

PHYSICS 405: FALL `04/05

Text: Semiconductor Device Fundamentals by R. F. Pierret
Laboratory text: Handouts distributed by Profs. Syed & Kirkpatrick
Instructor: Maarij Syed
Office: DL107 / 108 **Phone/Mail:** 8957 / Box 173.
Office Hours: 8th period every day except Wednesday.

Grade Details:

| | | |
|---------------------------|---|------------------|
| Homework | Four to five problems every week (solutions in the Logan library folder and outside my office). You will typically have 4 -7 days to turn in the homework. | [18%] |
| Quiz (15 min.) | Once or twice a week. | [15%] |
| Exams [†] | 3 class exams | [15+15+22 = 52%] |
| Activity | There will be weekly labs. You will be notified of the details. | [15%] |
| Extra-credit | You can discuss the possibility of an extra-credit assignment with me at any point. The maximum value of this would be 5 % and it can be an individual project or a group (of two) project. | |

[†] Exams (tentative details):

Exam 1: end of week 3. **Exam 2:** week 6/7 **Exam 3:** week 10.

Please note that the last exam is going to be comprehensive and will be a take-home. It will be handed out on Tuesday / Wednesday of 10th week and you will have till Friday of that week to turn it in.

-
- ⇒ You can not make up missed quizzes and exams without a legitimate excuse. If you can not make it to an exam or a quiz due to exceptional circumstances, please let me know well in advance.
 - ⇒ Employing unfair means (cheating) during a quiz or an exam will result in a course grade of "F" (among other things). Please refer to the rules and regulations listed in RHIT Academic Rules and Procedure Manual.
 - ❖ If you are having problems with the subject matter, please discuss these problems (general or specific) with me at the earliest available opportunity. Please do not wait till the first or the second exam. I can only help you if you recognize that you need help.

SYLLABUS DETAILS

PART I: SEMICONDUCTOR FUNDAMENTALS

- ⇒ General material properties, crystal lattices, crystal growth.
- ⇒ Quantization concepts, semiconductor models.
- ⇒ Carrier properties (charge, effective mass, intrinsic and extrinsic carrier numbers).
- ⇒ State and carrier distributions.
- ⇒ Equilibrium carrier concentrations, drift, mobility, resistivity, band bending.
- ⇒ Diffusion, the Einstein relationship.
- ⇒ Recombination – Generation and Equations of state.

PART II: DIODES

- ⇒ Fabrication of the *pn*-junction diode and its physical properties.
- ⇒ Equilibrium electrostatics.
- ⇒ *I-V* characteristics: qualitative analysis and quantitative solution strategy.
- ⇒ *I-V* characteristics: ideal diode equation derivation and examination of results.
- ⇒ Ideal theory vs. experiment, junction breakdown.
- ⇒ R-G current, high-current phenomena.

(B) Schottky Diode (time permitting)

- ⇒ Ideal MS contacts, Schottky diode electrostatics
- ⇒ *I-V* characteristics
- ⇒ A.C. response, practical considerations

(C) Optoelectronic Diodes (time permitting)

- ⇒ Select topics