Course: ECE 633
Nanoelectronics

Instructor: Prof. Youngki Yoon
Virtual Office Hours: Immediately after synchronous lectures
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Type of Lectures: Synchronous & asynchronous

Synchronous Lecture Hour: [redacted]. It is basically a one-hour session, but it can run for up to 2 hours if needed (office hours included). To attend the lecture, use the link provided on the Learn. The first live lecture is scheduled o[redacted] PM.

Asynchronous Lectures: A few pieces of pre-recorded video will be uploaded every week.

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)

Week	Synchronous Lecture	Topics
1	Sep 9	Introduction; Origin of current flow
2	Sep 16	Current flow in a single- and multi-level system; Conductance quantum
3	Sep 23	Nanotransistors; Current-voltage characteristics; Quantum capacitance
4	Sep 30	1D Schrödinger Equation; Boundary conditions; Finite difference method
5	Oct 7	2D Schrödinger Equation; Hydrogen atom and molecule
	No class	Reading Week (Oct 10–18)
6	Oct 21	Basis function; Energy levels
7	Oct 28	Hilbert space; Basis transformation; Hermitian matrix
8	Nov 4	Diagonalization of Hermitian matrix; Density matrix
9	Nov 11	Band structure
10	Nov 18	Band structure (cont'd); Brillouin zone; Density of states
11	Nov 25	Graphene
12	Dec 2	Carbon nanotube; subbands

Assignments:

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

Project:

Online simulation tools will be used for a small project.

Computer Lab: https://uwaterloo.ca/engineering-computing/computer-labs

MATLAB is available at most Engineering Computer Labs and ECE labs. Remote access is also available to Engineering Computing. Please check the above link for details.

Textbook:

No textbook is required.

General Reference:

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

Marking Scheme:

- Assignment: 25%
- Project: 25%
- Quiz: 20%
- Final Exam: 30%