

COURSE: ECE 633
Nanoelectronics

INSTRUCTOR: Prof. Youngki Yoon
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Office Hours: After class; by appointment (via email) for other times
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LECTURE HOURS: TBA

COURSE WEBSITE: learn.uwaterloo.ca (login with your WatIAM userid and password)

COURSE OBJECTIVES:

This course will help students with limited prior background in nanoelectronics

- Acquire the understanding of nanomaterials and nanoscale electronic devices, and
- Develop hands-on coding experience for plotting electronic band structures of various nanomaterials.

COURSE SCHEDULE (Tentative)

1. Bottom-up view on nanoelectronic devices (2 weeks)
Origin of current flow; conductance quantum; current-voltage characteristics
2. Quantum mechanics of electrons (2 weeks)
Schrödinger equation; finite difference method; hydrogen atom
3. Basis functions (2 weeks)
Hydrogen molecule; basis functions; basis transformation; density matrix
4. Band theory of solids (2 weeks)
Reciprocal lattice; Brillouin zone
5. Band structures of nanomaterials (2 weeks)
Graphene, carbon nanotube, layered semiconductors
6. Nanomaterials to nanoelectronic devices (2 weeks)

CODING ASSIGNMENT:

MATLAB (or equivalent software package) will be used to plot the band structures of various nanomaterials. No prior programming experience is required!

COMPUTER LAB: <https://uwaterloo.ca/engineering-computing/computer-labs>

Matlab is available at most engineering computer labs and ECE labs. Please check the above link for details.

TEXTBOOK:

No textbook is required for this course.

GENERAL REFERENCES:

- Quantum Transport: Atom to Transistor, Supriyo Datta, Cambridge University Press (2013).

MARKING SCHEME:

- Assignment: 30%
- Project: 20%
- Final Exam: 50%
- No Midterm Exam