

PHYSICS DEPARTMENT

The Physics Department is one of the 13 departments under the College of Arts and Sciences of Silliman University. Until 1976, the Physics Department had been a service unit offering required and elective courses for the different degree programs of the university. Today, the Physics Department has teaching laboratories and research laboratories in several fields of physics. From 1998 to 2006, the Silliman Physics Department had been designated by CHED as a Center of Development in Physics.

As a service unit in the 1960's, the Silliman Physics Department was run by faculty members who were holders of BSE Major in Physics degrees or BS Engineering degrees. No one had a BS Physics degree then. This was a typical situation in most universities in the Philippines at this time. In 1972, however, an M.S. Physics degree holder joined the faculty. Then in 1974 and 1976, respectively, a B.S. Physics degree holder and a second M.S. Physics degree holder joined the Silliman Physics Department. With these three physics degree holders, a new program, Bachelor of Science (major in Physics) was presented to the Academic Council and officially opened in 1976.

The offering of the Bachelor of Science (Major in Physics) made Silliman University one of the seven institutions in the entire Philippines offering the baccalaureate degree in Physics. The 1991 Official Report of the Congressional Committee on Education declared physics as the most depressed sector in Philippine education with only 4% of the high school physics teachers having a major in Physics. Very few Filipino students were interested in Physics. The number of students enrolling in the B.S. (Physics) program was never more than five at any given year.

The Bachelor of Science (major in Physics) program attracted students who enrolled in it but in 1986, the program stopped due to a change in administrative priorities. In 1992, after research studies showed that many students were fascinated by computers, the BS (Physics) program was reopened as BS Physics with Emphasis in Computer Applications. This new program was designed for students interested not only in why and how computers work but also in understanding and mastering physical phenomena. In 1992, when a third faculty member with an MS Physics degree joined the Physics Department, the Physics Department had now enough highly qualified faculty to embark on a new program. In 1993, BS Physics with Emphasis in Medical Applications was offered for students interested in medical careers in modern hospitals where physics has made significant inroads with such techniques as ultrasonic imaging, magnetic resonance imaging (MRI), or laser surgery. In November 1996 Dr. Christian Karl Schales, a Visiting Professor in Information Technology, joined the Physics Department. He established the Local Area Network (LAN) Laboratory, a great boost to the Computer Applications Program. With his help, the computer subjects were updated and enhanced and the department acquired additional computer

seminars in Information Technology for members of the Silliman community.

Graduate physics programs were introduced in the schoolyear 1993-1994. BS Physics With Emphasis in Medical Applications was offered.

Introducing major fields of concentration into the BS Physics curriculum was a pioneering act in the field of physics education. It allows students to choose a special field to study in their BS Physics curriculum. Right on their first year in college as they take their Algebra, they also start to learn how to program a computer so it is able to do simple repetitive tasks. Every semester thereafter, the BS Physics students are trained to use the computer as a tool that can be used in the laboratory or in the office while they master the principles that govern the physical world.

Graduate physics programs were introduced in school year 1993-1994. Presently the department offers Masters of Science in Physics (MS Physics) and Masters of Arts in Science Teaching in Physics (MAST Physics).

In 1998, the Silliman Physics Department became a CHED Center of Development in Physics. As such, it was tasked with leading in the development of physics and physics education in Region VII and in the country as a whole.

Silliman University – A Focus of Physics Activities in the Visayas

Dr. Gerardo Maxino, together with other Physics graduates from the University of San Carlos, founded the Philippine Physics Society (PPS) in 1974. In 1979, Silliman University was the site of a meeting of physicists which gathered for the first time nearly all physics Ph.D. holders and all active physics professionals in the country. This gathering inaugurated the strong involvement of the Silliman Physics Department in the PPS. The PPS, which meets yearly in a different school in the Visayas and Mindanao has become for the Physics faculty a motivation to prepare lectures, build equipment, and write papers. The Silliman Physics Department has been the homebase of the PPS from its inception until 2007.

As a result of the gathering of physicists at Silliman University in 1979, national science agencies became aware of the existence of the Silliman Physics Department. In the same year, the physics department was the recipient of a research grant from the Philippine Atomic Energy Commission, which included equipment as well as salaries for research personnel. Thus the Environmental Radioactivity Monitoring Center at the Silliman Physics Department was born. The project lasted until 1986. Also, in the summer of 1994, the Philippine Nuclear Research Institute held its Radioisotope Techniques Training Course at Silliman.

In 1980, through the efforts of the PPS, the Fund for Assistance to Private Education (FAPE), funded the Southern Teachers Enrichment Program (STEP) which offered physics major subjects to physics teachers who were non-majors in physics, and the MS Physics degree to BS Physics degree holders. Silliman University physics faculty made up part of the teaching consortium for

which ran for the summer terms 1981, 1982, and 1983. From 1986 to 1988, the Silliman Physics Department handled for the Department of Science and Technology Science Education Institute, the Certificate Program for Physics Teachers in Secondary Schools.

In 1990, UNESCO invited Dr. Gerardo Maxino to participate in its University Physics Project. The project provided him funds to design, construct, and reproduce instructional materials and equipment useful for physics education. Many of the equipment produced from this project have been introduced in barangay and diocesan high schools. The Instructional Physics Toys Research Laboratory at the Silliman Physics Department is an offshoot of this project.

S.U. Physics Department -- CHED Center of Development (COD) in Physics

To hasten the development of quality education in the country, CHED designated Centers of Development and Centers of Excellence in different fields throughout the Philippines. The bases for selection included the academic degrees of the faculty, their research, publication, and extension work, and the laboratory and library facilities of the school. The Silliman Physics Department had been designated a COD in Physics in 1998. As COD in Physics, the department was entitled to receive one million pesos yearly for three years to upgrade its laboratory and library facilities, to send its faculty for higher degrees or to attend conferences, to grant scholarship to its Physics majors, and to improve instruction through linkages.

Starting out with nothing but the most basic physics laboratories, Silliman University Physics Department, under the dedicated, competent, and excellent leadership of Dr. Gerardo Maxino and Dr. Vicenta Maxino, was able to set up teaching laboratories in Optics, Modern Physics, Electricity and Magnetism, Electronics, and Heat, and research laboratories in Environmental Radioactivity, Acoustics and Material Properties, Instructional Physics Toys, and the Local Area Network (LAN) Laboratory.

B.S. Physics Curriculum With Emphasis in Computer Applications

FIRST YEAR

First Semester	units	Second Semester	units
BC11 (Basic Communication)	3	BC 12 (Basic Communication)	3
Spch 11 (Basic Speech Comm)	3	Phys 32 (Computational Physics)	3
Phys 31 (Computational Physics)	3	Chem 12 (General Chemistry)	5
Chem 11 (General Chemistry)	5	Math 25 (Mathematical Analysis)	5
Math 11 (College Algebra)	3	Phys 45 (General Physics I)	4
Math 12 (Plane Trigo)	3	PE 11 (Basic Physical Ed)	2
PE 11 (Basic Physical Ed.)	2	CMT 12	3
CMT 11	3		

SECOND YEAR

First Semester	Units
BC 21 (Basic Communication)	3
Phys 46 (General Physics II)	4
Phys 66 (Statistical Methods)	3
Math 26 (Mathematical Analysis)	5
Rel 11 (Old Testament Message)	3
Phys 39 (Computer Lang/ Foreign Lang)	3
PE 21 (Basic Physical Ed.)	2
Second Semester	Units
Lit 22 (Literature of the World)	3
Socio 11 (Introduction to Socio)	3
Phys 40 (Comp Lang/ Foreign Lang II)	3
Phys 47 (General Physics III)	3
Math 31 (Mathematical Analysis)	5
PolSci 11 (Tax and Land Reform)	3
Rel. 22 (New Testament Msg)	3
P.E.22 (Basic Physical Ed)	2

THIRD YEAR

First Semester	Units
Fil 13 (Basic Communication Skills)	3
PolSci 51 (Phil Gov't and Constitution)	3
Math 51 (Differential Equation)	3
Philo 31 (Introduction to Logic)	3
Phys 67 (Vector Analysis)	3
Phys 71 (Mathematical Physics)	3
Phys 83 (Computer in Scient'fc Reports)	2
Phys 91 (Geometrical Optics)	4
Second Semester	Units
Fil 24 (Pilipino Literature)	3
Hist 52 (Phil. History)	3
Lit 20 (Literature of the Phil.)	3
Phys 50 (Elementary Biophysics)	4
Phys 86 (Computer Physics)	4
Phys 92 (Physics Optics)	4
Phys 84 (Fund of Electronics)	3

FOURTH YEAR

First Semester	Units
Philo 61 (Christian Ethics)	3
Hist 41 (Rizal's Life and Works)	3
Phys 81 (Electricity and Magnetism I)	4
Phys 87 (Computer Interfacing)	4
Phys 93 (Modern Physics I)	4
Phys 95 (Elem. Quantum Mechanics)	3
Second Semester	Units
Phys 76 (Statistical Physics)	4

Phys 82 (Electricity and Magnetism)	4
Phys 88 (Computer in Data Handling)	3
Phys 94 (Modern Physics II)	4
Phys 100 (Research Problem)	3
Socio 63 (Current Issues & Social Problems)	3

COURSE DESCRIPTIONS

Physics 11 BASIC CONCEPTS OF PHYSICS 3 units

Selected basic concepts of physics (from Newtonian Mechanics down to Modern Physics) with selected experiments to illustrate the experimental methods employed in Physics.

6 hours/week

Physics 13 COMPUTER AND SOCIETY 3 units

A study of the fundamental principles of computers, programming, operations, application and social-cultural implications of computers.

5 hours/week

Physics 24 SELECTED TOPICS IN PHYSICS 5 units

A selection of fundamental principles and experiments in mechanics, heat, vibration and waves, electromagnetism, optics, modern physics, and physical pollution.

7 hours/week

Physics 25 EARTH SCIENCE 3 units

The earth and its environment in space. Selected principles of astronomy, geology, meteorology, oceanography, soil science, physical pollution, and wise conservation and utilization of natural resources.

5 hours/week

Physics 28 ASTROPHYSICS 3 units

Newton's laws of motion and universal gravitation, Kepler's laws, astronomical bodies and the dynamics of their motion, energy production in stars, black holes, big band spectroscopy and astronomical instruments.

5 hours/week

Mathphysics 25 MATHEMATICAL ANALYSIS I 5 units

Analytical geometry in a line, algebraic transcendental functions of one variable, rate of change of a function, derivative and differential limits, continuity, the mean-value theorem, applications of the derivatives, indefinite integration area under a curve, the fundamental theorem of integral calculus, applications in physics.

Prerequisites: Math 11 and 12 5 hours/week

Mathphysics 26 MATHEMATICAL ANALYSIS II 5 units

Techniques of integration, improper integrals, numerical methods of integration, plane analytic geometry in Cartesian and polar coordinates, tangents and normals, curve plotting, conics, curve fitting, hyperbolic functions, parametric equations,

curve plotting, conics, curve fitting, hyperbolic functions, parametric equations, applications in physics.

Prerequisite: Math 25

5 hours/week

Mathphysics 31 MATHEMATICAL ANALYSIS III **5 units**

Vectors, space geometry, functions of several variables, directional derivatives, gradient, partial differentiations and applications, multiple integration and applications, infinite series, power series, expansions, Taylor's theorem, convergence, first order differential equations, nth order differential equations, infinite series solutions of differential equations, application in physics.

Prerequisite: Math 26 5 hours/week

Mathphysics 51 DIFFERENTIAL EQUATION **3 units**

Review of ordinary differential equations, Laplace transforms, Gamma function, total differential equations, application of total and simultaneous equations. Solution by series, the Runge-Kutta method, Sturm Ouville problems, Fourier Series, partial differential equations and applications in physics.

3 hours/week

Physics 30 PRINCIPLES OF GEOLOGY **3 units**

A general geology course. It is concerned with the processes that are at work upon and within the earth. It deals with the record of the rocks; rock weathering, the work of streams, ground water, wind, ocean and ice; movement of the earth's crust; igneous activity; earthquakes and the earth's interior, mountain making; sedimentary rocks and environment of deposition, strata, fossils, and time, identification of rocks and minerals.

3 hours/week

Physics 31 COMPUTATIONAL PHYSICS **3 units**

Boolean Algebra, Logic circuits and introduction to programming as applied to basic mathematical and physical problems.

6 hours/week

Physics 32 COMPUTATIONAL PHYSICS II **3 units**

Programming language like JAVA as applied to Physics.

Prerequisites: Physics 31 6 hours/week

Physics 33 GENERAL PHYSICS A **3 units**

Deals with mechanics, fluids, heat, vibration and sound with special applications slanted for agriculture.

6 hours/week

Physics 34 GENERAL PHYSICS B **3 units**

Deals with optics, electricity, magnetism, atomic and nuclear physics with special applications slanted for agriculture.

Prerequisite: Physics 33

6 hours/week

Physics 36 BASIC PHYSICS FOR FOOD AND NUTRITION 3 units

A study of basic physics with emphasis on mechanics, heat, sound, light, electricity and magnetism, radioisotopes, and applications to food and nutrition.

5 hours/week

Physics 37-38 COMPUTER ASSISTED LEARNING 1-1 unit

A hands-on exploration and use of current software in physics education.

Prerequisite: Physics 32

4 hours/week

Physics 39 COMPUTER LANGUAGE I 3 units

(Assembly Language)

It deals with the use of low-level computer programming language on microprocessors. Assembly programs for controlling I/O devices such as disk drives, key boards, mouse, screen etc. are also given emphasis.

Prerequisite: Physics 32 5 hours/week

Physics 40 COMPUTER LANGUAGE II 3 units

(C++ Programming)

It deals with the concepts on object-oriented programming language by the use of C++. Physics and mathematical applications with the use of C++ program codes are also included.

Prerequisite: Physics 32

6 hours/week

Physics 41 METEOROLOGY 3 units

An introduction to meteorology, dealing with heat transfer processes in the atmosphere, atmospheric structure and stability, pressure, wind, water, cloud types, formation of precipitation, observational methods, radar, satellites, air masses, fronts, thunderstorms, tropical storms, anticyclones, depressions and atmospheric pollution. Some practical work will be involved in measuring various local parameters.

5 hours/week

Physics 45 GENERAL PHYSICS I 4 units

Deals with mechanics, fluids and vibration. Prerequisites: Algebra & Trigonometry, H.S. Physics. 6 hours/week

Physics 46 GENERAL PHYSICS II 4 units

Deals with heat, thermodynamics, electricity and magnetism.

Prerequisite: Physics 45 6 hours/week

Physics 47 GENERAL PHYSICS III 3 units

Optics and modern physics (relativity and quantum theory, atomic and nuclear physics).

Prerequisite: Physics 46

6 hours/weeks

Physics 50 ELEMENTARY BIOPHYSICS

4 units

The physics of liquids, sound, waves, light as applied to biological system and medical electronics.

Prerequisite: Physics 47 6 hours/week

Physics 65 RADIATION PHYSICS

3 units

X-rays, interactions of radiation with matter, radiation instruments, radiation statistics, measurements, and counting techniques, radioisotopes and their applications, health physics.

Prerequisite: Physics 47 or Concurrent 6 hours/week

Physics 66 STATISTICAL METHODS

3 units

A study of permutation, combination and probability, common sampling procedures, frequency distribution, measures of central tendency, measures of dispersion, linear correlation, the method of least squares, inferential statistics and other statistical measurements in physics including statistical software.

Prerequisite: Math 11 6 hours/week

Physics 67 VECTOR ANALYSIS

3 units

Vector algebra, vector differentiation and integration, introduction to tensors, applications.

Prerequisite: Physics 47 & Calculus 3 hours/week

Physics 69 ANALYTICAL MECHANICS

3 units

Dynamics of particles and system of particles,, gravitation, central force, energy, momentum, using Lagrangian and Hamiltonian formulations.

Prerequisites: Physics 47 and Calculus 6 hours/week

Physics 70 MEDICAL IMAGING TECHNIQUES

3 units

A study of current imaging techniques, imaging concepts, modes, analog versus digital considerations. Explores image production by x-rays, gamma rays, ultrasound and nuclear magnetic resonance.

Prerequisite: Physics 50 or concurrent 3 hours/week

Physics 71 MATHEMATICAL PHYSICS

3 units

Advanced mathematics using Lagrangian and Hamiltonian functions as applied to mechanics, conservation of energy, vibrations, wave propagation, and other physics problems.

Prerequisite Physics 47 and Math 31

3 hours/week

Physics 72 HEAT AND THERMODYNAMICS

3 units

Temperature, gas laws, thermodynamics processes and cycles, thermal properties of metals, thermal radiation.

Prerequisite: Physics 47 & Calculus

3 hours/week

- Physics 73 VIBRATION, WAVES & SOUND** **3 units**
 Simple harmonic motion, damped and forced vibration, resonance, wave propagation, standing waves, sound. Selected experiments
 Prerequisite: Physics 47 & Calculus 6 hours/week
- Physics 74 MECHANICS, HEAT & SOUND LABORATORY** **2 units**
 Selected experiments in mechanics, heat and sound.
 4 hours/week
- Physics 76 STATISTICAL PHYSICS** **4 units**
 A study of gas laws, thermodynamics processes and systems, thermal and mechanical properties of matter. Selected experiments.
 Prerequisite: Physics 47 6 hours/week
- Physics 81 ELECTRICITY & MAGNETISM I** **4 units**
 Potential, fields of charges at rest and in motion, capacitance, electric currents, and magnetic field. Selected experiments.
 Prerequisite: Physics 47 & Calculus 6 hours/week
- Physics 82 ELECTRICITY & MAGNETISM II** **4 units**
 Transformation of fields, electromagnetic induction and Maxwell's equations. Electric and magnetic fields in matter. Selected experiments.
 Prerequisite: Physics 81 & Calculus 6 hours/week
- Physics 83 COMPUTERS IN SCIENTIFIC REPORTS** **2 units**
 Word processing, spreadsheets, data base and presentation softwares as applied to scientific reports, the mechanics of term paper and thesis writing and physical bibliography.
 Prerequisite: Physics 32 4 hours/week
- Physics 84 FUNDAMENTALS OF ELECTRONICS** **3 units**
 Physical principles of vacuum tubes, semiconductor devices, integrated circuits and micro processors necessary to understand the modern electronic world.
 6 hours/week
- Physics 85 SOLID STATE PHYSICS** **3 units**
 A study of such topics as crystal structure analysis, elastic waves in crystals, electrons in metals, specific heat of solids, energy bands, semiconductors, superconductivity, and dielectric and magnetic properties of solids.
 Prerequisite: Physics 47 & Calculus 5 hours/week
- Physics 86 COMPUTER PHYSICS** **4 units**
 A study of computer concepts, hardware and operating systems, data signal processing,, fast fourier transforms, etc. with emphasis on physics applications
 Prerequisite: Physics 32
 6 hours/week

- Physics 87 COMPUTER INTERFACING** **4 units**
 Network and communication technologies, computer interfacing as applied to experimental physics.
 Prerequisite: Physics 32 & 47 6 hours/week
- Physics 88 COMPUTER DATA HANDLING** **3 units**
 Data acquisition, data structures and bases, and artificial neural network as related to physics and technological application.
 Prerequisite: Physics 32 6 contact hours
- Physics 91 GEOMETRICAL OPTICS AND OPTICAL INSTRUMENTS** **4 units**
 Fundamental principles of geometrical optics, lenses, and mirrors, ideal optical systems, images, stops, and pupils, optical instruments.
 Prerequisite: Physics 47 & Calculus 6 hours/week
- Physics 92 PHYSICAL OPTICS AND SPECTROSCOPY** **4 units**
 Huygens-Fresnel principles, intensity, photometry, refraction and reflection, dispersion, absorption, interference, diffraction, polarimetry, radiation and quantum optics, spectra.
 Prerequisite: Physics 91 6 hours/week
- Physics 93 MODERN PHYSICS I** **4 units**
 Special relativity, quantum theory, De Broglie waves, Schroedinger's equation, uncertainty principle, atomic structure and spectra. Selected experiments.
 Prerequisite: Physics 47 & Calculus 6 hours/week
- Physics 94 MODERN PHYSICS II** **4 units**
 Nuclear structure, nuclear forces and stability, radioactivity, radiation measurement, nuclear reactions, elementary particles. Selected experiments.
 Prerequisite: Physics 93 6 hours/week
- Physics 95 ELEMENTARY QUANTUM MECHANICS** **3 units**
 Deals with the dual nature of matter and radiation, state function. Schroedinger's equation and applications.
 Prerequisite" Physics 47 3 hours/week
- Physics 96 COLLEGE PHYSICS TEACHING** **3 units**
 Philosophy and methodology of physics education and teaching, curriculum development, learning resources. Includes effective methods of presentation and problem solving, preparing classroom demonstration, handling laboratory experiments, care, construction and repair of equipment.
 Prerequisite: At least 6 units of advance Physics 4 hours/week
- Physics 97-98 SEMINAR ON PHYSICS** **1-1 unit**
 At least one main paper and one minor paper required.

M.S. PHYSICS

Graduate Program Policies

Admission

1. For the M.S. Physics Program, only BS Physics or BS Major in Physics graduates can be directly admitted into the program. Graduates of other degrees should take at least 36 units of the undergraduate major physics courses beyond the general physics course. They should also have taken Calculus, Differential Equations, and Vector Analysis before admission to the program.
2. For the MAST Physics Program, the following requirements must be met before admission into the program:
 - a) Must have taken 18 units of undergraduate major physics courses beyond the general physics course
 - b) Must have taken Calculus, Differential Equations, and Vector Analysis.
3. Only those with a general QPA of 3.0 in their undergraduate degrees will be directly admitted to the program. Those who do not meet this requirement may be admitted on probation for a maximum period of two semesters. Students on probation who get a grade below 3.0 shall be dismissed from the program.

Retention

A student who gets a grade below 3.0 in at least two subjects shall be dismissed from the program.

Comprehensive Exam

1. The Comprehensive Exam shall cover topics corresponding to at least 24 academic units of the graduate physics program. The exams will be given only twice in one schoolyear.
2. If a student fails in a subject, he is allowed to retake the exam for the particular subject up to two times. If the student still fails after this, he must re-enroll in the subject.
3. Fees shall be paid on a per test/subject basis before the exams are given. The fees will be set by the Physics Department for each schoolyear.
4. Students should have passed all subjects in the graduate curriculum before taking the Comprehensive Exam.

Masteral Thesis

1. The Thesis Format is as follows:
Chapter I. The Problem and Definition of Terms
 - Introduction
 - Statement of the Problem
 - Scope and Limitations
 - Significance of the Problem
 - Definition of Terms

- Chapter II. Review of Related Literature
- Chapter III. Theoretical Considerations
- Chapter IV. Methodology
 - Method
 - Apparatus and Materials
 - Procedure
- Chapter V. Data and Analysis
- Chapter VI. Summary, Conclusion and Recommendations

2. To allow students enough time to conduct their research, the Colloquium may be made at any time after admission to the program.
3. Pre-orals may be held upon request of the student.
4. If a student fails to complete his thesis within five years after completing the academic requirements, he should enroll in six units of major Physics courses for every year beyond the limit of five years.

Graduation

For graduation, the following requirements must be met:

1. a QPA of 3.2 for the MS Physics Program and a QPA of 3.0 for the MAST Physics program.

All grades obtained in the MS Physics/MAST Physics program should be included in the computation of the QPA.

2. passing the Comprehensive Exam
3. successful oral defense of the thesis and submission of bound final copies of the thesis
4. for the MS Physics program, one lecture in a Physics seminar and one publication in a Physics journal while for the MAST Physics program, one lecture in a Physics seminar.

Minimum Group Requirements:

Basic Subjects	9 units
Major Subjects	15 units
Cognates	6 units
Thesis	6 units

Total	36 units
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Basic Subjects (9 units)

	Units
Physics 191 – Research Principles and Problems	3
Physics 121 -- Classical Mechanics	3
Physics 161 – Quantum mechanics	3

Major Subjects (15 units minimum)

Physics 132 – Electromagnetism	6
Physics 141 – Optics	6
Physics 151 – Modern Physics	6
Physics 125 -- Heat and Statistical Mechanics	3

Cognates (6 units minimum)

Physics 111 – Mathematical and Computer Physics	3
Physics 123 – Vibration and Sound	3
Physics 115 – Experimental Physics	1
Physics 116 – Seminar on Instrumentation	1
Physics 192 – Seminar on Current Developments in Physics Teaching	3

Thesis

Physics 200 – Masteral Thesis	3
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Course Description

Physics 101 MATHEMATICAL AND COMPUTER PHYSICS FOR TEACHERS 3 Units

Elements of vector analysis and computer-assisted learning in Physics (lec and lab)

Physics 102 – CLASSICAL MECHANICS FOR TEACHERS 3 units

Dynamics of particles and systems, central forces, gravitation, mechanics of rigid bodies and fluids; teaching methods integrated (lec and lab)

Physics 103 – VIBRATION AND SOUND FOR TEACHERS 3 units

Oscillations; vibrating strings; waves; sound; ultrasonics; teaching methods integrated (lec and lab)

Physics 104 – HEAT AND THERMODYNAMICS FOR TEACHERS 3 units

Kinetic theory, thermodynamic quantities, laws of thermodynamics; teaching methods integrated (lec and lab)

Physics 105 – ELECTROMAGNETISM FOR TEACHERS 3 units

Charges, fields, energy, potential, circuits, Maxwell's equations; teaching methods integrated (lec and lab)

Physics 106 – ELECTRONICS FOR TEACHERS 3 units

Principles and applications of electronics; elements of semiconductors, integrated circuits, logic circuits, microprocessors, quantum electronics; teaching methods integrated (lec and lab)

Physics 107 – OPTICS FOR TEACHERS 3 units

Intermediate geometrical, physical, and quantum optics; teaching methods integrated (lec and lab)

Physics 108 – MODERN PHYSICS FOR TEACHERS 3 units

Special theory of relativity, quantum theory of radiation, wave properties of matter, atomic physics, elementary particles; teaching methods integrated (lec and lab)

- Physics 109 – NUCLEAR PHYSICS FOR TEACHERS** **3 units**
Nucleus, radioactivity, nuclear reactions, radioisotopes, health physics; teaching methods integrated (lec and lab)
- Physics 110 – QUANTUM MECHANICS FOR TEACHERS** **3 units**
Introductory wave mechanics, Schroedinger wave equation, particle in a box, application to the hydrogen atom; teaching methods integrated (lec)
- Physics 111 – MATHEMATICAL AND COMPUTER PHYSICS** **3 units**
Vectors, tensors, matrices, numerical analysis, computer programming and applications
- Physics 113 -- ENVIRONMENTAL PHYSICS FOR TEACHERS** **3 units**
Physics principles as applied to the environment; teaching methods integrated (lec and lab)
- Physics 115 – EXPERIMENTAL PHYSICS** **1 unit**
Principles, methods, techniques, and instrumentation of experimental physics; design of experimental investigation
- Physics 116 – SEMINAR ON INSTRUMENTATION** **1 unit**
Design and construction of apparatus
- Physics 121 – CLASSICAL MECHANICS** **3 units**
Dynamics of particles and systems, central forces, gravitation, mechanics of rigid bodies and fluids, Lagrangian and Hamiltonian mechanics
- Physics 123 – VIBRATION AND SOUND** **3 units**
Free, damped, and forced oscillations; vibrating strings; plane, spherical and acoustical waves; ultrasonics. 2 lec, 1 lab unit
- Physics 125 – HEAT AND STATISTICAL MECHANICS** **3 units**
Kinetic theory, thermodynamic quantities, laws of thermodynamics, statistical mechanics. 2 lec, 1 lab unit
- Physics 132 – ELECTROMAGNETISM** **6 units**
Electrical charges and fields, forces, energy, potential, capacitance, current, circuits, Maxwell's equations, electronics. 4 lec, 2 lab units
- Physics 141 – OPTICS** **6 units**
Geometrical, physical, and quantum optics, optical instruments; opto-electronics. 4 lec, 2 lab units
- Physics 151 – MODERN PHYSICS** **6 units**
Special theory of relativity, quantum theory of radiation, wave properties of matter, atomic physics, nuclear physics, radiation and health physics, elementary

particles, relativistic cosmology. 4 lec, 2 lab units

Physics 161 – QUANTUM MECHANICS

3 units

Wave mechanics, uncertainty principle, state functions, Schroedinger wave equation, particle in a box, application to the hydrogen atom.

Physics 191 – RESEARCH PRINCIPLES AND PROBLEMS

3 units

Principles and methodology of research in physics and physics teaching; research problems.

Physics 192 – SEMINAR ON CURRENT DEVELOPMENTS IN PHYSICS TEACHING

1 unit

Current trends in physics education and teaching; preparation of a lecture, demonstration, or workshop presentable in a seminar/workshop of at least local level.

Physics 200 – MASTERAL THESIS

6 units

Masteral thesis on theoretical or experimental physics or on physics education/teaching.