Undergraduate Handbook

This handbook is designed to serve as a guide for the Physics major. It contains information on the major, department, courses, and faculty.

Advisor Contact Points

The undergraduate advisors in physics are Dr. Charley Myles and Dr. David Lamp. To discuss a major or courses in physics contact either of them at the following:

Dr. Charley Myles
Science 18
(806) 742-3768
Charley.Myles@ttu.edu

Dr. David Lamp
Science 23
(806) 742-3234
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Physics Department office
Science 101
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Texas Tech University
Department of Physics
Undergraduate Program

Horn Professor: Estreicher; Bucy Professor: Wigmans;
Professors: Borst, Cheng, Hatfield, Holtz, Lichti, Lodhi, Myles, and Quade;
Associate Professors: Akchurin, Gibson, Glab, Huang, Lamp, and Thacker;
Assistant Professors: Lee, Sanati, Volobouev, and Wilhelm;
Joint Professors: Dallas, Kristiansen, Krompholtz, Poirier, Quitevis, and Temkin;
Adjunct Professors: Guenther and Scully.

This department supervises the Bachelor of Science, Master of Science, and Doctor of Philosophy degrees in physics. The department also supervises an applied physics option in the MS and PhD degrees. The BSEP program in engineering physics is listed under the College of Engineering.

A typical sequence of courses begins with PHYS 1305, 1408, 2401, and 2402, for a total of 15 hours at the introductory level. These are usually followed by the intermediate and advanced sequences, PHYS 3304, 3305, 3306, 3401, 4302, 4304, and 4307. Students desiring to pursue advanced degrees are recommended to take advanced topic courses.

The required mathematics courses for physics majors are MATH 1351, 1352, 2350, and either (3350 and 3351) or (3354 and 4354). Students planning to pursue an advanced degree in physics should consult the physics undergraduate advisor about appropriate additional courses.

Majors in this department are required to maintain a minimum grade point average of 2.00 in physics courses, with at least 37 hours of physics courses with a grade of C or better. Students also have a variety of university and College of Arts & Sciences requirements that must be met. The minimum number of hours to attain a degree in physics is 133. Credit for any transferred physics hours will be handled on an individual basis with the department's undergraduate advisor.

Students are strongly encouraged to devote time to undergraduate research. Research areas in the department include AMO (atomic, molecular, and optical physics), solid state, physics education, particle physics, and biophysics. Applied physics is pursued in the areas of fluorescence spectroscopy, forensic studies, pulsed power, semiconductor materials, and surfaces.

A broad variety of minor subjects may be elected by a student majoring in physics. These include mathematics, biochemistry, physical chemistry, geophysics, computer science, business, and electrical engineering. Students contemplating minors outside of the College of Arts & Sciences should seek the advice of the physics undergraduate advisor before beginning that minor.

A minor in physics by majors outside of physics requires 18 semester hours of which at least 6 must be at the 3000 level or higher and must be approved by the undergraduate advisor. The minor sequence is PHYS 1408, 2401, and 2402 plus 6 hours of approved 3000+ courses. Students must receive a grade of C or better in all courses applied toward a minor.

The astronomy courses (ASTR 1400 and 1401) may not be used to satisfy requirements for the physics major or minor.

Students are encouraged to participate in the Society of Physics Students which sponsors several academic and social activities.

UG Course Schedule

odd falls	**even springs**
1305 Engineering Physics Analysis	
2402 Modern Physics	
3304 Modern Lab	
4304 Mechanics	4301 Computational
4309 Solid State	4307 Quantum Mechanics
even falls	**odd springs**
1305 Engineering Physics Analysis	1305 Engineering Physics Analysis
2402 Modern Physics	3306 E&M II
3304 Modern Lab	4302 Statistical
3401 Optics	4312 Nuclear and Particle
3305 E&M I	

Present Physics Major

1305	Engineering Physics Analysis
1408	Principles of Physics I
2401	Principles of Physics II
2402	Principles of Physics III (Modern Physics)
3304	Modern Physics Lab
3305	E&M I
3306	E&M II
3401	Optics
4302	Statistical
4304	Mechanics
4307	Quantum Mechanics 37 required hours
4000	Independent Study
4301	Computational
4306	Senior Project
4309	Solid State
4312	Nuclear and Particle

Physics Major
Degree Plan Worksheet

I. General Education

English (12 hours) ENGL 1301- ENGL 1302- ENGL 23-- ENGL 23--

Oral Communication (3 hours) COMS 1300 or 2300-

Foreign Language (6-16 hours)

Math (6 hours) MATH 1351- MATH 1352-

Science (8 hours) PHYS 1408- PHYS 2401-

Technology and Applied Science (3 hours) PHYS 1305-

History (6 hours) HIST 2300- HIST 2301-

Political Science (6 hours) POLS 1301- POLS 2302-

Individual or Group Behavior (3 hours)

Humanities (3 hours)

Visual and Performing Arts (3 hours)

Multicultural (3 hours)

Personal Fitness and Wellness (2 hours)

This menu of courses is required by Tech for any student seeking an A&S degree. The basic pattern is defined by the state and SACS. Courses for the various categories can be found near page 40 of the Undergraduate Catalog.

II. Physics Major (37 hours)

PHYS 1305 Engineering Physics Analysis
PHYS 1408 Principles I- Mechanics
PHYS 2401 Principles II- E&M
PHYS 2402 Principles III- Modern
PHYS 3304 Modern Lab
PHYS 3305 E&M I
PHYS 3306 E&M II
PHYS 3401 Optics
PHYS 4302 Statistical
PHYS 4304 Mechanics
PHYS 4307 Quantum Mechanics

Choose 3 hours

PHYS 3000 Undergraduate Research
PHYS 4000 Independent Study
PHYS 4301 Computational
PHYS 4306 Senior Project
PHYS 4309 Solid State
PHYS 4312 Nuclear and Particle

III. Chemistry (necessary for any physics degree)

CHEM 1307/1107 General Chemistry I
CHEM 1308/1108 General Chemistry II

IV. Math (necessay for any physics degree)

MATH 1351 Calculus I
MATH 1352 Calculus II
MATH 2350 Calculus III
MATH 3354 Differential Equations I (or 3350)
MATH 4354 Differential Equations II (or 3351)

Tech requires a Minor (18 hours of which 6 at 3000+ level)
Math minor must be approved by the advisor in Math

MATH ???? (2360 Linear Algebra often)

Math courses required in a Physics Major: 1351, 1352, 2350, and either (3350 and 3351) or (3354 and 4354)

1351. Calculus I (3:3:0)
1352. Calculus II (3:3:0)
2350. Calculus III (3:3:0)
2360. Linear Algebra (3:3:0)
3350. Higher Mathematics for Scientists and Engineers I (3:3:0)
3351. Higher Mathematics for Scientists and Engineers II (3:3:0)
3354. Differential Equations I (3:3:0)
4354. Differential Equations II (3:3:0)

Physics Major Prerequisite Flowchart

1305		
1408	co-req Math 1351	
2401	co-req Math 1352	pre-req 1408
2402		pre-req 2401
3304		co-req 2402
3401		pre-req 2401
3305		pre-req 2401
3306		pre-req 3305
4301		pre-req 2402
4302	pre-req Math 3350	pre-req 2402
4304	pre-req Math 3350	pre-req 2401
4307	pre-req Math 3350	
4309		pre-req 3305
4312		pre-req 4307

Procedure for Receiving Credit for PHYS 4306, Senior Project

The Senior Project course, PHYS 4306 is meant to be the final design course for Engineering Physics majors. Physics majors may also take this course and get three hours of credit working on the research of some faculty member.

Engineering Physics majors may select a project directed by a Physics faculty member or by a faculty member in the student's engineering specialty. Physics majors are expected to choose a faculty member in the Physics dept.

It is the responsibility of the student to find a faculty member to direct a suitable project. A suitable project is one which has a clear objective. For example, one might be assigned to build a whale aquarium out of transparent aluminum. The dimensions of the aquarium might be one of the instructions given for the project. The student could then enroll in the course. The faculty member must provide an abstract which outlines the project and sets definite criteria for completion. The abstract should be reviewed with the undergraduate advisor in the Physics dept. and must be on file in the Physics dept. office.

Upon completion of the project, the student must present a written report to the faculty member directing the project. On the basis of the work done, the faculty member will assign a letter grade for the report and the course and report that to the Physics dept. office. A copy of the report must be placed on file in the Physics dept. office.

It should be noted that often the project takes longer than anticipated. The student should plan to sign up for PHYS 4306 in the fall and then could extend the project into the spring semester if necessary.

Physics Department Course Descriptions

1304. Physics: Basic Ideas and Methods (3:3:0). Intended to provide physics background to pre-engineering students. Examines basic concepts in physics. Problem-solving techniques, graphical representations, and pertinent mathematics. [PHYS 1310]

1305. Engineering Physics Analysis I (3:3:0). The profession of engineering physics and its relation to energy, materials, resources, computers, communication, and control. Basic computer programming. Synthesis and analysis of typical engineering physics problems.

1401. Physics for Nonscience Majors (4:3:2). Course intended to acquaint students with the basic laws and vocabulary of physics. A minimum of mathematics is used.

1403, 1404. General Physics (4:3:2 each). Prerequisite: MATH 1320 and 1321. A non-calculus introductory physics course designed to provide students with a background for further study in science and related areas. Covers mechanics, heat, sound, electricity and magnetism, light, and modern physics.

1406. Physics of Sound and Music (4:3:3). A qualitative course designed to acquaint the student with the principles of physics used in the production of sound and music. A minimum of mathematics will be used. Some of the physical principles are exemplified in laboratory sessions. Satisfies natural science requirement in Arts and Sciences.

1408. Principles of Physics I (4:3:2). Corequisite: MATH 1351. Calculus-based introductory physics course. Mechanics, kinematics, energy, momentum, gravitation, waves, and thermodynamics. (Honors section offered.)

2351. Introduction to Forensic Science (3:3:0). Identification methods (fingerprints, DNA, serology), physical and biological trace evidence examination, arson and explosives detection, spectroscopic and analytical chemical techniques, pathology, and law.

2401. Principles of Physics II (4:3:2). Corequisite: MATH 1352. Calculus-based introductory physics. Electric and magnetic fields, electromagnetic waves, and optics. (Honors section offered.)

2402. Principles of Physics III (4:3:3). Prerequisite: PHYS 2401. Study of atomic, molecular, and nuclear phenomena. Relativity, quantum effects, hydrogen atom, many electron atoms, and some molecular physics. Includes laboratory.

3000. Undergraduate Research (V1-6). Individual and/or group research projects in basic or applied physics, under the guidance of a faculty member.

3302. Cosmophysics: the universe as a physics lab (3:3:0). Pre-requisite: 2402. This course deals with topics from astrophysics, cosmology, and cosmic ray physics of interest to all physicists.

3304. Modern Physics Laboratory (3:0:6). Corequisite: PHYS 2402. Laboratory course on advanced physical principles, including experiments in optics, atomic, molecular, solid state, and nuclear physics.

3305, 3306. Electricity and Magnetism (3:3:0 each). Prerequisite: PHYS 2401. Maxwell's equations, electrostatics, dielectric materials. Magnetic fields and materials. Electromagnetic waves, radiation. Relativity.

3351. Photoluminescence in Criminalistics (3:3:0). Prerequisite: PHYS 2401: Spectoscopic techniques and instrumentation, fingerprint detection methodology, fiber and document examination, trace evidence, explosives, blood detection, and DNA labeling.

3400. Fundamentals of Physics (4:3:3). Prerequisite: MATH 1320. Development of basic concepts of physics: Astronomy, motion, density, sound, electricity, magnetism, atoms, light, and radioactivity. Not for engineering, science, or mathematics majors.

3401. Optics (4:2:4). Prerequisite: PHYS 2401. Geometrical and physical optics with emphasis on the latter. Waves, reflection, scattering, polarization, interference, diffraction, modern optics, and optical instrumentation.

4000. Independent Study (V1-4). Prerequisite: Approval of advisor. Study of advanced topics of current interest under direct supervision of a faculty member.

4301. Computational Physics (3:2:2). Prerequisite: PHYS 1408, 2401, 2402. Numerical modeling of physical systems. Data acquisition and analysis. Graphics for displaying complex results. Quadrature schemes, solution of equations. Use of microcomputers in assignments.

4302. Statistical and Thermal Physics (3:3:0). Prerequisite: PHYS 2402 and knowledge of differential equations. Introduction to statistical methods in physics. Formulation of thermodynamics and statistical mechanics from a unified viewpoint with applications from classical and quantum physics.

4304. Mechanics (3:3:0). Prerequisite: PHYS 1408, 2401, or equivalent, and differential equations. Dynamics of particles and extended bodies, both rigid and fluid, using Newtonian mechanics and the Euler-Lagrange equations from Hamilton's principle. Nonlinear systems and chaos with numerical modeling. Applications of the Navier-Stokes equation.

4306. Senior Project (3). Prerequisite: Senior standing in physics or engineering physics. Individual research project under the guidance of a faculty member.

4307. Introduction to Quantum Mechanics (3:3:0). Prerequisite: MATH 3350. Experimental and conceptual bases. Dualism, uncertainty principle. Mathematical framework. Schrödinger equation, solutions. Hydrogen atom. Pauli principle, spin. Periodic table. Perturbation theory.

4309. Solid State Physics (3:3:0). Prerequisite: PHYS 3305 and knowledge of elementary quantum mechanics. The structural, thermal, electric, and magnetic properties of crystalline solids. Free electron theory of metals. Concept of energy bands and elementary semiconductor physics.

4312. Nuclear and Particle Physics (3:3:0). Prerequisite: PHYS 4307. This is a course dealing with modern nuclear physics covering such topics as nuclear structure models, radioactivity, nuclear reactions, elementary particles, nuclear conservation, forces, and symmetry.

5000. Independent Study (V1-3).

5001. Master's Internship (V1-12). Internship in an industrial or research laboratory setting. Arranged through the department and directly related to degree program with approval of Internship Coordinator.

5101. Seminar (1:1:0). Must be taken by every graduate student for at least the first four semesters. Taken pass-fail.

5104. Instructional Laboratory Techniques in Physics (1:1:0). Laboratory organization and instructional techniques. Does not count toward the minimum requirement of a graduate degree. Must be taken pass-fail by all teaching assistants when on appointment.

5300. Special Topics (3:3:0). Prerequisite: Approval of graduate advisor. Topics in semiconductor, plasma, surface, particle physics, spectroscopy, and others. May be repeated in different areas.

5301. Quantum Mechanics I (3:3:0). Experimental basis and history, wave equation, Schrödinger equation, harmonic oscillator, piecewise constant potentials, WKB approximation, central forces and angular momentum, hydrogen atom, spin, two-level systems, and scattering. M.S. and Ph.D. core course.

5302. Quantum Mechanics II (3:3:0). Prerequisite: PHYS 5301 or equivalent. Quantum dynamics, rotations, bound-state and time-dependent perturbation theory, identical particles, atomic and molecular structure, electromagnetic interactions, and formal scattering theory. Ph.D. core course.

5303. Electromagnetic Theory (3:3:0). Electrostatics and magnetostatics, time varying fields, Maxwell's equations and conservation laws, electromagnetic waves in materials and in waveguides. M.S. and Ph.D. core course.

5304. Solid State Physics (3:3:0). Prerequisite: PHYS 5301 or equivalent. A survey of the microscopic properties of crystalline solids. Major topics include lattice structures, vibrational properties, electronic band structure, and electronic transport.

5305. Statistical Physics (3:3:0). Elements of probability theory and statistics; foundations of kinetic theory. Gibb's statistical mechanics, the method of Darwin and Fowler, derivation of the laws of macroscopic thermodynamics from statistical considerations; other selected applications in both classical and quantum physics. M.S. and Ph.D. core course.

5306. Classical Dynamics (3:3:0). Lagrangian dynamics and variational principles. Kinematics and dynamics of two-body scattering. Rigid body dynamics. Hamiltonian dynamics, canonical transformations, and Hamilton-Jacobi theory of discrete and continuous systems. M.S. and Ph.D. core course.

5307. Methods in Physics I (3:3:0). Provides first-year graduate students the necessary skill in mathematical methods for graduate courses in physical sciences; applications such as coordinate systems, vector and tensor analysis, matrices, group theory, functions of a complex variable, variational methods, Fourier series, integral transforms, Sturm-Liouville theory, eigenvalues and functions, Green functions, special functions and boundary value problems. Tools course.

5309. Atomic and Molecular Physics (3:3:0). Prerequisite: PHYS 5301 or equivalent. A survey of atomic and molecular physics. Major topics include group theory, molecular orbital theory, and energy transfer processes.

5311. Nuclear Physics (3:3:0). Prerequisite: PHYS 5301. This is a course dealing with nuclear physics covering such topics as nuclear structure models, interactions, reactions, scattering, and resonance. Nuclear energy is discussed as an application.

5322. Computational Physics (3:2:2). Numerical modeling of physical systems. Data acquisition and analysis. Graphics for displaying complex results. Quadrature schemes and solution of equations. Use of minicomputers and microcomputers. Tools course.

5324. Classical Mechanics I (3:3:0). Prerequisite: PHYS 1308, MATH 3350, 3351, or equivalent. Introduction to Newtonian Mechanics, Euler-Lagrange Equations, and Hamilton's Principle. For graduate students in departments other than physics.

5330. Semiconductor Materials and Processing (3:3:0). Survey of semiconductor materials deposition, characterization, and processing techniques with emphasis on the fundamental physical interactions underlying device processing steps.

5332. Semiconductor Characterization and Processing Laboratory (3:1:4). A hands-on introduction to semiconductor processing technology and materials characterization techniques. Intended to accompany PHYS 5330.

5335. Physics of Semiconductors (3:3:0). Theoretical description of the physical and electrical properties of semiconductors; Band structures, vibrational properties and phonons, defects, transport and carrier statistics, optical properties, and quantum confinement.

5336. Device Physics (3:3:2). Principles of semiconductor devices; description of modeling of p/n junctions, transistors, and other basic units in integrated circuits; relationship between physical structures and electrical parameters.

5371. Conceptual Physics for Teachers (3:3:0). Inquiry-based course in elementary physical principles of mechanics, heat, electricity, and magnetism.

5372. Astronomy for Teachers (3:3:0). Inquiry-based course in solar system, stellar, and galactic astronomy. Discusses history of human understanding of the universe.

5380. Introduction to Microsystems (3:3:0). Fundamentals of microelectromechanical (MEMS) and microfluidic systems. Project-based course introduces basic microsystem design, analysis, simulation, and manufacture through several case studies using representative devices.

6000. Master's Thesis (V1-6).

6002. Master's Report (V1-6).

6306. Advanced Electromagnetic Theory (3:3:0). Prerequisite: PHYS 5303. Classical theory of electromagnetic fields, radiation, scattering and diffraction, special theory of relativity and electrodynamics, special topics. Ph.D. core course.

7000. Research (V1-12).

7304. Condensed Matter Physics (3:3:0). Prerequisite: PHYS 5304. Problems of current interest in condensed matter physics. Topics include transport properties in solids, superconductivity, magnetism, semiconductors, and related topics.

8000. Doctor's Dissertation (V1-12).

Astronomy Courses

ASTR 1400. Solar System Astronomy (4:3:2). Structure of the solar system. Gravitation, light, and orbits of the solar system. Planets and their moons, asteroids, and comets. (Honors section offered.)

ASTR 1401. Stellar Astronomy (4:3:2). Structure, models of the universe. Stellar evolution. Gravitation, light, orbits of the stars and galaxies. Endpoints of stellar evolution. (Honors section offered.)

Faculty Members

Nural Akchurin – Asc. Prof. 2000, Ph.D. Iowa 1990. Particles.

Walter Borst – Prof. 1984, Ph.D. Berkeley 1968. Atomic and molecular.

Kelvin Cheng – Prof. 1988, Ph.D. Waterloo 1983. Biophysics.

Stefan Estreicher – Horn Prof. 1986, Ph.D. Zurich 1982. Solid state.

Tom Gibson – Asc. Prof. 1985, Ph.D. Oklahoma 1982. Atomic and molecular.

Wallace Glab – Asc. Prof. 1990, Ph.D. Illinois 1984. Atomic and molecular.

Luis Grava de Peralta – Ast. Prof. 2007, Ph.D. Oriente, Cuba 1982. Solid state.

Mark Holtz – Prof. 1991, Ph.D. Virginia Tech 1987. Solid state.

Juyang Huang – Asc. Prof. 1999, Ph.D. Buffalo 1987. Biophysics.

David Lamp – Asc. Prof. 1988, Ph.D. Missouri 1984. Physics education.

Sungwon Lee - Ast. Prof. 2006, Ph.D. Glasgow 2000. Particles.

Roger Lichti – Prof. 1979, Ph.D. Illinois 1972. Solid state.

Arfen Lodhi – Prof. 1963, Ph.D. London 1963. Nuclear.

Charles Myles – Prof. 1978, Ph.D. Washington 1973. Solid state.

Park – Ast. Prof. 2007, Ph.D. . Biophysics.

Dick Quade – Prof. 1965, Ph.D. Oklahoma 1962. Atomic and molecular.

Mahdi Sanati – Ast. Prof. 2004, Ph.D. Cincinnati 1999. Solid state.

Beth Ann Thacker – Asc. Prof. 1999, Ph.D. Cornell 1990. Particles/Education.

Igor Volobouev – Ast. Prof. 2006, Ph.D. SMU 1997. Particles.

Richard Wigmans – Bucy Prof. 1992, Ph.D. Vrije, Amsterdam 1975. Particles.

Ron Wilhelm – Ast. Prof. 2002, Ph.D. Michigan State 1995. Astronomy.