DEPARTMENT OF PHYSICS

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Physics is the scientific study of the nature and behavior of matter and energy. On the basis of quantitative observations, physicists develop theories to describe the observed behavior. Further experiments and observations are used to verify or refine the theories. The scientific method demands logical and mathematical rigor. The wealth of applications of physics to technology appeals to pragmatic persons, yet physics has much greater similarity to the arts and humanities than is commonly realized, because of the intellectual curiosity and creativity on which it is built.

The physics program at UI introduces students in technical and non-technical curricula alike to the scientific method and to physical laws. The B.A. and B.S. curricula in physics emphasize a broad liberal-arts education and the core subjects in physics. Many B.A. and B.S. recipients go on to graduate study in physics or related disciplines.

Training in the theory, history, and philosophy of physics is provided by the required core courses and electives in most of the major areas of specialization. Formal laboratory courses and directed research familiarize students with experimental techniques, modern instrumentation, and computers. Equipment in the department's research laboratories includes low-temperature, strong magnetic field, high-vacuum, and vapor deposition facilities, electron and atomic beam apparatus, plasma devices, various lasers, spectrometers, optical telescopes, and nuclear radiation detectors. All offices, laboratories, and classrooms have computer network connections. The program is supported by a machine shop and a computer services shop. Collaborations with other universities and research institutes provide access to an even wider range of facilities.

The department offers graduate curricula leading to the M.S. and Ph.D. degrees. A bachelor's degree in physics is normally required as preparation for graduate study. Students with a bachelor's degree in another physical science, engineering, or mathematics will generally qualify after removal of a few upper-division-level deficiencies.

Research in the Department of Physics emphasizes the areas of condensed matter physics, nuclear physics, atomic physics, astrophysics, and biophysics. In addition, there is an interest in research on physics teaching.

The M.S. is not a prerequisite for the Ph.D., but beginning doctoral students may earn the M.S. if they wish. General departmental course requirements exist for the M.S. and Ph.D. degrees, in addition to the general requirements of the Graduate College. Other course requirements are specified in the student's study plan, developed by the student and his or her advisor and approved by the student's supervisory committee. All graduate students are encouraged to gain some teaching experience during the course of their graduate studies.

Physics Department Statement of Objectives

Undergraduate Program: Our goal is to provide students with a qualitative and quantitative understanding of the core topics in theoretical physics: classical mechanics, electricity and magnetism, modern physics, quantum mechanics, thermal physics, and mathematical methods, as well as a familiarity with the experimental techniques on which advances in physics are based. In addition, it is expected that each student will develop a more detailed knowledge of several special areas in physics such as atomic and molecular physics, nuclear and particle physics, classical optics and quantum optics, solid state physics, astronomy, relativity and computational physics.

In the process of developing specific knowledge of areas in physics, students will learn to analyze physical phenomena using basic physical principles and acquire skills in: basic logic and reasoning, mathematics and computation, problem solving, experimental technique, and oral and written communication.

Students completing the undergraduate program should be well prepared for further study at the graduate level or to apply their skills successfully in other professional settings. They will be able to communicate effectively orally and in writing either with co-workers in a team effort, or with non-scientists in public discussions of scientific issues

Graduate Program: In the graduate program we aim to deepen a student's basic knowledge and understanding of theoretical and experimental physics, as well as to guide him or her to achieving expert status in a particular area of contemporary interest to the physics community. By carrying out a research project in collaboration with a major-professor acting as mentor, the student will develop the skills required to initiate, and carry to completion, an independent research program upon obtaining an advanced degree.

Faculty members in the department will be happy to discuss programs in detail with interested persons. Requests for information or a tour of the facilities can be made by a letter, e-mail, or telephone call (208/885-6380) to the department.

Courses

See the course description section for courses in Physics (Phys).

Physics Undergraduate Curricular Requirements

Physics (B.S.)

Required course work includes the university requirements (see regulation J-3) and:

Chem 111	Principles of Chemistry I (4 cr)
Chem 112	Principles of Chemistry II (5 cr)
Math 170	Analytic Geometry and Calculus I (4 cr)
Math 175	Analytic Geometry and Calculus II (4 cr)
Math 275	Analytic Geometry and Calculus III (3 cr)
Phys 200	Physics Seminar (1 cr)
Phys 211, Phys 211L	Engineering Physics I and Lab (4 cr)
Phys 212, Phys 212L	Engineering Physics II and Lab (4 cr)
Phys 213, Phys 213L	Engineering Physics III and Lab (4 cr)
Phys 305	Modern Physics (3 cr)
Phys 321	Analytical Mechanics (3 cr)
Phys 341	Electromagnetic Fields I (3 cr)
Phys 351	Introductory Quantum Mechanics I (3 cr)

And one of the following emphases:

A. General Physics Emphasis

Phys 342	Electromagnetic Fields II (3 cr)
Phys 371	Mathematical Physics (3 cr)
Phys 433	Statistical Thermodynamics (3 cr)

Upper-division mathematics electives (6 cr)

Upper-division physics courses, including at least 4 cr of lab and 9 cr from the following: Phys 411, Phys 412, Phys 425, Phys 428, Phys 443, Phys 444, Phys 464, Phys 465, and Phys 484 (at least 15 cr).

Courses to total 120 credits for this degree

B. Applied Physics Emphasis

Math 310	Ordinary Differential Equations (3 cr)
Math 330	Linear Algebra (3 cr)
Phys 411	Physical Instrumentation I (3 cr)

Four credits of upper-division lab work in physics and engineering

Physics and engineering electives (27 credit, of which at least 21 credits must be upper-division and at least 9 credits must be 400-level and 21 credits must come from the following: ECE 350 + ECE 351, ECE 460, ECE 462, Engr 210, Engr 240, Engr 335, Engr 350, ME 301, ME 412, ME 413, ME 420, MSE 201, MSE 313, MSE 427, Phys 428, Phys 433, Phys 443, Phys 444.)

Courses to total 120 credits for this degree

Physics (B.A.)

Required course work includes the university requirements (see regulation J-3) and:

Chem 111	Principles of Chemistry I (4 cr)
Chem 112	Principles of Chemistry II (5 cr)
Math 170	Analytic Geometry and Calculus I (4 cr)
Math 175	Analytic Geometry and Calculus II (4 cr)
Math 275	Analytic Geometry and Calculus III (3 cr)
Phys 200	Physics Seminar (1 cr)
Phys 211, Phys 211L	Engineering Physics I and Lab (4 cr)
Phys 212, Phys 212L	Engineering Physics II and Lab (4 cr)
Phys 213, Phys 213L	Engineering Physics III and Lab (4 cr)
Phys 305	Modern Physics (3 cr)
Phys 321	Analytical Mechanics (3 cr)
Phys 341	Electromagnetic Fields I (3 cr)

Physics elective courses numbered 300 or above (11 cr)
Mathematics upper-division elective courses (6 cr)
3 credits in the humanities, in a course numbered 300 or above in addition to the minimum university-wide general education requirements.*
3 credits in the social sciences, in a course numbered 300 or above in addition to the minimum university -wide general education requirements.*
4 credits in any course(s) numbered 300 or above approved by student's advisor

Courses to total 120 credits for this degree

Physics Academic Minor Requirements

Physics Minor

Phys 211, Phys 211L	Engineering Physics I and Lab (4 cr)
Phys 212, Phys 212L	Engineering Physics II and Lab (4 cr)

Physics courses numbered 300 or above (usual prerequisites are Math 170, Math 175, Math 275) (9 cr)

One of the following (3-4 cr)

Engr 210	Engineering Statics (3 cr)
Phys 213, Phys 213L	Engineering Physics III and Lab (4 cr)

Courses to total 18 credits for this minor

Physics Graduate Degree Programs

Candidates must fulfill the requirements of the College of Graduate Studies and of the Department of Physics. See the College of Graduate Studies section for the general requirements applicable to each degree.

Master of Science (Non-thesis Option). Major in Physics. General M.S. non-thesis requirements apply. The requirement is a minimum of 30 credits in coursework and the credits must be distributed as follows: (1) 20 cr in physics courses numbered 500 and higher (including 2 cr for Phys 501); (2) 10 cr in courses numbered 400 and higher (these may be non-physics courses upon the approval of the physics department Academic Standards Committee). Phys 521, Phys 533, Phys 541, Phys 542, and Phys 550 are required.

Students must pass a comprehensive examination, which must be taken at the first offering after the student has completed the core courses required for the M.S. degree. Full-time students may not delay the completion of their core course requirements by avoiding the taking of a core course when offered except with the prior written consent of the Academic Standards Committee and the student's major professor. The examination is written and covers all of general graduate-level physics as defined by the required courses for the M.S. degree. Typically, it will be administered on two different days, with a time limit of approximately three hours for each day. The results of the examination will be evaluated by the physics faculty. If the comprehensive examination is failed, it may be repeated only once; the repeat examination must be taken within a period of not less than three nor more than 14 months following the first attempt.

Master of Science (Thesis Option). Major in Physics. General M.S. requirements for a degree with thesis apply. The student must complete a total of at least 30 credits at 400 level or higher, 20 of which must be at the graduate level, including a maximum of 10 credits in research and thesis. Specific departmental graduate course requirements are 2 credits in Phys 501 and Phys 521, Phys 541, Phys 542, and Phys 550. If a student's undergraduate preparation is considered deficient (e.g., if it lacks laboratory experience at the upper-division level), then certain undergraduate courses will be required in the study plan. Such remedial credits are not to be counted towards the total required for the degree. No departmental comprehensive exam is required.

A final defense of the M.S. thesis is scheduled upon completion of the thesis. Full-time students have to take this examination no later than two years after passing the comprehensive examination. The candidate is required to defend his or her work and show a satisfactory knowledge of the field in which the thesis research has been performed. The defense is oral and would typically last for one hour. The exam has to be announced to the physics faculty at least one week in advance. All members of the physics faculty are permitted to attend and ask questions. A recommendation of a majority of the student's graduate committee is necessary to pass the defense. If the defense is failed, it may be repeated only once; the repeat defense must be taken within a period of not less than three months nor more than one year following the first attempt.

Doctor of Philosophy. Major in Physics. General Ph.D. requirements apply. Correspondence concerning the student's specific goals is encouraged in the preliminary planning of the Ph.D. program.

Specific departmental course requirements are: Phys 501 (2 cr), Phys 521, Phys 533, Phys 541, Phys 542, Phys 550, Phys 551, Phys 571, and at least nine additional semester-hours of physics courses at the 500 level. A typical study plan would include 40 to 50 credits of course work at the 500 level in physics and about 30 credits in research and thesis. The study plan also would include at least six units of upper-division or graduate course work outside of physics. The nature and number of these additional units will depend upon the professional goals of the individual student. In planning a program, the student should consult with the departmental Academic Standards Committee for approval of any particular choice of nonphysics course work. The Ph.D. degree in physics is primarily a recognition of ability and accomplishment in research. The purpose of the course work is to provide the factual and theoretical background for research. Successful completion of course work is not in itself considered as completion of the major requirement for the degree.

All Ph.D. graduate students are required to enroll in Phys 501 (Physics Seminar) each semester while in residence.

No formal foreign language requirement exists for Ph.D. candidates; however, in individual cases, depending on the research topic, a reading knowledge in one foreign language may be required by the thesis advisor.

A two-Part preliminary examination is required. Part I is taken after the student has completed the courses required for the Ph.D. degree. Full-time students must take this exam no later than 2 years after entering the Ph.D. program. Students who have earned a masters degree in physics or wish to transfer credits to satisfy any of the departmental requirements (Phys 521, Phys 533, Phys 541, Phys 542, Phys 550, Phys 551, or Phys 571) may be required by the Academic Standards Committee to take the exam earlier. The examination is written and covers all of general graduate-level physics as defined by the required courses for a Ph.D. degree. Typically, it will be administered on two different days, with a time limit of approximately five hours for each day. The results of the examination will be evaluated by the physics faculty. If the preliminary examination, Part I, is failed, it may be repeated only once; the repeat examination must be taken within a period of not less than three months nor more than 14 months following the first attempt.

Part II of the preliminary examination is set by the major professor of the Ph.D. student for a date within the second semester after Part I has been passed. The student is required to explain the goals of his or her planned Ph.D. research to the thesis committee and show general familiarity with the fields relevant for the research. Part II is oral and would typically last for one hour. The exam is to be announced to the physics faculty at least one week in advance. All members of the physics faculty are permitted to attend and ask questions. The student's committee certifies to the Graduate College the results of the preliminary examinations. Upon passing, the student is advanced to candidacy for the Ph.D. degree. If Part II is failed, it may be repeated only once; the repeat examination must be taken within a period of not less than three months nor more than one year following the first attempt.

A final defense of the Ph.D. thesis is scheduled upon completion of the dissertation. The candidate is required to defend his or her work and show a superior knowledge of the field in which the thesis research has been performed. The defense is oral and would typically last for one hour. The exam is to be announced to the physics faculty at least one week in

advance. All members of the physics faculty are permitted to attend and ask questions. A recommendation of a majority of the student's graduate committee is necessary to pass the defense. If the defense is failed, it may be repeated only once; the repeat defense must be taken within a period of not less than three months nor more than one year following the first attempt.

PHYSICS COURSES

David N McIlroy, Dept. Chair, Dept. of Physics; (323 Engineering/Physics Bldg. 83844-0903; phone 208/885-5768; physics@uidaho.edu)

Credit Limitations: Phys 100 carries no credit after Phys 111 or Phys 211; Phys 111 carries no credit after Phys 211; Phys 112 carries no credit after Phys 212.

Phys 100 Fundamentals of Physics (3 cr)
For students in nontechnical fields. Conceptual study of laws of nature and their application, including mechanics, heat, electricity and magnetism, light, and modern physics. Three lec and one 2-hr lab a wk. (Spring only)

Phys 100L Fundamentals of Physics Lab (1 cr)
For students in nontechnical fields. Conceptual study of laws of nature and their application, including mechanics, heat, electricity and magnetism, light, and modern physics. Three lec and one 2-hr lab a wk. (Spring only)

Phys 103 General Astronomy (3 cr)
Descriptive and physical astronomy; development of astronomical thought; properties and evolution of the solar system, stars, galaxies, and the universe. (Fall only)

Phys 104 Astronomy Lab (1 cr)
May be used as general education credit in J-3-b. Naked eye, telescopic, and photographic observations of constellations, stars, and planets. One 2-hr lab a wk; some evening meetings.
Prereq or Coreq: *Phys 103*

Phys 111 General Physics I (3 cr)
Kinematics, forces and dynamics, conservation laws, thermodynamics, waves. Three lec, one recitation, and one 2-hr lab a wk.
Prereq: *Math 143*

Phys 111L General Physics I Lab (1 cr)
Kinematics, forces and dynamics, conservation laws, thermodynamics, waves. Three lec, one recitation, and one 2-hr lab a wk.
Prereq: *Math 143*

Phys 112 General Physics II (3 cr)
Electricity, magnetism, optics, and modern physics. Three lec, one recitation, and one 2-hr lab a wk.
Prereq: *Phys 111*

Phys 112L General Physics II Lab (1 cr)
Electricity, magnetism, optics, and modern physics. Three lec, one recitation, and one 2-hr lab a wk.
Prereq: *Phys 111/111L*

Phys 200 (s) Physics Seminar (1 cr, max 8)
Introductory-level discussion of topics in modern physics; introduction to physics research topics and scientific information search techniques; written and/or oral reports of a pertinent topic in current physics. (Fall only)

Phys 211 Engineering Physics I (3 cr)
Kinematics and dynamics, Newton's laws, work and energy, rotational dynamics, linear and angular momentum, collisions, static equilibrium, oscillations, gravity and central forces. Three lec, one recitation, and one 2-hr lab a wk.
Prereq or Coreq: *Math 170*

Phys 211L Engineering Physics I Lab (1 cr)
Kinematics and dynamics, Newton's laws, work and energy, rotational dynamics, linear and angular momentum, collisions, static equilibrium, oscillations, gravity and central forces. Three lec, one recitation, and one 2-hr lab a wk.
Prereq or Coreq: *Math 170*

Phys 212 Engineering Physics II (3 cr)
Electric fields and potentials, magnetic fields, capacitance and inductance, DC and AC circuits, electromagnetic waves. Three lec, one recitation, and one 2-hr lab a wk.
Prereq: *Phys 211*
Prereq or Coreq: *Math 175*

Phys 212L Engineering Physics II Lab (1 cr)
Electric fields and potentials, magnetic fields, capacitance and inductance, DC and AC circuits, electromagnetic waves. Three lec, one recitation, and one 2-hr lab a wk.
Prereq: *Phys 211/211L*
Prereq or Coreq: *Math 175*

Phys 213 Engineering Physics III (3 cr)
Fluid dynamics, waves in elastic media, sound waves, temperature, heat and thermodynamics, kinetic theory, geometric and physical optics. Three lec, one recitation, and one 2-hr lab a wk. (Spring only)
Prereq: *Phys 211*
Prereq or Coreq: *Math 175*

Phys 213L Engineering Physics III Lab (1 cr)
Fluid dynamics, waves in elastic media, sound waves, temperature, heat and thermodynamics, kinetic theory, geometric and physical optics. Three lec, one recitation, and one 2-hr lab a wk. (Spring only)
Prereq: *Phys 211/211L*
Prereq or Coreq: *Math 175*

Phys 301 Junior Physics Lab (2 cr)
Experimental techniques in modern physics, including optics, atomic, nuclear, and solid state physics; computer uses, error analysis, and scientific literature searches. One 1-hr lec and one 3-hr lab a wk. (Spring only)
Prereq: *Phys 213/213L or Permission*

Phys 305 Modern Physics (3 cr)
Quantum and relativity theories with applications to atomic, solid state, nuclear, and elementary particle physics. (Spring only)
Prereq: *Phys 212/212L*
Coreq: *Math 275 and Phys 213/213L*

Phys 321 Analytical Mechanics (3 cr)
Kinematics and dynamics of particles; oscillating systems; dynamics of the rigid body.
Prereq: *Phys 212/212L and Math 275*

Phys 322 Analytical Mechanics (3 cr)
Principle of least action, dynamics of systems of particles, theory of oscillations, mechanics of continuous media.
Prereq: *Phys 321*

Phys 341 Electromagnetic Fields I (3 cr)
Theory using vector calculus; electrostatics; magnetostatics, electromagnetism, analysis of AC and DC circuits; Maxwell's equations; radiation and propagation of electromagnetic waves.
Prereq: *Phys 212/212L and Math 275*

Phys 342 Electromagnetic Fields II (3 cr)
Theory using vector calculus; electrostatics; magnetostatics, electromagnetism, analysis of AC and DC circuits; Maxwell's equations; radiation and propagation of electromagnetic waves.
Prereq: *Phys 341*

Phys 351 Introductory Quantum Mechanics I (3 cr)
One-dimensional theory; free particle, bound states, potential barriers, harmonic oscillator, matrix methods, and Dirac notation; interpretations of quantum theory.
Prereq: *Phys 305, 371*

Phys 371 Mathematical Physics (3 cr)
Same as Math 371. Mathematical techniques needed in upper-division physics courses, including vector analysis, matrices, Sturm-Liouville problems, special functions, partial differential equations, complex variables.
Prereq: *Phys 212/212L, Math 275*

Phys 400 (s) Seminar (cr arr)

Phys 403 (s) Workshop (cr arr)

Phys 404 (s) Special Topics (cr arr)

Phys 411 Physical Instrumentation I (3 cr)
Methods and instruments used in experimental physics; electronic techniques; design problems in electronic measurement of physical quantities encountered in research. Two lec and one 3-hr lab a wk.
Prereq: *Phys 212/212L or Phys 213/213L, and Math 275*

Phys 412 Physical Instrumentation II (3 cr)
Methods and instruments used in experimental physics; electronic techniques; design problems in electronic measurement of physical quantities encountered in research. Two lec and one 3-hr lab a wk.
Prereq: *Phys 411*

Phys J425/J525 Relativity (3 cr)
Introduction to the Special and General Theories of Relativity. Principle of relativity, Poincare and Lorentz transformations and their consequences. Four-dimensional formulation of relativistic mechanics and electromagnetism. Principle of equivalence and the geometric theory of gravitation. Additional projects/assignments required for graduate credit.
Prereq for 425: *Phys 305 and Senior standing*
Prereq for 525: *Admission to physics graduate program or Permission*

Phys J428/J528 Numerical Methods (3 cr)
Phys 428 same as Math 428 and Engr 428. Systems of equations, root finding, error analysis, numerical solution to differential equations, interpolation and data fitting, numerical integration, related topics and applications. Additional projects and/or assignments required for graduate credit in Phys 528.
Prereq: *Math 310*

Phys J433/J533 Statistical Thermodynamics (3 cr)
Phys 433 same as Chem 495. Classical thermodynamics, entropy, thermodynamic potentials, kinetic theory, classical and quantum statistical mechanics, ensembles, partition functions, introduction to phase transitions. Additional assignments required for graduate credit.
Prereq: *Chem 306 or Phys 305 or equivalent*

Phys J443/J543 Optics (3 cr)
Geometrical optics, wave optics and physical optics with emphasis on modern instrumentation and methods of measurement. Additional projects/assignments required for graduate credit.
Prereq *for Phys 443: Phys 342*
Prereq *for Phys 543: Admission to Physics Graduate program or Permission*

Phys J444/J544 Quantum Optics (3 cr)
Introduction to the physics of lasers, laser spectroscopy, non-linear optical effects, and the interaction of radiation and matter. Additional projects/assignments required for graduate credit.
Prereq for Phys 444: *Phys 212/212L or Phys 213/213L, Math 175, and Senior standing or Permission*
Prereq for Phys 544: *Admission to Physics Graduate program or Permission*

Phys J464/J564 Materials Physics and Engineering (3 cr)
See MSE J464/J564.

Phys J465/J565 Particle and Nuclear Physics (3 cr)
Particle production and detection, properties and classification of particles, the quark model of hadrons, symmetries and conservation laws, interactions, grand unification, the strong interaction and nuclear forces, models for nuclear structure and reactions. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereq for 465: *Phys 305*
Prereq for 565: *Admission to physics graduate program or Permission*

Phys J484/J584 Astrophysics (3 cr)
Celestial mechanics; planets and planetary systems; structure and evolution of stars and star systems; special and general relativity; cosmology. Additional projects/assignments required for graduate credit. Phys 484 is a cooperative course available to WSU degree-seeking students.
Prereq for Phys 484: *Phys 305 or Math 275; or Permission*
Prereq for Phys 584: *Admission to physics graduate program or Permission*

Phys 490 Research (1-6 cr, max 6)
Undergrad thesis.
Prereq: *Junior standing in physics and Permission of department*

Phys 499 (s) Directed Study (cr arr)

Phys 500 Master's Research and Thesis (cr arr)

Phys 501 (s) Seminar (cr arr)
Graded Pass/Fail.
Prereq: *Permission*

Phys 502 (s) Directed Study (cr arr)

Phys 503 (s) Workshop (cr arr)

Phys 504 (s) Special Topics (cr arr)

Phys 521 Advanced Mechanics (3 cr)
Classical mechanics; Lagrange's and Hamilton's principles, two-body problem, rigid body motion, special relativity, canonical transformation, Hamilton-Jacobi theory, small oscillations, and Lagrangian and Hamiltonian formulations for continuous systems and fields. Cooperative: open to WSU degree-seeking students.
Prereq: *Phys 322*

Phys 525 Relativity (3 cr)
See Phys J425/J525.

Phys 528 Numerical Methods (3 cr)
See Phys J428/J528.

Phys 533 Statistical Thermodynamics (3 cr)
See Phys J433/J533.

Phys 541 Electromagnetic Theory (3 cr)
Includes Maxwell's equations, electrostatics, magnetostatics, currents and their interactions, general theory of emission, propagation and absorption of electromagnetic waves, boundary value problems, relativistic formulation of electrodynamics. Cooperative: open to WSU degree-seeking students.
Prereq: *Phys 322, Phys 342*

Phys 542 Electromagnetic Theory (3 cr)
Includes Maxwell's equations, electrostatics, magnetostatics, currents and their interactions, general theory of emission, propagation and absorption of electromagnetic waves, boundary value problems, relativistic formulation of electrodynamics. Cooperative: open to WSU degree-seeking students.
Prereq: *Phys 322, Phys 342*

Phys 543 Optics (3 cr)
See Phys J443/J543.

Phys 544 Quantum Optics (3 cr)
See Phys J444/J544.

Phys 550 Quantum Mechanics (3 cr)
Physical basis; Schroedinger wave formulation, Heisenberg matrix formulation, transformation theory, approximation methods, radiation theory, theory of scattering; application to atomic systems. Cooperative: open to WSU degree-seeking students.
Prereq: *Phys 305, Phys 322*

Phys 551 Quantum Mechanics (3 cr)
Physical basis; Schroedinger wave formulation, Heisenberg matrix formulation, transformation theory, approximation methods, radiation theory, theory of scattering; application to atomic systems. Cooperative: open to WSU degree-seeking students.
Prereq: *Phys 305, Phys 322*

Phys 564 Materials Physics and Engineering (3 cr)
See Phys J464/J564.

Phys 565 Particle and Nuclear Physics (3 cr)
See Phys J465/J565.

Phys 571 Mathematical Methods of Physics (3 cr)
Methods and problems. Cooperative: open to WSU degree-seeking students.
Prereq: *Phys 322 or Permission*

Phys 584 Astrophysics (3 cr)
See Phys J484/J584.

Phys 600 Doctoral Research and Dissertation (cr arr)

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