

Advanced Concepts in Electronic and Optoelectronic Devices

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Course Information is available at

<http://nina.ecse.rpi.edu/shur/advanced/default.htm>

Viewgraph Files are Available on the WEB at

<http://nina.ecse.rpi.edu/shur/advanced/Notes/Index.htm>

Typical home work assignments are available at

<http://nina.ecse.rpi.edu/shur/advanced/Homework/Index.htm>

| Lecture topic | Date | Viewgraph Files |
|--|-------|--------------------------|
| Lecture 1, 2. Course information. Review: semiconductor physics, electronic materials. Metal-semiconductor contacts. p-n junctions. | 8/30 | Preview, 1, 2, 3, 4 |
| Lecture 3, 4. MOS capacitor. Quantum wells, wires, and dots. Superlattices. Planar Doped barriers. | 9/6 | 5, 6, 7, 8, 9 |
| Lecture 5, 6. Problem solving session 1. | 9/13 | |
| Lecture 7, 8. Deep submicron CMOS. Scaling. Channel Engineering. Variable Threshold Transistors, surface mobility, Drain Induced Barrier Lowering. | 9/20 | 10,11 |
| Lecture 9, 10. SOI. Physics of Deep Submicron CMOS. Compound Semiconductor FETs. GaN-based Materials and Devices | 9/27 | 12, 13, GaN tutorial |
| Lecture 11, 12. GaN-based Materials and Devices , continued | 10/4 | GaN tutorial, 15,16 |
| Lecture 13, 14. Midterm presentations | 10/18 | |
| Lecture 15, 16. Thin Film Transistors. Technology issues. Applications. Heterodimensional Technology. Organic TFTs. Wide band gap devices. SiC electronics. AlGaIn/GaN HEMTs. Si-Ge technology. Si-Ge HBTs. | 10/25 | 17,18,19,20,21, 22,23,24 |
| Lecture 17, 18 Problem solving session 2 | 11/1 | |
| Lecture 19, 20 Ballistic Transport. Hot Electron Transistors. Resonant Tunneling devices. Plasma wave electronics. Single electronics. Superconducting Electronics.. | 11/8 | 25,26,27 |
| Lecture 21, 22. Solar cells. Photodetectors. Light Emitting Diodes. | 11/15 | 28,29,30 |
| Lecture 23, 24. Lasers. Laser modulation. Optical waveguides. Optical fibers. Optoelectronic Integrated Circuits (OEICs). Displays: Cathode Ray Tubes, Liquid Crystal Displays, Plasma Displays, and Field Emission Displays | 11/22 | 31,32,33 |
| Lecture 25, 26. Final project presentations | 11/29 | |
| Lecture 27, 28. Final project presentations | 12/6 | |

| Assignments | Date |
|--|-------------|
| Lecture 1, 2. | 8/30 |
| Lecture 3, 4. HW 1 assigned | 9/6 |
| Lecture 5, 6. Problem solving session 1. Final Project Topic and Team Selected | 9/13 |
| Lecture 7, 8. HW 1 is due. HW 2 assigned. Literature search done | 9/20 |
| Lecture 9, 10. HW2 is due. HW 3 assigned | 9/27 |
| Lecture 11, 12 Midterm abstracts are due (half a page) | 10/4 |
| Lecture 13, 14. Midterm presentations HW3 is due. HW 4 assigned | 10/18 |
| Lecture 15, 16. Final project abstracts are due (one page) | 10/25 |
| Lecture 17, 18 Problem solving session 2 | 11/1 |
| Lecture 19, 20 HW4 is due. HW 5 assigned | 11/8 |
| Lecture 21, 22. Solar cells. Photodetectors. Light Emitting Diodes. | 11/15 |
| Lecture 23, 24. HW 5 is due | 11/22 |
| Lecture 25, 26. Final project presentations | 11/29 |
| Lecture 27, 28. Final project presentations | 12/6 |
| Final projects are due | 12/10 |

Final Project Description

The project includes:

1. Midterm presentation
2. Research paper with the statement of work load distribution between the team members and the description of their specific assignments during the project
3. Final presentation
4. Peer reviews of another final project (by each team member)

Project Schedule

Before the midterm presentation

- Step 1. Topic selection and team selection
- Step 2. WEB search
- Step 3. Preliminary literature search
 - Books
 - Key papers (use RPI library electronic journal collection)
- Step 4. Prepare one-page write-up and from zero to 5 overheads stating
 - Title
 - Team composition
 - Preliminary division of responsibilities among the team members
 - Significance of the project
 - Expected outcome
 - Suggested peer reviewers (if possible)

Midterm presentation

1 page summary to be submitted
Suggested duration of oral presentation 5 minutes

Research paper

Each paper should contain

1. A brief history of the subject, including important milestones, dates, names of principal contributors and their affiliations.
2. Review of the state-of-the-art .
3. Comments on controversies, if any.
4. Author's own thoughts, calculations, estimates, suggestions, etc.
5. Suggestions for further studies.
6. Key references.
7. Index.

Articles in IEEE Spectrum on important technologies may serve as examples.
The size of the paper should be approximately 10 pages.

The length of an oral presentation is 30 minutes including questions.

A technical presentation might include a joke. This joke does not have to be very funny but must be non-offensive and moderate.

Evaluation of research papers.

Technical content (70%)

Presentation (20%)

Transparencies (10%)

Overall score

Academic Dishonesty

Academic dishonesty is a very serious matter, and we suggest that you read the remainder of this statement carefully:

Student-teacher relationships are built upon trust. For example, students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments which students turn in are their own. Acts which violate this trust undermine the educational process.

The Rensselaer Handbook defines various forms of Academic Dishonesty and procedures for responding to them. All forms are violations of the trust between students and teachers. Students should familiarize themselves with this portion of the Rensselaer Handbook and should note that the penalties for plagiarism and other forms of cheating can be quite harsh.

Any portion of work handed in that is not your own, should cite the author. Just as you would not write a history paper by copying text from the encyclopedia, you should not take credit for another person's engineering work.

Collaboration on the final project is both allowed and encouraged between the team members. However, all team members should understand and participate in all aspects of the project. Their individual contributions should be documented and clearly explained in the Final Paper. Collaboration on home work assignments is not allowed. Turning identical home work solutions, which suggest that copying (in part or in total) has taken place, will be considered as academic dishonesty.