

Fall 2018

# MTSE 724-001: Transport of Electrons, Phonons, and Photons

Andres Jerez

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New Jersey Institute of Technology, Department of Physics  
MTSE 724-001 (CRN 94055), Fall 2016  
**TRANSPORT OF ELECTRONS, PHONONS, AND PHOTONS**  
Mondays, 2:30 pm to 5:20 pm, FMH 106

Instructor: Dr. Andrés Jerez, Tiernan Hall 455  
Phone: 973-596-3531, **email:** [jerez@njit.edu](mailto:jerez@njit.edu)

**Textbook:** Gang Chen, **Nanoscale Energy Transport and Conversion**, Oxford University Press, 2005, ISBN-13: 978-0195159424.

**Learning Outcomes:** This course provides a microscopic description of energy transport and energy conversion processes in solids. Students will learn about the behavior different energy carriers: electrons, phonons, photons. Energy transport both as waves and as particles will be considered in detail, due to the quantum nature of the carriers. The effect of small size structures on transport will be considered. Students will apply this knowledge to the study of Thermoelectric systems, Semiconductors, and Photovoltaic devices.

**Moodle:** I will be posting additional material in Moodle. Go to <http://moodle.njit.edu>, log in with your UCID. Rutgers students check here: [http://moodle.njit.edu/rutgers\\_students.php](http://moodle.njit.edu/rutgers_students.php)

| <b>Date:</b> | <b>Subject</b> (book chapter):                                     |
|--------------|--|
| 09/12        | Introduction, (Ch. 1)  |
| 09/19        | Material Waves and Energy Quantization (Ch. 2)                     |
| 09/26        | Electronic Energy States in Crystals (Ch. 3)                       |
| 10/03        | Phonon Energy Levels in Crystals (Ch. 3)                           |
| 10/10        | Statistical Thermodynamics (Ch. 4)                                 |
| 10/17        | Energy Transfer by Waves (Ch. 5)                                   |
| 10/24        | Wave Phenomena and Landauer Formalism (Ch. 5)                      |
| 10/31        | <i>Midterm Exam (Ch. 1-5)</i>                                      |
| 11/07        | Particle Description, Liouville and Boltzman Equations (Ch. 6)     |
| 11/14        | Electron Transport and Thermoelectric effects (Ch. 6)              |
| 11/21        | Classical Size Effects (Ch. 7)                                     |
| 11/28        | Coupled Transport Processes, Semiconductors, Photovoltaics (Ch. 8) |
| 12/05        | Forces and Potentials Between Particles and Surfaces (Ch. 9)       |
| 12/12        | Special Topics   |
| TBA          | <i>Final Exam (Comprehensive)</i>                                  |

**Final Grade:**

Midterm Exam: 35%  
Final Exam: 35%  
Homework: 30%