

Syllabus 1 Dr. Chun-Wei Pao

1. **(9/4) Applications of multi-scale simulations to nanomaterials I**
2. **(9/11) Applications of multi-scale simulations to nanomaterials II**
3. **(9/18) High-dimensional universal approximation functions and their applications to nanomaterials**

References: relevant literatures in each subjects

Syllabus 2 Dr. Min-Hsiung Shih

- 1) **(09/25) The fundamental tools for photonic crystals**
 - Photonic Maxwell's equations, wave equation, light propagation in the mater
 - Simulation tools: plane wave expansion (PWE) method
 - Simulation tools: finite-difference time-domain (FDTD) method
 - Photonic band structure
- 2) **(10/02) Photonic crystal cavity laser**
 - Defect modes inside the band gap
 - Quality factor of a cavity and photon lifetime
 - Different types of micro-cavities
 - Applications: lasers, LEDs and etc
 - Cavity QED
- 3) **(10/16) Photonic crystal waveguides and integrated circuits**
 - Defect bands inside the band gap
 - Propagation loss issue
 - Different types of photonic crystal waveguides
 - Applications

References:

- 1) J. D. Joannopoulos, R.D. Meade and J.N. Winn, Photonic crystals: Molding the follow of light (1995)
- 2) J.-M. Lourtioz et al., Photonic crystals: towards nanoscale photonic devices (2005)
- 3) K. Sakoda, Optical properties of photonic crystals (2001)
- 4) K. Inoue and K. Ohtaka, Photonic crystals: physics, fabrication, and applications (2004)
- 5) A. Yariv and P. Yeh, Optical waves in crystals (1984)

Syllabus 3 Dr. Chao-Cheng Kaun

- 1. (10/23) Electron Transport**
 - mean free length, ballistic conductance, Landauer formula
- 2. (10/30) Nanoelectronics**
 - quantum well states, contact resistance, nanotransistors
- 3. (11/6) Emerging Materials**
 - nanoparticles, 2D materials, oxide films

References: relevant literatures in each subjects

Syllabus 4 Dr. Chi Chen

Spectroscopy of Nanomaterials and Near-field optics

- 1. (11/13) Nano semiconductors:** quantum confinement, excitons, quantum dots, and quantum wells.
- 2. (11/20) Nano carbons:** C60, carbon nanotubes, graphenes, and nanodiamonds.
- 3. (11/27) Near-field optics:** spatial resolution, near-field, experimental realization, and examples.

References: relevant literatures in each subjects

Syllabus 5 Dr. Yun-Chorng Chang

- 1. (12/4) Standard nanofabrication methods**
 - Electron beam Lithography, Focused ion beam milling, DUV/EUV lithography...
- 2. (12/11) Low-cost nanofabrication methods**
 - Nanosphere Lithography, Nano-imprint Lithography, Nano-stencil Lithography...
- 3. (12/18) Optical and electrical properties of nanostructured materials**
 - Surface plasmon, Mie resonance, Metamaterials, Metasurface

References: