Department of Physics

(Division of Science)

Professor Marilyn Gunner, Chair • Department Office: MR 419 • Tel: 212-650-8332

General Information

The City College offers the following master's degree in Physics:

M.S.

Degree Requirements

Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS V5100</td>
<td>Mathematical Methods in Physics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS V1100</td>
<td>Analytical Dynamics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS V5100-1000</td>
<td>Electromagnetic Theory</td>
<td>8</td>
</tr>
<tr>
<td>PHYS V5200-2600</td>
<td>Quantum Mechanics</td>
<td>8</td>
</tr>
<tr>
<td>Elective Courses</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Total Credits: 30

Additional Requirements

No more than nine credits taken in 6000-level courses (see PHYS SS 5100-5500, PHYS 53000, PHYS 54100 in the Undergraduate Bulletin) may be counted toward the graduate degree. Nine credits may be taken in graduate courses in subjects other than Physics, upon approval of the Graduate Committee.

Thesis: Not required.

Comprehensive Examination: A written comprehensive examination is required unless waived by the Graduate Committee.

Foreign Language Requirement: Not required.

Transfer to Ph.D. Program

Students in the Master's Program at The City College can usually transfer to the Ph.D. program by taking and passing the "First Examination." See the Graduate Advisor.

Advisement

Graduate Advisor

Prof. Timothy Boyer

Location: MR 331

Tel: 212-650-5556

Doctoral Courses Open to Master's Students

The City College is a major participant in the University Ph.D. program in Physics and offers extensive research facilities for experimental and theoretical research. Both master's and undergraduate students often take part in these research efforts. For more details please see the Bulletin of the Graduate School of the City University of New York.

Some of the courses offered regularly on the advanced level include:

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>PHYS W1200</td>
<td>Continuum Mechanics</td>
<td>4 cr.</td>
</tr>
<tr>
<td>PHYS W2500-2600</td>
<td>Quantum Field Theory</td>
<td>4 cr.</td>
</tr>
<tr>
<td>PHYS W3000</td>
<td>Theory of Relativity</td>
<td>4 cr.</td>
</tr>
<tr>
<td>PHYS W5100-4600</td>
<td>Quantum Theory of Solids</td>
<td>4 cr.</td>
</tr>
<tr>
<td>PHYS W5100-5900</td>
<td>Selected Topics in Advanced Physics</td>
<td>4 cr.</td>
</tr>
</tbody>
</table>

Physics Course Descriptions

Master's Level Courses

PHYS U3500: Introduction to Quantum Physics I


PHYS U3600: Introduction to Quantum Physics II

Review of Schrödinger equation, Uncertainty principle, Formalism: Observables, Operators, etc. Application to simple cases: 2D level systems, electron in magnetic field, Angular momentum: Both model realized, Magnetic properties of solids, Time-independent perturbation theory and applications, Time-dependent perturbation theory, lasers, Masers, etc. Adiabatic processes, Berry's phase, when does phase matter? Quantum entanglement, Bell's theorem and recent experiments. Required for Physics majors. Prereq: PHYS 35100, or PHYS U3500, MATH 39100, MATH 39200. 4 hr./wk., 4 cr.

PHYS U4500: Solid State Physics (same as Physics 54000)

3 hr./wk., 3 cr.

PHYS U5300: Photonics I - Laser Physics

Theory and application of lasers and masers. Physical principles underlying the design of lasers, coherent optics, and non-linear optics. Prereq: A course in modern physics (PHYS 35100 or PHYS 32100 or PHYS 32000) and a course in Electricity and Magnetism (PHYS 35400 or EE 33200). 3 hrs./wk., 3 cr.

PHYS V1100: Analytical Dynamics

The Lagrangian formulation, including Hamilton's principle, Lagrange's equations, central force motion, Kepler problem, scattering, rigid body motion, transformation matrices, Eulerian angles, media tensor, The Hamiltonian formulation, including canonical equations; canonical transformations; Hamilton-Jacobi theory; Small oscillations. Continuous systems and fields; Relativistic dynamics. All master's students will generally be required to take Physics V1100. 3 hr./wk., plus conf., 4 cr.

PHYS V1500: Analytical Mechanics

Electrostatics, magnetostatics, and boundary value problems; Maxwell's equations; multipole radiation from accelerated charges; scattering theory; Special Theory of Relativity. Prereq: PHYS V1100 all master's students will generally be required to take PHYS V1500. 3 hr./wk., plus conf., 4 cr./sem.

PHYS V2500-2600: Quantum Mechanics


PHYS V3800: Biophysics

Introduction to the structure, properties and function of proteins, nucleic acids, lipids and membranes. In depth study of the physical basis of selected systems including vision, nerve transmission, photosynthesis, enzyme mechanism and cellular diffusion. Introduction to spectroscopic methods for monitoring reactions and determining structure including light absorption or scattering, Fluorescence, NMR and X-ray diffraction. The course emphasizes reading and interpretation of original literature. 3 hr./wk., plus conf., 4 cr.

PHYS V4100: Statistical Mechanics

Probability theory, ensembles, approach to equilibrium, quantum and classical local and non-local gases, cooperative phenomena, density matrices, averages and fluctuations, and other selected topics, such as the time-temperature Green's functions, nonequilibrium temperature variation and perturbation methods. Prereq: PHYS V2500. 3 hr./wk., plus conf., 4 cr.

PHYS V4500: Solid State Physics

Principles of crystallography; crystal structure; lattice vibrations, band theory, defects; study of ionic crystal, dielectrics, magnetism, and free electron theory of metals and semiconductors. Topics of current interest such as high
temperature superconductivity, quantum Hall Effect, and fullerenes will be included, depending on interest. Prereq: PHYS V2000. 3 hr/week, plus coreq: 4 cr.

PHYS V7100, V7200: Graduate Physics Laboratory I, II
The concepts and tools of experimental physics. Basic analog apparatus and digital electronics: the use of minicomputers for data acquisition, the control of experiments and data analysis; discussion of intrinsic noise and error analysis. Execution of several advanced experiments, including statistics of radioactive decay, Raman spectroscopy, temperature dependence of resistivity, and others. The second semester of this course is PHYS V7901. 2 lst, 2 lab hr/week, 4 cr.

PHYS W1200: Centrifugal Mechanics
4 cr.

PHYS W3060-2600: Quantum Field Theory
4 cr.

PHYS W3400: Theory of Relativity
4 cr.

PHYS W4600-4600: Quantum Theory of Solids
4 cr.

PHYS W5100-5900: Selected Topics in Advanced Physics
4 cr.

Faculty

Robert B. Alfano, Distinguished Professor
B.S., Fairleigh Dickinson Univ, M.S., Ph.D., New York Univ.
Joseph E. Benziger, Distinguished Professor
B.S., The City College, M.S., Columbia Univ, Ph.D.; Der-science
Timothy Boyer, Professor
B.A., Yale Univ, M.A., Harvard Univ, Ph.D.
Ngue-Peng Chang, Professor
B.S., Ohio Wesleyan Univ; Ph.D., Columbia Univ.
Harold Fish, Professor
B.S., Iowa State Univ, Ph.D., Univ. of Washington
Swapan K. Gayer, Professor
B.S. (Bhawan), Univ. of Dehradun, M.Sc., M.S., Univ. of Connecticut, Ph.D.
Jud Gerstein, Professor
B.S., The City College, M.A., Columbia Univ, Ph.D.
Daniel G. Griswold, Mark R. Zumberg Professor
B.S., M.I.T., M.S., Univ. of Illinois, Ph.D.
Wayne Gunther, Professor and Chair
B.A., SUNY Binghamton; Ph.D., Univ. of Pennsylvania
Michio Kaku, Senior Professor
B.A., Harvard Univ; Ph.D., Univ. of California (Berkeley)
Ronald Kother, Assistant Professor
B.S., Univ. of Virginia-Columbia; Ph.D., John Hopkins
Jacek Koplik, Professor
B.S., Cooper Union; Ph.D., Univ. of California (Berkeley)
Lia Kroun-Rubin, Professor
Ph.D., New York University
Michael K. Rubenstein, Professor
B.A., Columbia Univ; M.S., Yale Univ, Ph.D.
Herman Makie, Professor
Licenciatura (Physics), Univ. of Buenos Aires; Ph.D., Boston Univ.
Carlos Andres Martinez, Associate Professor
B.S., FAMAR, Universidad Nacional de Cordoba, Argentina, Ph.D.
V. Parameswaran Nair, Distinguished Professor
B.S., Univ. of Kerala, M.Sc., Syracuse Univ, Ph.D.
Vladimir Petrovic, Professor
Dipl. EE, Univ. of Belgrade, M.S., Miami Univ, Ph.D., CUNY
Aleks P. Polychronakos, Professor
Dipl. EE, National Technical Univ. of Athens; M.Sc., California Institute of Technology, Ph.D.
Myriam P. Saravov, Distinguished Professor
B.A., Bernard College, M.S., Columbia Univ, Ph.D.
David Schumaker, Professor
B.Sc., Hebrew Univ; M.Sc., Technion, D.Sc.
Mark Shattuck, Associate Professor
B.A., Wake Forest Univ, M.S., Ph.D., Duke Univ.
Frederick W. Smith, Professor
B.A., Lehigh Univ; Ph.D., Brown Univ.
Brian Tiburzi, Assistant Professor
B.A., Amherst College; M.S., Univ. of Washington, Ph.D.
Jianfeng J. Tu, Associate Professor
A.B., Harvard Univ, A.M., M.S., Cornell Univ, Ph.D.
Sergey A. Vlaskin, Associate Professor
M.S., Moscow Institute of Physics and Technology, Ph.D., Institute of Solid State Physics, Russian Academy of Sciences

Participating Faculty

Morton M. Denn, Albert Einstein Professor
B.S.E. (E.E.), Princeton Univ; Ph.D., Univ. of Minnesota
Richard N. Steinberg, Professor
B.S., SUNY Binghamton, M.S., Yale Univ, Ph.D.

Professors Emeriti

Adolph Abrahamson
Michael Arens
Alvin Bachman
Robert Callender
Victor Chuang
Erich Eichbach
Hiram Hart
Martin Kramer
Robert M. Lea
Harry Lustig
William Miller
Marvin Mittelman
David Shobolzky
Martin Forsten