

EE 5384-001 Optoelectronic Devices (3-0)

Spring 2015 T/Th 3:30pm - 4:50pm NH112

Instructor: Dr. Weidong Zhou
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Required Textbook:

P. Bhattacharya, Semiconductor Optoelectronic Devices (2nd Edition, Prentice Hall, 1997)

References (at SEL):

1. L. A. Coldren and S. W. Corzine, Diode Lasers and Photonic Integrated Circuits, (Wiley, 1995)
2. S. O. Kasap, Optoelectronics and Photonics, (Prentice Hall, 2001)
3. S. M. Sze, Physics of Semiconductor Devices, (Wiley, 1981)
4. C. Kittel, Introduction to Solid State Physics, (Wiley, 1996)

Course Description: Introduction to semiconductor crystal and electronic and optical processes thereof; p-n junction theory and photon-electron process in light emitting diodes (LEDs); semiconductor laser structures, properties and operating principles; Photodetectors and solar cells; optoelectronic modulators and switching devices; integrated optoelectronics and new device challenges.

Course Learning Goals/Objectives: This course is designed to give graduate students an understanding of principles and applications of photonic devices. Students shall have a clear understanding about semiconductor materials and photonic device properties, principles, and their applications.

Lecture Topics:

1. **Semiconductor** crystal and electronics band gap. Heterostructures and quantum wells (2 lec).
2. Semiconductor electronic properties and PN junction theory (4 lec).
3. Semiconductor optical properties. Absorption and recombination processes (4 lec).
4. **Light-emitting diodes (LED)**: materials for visible and infrared LEDs; theory of operation; configuration and performance packaging and testing (3 lec).
5. **Semiconductor junction lasers**; materials considerations; stimulated emission; mode propagation and guiding in dielectric guides; threshold current density; operating characteristics. Novel laser structures; double-heterostructure, separate confinement heterostructure (SCH), GRIN-SCH and quantum-well lasers (5 lec).
6. **Photodetectors**; theory and performance of photoconductive detectors; junction photodiodes; p-i-n, Schottky barrier, and avalanche photodiodes; impact ionization and multiplication effects; enhanced α/β ratios in multilayered materials; phototransistors; gain, responsivity, detectivity, signal-to-noise ratio, response speed (2 lec).
7. **Optoelectronic modulation and switching devices**. Electro-optic and electro-absorption modulators. Opto-electronic integrated circuits (2 lec).
8. **Junction solar cells**; conversion efficiency; heterojunction, concentrator and thin-film solar cells, spectral response and output characteristics; device configurations, temperature and radiation effects, optical concentration (2 lec).
9. **OEIC** and research topics (2 lec)

Course Requirements and Grading:

- Homework (10%): Assigned
- Midterm: (30%)
- Final: (30%)
- Term paper: (30%)

Tentative Course Schedule (EE 5384 Optoelectronic Devices)

Wk	Date	Topics	Reference	Notes
1	Jan. 20	Introduction		
	Jan. 22	I: Semiconductor crystals	Ch 1	
2	Jan. 27	Cont'd		
	Jan. 29	II: Semiconductor electrical properties	Ch2	
3	Feb. 3	Cont'd		
	Feb. 5	PN junctions	Ch4	
4	Feb. 10	Cont'd		T
	Feb. 12	III: Optical properties	Ch3	T
5	Feb. 17	Cont'd		
	Feb. 19	IV: LED	Ch5	
6	Feb. 24	Cont'd		T
	Feb. 26	LED cont'd/Review		
7	Mar. 3	LED or laser waveguide		Term paper topics
	Mar. 5	Midterm		
8	Mar. 10	Spring Vacation		
	Mar. 12	Spring Vacation		
9	Mar. 17	Lasers waveguide		
	Mar. 19			
10	Mar. 24	Lasers		
	Mar. 26			Seminar 3/27
11	Mar. 31	V: Lasers recombination	Ch 7	
	Apr. 2	Lasers gain threshold		
12	Apr. 7	Lasers properties		
	Apr. 9	Lasers structures/types		
13	Apr. 14	VI: Receivers PC	Ch 8	
	Apr. 16	PIN		
14	Apr. 21	APD		
	Apr. 23	VII: Solar Cells	Ch 10	
15	Apr. 28	VIII: Modulators	Ch 11	
	Apr. 30			
16	May 5	IX: OEIC	Ch 12	
	May 7	Last day of class is May 8		
		Final Exam		Term paper due

Grading Scale:

A ($\geq 85\%$); B ($\geq 70\%$ to $< 85\%$); C ($\geq 60\%$ to $< 70\%$); D ($\geq 50\%$ to $< 60\%$); F ($< 50\%$).

Class Attendance and Drop Policy: Attendance is required. Students are responsible for all materials covered in class. Drop policy: As per University guidelines. See the Registrar's Bulletin or the University Calendar in the front part of the UTA catalog for drop dates.

Academic Dishonesty

It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University.

"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, and the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22)

Americans With Disabilities Act

The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112 -- The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans with Disabilities Act - (ADA), pursuant to section 504 of The Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

As a faculty member, I am required by law to provide "**reasonable accommodation**" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with **informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.**

Student Support Services Available

The University of Texas at Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.