

NATIONAL TSING HUA UNIVERSITY
DEPARTMENT OF POWER MECHANICAL ENGINEERING
2011 Spring Semester

- Course No.:** PME 5130 00
Course Title: **Special Topics on Green Energies (綠能專題)**
Hours/Week: 3 (T3T4R4)
Classroom: 工一 R210
Teacher: Prof. Che-Wun Hong (洪哲文教授)
- Contents:**
- (1) **Review of Modern Physics (Electrons+ Photons)**
 - 1.1 Quantum Mechanics
 - 1.2 The Bohn Interpretation
 - 1.3 Classical Wave Equations
 - 1.4 Wavefunction for a Free Particle
 - 1.5 The Schrödinger Equation
 - 1.6 The Particle in a Box
 - 1.7 The Finite Square Well
 - 1.8 Tunneling Phenomena
 - 1.9 3-D Schrödinger Equation
 - 1.10 Exact Solutions in Spherical Coordinates
 - 1.11 The Periodic Table
 - 1.12 Statistical Physics
 - (2) **Review of Solid State Physics (Phonons)**
 - 2.1 Crystal Structure (Periodic Arrays of Atoms)
 - 2.2 Diffraction of Waves by Crystals
 - 2.3 Phonons: Crystal Vibrations
 - 2.4 Phonons: Thermal Properties
 - 2.5 Energy Bands
 - 2.6 Semiconductor Crystals
 - (3) **Special Topics on Solar Cells (Photons→Electrons)**
 - 3.1 How a Solar Cell Work?
 - 3.2 Air Mass
 - 3.3 Solar Spectrum
 - 3.4 Quantum Efficiency for Current Collection
 - 3.5 PV Device Performance
 - 3.6 Organic Solar Cells
 - 3.7 Polymer Solar Cells
 - 3.8 Organic Photovoltaic Materials

- (4) **Special Topics on LEDs (Electrons→Photons)**
 - 4.1 Light Emitting Diode
 - 4.2 LED Basic Optical Properties
 - 4.3 Organic Light Emitting Diode (OLED)
 - 4.4 Photons
 - 4.5 Density of States (DOS) for Photons
 - 4.6 Energy Distribution of Photons
- (5) **Special Topics on Thermoelectricity (Electrons↔ Phonons)**
 - 5.1 Introduction
 - 5.2 Seebeck Effect
 - 5.3 Peltier Effect
 - 5.4 Bond Graph Approach
 - 5.5 Electric Circuit Analogy
 - 5.6 Thermoelectric Model
 - 5.7 Thermoelectric Figure of Merit
 - 5.8 Superlattice Nanowires
- (6) **Special Topics on Other Green Energies**
 - 6.1 Energy Storage: Li-ion Batteries
 - 6.2 Semiconductor Hydrogen Production
- (7) **Special Topics- Invited Speech**

Prerequisite: Thermodynamics, Modern Physics (preferred)
Lecture Notes: Supplement notes provided by PDF in each lecture
References:

- [1] “Modern Physics”, R.A. Serway, C.J. Moses, C.A. Moyer, 3rd Edition, Brooks/Cole, 2005
- [2] “Introduction to Solid State Physics”, C. Kittel, 8th Edition, John Wiley & Sons, Inc, 2005
- [3] “The Physics of Solar Cells”, J. Nelson, Imperial College Press, 2007
- [4] “Light-Emitting Diodes”, E.F. Schubert, Cambridge University Press, 2008
- [5] “Nanoscale Energy Transport and Conversion”, G. Chen, Oxford Univ. Press, 2005

Grades: Midterm Exam (30%)- close book
 Reports and Presentation (40%)
 Final Exam (30%)- open book