INSTRUCTOR

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DESCRIPTION

Semiconductor Physics, covering fundamentals at an advanced level, is based on solid state physics and quantum mechanics with an emphasis on semiconductor materials. Topics covered will include crystal structures, lattice vibrations, quantum mechanical description of electrons in crystals, and transport and recombination of excess carriers.

The course will also touch upon active and emerging semiconductor research topics which include thin film and nanocrystalline semiconductors, application of semiconductor materials for energy applications, and quantum effects in nanostructured semiconductors. These topics will be covered through the research seminars.

This course, which provides a foundation in advanced semiconductor physics will be of interest to graduate students in the Electronics and Photonics groups, as well as those in Materials Science.

ORGANIZATION

1. Lectures – Active Participation(30%) -see page 2 for details

   - Final Examination (30%) - **Final Exam:** Thursday, December 8th, 4-5pm

2. Research Paper and Presentation (25%)
   - Topic relevant to the course subject matter
   - Potentially of current research interest
   - Elaborative, in-depth treatment
   - Explicative (analyse and develop (an idea or principle) in detail)
   - Submit abstract on Oct 15th for approval/feedback of topic
   - Presentations (25 min + 5 min QA)
   - Essay, review paper format, length of paper ~15 pages, double spaced, plus figures
   - **Paper Due Date:** Monday, Dec 12th
   - **Research Seminar Presentations**: Tuesday, Dec 13th, All Day

3. Assignments (15%): Problem Sets due on the Friday after the relevant lecture

Note: The above is a mark distribution guide only; the final grade is determined by the instructor and the Graduate Department.

LECTURE TOPICS (subject to change)

1. Crystallography
2. Diffraction
3. Atomic Bonding and Crystal Types
4. Lattice Vibrations
5. Statistical Mechanics and Quantum Mechanics - Overview
6. Lattice Vibrations and Thermal Properties
7. Free-Electron Theory of Metals
8. Quantum Theory of Electrons – I
9. Quantum Theory of Electrons – II
10. Uniform Electronic Semiconductors in Equilibrium
11. Excess Carriers & Recombination-Generation Processes
12. Contacts and Surfaces

REFERENCES

1. Solid State Physics for Engineering and Materials Science, J.P. McKelvey, Krieger, 1993.
2. Fundamentals of Semiconductor Theory and Device Physics, S. Wang, Prentice-Hall, 1989.
3. Solid State and Semiconductor Physics, J.P. McKelvey, Harper, 1966.
4. Solid State Physics, N.W. Ashcroft, N.D. Mermin, Saunders, 1976.
5. Advanced Semiconductor Fundamentals, R.F Pierret, 2nd Ed., Prentice-Hall, 2003.
6. Physical Properties of Semiconductors, C.M. Wolfe, N. Holonyak Jr., G.E. Stillman, Prentice-Hall, 1989.
7. Semiconductor Physics, K. Seeger, Springer-Verlag.
8. Fundamentals of Semiconductors-Physics and Material Properties, P.Y. Yu, M. Cardona, Springer-Verlag, 2001.

ACTIVE PARTICIPATION

The lectures will be conducted in a seminar style where active participation from all students is required. Please note the following in aid of preparing yourself for each lecture.

1. Lecture handouts and the Lecture Program will be posted at least one week prior to the schedule lecture.
2. The handouts will include primary reading material and supplementary reading material.
3. Students are required to read and study the reading material and in particular be prepared to discuss all the topics listed on the Lecture Program.
4. The lectures will be conducted in an interactive seminar style, and in particular students will be selected at random and asked to speak intelligibly on any given topic in the Lecture Program.

In order to succeed in this course it is
- (a) imperative that each student prepares for each lecture as outlined above, and
- (b) attends and actively participates in each lecture.