

Department of Physics

Chairperson:	Tabbal, Malek D.
Professors:	Bitar, Khalil M.; Chamseddine, Ali H.; El Eid, Mounib F.; *Klushin, Leonid I.; Sabra, Wafic A.; Tabbal, Malek D.
Visiting Professor:	Mavromatis, Harry, A.
Associate Professors:	Isber, Samih T.; Touma, Jihad R.
Assistant Professor:	Antar, Ghassan Y.
Research Associate:	Christidis, Theodore C.
Senior Lecturer:	^P Nasrallah, Nasrallah F.
Lecturers:	^P Bodakian, Berjouhi H.; ^P Roumieh, Mohammad A.

Undergraduate Program

The Department of Physics offers courses at the undergraduate level leading to a bachelor's degree in physics.

The requirements for a BS in Physics are 90 credits for students entering at the Sophomore level. The distribution of these courses are as follows:

1) Department Requirements

- 36 credits in Natural Sciences (24 credits required Physics courses; 6 credits elective Physics courses; 6 credits required Physics Lab courses).
37 credits if PHYS 228 is chosen as an elective.
- 13 credits in Qualitative Thought (9 credits in Math; 4 credits in CMPS 200 or EECE 230).
- 14 credits in free electives

2) University Requirements

- Language Requirements: 9 credits in Language requirements (3 credits in Arabic; 6 credits in English - Eng. 203 and Eng. 204).
- General Education Requirements: 12 credits in Humanities (including 6 credits in CVSP) and 6 credits in Social Sciences.

The program for the physics major includes the following required courses: PHYS 210, PHYS 210L, PHYS 212, PHYS 217, PHYS 220, PHYS 221L, PHYS 222, PHYS 226, PHYS 235, PHYS 236, and PHYS 257L. Moreover, two elective courses must be selected from PHYS 223, PHYS 228/228L, PHYS 231, PHYS 232, PHYS 248, PHYS 249. Also required are the following courses in mathematics: MATH 101, MATH 102, CMPS 200, MATH 201, MATH 202, and MATH 212.

- PHYS 204L** **Classical Physics for Life Sciences Laboratory** **0.2; 1 cr.**
Techniques of laboratory work, surface tension, coefficient of viscosity, gas thermometer, Boyle's law, adiabatic compression of gases, mechanical equivalent of heat, waves on a stretched string, standing waves in air columns, geometrical optics I: reflection and refraction, geometrical optics II: mirrors and lenses, Michelson interferometer, and interference and diffraction. *Pre- or corequisite: PHYS 204. Annually.*
- PHYS 205** **Modern Physics for Life Sciences** **3.0; 3 cr.**
Electricity: electric field and electric potential, electric current and circuits, and capacitance. Magnetism: magnetic field, magnetic materials, electromagnetic induction, electromagnetism applied to biological systems, introduction to special relativity, atoms and atomic structure, nuclei, and radioactivity. *Prerequisite: PHYS 103 (or equivalent). Annually.*
- PHYS 205L** **Modern Physics for Life Sciences Laboratory** **0.2; 1 cr.**
Electric field mapping, capacitance and dielectric constants, basic oscilloscope operations, Wheatstone bridge, RC and RL circuits, measurements of magnetic induction fields, measurement of the charge to mass ratio of electrons, RC and RLC-circuits, Ohm's law, Planck's constant, atomic spectroscopy, and classical scattering. *Pre- or corequisite: PHYS 205. Annually.*
- PHYS 210** **Introductory Physics II** **3.1; 3 cr.**
Review of classical mechanics, fluid statics, fluid dynamics, temperature, heat and first law of thermodynamics, kinetic theory of gases, heat engines, entropy and second law of thermodynamics, general properties of waves, sound waves and resonances, light and optics, interference, diffraction, and polarization. *Pre- or corequisite: MATH 201. Each semester.*
- PHYS 210L** **Introductory Physics Laboratory II** **0.2; 1 cr.**
Surface tension, gas thermometer, mechanical equivalent of heat, Boyle's law, adiabatic compression of gases, measurement of γ for air and fluid gas, standing waves on a stretched string, standing waves in air columns, geometrical optics: law of refraction and prism, mirrors and lenses, interference and diffraction, the spectrometer, and polarization. *Pre- or corequisite: PHYS 210. Each semester.*
- PHYS 211** **Electricity and Magnetism** **3.0; 3 cr.**
Electrostatics, current, resistance, Ohm's law, Kirchhoff's laws, RC circuits, magnetostatic theory, Ampere's law, Biot-Savart law, Faraday's law, LR circuit, RLC circuits, and a qualitative discussion of Maxwell's equations. *Pre- or corequisite: MATH 201. Each semester.*
- PHYS 211L** **Electricity and Magnetism Laboratory** **0.2; 1 cr.**
Electric fields, capacitance and dielectric constant measurements, construction and calibration of ammeter and a voltmeter, electrical circuits, Wheatstone bridge, potentiometer, Thomson's experiment, measurement of the force between two parallel current-carrying conductors, measurement of magnetic induction fields, basic oscilloscope operations, RL, RC, and RLC circuits. *Pre- or corequisite: PHYS 211. Each semester.*
- PHYS 212** **Modern Physics** **3.0; 3 cr.**
Special theory of relativity, introductory quantum mechanics, atomic physics, nuclear physics, and introduction to elementary particles. Students cannot receive credit for both PHYS 212 and CHEM 218. *Pre- or corequisite: MATH 201. Each semester.*
- PHYS 217** **Mechanics** **3.0; 3 cr.**
Kinematics of particles motion, Newtonian formulation of mechanics, integration of Newtonian equations of motion, Lagrangian formulation of mechanics, Hamilton dynamics, central forces, linear oscillations, nonlinear oscillations and chaos, collisions, noninertial systems, coupled oscillations, and motion of rigid bodies. *Prerequisite: MATH 202. Annually.*

- PHYS 220 Electromagnetic Theory 3.0; 3 cr.**
Electrostatics: electric potential, Gauss' law, Poisson's and Laplace's equations, boundary conditions, electric currents, Faraday's law, Lenz's law, mutual inductance. Maxwell's equations, and propagation of electromagnetic waves. *Prerequisite: MATH 202. Annually.*
- PHYS 221L Junior Laboratory 0.4; 2 cr.**
A course of experiments selected from the topics of diffraction, e/m ratio, magnetic field, RL, RC, RLC circuits, ohmic and non-ohmic devices, atomic spectroscopy, Milikan's experiment, Frank-Hertz experiment, speed of sound, gravitational acceleration, Planck's constant, and physical optics. *Prerequisite: Junior standing. Annually.*
- PHYS 222 Computational Physics 0.3; 3 cr.**
Basics of numerical analysis: quadrature, solutions of algebraic and transcendental equations, methods for solving systems of linear equations, methods for solving differential equation, and scholastic methods. Applications: planetary motion, simple models of stars, nonlinear dynamics and chaos, potentials and fields, waves, random systems, computational fluid dynamics, statistical mechanics (phase transitions, Ising model), molecular dynamics, and quantum mechanics. *Prerequisites: MATH 201 and MATH 202. Annually.*
- PHYS 223 Physical Optics 3.0; 3 cr.**
Wave theory of light, Maxwell's equations, superposition and polarization, interference, interferometers, diffraction, coherence, lasers, and holography. *Annually.*
- PHYS 226 Solid State Physics 3.0; 3 cr.**
Electrons in one-dimensional periodic lattice, vibrations in one-dimensional periodic lattice, geometrical description of crystals, free-electron theory in metals, excitons, plasmons, polarons, lattice dynamics, semi-conductors, magnetic ordering, superconductivity, and electron gas in a magnetic field. *Prerequisites: PHYS 235 and PHYS 236. Annually.*
- PHYS 228 Electronics 3.0; 3 cr.**
DC linear circuits, capacitors, inductors and transients, periodic waveforms, diodes, power supplies, operational amplifier, logic gates, timers, multiplexers, flip-flops, and counting circuits. Students may not get credit for this course unless they pass PHYS 228L. *Annually. Fall semester.*
- PHYS 228L Electronics Laboratory 0.3; 1 cr.**
DC measurements, periodic waveforms, power supplies, transients, frequency and period measurements, operational amplifiers, and some digital circuits. *Pre- or corequisite: PHYS 228. Each semester.*
- PHYS 231 Special Topics 3.0; 3 cr.**
May be repeated for credit. *Prerequisite: Consent of department.*
- PHYS 232 Special Topics 3.0; 3 cr.**
May be repeated for credit. *Prerequisite: Consent of department.*
- PHYS 235 Statistical Physics 3.0; 3 cr.**
Boltzmann distribution, Gibbs distribution, thermal radiation, heat and work, kinetic theory of gases, entropy and temperature, statistical mechanics of semiconductors, kinetics of chemical reactions, and phase transitions. *Prerequisite: PHYS 210. Annually.*

PHYS 236 Quantum Mechanics 3.0; 3 cr.

Fundamental concepts: Bras, Kets, matrix representation of operators, change of basis; quantum dynamics: time evolution of quantum mechanical systems, spin; translational and rotational symmetry: Schrodinger equation in one and three dimensions; spherical symmetric systems: three-dimensional oscillator, hydrogen atom; theory of angular momentum: rotation operator, addition of angular momenta; time-independent perturbation theory, Zeeman effect, Stark effect, spin-orbit coupling, time-dependent perturbation theory, variational methods. *Prerequisites: MATH 212 or MATH 224 (or equivalent) and PHYS 212. Annually.*

PHYS 248 Undergraduate Seminar 1.0; 1 cr.

Prerequisite: Senior standing. Annually.

PHYS 249 Nuclear and Elementary Particle Physics 3.0; 3 cr.

Introduction to scattering theory, nuclear phenomenology, nuclear models, nuclear radiation and fission and fusion, detectors and accelerators, properties of elementary particles, symmetries and transformations, and the standard model of elementary particles. *Prerequisites: Senior standing or consent of department. Annually.*

PHYS 257L Advanced Laboratory 0.6; 3 cr.

A weekly lecture on instrumentation and a selection of six to eight experiments from the following list: transient and steady states of SH-oscillator, coupled oscillators bridge circuits, speed of sound in liquid, prism spectrometer, Frank–Hertz experiment, Planck constant, Currie temperature, magnetic susceptibility, measurement of gravitational acceleration, speed of light, Milikan's drop oil experiment, the Hall effect, optics, the Faraday effect, and nuclear magnetic resonance. *Prerequisite: PHYS 221L. Annually.*

36 Credits in Physics

Modes of Analysis	English and Arabic (9)	Humanities (12)	Social Sciences (6)	Natural Sciences (36)	Quantitative Thought (12 or 13)
LectureCourses (9+12+6+30 +13)	<ol style="list-style-type: none"> Required Arabic courses: ARAB 201A or B, or any upper level course (3) Required English courses (6): ENGL 203(3), 204(3) 	Required credits in the humanities: 12 credits including 6 credits from CVSP (see CVSP requirements under Civilization Sequence Program)	Two courses: The Department recommends that at least one of them is a level-200 Economics course	<ol style="list-style-type: none"> Required physics courses (24): PHYS 210(3), 212(3), 217(3), 220(3), 222(3), 226(3), 235(3), 236(3) Two elective physics courses (6): PHYS 228 + 228L (3+1)¹, 223(3), 231(3), 232(3), 249(3), or other selected topics in physics 	Required mathematics and technology courses (12 or 13): MATH 201(3), 202(3), 212(3), CMPS 200(4) or EECE 230(3)
Seminar (1)				PHYS 248(1)	
Laboratory (6)				Required Physics Labs: PHYS 210L(1), 221L(2), 257L(3)	
Research Project				The following courses may include a research project: PHYS 222, 226, 231, 232, 235, 236, 249	

¹ Students may not get credit for PHYS 228 unless they pass PHYS 228L.