Physics

PHYS 1100 The Fun of Physics (1 semester credit hour) An introductory course in physics in the modern world. Focuses on the work of a physicist. What does a physicist do? What are some of the exciting topics on which physicists are working today? The faculty discusses their favorite concepts and the opportunities for student participation in research. Credit/No Credit only. (1-0) Y

PHYS 1101 (PHYS 1101) College Physics Laboratory I (1 semester credit hour) An algebra-based laboratory course to accompany PHYS 1301. Experiments investigate measurements and statistics; one dimensional and two-dimensional motion; Newton's laws; conservation laws of energy and momentum; rotational motion and oscillations. Lab fee of $30 required. Corequisite: PHYS 1301. (0-3) R

PHYS 1102 (PHYS 1102) College Physics Laboratory II (1 semester credit hour) An algebra-based laboratory course to accompany PHYS 1302. Experiments may investigate electrostatics, electric circuits, magnetism, optics, and topics coordinating with PHYS 1302. Lab fee of $30 required. Corequisite: PHYS 1302. (0-3) R

PHYS 1301 (PHYS 1301) College Physics I (3 semester credit hours) Algebra and trigonometry based basic physics. Topics include mechanics, heat and thermodynamics. Students will also be registered for an exam section. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science. Check with your program advisor. An online subscription fee of up to $100 is required for this course for online homework access. Prerequisite: MATH 1314 or equivalent. Corequisite: PHYS 1101. (3-0) S

PHYS 1302 (PHYS 1302) College Physics II (3 semester credit hours) Continuation of PHYS 1301. Topics include electricity, magnetism and optics. Students will also be registered for an exam section. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science. Check with your program advisor. An online subscription fee of up to $100 is required for this course for online homework access. Prerequisite: PHYS 1301. Corequisite: PHYS 1102. (3-0) S

PHYS 2125 (PHYS 2125) Physics Laboratory I (1 semester credit hour) Laboratory course to accompany PHYS 2325 or PHYS 2421. Experiments investigate basic measurements and statistics; one dimensional and two dimensional motion; Newton's laws; conservation laws of energy and momentum; rotational motion; and oscillations. Lab fee of $30 required. Corequisite: PHYS 2325 or PHYS 2421. (0-3) S

PHYS 2126 (PHYS 2126) Physics Laboratory II (1 semester credit hour) A calculus-based laboratory course to accompany PHYS 2326 or PHYS 2422. Experiments investigate electrostatics, electric circuits, magnetism, and optics. Lab fee of $30 required. Corequisite: PHYS 2326 or PHYS 2422. (0-3) S

PHYS 2303 Contemporary Physics (3 semester credit hours) Topics include the fundamentals of

geometric optics, interference, diffraction, special relativity, structure of the atom, nuclear physics, radioactivity, and elementary particles. An online subscription fee of up to $100 is required for this course for online homework access. (3-0) S

PHYS 2325 (PHYS 2325) Mechanics (3 semester credit hours) Calculus based. Basic physics including a study of space and time, kinematics, forces, energy and momentum, conservation laws, rotational motion, torques, and harmonic oscillation. Two lectures per week. Students will also be registered for an exam section. An online subscription fee of up to $100 is required for this course for online homework access. Prerequisite: MATH 2413 or MATH 2417. Corequisites: (MATH 2414 or MATH 2419) and (PHYS 2121 or PHYS 2125). (3-0) S

PHYS 2326 (PHYS 2326) Electromagnetism and Waves (3 semester credit hours) Continuation of PHYS 2325. Topics include electrostatics and electromagnetics, electric field and potential, electric currents, magnetic fields, laws of Coulomb, Ampere, and Faraday, Maxwell's theory of wave propagation. Two lectures per week. Students will also be registered for an exam section. An online subscription fee of up to $100 is required for this course for online homework access. Prerequisites: PHYS 2325 and (MATH 2414 or MATH 2419). Corequisite: PHYS 2126. (3-0) S

PHYS 2421 Honors Physics I - Mechanics and Heat (4 semester credit hours) Calculus-based physics. This class is a more rigorous version of PHYS 2325 with additional topics in thermal physics. Derivations are more general and rely more heavily on calculus and the use of vectors. More challenging problems and applications. A laboratory component has been integrated directly into the course. Laboratory topics include statistical and systematic uncertainty, multivariate error propagation, calibration, and experiments with an accelerometer. Lab fee of $30 required. Prerequisite: MATH 2413 or MATH 2417 with a minimum grade of B+ in either course. Corequisites: (MATH 2414 or MATH 2419). (3-1) Y

PHYS 2422 Honors Physics II - Electromagnetism and Waves (4 semester credit hours) Calculus-based basic physics. This class is a more rigorous version of PHYS 2326. Derivations are more general and rely more heavily on multi-dimensional calculus concepts such as divergence, gradient, curl, and the theorems of Green, Stokes, and Gauss. More challenging problems and applications. Two lectures plus a required recitation session per week. Students will also be registered for an exam section. Prerequisites: (PHYS 2325 with a grade of B+ or PHYS 2421) and (MATH 2414 or MATH 2419). Corequisites: (MATH 2415 or MATH 2451 or MATH 3351) and PHYS 2126. (4-0) Y

PHYS 3312 Classical Mechanics (3 semester credit hours) Newton's laws; collisions; two body problems and trajectories; Lagrangian formulation; rotational dynamics and the inertia tensor; rotating coordinate systems; gravitation; special relativity. Prerequisite: PHYS 3311 or PHYS 3411 or equivalent. (3-0) Y

PHYS 3330 Numerical Methods in Physics and Computational Techniques (3 semester credit hours) The course covers concepts and computational techniques in numerical methods for solving physics problems. Topics typically include probability, statistics, data analysis, fits, numerical solutions, and interpretation of the experimental data. Prerequisites: (MATH 2415 or MATH 2419 or equivalent) and MATH 2418. (3-0) Y

PHYS 3380 Astronomy (3 semester credit hours) An essentially descriptive course outlining the current views of the universe and the sources of data supporting those views. The solar system and its origin, stars, galaxies, pulsars, quasars, black holes, nebulae, and the evolution of the universe. Opportunity to use a UT Dallas telescope is provided. Prerequisite: PHYS 2326 or PHYS 2422. (3-0) Y

PHYS 3411 Theoretical Physics (4 semester credit hours) Index Notation; Vector spaces and linear operators; Gradient, divergence and curl; Using Green's, Stokes' and divergence theorems to relate surface integrals to either line or volume integrals; Fourier series; Separating variables in PDEs. Corequisite: MATH 2420. Prerequisites: MATH 2418 with a grade of at least C- and [(MATH 2415 with a grade of at least C-) or (MATH 2451 or MATH 3351 with a grade of at least C-)] and (PHYS 2326 or PHYS 2422). (4-0) S

PHYS 3416 Electricity and Magnetism (4 semester credit hours) Coulomb's and Gauss' laws; potentials, methods for solving electric field distributions near conductors; potentials due to clusters of charges; polarization of dielectric materials; electric displacement. Magnetic fields in a vacuum and in matter; time varying electric and magnetic fields; Maxwell's equations; electromagnetic waves. Prerequisite: PHYS 3311 or PHYS 3411 or equivalent. (4-0) Y

PHYS 3427 Electronics with Laboratory (4 semester credit hours) Topics include direct and alternating current circuits, diodes and transistors, feedback, passive and active filters, simple amplifiers, and combinatorial and sequential digital electronics. Includes laboratory where students will learn to use typical laboratory instruments to test and to diagnose and troubleshoot problems inherent in the circuits they build in lab. The lab exercises are closely tied to the topics covered weekly in the lectures. Lab fee of $30 required. Prerequisite: PHYS 2326 or PHYS 2422. (3-3) Y

PHYS 4301 Quantum Mechanics I (3 semester credit hours) Fundamental concepts: the Stern Gerlach experiment; the Dirac formalism; kets; bras and operators; base kets and matrix representations. Measurements, observables and the uncertainty relations. Position, momentum, and translation. Wave functions in position and momentum space. Time evolution and Schrodinger's equation, Heisenberg picture. Orbital angular momentum, spin, and angular momentum addition. Applications include simple harmonic oscillator and the Hydrogen atom. Prerequisites: (PHYS 3311 or PHYS 3411) and MATH 2418. (3-0) Y

PHYS 4302 Quantum Mechanics II (3 semester credit hours) Fermions and bosons, perturbation theory, WKB approximation, scattering. Prerequisite: PHYS 4301. (3-0) Y

PHYS 4311 Thermodynamics and Statistical Mechanics (3 semester credit hours) Study of the elements of thermodynamics, kinetic theory, and statistical mechanics; the concepts of temperature, entropy, phase transitions, transport phenomena, partition functions, statistical ensembles; the Maxwell Boltzmann, Fermi-Dirac, and Bose-Einstein distributions; and the equipartition theorem. Applications of the theories will be considered. Corequisite: PHYS 3311 or PHYS 3411. Prerequisite: PHYS 2325 or PHYS 2421. (3-0) Y

PHYS 4319 Cyber-Physical Systems (3 semester credit hours) This course introduces students to

cyber-physical systems - systems that involve the synergy between physical measurement, physical computation and physical control. Physical sensors paired with embedded computers and networks monitor and control physical processes, with feedback where physical processes affect computations and vice versa. Applications of such systems include laboratory instrumentation, process control, energy management and conservation, environmental control, aircraft control systems, communications systems, instrumentation, critical infrastructure control (electric power, water resources, and communications systems for example), robotics and distributed robotics (telepresence and telemedicine), defense systems, manufacturing, smart structures, medical devices and systems, consumer electronics, toys and games, assisted living, traffic control and safety, and automotive systems. The scientific, economic and societal potential of such systems is massive, and major investments are being made worldwide to develop the technology. The class will give hands on experience with micro-controllers, analog to digital converters, digital electronics interfaces, and cyber physical systems. Prerequisite: PHYS 2326. (3-0) R

PHYS 4328 Optics (3 semester credit hours) Topics include electromagnetic waves and radiation, the interaction of light and matter, geometric optics, polarization, interference, and diffraction. Prerequisite: PHYS 3416. (3-0) Y

PHYS 4340 Introduction to Quantum Information (3 semester credit hours) A general introduction to the field of quantum information: physics of information processing; quantum logic; quantum algorithms including Shor's factoring algorithm; physics hardware for quantum computation; quantum communications; error corrections. Prerequisites: ((MATH 2413 or MATH 2417) and (MATH 2414 or MATH 2419)) or equivalent and (MATH 2418 or equivalent). (3-0) Y

PHYS 4346 Quantum Physics for Engineers and Programmers (3 semester credit hours) This course provides an introduction to quantum physics for non-physicists. The course will introduce and build on mathematical and physical descriptions of the quantum bit (qubit). Topics include linear algebra description of qubits, quantum measurement, postulates of quantum mechanics, physical realizations of qubits, single-qubit gates, multi-qubit gates, entanglement, and decoherence. In-class instruction will be complemented by simulations using state-of-the-art tools such as Qiskit. This course may be taken in parallel with PHYS 4340. No previous experience with quantum mechanics is needed. Prerequisites: (MATH 2413 or MATH 2417 or equivalent) and (MATH 2414 or MATH 2419 or equivalent) and (MATH 2418 or equivalent). (3-0) Y

PHYS 4347 Quantum Network and Communication (3 semester credit hours) This course provides an introduction to quantum networks and quantum communication. Topics include the Einstein-Podolsky-Rosen paradox, Bell inequality, photonic entanglement, single-photon sources, quantum key distribution, quantum memory, quantum transducers, quantum repeater, quantum state teleportation, entanglement swapping, and distributed quantum computing. Prerequisite: PHYS 4346 or PHYS 4301 or equivalent. (3-0) Y

PHYS 4350 Quantum Algorithm and Software (3 semester credit hours) An introduction to quantum algorithms and current software development. Topics covered: Introduction to quantum circuits; Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Quantum Fourier transform, Quantum Phase Estimation; Shor's Algorithm, Grover's Algorithm, Quantum

Counting; Solving linear systems of equations using quantum algorithm and its Qiskit implementation; Solving combinatorial optimization problems; Travelling Salesman Problem using Quantum Phase Estimation; quantum machine learning, Qiskit quantum software. Prerequisites: (MATH 2413 or MATH 2417 or equivalent) and (MATH 2414 or MATH 2419 or equivalent) and (MATH 2418 or equivalent). (3-0) Y

PHYS 4352 Concepts of Modern Physics (3 semester credit hours) Quantum mechanics at an advanced undergraduate level will be applied to the discussion of applications such as lasers, semiconductors, superconductors, solid state devices, and elementary particle physics. Selection of topics may vary by semester. Prerequisite: PHYS 4302. (3-0) Y

PHYS 4371 Solid State Physics (3 semester credit hours) This course provides a basic but detailed picture of important concepts in solid state physics. Material covered includes crystal structure, x-ray crystallography, reciprocal space, lattice vibrations, thermal properties of solids, free electron gas, Bloch functions, metals, insulators, and semiconductors. The course concludes with a description of basic semiconductor devices. Prerequisite: PHYS 3416 and PHYS 4301. (3-0) Y

PHYS 4373 Physical Measurements Laboratory (3 semester credit hours) Experiments illustrating concepts in thermodynamics and physical properties of matter, vacuum technology, gas phase kinetics, mass spectroscopy and optical spectroscopy, basic operations in electronics, literature skills, and use of computers. Lab fee of $30 required. Prerequisite: PHYS 3416. (0-6) S

PHYS 4386 Elementary Particle Physics (3 semester credit hours) The course will cover current knowledge and understanding of elementary particle physics, the kinematics of productions and decays of particles, the Quark Model and the Standard Model, particle compositions, and the principles of modern particle detectors. Prerequisites: PHYS 4301 and PHYS 4311. (3-0) T

PHYS 4390 Senior Research (3 semester credit hours) Individual instruction course designed to develop skills for research and clear, precise and accurate scientific writing. Research may be either scientific experimentation or critical analysis of scientific literature. Topics will vary from section to section depending upon the interests of the student, but will be selected from a specific area of physics. Instructor consent required. (3-0) S

PHYS 4392 Extragalactic Astrophysics (3 semester credit hours) This course provides a grounding in the key concepts and physical principles of modern extragalactic astrophysics. Topics covered include galaxies and galaxy clusters (e.g. galaxy formation, and constituents such as dark matter and stellar populations); exotic objects in the universe like quasars, black holes; finding the most distant objects in the universe; and gravitational waves. The theoretical principles will be related to observational signatures already seen or expected to be observed using telescopes and other experiments in the next few years. Prerequisite: PHYS 2326 or PHYS 2422. (3-0) R

PHYS 4398 Senior Research Project for BA Degree (3 semester credit hours) Individual instruction course for students seeking the Bachelor of Arts degree designed to develop skills for clear, precise and accurate scientific writing. The Bachelor of Arts degree is designed as a strong base in physics to pursue graduate studies or work in fields other than physics. The requirement involves research in a topic of the student's choice that the shows the physics involved and the application of the

physics background to the field and the development of a plan for implementing such a program. Possibilities include other sciences, medical fields including radiology and diagnostic tools involving physics principles, economics, finance, accounting, patent or high technology law and education at the primary or secondary school level. The research culminates in a minimum of a 12 page paper submitted to the faculty mentor, critiqued and rewritten by the student incorporating the suggestions from the mentor and resubmitted. Instructor consent required. Please consult advisors for more detailed information. (3-0) S

PHYS 4399 Senior Honors Research in Physics (3 semester credit hours) Individual instruction course designed to develop skills for research and clear, precise and accurate scientific writing. Research may be either scientific experimentation or critical analysis of scientific literature. Topics will vary from section to section depending on the interests of the student, but will be selected from a specific area of physics. See current catalog for information on graduation with major honors and honors with distinction. Instructor consent required. (3-0) S

PHYS 4V07 Senior Research Projects (1-6 semester credit hours) Intended as an introduction to research, this course involves independent research activities under the guidance of a faculty member on advanced topics in physics. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) R

PHYS 4V10 Research Topics in Physics (1-9 semester credit hours) Independent research under the guidance of a faculty member on advanced topics in physics. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. Additional prerequisites may be required depending on the specific course topic ([1-9]-0) R

PHYS 4V11 Topics in Physics (1-4 semester credit hours) This course is for new offerings prior to placing them in the catalog. May be repeated for credit as topics vary (9 semester credit hours maximum). Additional prerequisites may be required depending on the specific course topic. ([1-4]-0) R