

OPTI 341: Semiconductor Physics and Lasers

Instructor: Mahmoud Fallahi

Fall 2026

Course Website: <https://wp.optics.arizona.edu/opti341/>

- Semiconductor Optoelectronic: Various semiconductors: IV, III-V, II-VI
- Solids and crystal structures
- Introduction to quantum mechanics: Energy, momentum, Uncertainty Principle, Schrödinger wave equation, potential well
- Atoms and Solids: Pauli exclusion principle
- Metal, Insulator, Semiconductor
- Conduction band, valance band, energy gap
- Electrons and holes
- Direct and indirect band
- Intrinsic, extrinsic (P and N doping)
- Distribution Functions and Fermi Energy
- Intrinsic Carrier concentration

----- First Exam (Tuesday October 6) -----

- Extrinsic Carrier Concentration: Majority and Minority Charges
- Carrier Transport
- P-N Junction: equilibrium potential, space charge, current-voltage
- Heterojunction
- Metal-Semiconductor contact
- Semiconductor-Light interaction: Absorption, Spontaneous vs Stimulated Emission

----- Second Exam (Thursday November 12) -----

- Photoconductor, Photodiodes, Photovoltaic solar cells
- Light emitting diodes
- Waveguides: Snell's law, TIR
- Semiconductor Fabry-Perot Lasers: Gain, Lasing condition, Output power.
- Other Semiconductor Lasers (Single mode versus Multi mode lasers)

----- Final Exam -----

Required Book: Semiconductor Physics and Devices: Basic Principles, 4th Edition, Author: Donald A. Neamen, Publisher: McGraw-Hill.

Recommended Books:

Semiconductor Optoelectronic Devices, Author: Pallab Bhattacharya, Publisher: Prentice Hall.
Essential of photonics: Author: Alan Rogers, CRC Press

Grading:

Class participation:	5 %
Homework:	10 %
First Exam:	30 %
Second Exam:	30 %
Final Exam:	25 %

Total: 100%