

WUN2K FOR LECTURE 12

These are notes summarizing the main concepts you need to understand and be able to apply.

- Some specialized diode types have particular applications.
 - *Zener diodes* are able to support avalanche breakdown current when reverse-bias voltage exceeds a given threshold V_Z (the specific value of which depends on the device, but is typically a few to a few tens of volts). They can be treated in a simplified model as devices that act like small-value resistors with V_Z across them when reverse-biased with $|V| > V_Z$. They are useful in circuits as voltage references.
 - *Light-emitting diodes* (LEDs) emit light proportional to forward current going through them. An external voltage source (forward-biased) drives the majority charge carriers which recombine (holes from the p-type combine with electrons in the N-type, and vice versa) in the junction region, and the binding energy is released in the form of photons.
 - *Photodiodes* produce a current when light is incident on them when they are reverse-biased: absorbed photons kick charge carriers up into the conduction band, creating mobile electron-hole pairs, and these charge carriers are drifted by the potential difference across the depletion region to create a current. (Particle detectors work this way, too, except that particles create electron-hole pairs as they deposit energy in the depletion region.)
- Diodes have a number of useful applications. You don't need to memorize these, but understand the basic concepts and be able to analyze the function of circuits like these.

- One of the important basic uses of diodes is in *rectifiers*, which are circuits that convert AC to DC power. The simplest example is a *half-wave* rectifier, in which a diode is placed between an AC supply and a load, such that the diode only conducts during the positive swing of the supply. *full-wave bridge* rectifier is an arrangement of diodes that allows current to flow for both positive and negative swings of the supply. To reduce the remaining “ripple” after rectification, the standard solution is to use a low-pass filter, followed by a *regulator*. A regulator is a device that smooths the output by setting a reference voltage— it can be as simple as a Zener diode, but in practice will be typically an active integrated-circuit device that uses feedback (and may serve also as a buffer).