PHYS 485 Materials Physics **Spring 2019**

Read: Chapters 10 & 11 [We obviously will not discuss all of the material in Ch 9 - 11, but reading these chapters will provide you with a good context for what we will cover in class.]

Homework 11

Due date: Not collected; solutions in binder.

Work problems 10.6, 10.8, 10.9 in the text.

AQ 1: Sketch a p-n junction and describe how the depletion layer forms and its associated electric field. By applying an external voltage (electric potential) across the p-n junction, we can set up an external electric field within the p-n junction. Describe how the polarity of the applied potential determines whether the junction is forward biased (conducts) or reverse biased (does not conduct).

AQ2: Let's consider the following two functions for standing waves at the FBZ boundary ($k = \pi/a$) for a model 1-dimensional material:

$$\psi(+) = 2A\cos(\pi x/a)e^{-i\omega t}$$

and

$$\psi(-) = 2Ai\sin(\pi x/a)e^{-i\omega t}$$

If we assume a periodic potential of $U(x) = U_o \cos(2\pi x/a)$ show that the gap energy, E_g, (the difference in the expectation value for $U(x)$ between the two wavefunctions at $k = \pi/a$) is given by U_o.