

Fall 2020

MTSE 724-101: Transport of Electrons, Phonons, and Photons

Andres Jerez

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New Jersey Institute of Technology, Department of Physics
MTSE 724-001 (CRN 94456), Fall 2020
TRANSPORT OF ELECTRONS, PHONONS, AND PHOTONS
Mondays, 6:00 pm to 8:50 pm, Synchronous Online

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

Textbooks:

- Gang Chen, **Nanoscale Energy Transport and Conversion**, Oxford University Press, 2005, ISBN-13: 978-0195159424.
- Charles Kittel, **Introduction do Solid State Physics**, (eighth edition) Wiley, (2004), ISBN-13 : 978-0471415268

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.

Synchronous Online:

- **Canvas:** I will be posting lecture material and assignments the Canvas page for this course, <https://njit.instructure.com/courses/12691>
- **Meetings:** There will be lectures are the scheduled times (Monday, 6pm) via Webex. The meetings are scheduled and the links available on Canvas.

Date:	Subject (book chapter from Chen):
09/08	Introduction, (Ch. 1)
09/14	Material Waves and Energy Quantization (Ch. 2)
09/21	Electronic Energy States in Crystals (Ch. 3)
10/28	Phonon Energy Levels in Crystals (Ch. 3)
10/05	Statistical Thermodynamics (Ch. 4)
10/12	Energy Transfer by Waves (Ch. 5)
10/19	Wave Phenomena and Landauer Formalism (Ch. 5)
10/26	<i>Midterm Exam (First half of the Course)</i>
11/02	Particle Description, Liouville and Boltzman Equations (Ch. 6)
11/09	Electron Transport and Thermoelectric effects (Ch. 6)
11/16	Classical Size Effects (Ch. 7)
11/23	Coupled Transport Processes, Semiconductors, Photovoltaics (Ch. 8)
12/30	Forces and Potentials Between Particles and Surfaces (Ch. 9)
12/07	Special Topics

<i>TBA</i>	<i>Final Exam (Second half of the Course)</i>
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Final Grade: Midterm Exam: 25%; Final Exam: 25%; Homework: 25%; Project: 25

Grade Scale: A: 85% and more; B+: 75% - 84%; B: 65% - 74%;
C: 55% - 64%; D: 50% - 54%; F: 49% and less