates which have transformed digital signal circuits.

So take time to understand each new idea, help yourself to imagine what goes on inside materials for electrical conduction .watch the videos and animation .these will help you to

overcome many gaps in understanding and enable you to go through the syllabus in an easy way.

Make a check list; this is a must as each part of the syllabus must be covered.

Energy bands in conductors, semiconductors and insulators (qualitative only)

Take care to follow the formation of bands, why are they formed? What could be their shape? What is a valence band? How is valence band different from conduction band? What is the idea of energy gap? What is meant by filled and unfilled bands? What is the difference between energy bands in semiconductors conductors and insulators? Is there band formation for energy levels below the valence band if yes why? If not, why?

Try and answer as many questions that come to your mind. Remember you need to imagine the internal structure in three dimensions but draw the same in 2 dimensions.

Semiconductors intrinsic and extrinsic

Draw diagrams and explain the two types to yourself. Write out the definition. Draw energy band for intrinsic pure semiconductor (Si and Ge). p-type and n-type and different materials with the same property. Understand natural and artificially created semiconductors.

Semiconductor diode

pn junction diode watch animation, understand how the diode is formed, barrier potential, depletion layer, drift and diffusion, meaning of forward and reverse bias, diode barrier/junction resistance.

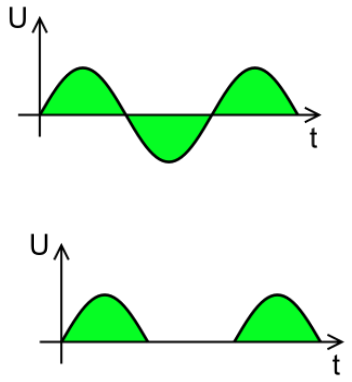
Semiconductor diode IV characteristics in forward and reverse bias,

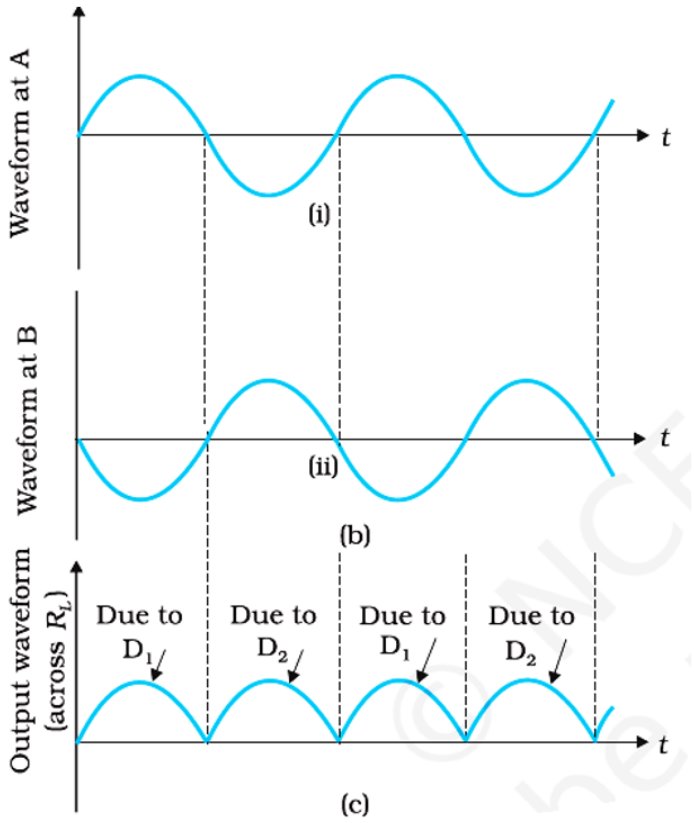
Use the experiment done in the laboratory. Study the readings and analyse the result. Would all diodes be the same? Would the knee voltage be the same in every case? What factors change the value of diode resistance? Is it possible to make a diode with only p type or only n type semiconductor by changing the doping levels?

Get connected to the working of a p-n junction diode. Read the e content very carefully

Application of diode as a rectifier

Draw a labelled circuit diagram for half and full wave rectifier explains the meaning of the terms. Graphically represent the input and output signal for each take care that these are drawn to same scale.





Special purpose p-n diodes

All such devices are called **optoelectronic devices**. We shall study the functioning of the following optoelectronic devices:

(i) **Photodiodes used for detecting optical signals (photodetectors).**

(ii) **Light emitting diodes (LED) which convert electrical energy into light.**

(iii) Photovoltaic devices which convert optical radiation into electricity (solar cells).

Make a comparative chart for

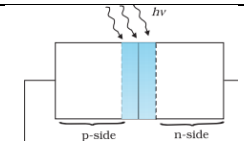
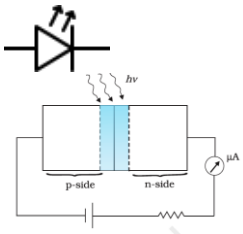
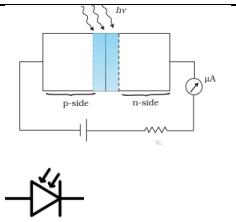
LED,

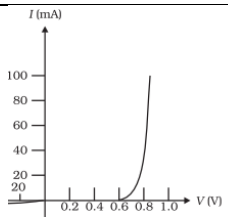
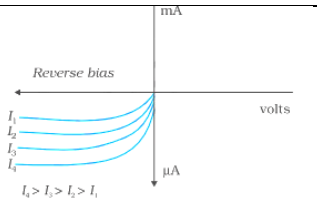
Photodiode,

Solar cell and

Zener diode

Make sure you highlight structure, diagram, doping level, bias, IV characteristic curve, application or use

Name of diode	LED	Photodiode	Solar cell	Zener
Structure	Light Emitting Diode converts electrical energy into light energy			
Diagram/symbol				
Doping level, working	heavily doped pn junction	If the light photon energy of the incident light, is greater than the band gap of the semiconductor, the valance electrons gain energy and break free from their atoms, creating electron- hole pairs		

bias	forward bias	Reverse bias		
IV characteristics				
Application	• In alarm signals, infrared LEDs are used • In calculators, display sign boards , digital watches, LEDs are used as seven segment display • In optical communications, the high radiating LEDs are used to give signals through optical fibres • In optical mouse setups use LEDs as a light source	• Photodiodes are used in consumer electronics devices such as CD players, smoke detectors, receiver for infrared remote control devices used to control TV or air conditioner etc. • Photodiodes are used in switching the lights on or off in street lighting after dark. • Photodiodes are used in optical communications circuits which couple a photodiode and a LED as a sensor system. • Photodiodes are used in demodulation of optical signals.		

	and a light detector like photodiodes to detect the movement relative to a surface • In traffic lights to illuminate them • In remote controls to transmit information	• Photodiodes are used in reading of punched cards and tapes.		

You can make the rest yourself and have an easy revision s sheet

Zener and their characteristics

Understand how Zener effect works, study its characteristic curve

Zener diode as a voltage regulator

Write a note to explain this.

Junction transistor,

Slowly understand the design of a p-n-p and n-p-n transistor, note the symbols, doping levels, base emitter and collector

Transistor action, characteristics of a transistor

Transistor as amplifier common emitter configuration

Take time over the e content and understand the behaviour and hence the use of a n-p-n transistor only common emitter configuration.

Basic idea of analog and digital signal,

Logic gates OR, AND, NOR, NOT, NAND

This part requires understanding the meaning of logic gate writing truth tables connecting them to digital signals. Read carefully

Follow the e content and the video.do all the solved examples from NCERT

Good luck!!

Write to us in case you have any problem in any section of the unit.