Graduate Study for Improving the Teaching of Physics

Description

The sequence of graduate courses for *Improving the Teaching of Physics* (ITOP) is offered through a partnership between the BU Wheelock College of Education and the Physics Department of Boston University.

ITOP participants earn graduate credits for professional advancement. The courses are offered for non-degree study, but may be used by degree students in the School of Education to satisfy requirements for the Master's Degree. The Wheelock College of Education also offers a Masters of Arts in Teaching Degree with Initial Licensure in Physics.

Frequently, science teachers are required to teach out of their content area. ITOP is designed to give teachers the opportunity to become proficient in physics concepts and teaching strategies, and to prepare for the Massachusetts Test for Educator Licensure (MTEL) in Physics.

Our approach to teaching physics is based on the physics education research literature. The history and philosophy of physics is included to enrich the understanding of the physics concepts. Our goal is for participants to develop a conceptual understanding of physics, to implement science education research findings in their lessons, and to significantly improve problem-solving and laboratory skills for themselves and subsequently for their students.

ITOP classes are small and provide individual attention and hands-on, inquiry-based learning in a relaxed, friendly environment. We are aware of teachers' heavy work schedules. We try to adjust the ITOP course schedules and requirements to accommodate the other professional demands on participants' time.

Below is provided a brief description of the ITOP courses.

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Course Descriptions

NS 540 Concepts in Physics I: Forces and Motion

- **Physics content:** Focus on classical physics and the Newtonian concepts of rectilinear motion, conservation of momentum and conservation of energy.
- **Philosophy and History of Physics:** A comparison of Newtonian and pre-Newtonian models of motion.
- **Physics Education Research:** Introduction to students' misconceptions research on kinematics and dynamics.

NS 541 Concepts in Physics II: Rotation and Gravitation

- **Physics content:** The universal law of gravitation, uniform circular motion, rotational motion.
- **Philosophy and History of Physics:** Historical development of the experimental method.
- **Physics Education Research**: Introduction to novice and expert problem-solving strategies, concept-mapping for physics, and misconceptions about gravity.

NS 542 Concepts in Physics III: Fluids and Thermodynamics

- **Physics content:** Fluids, buoyancy, and the Laws of Thermodynamics
- **Philosophy and History of Physics:** Comparison of historical models of heat.
- **Physics Education Research**: Misconceptions about heat, temperature and kinetic energy.

NS 543 Concepts in Physics IV: Electrostatics, Magnetostatics & DC Circuits

- **Physics content:** Electric charge, electric and magnetic fields, and DC circuits.
- **Philosophy and History of Physics:** History of electricity and magnetism.
- **Physics Education Research**: Misconceptions about electricity and magnetism with applications to curriculum development.

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NS 544 Concepts in Physics V: Waves and Optics

Physics content: Harmonic motion, mechanical waves, and introduction to physical optics.

Philosophy and History of Physics: Introduction to the structure of scientific revolutions and examination of the case study of the pendulum.

Physics Education Research: Misconceptions on waves and optics.

NS 545 Concepts in Physics VI: Electromagnetism

Physics content: Accelerating charges, electromagnetic induction, AC circuits, resonance, and geometrical optics.

Philosophy and History of Physics: History of electromagnetism.

Physics Education Research: Misconceptions about electromagnetism.

NS 546 Concepts in Modern Physics I: Quantum Physics

Physics content: Experimental foundations of quantum physics, such as blackbody radiation, the photoelectric effect, and wave-particle duality.

Philosophy and History of Physics: An investigation of Millikan's oil drop experiment; development of quantum physics.

Physics Education Research: Misconceptions about atomic structure.

NS 547 Concepts in Modern Physics II: Special Relativity and Related Topics

Physics content: Einstein's Theory of Special Relativity and its applications to nuclear physics, particle physics, astronomy, and cosmology.

Philosophy and History of Physics: The development of nuclear physics and its ethical considerations.

Physics Education Research: The history of the atomic bomb and misconceptions about special relativity.

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NS 548 Computer Modeling of Physical Phenomena

Physics content: The use and development of simulations to model classical physical phenomena in mechanics, optics, electricity and magnetism; investigations of nonlinear dynamics and chaos.

Philosophy and History of Physics: Chaos, determinism and indeterminism in physics.

Physics Education Research: Literature on the effective use of computer simulations in the physics classroom.

NS 549 Everyday Applications of Physics

Physics content: Physics of everyday life. In-detail examination of real-world applications.

Philosophy and History of Physics: Challenging the commonsensical understanding of physics through epistemology.

Physics Education Research: Exploration of effective techniques for designing physics projects.

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Paying for ITOP Courses

The ten two-credit ITOP courses are currently offered as Boston University Extension Courses. For the academic year 2019 – 19, the price per two-credit course is $855. The BU price per credit changes each year with the beginning of the summer semester.

In addition to tuition, there is a registration fee of $70 paid once each semester.

Commuting and Parking

Courses at Boston University are held at 590 Commonwealth Avenue, the Metcalf Science Center. For commuters, the Green Line stops in front of the Metcalf Center for Science and Engineering (the Blandford Street stop, the first one outbound after Kenmore). If you choose to drive, Boston University graduate students can purchase an inexpensive parking permit valid after 4 PM at the parking structures on campus. For the 2019 – 20 year, the White Permit costs $129.20 per semester for graduate students.