De La Salle University

MASTER OF SCIENCE IN PHYSICS

The Master of Science in Physics program aims to develop competent manpower to fill the demands of industry and academe. At the end of the program, the students should have acquired a deeper understanding of the fundamental principles and concepts in physics. This would enable them to make creditable contributions to the research and development programs of industries involved in solid state physics, materials science, semiconductor physics, laser remote sensing, computational physics, and instrumentation.

Program Requirements

Advance Academic Writing	(6 units)
Basic Courses	9 units
Major Courses	15 units
Elective Courses	6 units
Comprehensive Examination	0 unit
Thesis	6 units
Total	**36 units**

Course Descriptions

Advance Academic Writing Courses:

Advanced Technical Reading and Writing I (ENG501M)
3 units
The first part of an intensive English academic reading and writing course, focuses on the review of basic reading and writing skills and their application in the preparation of short academic papers such as definitions and descriptions, and non-prose forms. It emphasizes the mastery of active reading strategies, the effective use of rhetorical and organizational features of academic writing, and proper documentation.

Advanced Technical Reading and Writing II (ENG502M)
3 units
The second part of the intensive English academic reading and writing course, focuses on the writing of data commentary and the various parts of a research report, with emphasis on the different rhetorical moves and the linguistic features that realize these moves. The course continues to emphasize the observance of integrity in writing and research.

Basic Courses

History and Philosophy of Science and Mathematics (PHY551M)
3 units
A course on the history of science and mathematics with emphasis on the significant contributions of people who have laid the foundations of science and mathematics; the philosophy of science with concentration on the conceptualization and methodology of science, elements of scientific enterprises and movements of scientific thought; and the relation of science to other fields: religion, literature, politics and other social sciences.

Fundamental Statistics and Statistical Mechanics I (PHY619M)
3 units
A course on the application of probability and statistical ideas to systems is particles in equilibrium. The basic notions to derive macroscopic thermodynamics on the basis of a microscopic description. Among the topics covered are the canonical distribution, micrononical distribution, Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics, strongly interacting systems, fluctuations and kinetic theories.

Research Apprenticeship and Seminar I (PHY851M)
1 unit
A research course where students are required to work as apprentice of a research group of the department. Students are also required to attend seminars of the research group.

Research Apprenticeship and Seminar II (PHY853M)
1 unit
A research course where students are required to collaborate in research work of a research group of the department.

Research Apprenticeship and Seminar III (PHY854M)
1 unit
A research and seminar course where students are required to collaborate in research work of a research group of the department. Students are also required to give a seminar related to his research work.

Major Courses:

Classical Mechanics I (PHY601M)
3 units
Introduction to dynamical systems, Hamilton dynamics, variational principles, canonical transformations, Hamilton Jacobi theory, advanced linear dynamics, and classical field theory.

Classical Electrodynamics I (PHY605M)
3 units
The microscopic Maxwell equations; electrostatics in vacuum and in dielectrics; stationary currents and magnetostatics; conservation theorems for the electromagnetic waves; and wave guide and resonant cavities.

Quantum Mechanics I (PHY609M)
3 units
Linear vector spaces and representation theory; general formulations; simple quantum mechanical systems; quantum dynamics; and path integral methods.

Quantum Mechanics II (PHY611M)
3 units
Symmetries, stationary-state perturbations theory; time-dependent perturbation theory; collision theory.
Prerequisite: Quantum Mechanics I

Solid State Physics I (PHY625M)
3 units
Fundamental principles of the physics of solids. Topics include periodic structure, lattice waves, electron states, static properties of solids, and dynamics of electrons in solids.
Prerequisite : Classical Mechanics I, Classical Electrodynamics I, and Statistical Mechanics I

Elective Courses:

Advanced Quantum Mechanics I (PHY613M)
3 units
Formal scattering theory; relativistic quantum mechanics; Feynman calculational techniques and Feynman graphs.
Prerequisite : Quantum Mechanics II

Atomic and Molecular Physics I (PHY699M)
3 units
Quantum mechanical treatment of the structure and interactions of atoms and molecules; complex atomic spectra; Hartee Fock Slater methods; vector coupling; multiplet theory and Racal methods; transition probabilities and selection rules; molecular rotations and vibrations; and group theoretic methods in molecular physics.
Prerequisite : Quantum Mechanics II

Atomic and Molecular Physics II (PHY701M)
3 units
Topics to be selected from rotational, vibrational and electronic spectra of molecules; molecular orbitals; techniques of nuclear magnetic resonance, microwave, electron spin resonance, infrared, Raman, optical and ultraviolet spectroscopy; applications to stellar spectra; and introductions to the theory of atomic collisions.
Prerequisite : Atomic and Molecular Physics I

Classical Mechanics II (PHY603M)
3 units
Methods of non-linear dynamics, chaotic dynamical systems, strange attractors, routes to chaos, solitary waves and solitons, the methods of inverse scattering, kinks and vortices.
Prerequisite : Classical Mechanics I

Classical Electrodynamics II (PHY607M)
3 units
Electromagnetic multipole radiation; principles of special relativity; covariant formulation of electrodynamics; radiation from moving charges; bremsstrahlung; relativistic dynamics of charges and fields; classical electron theory; and magnetohydrodynamics.
Prerequisite : Classical Electrodynamics I

Computational Methods of Physics (PY637M)
3 units
A course on numerical methods, introduction to linear and dynamics programming, principles of simulation and modeling, computer languages for numerical solutions and algebraic manipulations.

Condensed Matter Physics (PHY717M)
3 units
It is an introductory course on the quantum-mechanical treatment of the physics of solids and quantum liquids. It begins with discussions on collective excitations and quasiparticles, develops calculational methods such as the Hartree-Fock approximation and the random phase approximation that are appropriate for fermions, the Bogoliubov theory and the Debye model that are appropriate for bosons, develops the one-electron theory to treat metals, insulators and semiconductors, and ends with discussions on density functional theory.
Prerequisite : Classical Mechanics I, Classical Electrodynamics I, Quantum Mechanics I, and Statistical Mechanics I

Elementary Particle Physics (PHY643M)
3 units
Space-time properties of particles; classification of particles and their symmetries; and properties of particles and their interactions.
Prerequisite : Quantum Mechanics II

Experimental Methods in Physics (PHY693M)
3 units
A course on the basic experimental techniques in physics and practical work on vacuum systems.

General Relativity (PHY647M)
3 units
Manifolds, modern differential geometry and tensor analysis; basic principles of general relativity; Einstein's field equations and their mathematical properties; exact solutions; linearized theory; variational principles and conservation laws; equations of motion; gravitational waves; and experimental tests.

Laser Physics (PHY651M)
3 units
Einstein's theory of light-matter interaction; rate equation; density matrix formalism of quantum mechanics; Maxwell Schrodinger equation, Maxwell Bloch equations; steady state behavior and instabilities of single-mode lasers; optical bistability; multimode laser operation and multimode instabilities; and coherent pulse propagation.
Prerequisite : Quantum Mechanics II

Mathematical Methods of Physics I (PHY655M)
3 units
Selected advanced methods in partial differential equations and integral equations such as Hilbert space methods, Green-function methods, approximation methods, variation methods, and optimization methods.

Mathematical Methods in Physics II (PHY657M)
3 units
A course on group theory and its applications to physics, including such topics as abstract groups, group representation, the symmetric, permutation, and other finite groups; topological groups, Lie groups, the rotation, Lorenz and other important Lie groups of physics, and various physical applications of grouptheory.

Mathematical Methods of Physics III (PHY659M)
3 units
Selected advanced topics in topology, differential geometry, and related areas of mathematics that are important in contemporary theoretical physics.

Mathematical Methods in Physics IV (PHY661M)
3 units
Selected advanced topics in functional analysis, operator algebras, and related areas of mathematics that are important in contemporary theoretical physics.

Nuclear Physics (PHY667M)
3 units
Nuclear Structure; self-consistent fields; shell model; single particle excitations and vibrations, linearization methods; theory of deformed nuclei, pairing in nuclei; and quasi-particles.
Prerequisite : Quantum Mechanics I

Quantum Electronics (PHY683M)
3 units
An introductory graduate course on quantum electronics covering such topics as quantization of lattice vibration, quantization of electromagnetic fields, the propagation of optical beams, optical resonators, laser oscillation and laser systems.
Prerequisite : Quantum Mechanics I

Quantum Field Theory (PHY679M)
3 units
Lagrangian field theory; field quantization; Feynman path integral in field theory; renormalization; dimensional regularization and its application to lambda phi to the 4th theory.
Prerequisite : Advanced Quantum Mechanics I

Semiconductor Physics (PHY673M)
3 units
A course on semiconductor physics covering such topics as transport properties, carrier diffusion processes, scattering processes, quantum effects in transport phenomena, and optical properties of semiconductors.
Prerequisite : Solid State Physics I

Solid State Physics II (PHY627M)
3 units
Transport and optical properties of solids, Fermi surface, magnetism, superconductivity, amorphous and disordered systems.
Prerequisite : Solid State Physics I

Statistical Mechanics II (PHY621M)
3 units
Elementary transport theory; Onsager's relations; Wiener Khinchin theorem; fluctuation dissipation theorem; Linear response theory; response theory; thermodynamics stability criteria far from equilibrium; and examples of non-equilibrium phase transitions.
Prerequisite : Statistical Mechanics I

Research Courses:

Directed Research with laboratory (PHY870M)
0 unit
Preliminary investigation on an original research problem under the supervision of an adviser. The course is designed for students who wish to start research work, but are not yet eligible to enroll in a thesis course.

Physics Thesis I to IX (PHY876M – PHY884M)
6 units
Conduct of an original research under the supervision of an adviser. The course requires the presentation and oral defense of the results of an approved research problem before a panel of examiners as well as the submission of the final bound copies of the thesis.

Comprehensive Examination:

Each student should have a minimum grade of **50%** percentile score in all four areas: classical mechanics, classical electrodynamics, quantum mechanics, and statistical mechanics to pass the written comprehensive examination.