PHY 11030 - Seven Ideas that Shook the Universe

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Recount the origins, development, and significance of each of the seven major ideas of the course.
2. Describe the nature of science as a dynamic human activity, always open to improvement and new insights.
3. Demonstrate knowledge through a project and other activities.
4. Relate classroom content to current events in science.
5. Feel comfortable and at home with the physical universe, as much as possible.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will watch PowerPoint presentations on various topics and will be responsible for understanding their content.
3. Students will watch video presentations, take notes on them, and be responsible for understanding their content.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing assigned projects and review materials.

PHY 12000 - Introductory Physics Seminar

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Describe the areas of research conducted by members of the Department of Physics.
2. Answer questions about a particular subfield of physics that was the content area focus for the Seminar that semester (for example, nuclear physics, light and optics, or liquid crystals).
3. Name some professors in the Department and describe their work.
4. Describe the undergraduate program concentrations in the Department of Physics.

In-class Activities:

1. Students will participate in discussions about problem-solving methods that will be useful in physics coursework.
2. Students will study some physics content from a particular subfield of the discipline that will vary from one semester to the next.
3. Students will meet some professors and listen to them relate their background and describe their work.

Out-of-class Activities:

1. Students will attend occasional field trips to area research sites.
2. Students will be responsible for completing content-related mathematical problems for homework.

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PHY 12111 – Physics for Health Technologies

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate a proficiency at problem solving.
2. Understand torque as it applies to skeleto-muscular systems.
3. Understand how conservation laws impact both physical and human-energy systems.
4. Understand how ideal gas laws affect stored gasses and respiration.
5. Understand household electricity and electrical safety.

In-class Activities:

1. Students will interact with the instructor’s lecture content.
2. Students will ask questions about their problem areas.

Out-of-class Activities:

1. Students will read the accompanying class content in the textbook.
2. Students will identify problem areas for further study.

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PHY 12201 - Technical Physics I

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Use scientific and engineering notation and convert between units in various systems.
2. Solve one and two dimensional motion problems using vector addition when necessary.
3. Solve statics and dynamics problems using Newton’s Laws of Motion.
4. Solve translational and rotational motion problems using, as necessary, the laws of the Conservation of Energy and the Conservation of Linear/Angular Momentum.
5. Solve problems in material elasticity.
6. Solve harmonic motion problems utilizing the properties of waves and rotational motion.
7. Solve fluid problems using Archimedes’ Principle and Bernoulli’s Equation.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will work example problems in groups under the supervision of the instructor.
3. Students will work in groups to accomplish laboratory experiments and to analyze the experimental data obtained.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

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PHY 12202 - Technical Physics II

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Solve problems in thermodynamics using the thermal properties of matter and the Laws of Thermodynamics.
2. Solve mechanical/sound wave problems.
3. Solve static electricity problems using, as necessary, Coulomb’s Law.
4. Solve direct/alternating current circuit problems.
5. Solve magnetic field problems.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will work example problems in groups under the supervision of the instructor.
3. Students will work in groups to accomplish laboratory experiments and to analyze the experimental data obtained.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

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PHY 13001 - General College Physics I

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. State, explain, and apply Newton’s laws of motion and gravitation.
2. Relate any physical phenomenon to Newton’s laws.
3. Answer questions and solve mathematical puzzles applying Newton’s laws in a wide variety of situations.
4. Acquire a broad and general knowledge of classical physics sufficient for success in many programs of study and future careers.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will observe and model the steps in solving content-related mathematical problems.
3. Students will work with teaching assistants to practice solving content-related mathematical problems.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing content-related mathematical problems for homework.

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PHY 13002 - General College Physics II

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain a wide array of physical phenomena in terms of the behavior of electrons.
2. Predict the behavior of light rays in a variety of situations and circumstances.
3. Extend their competence in physics through relativity and quantum theory.
4. Answer questions and solve mathematical puzzles in a wide variety of situations.
5. Acquire a broad and general knowledge of physics sufficient for success in many programs of study and future careers.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will observe and model the steps in solving content-related mathematical problems.
3. Students will work with teaching assistants to practice solving content-related mathematical problems.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing content-related mathematical problems for homework.

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PHY 13011 - College Physics I

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. State, explain, and apply Newton’s laws of motion and gravitation.
2. Relate any physical phenomenon to Newton’s laws.
3. Answer questions and solve mathematical puzzles applying Newton’s laws in a wide variety of situations.
4. Acquire a broad and general knowledge of classical physics sufficient for success in many programs of study and future careers.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will observe and model the steps in solving content-related mathematical problems.
3. Students will work with teaching assistants to practice solving content-related mathematical problems.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing content-related mathematical problems for homework.

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PHY 13012 - College Physics II

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain a wide array of physical phenomena in terms of the behavior of electrons.
2. Predict the behavior of light rays in a variety of situations and circumstances.
3. Extend their competence in physics through relativity and quantum theory.
4. Answer questions and solve mathematical puzzles in a wide variety of situations.
5. Acquire a broad and general knowledge of physics sufficient for success in many programs of study and future careers.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will observe and model the steps in solving content-related mathematical problems.
3. Students will work with teaching assistants to practice solving content-related mathematical problems.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing content-related mathematical problems for homework.

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PHY 13021 - General College Physics Laboratory I

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Directly relate their own observations to physical laws.
2. Understand physical quantities of motion, including displacement, velocity and acceleration, and be able to interpret graphs of all of these quantities vs. time.
3. State, explain, and apply Newton’s laws of motion.
4. State, explain, and apply conservations laws (momentum and energy.)
5. Relate temperature, energy transfer and heat in real materials.
6. Recognize and utilize these phenomena in their everyday lives and careers.

In-class Activities:

1. Students will construct their own models of physical phenomena based on guided observations and experiments.
2. Students will collect and graph data from these experiments in real time, and interpret the results.
3. Students will discuss their results and difficulties with their group, the teaching assistants, and the rest of the class.

Out-of-class Activities:

1. Students will be responsible for reading the laboratory guide and answering pre-lab questions before the laboratory.
2. Students will be responsible for post-laboratory homework assignments that reinforce critical physics concepts and investigative skills.

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PHY 13022 - General College Physics Laboratory II

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Directly relate their own observations to physical laws.
2. Predict and explain the behavior of a wide variety of electronic circuits and other electrical phenomena in terms of the behavior of electrons.
3. Predict and explain the behavior of light in a variety of situations and circumstances, including geometric optics, polarization, interference, and diffraction.
4. Recognize and utilize these phenomena in their everyday lives and careers.

In-class Activities:

1. Students will construct their own models of physical phenomena based on guided observations and experiments.
2. Students will collect and graph data from these experiments in real time, and interpret the results.
3. Students will discuss their results and difficulties with their group, the teaching assistants, and the rest of the class.

Out-of-class Activities:

1. Students will be responsible for reading the laboratory guide and answering pre-lab questions before the laboratory.
2. Students will be responsible for post-laboratory homework assignments that reinforce critical physics concepts and investigative skills.

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PHY 20095 – Special Topics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate knowledge and understanding of major concepts and/or theoretical principles in the topic area.
2. Communicate effectively in a variety of formats as appropriate to the topic.
3. Engage in critical discussions about the topic.
4. Use the concepts, language, and major theories of the discipline.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

PHY 21040 - Physics in Entertainment and the Arts

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Identify, define, and calculate basic properties, parameters, and phenomena of waves.
2. Define and explain the importance of standing waves.
3. Relate wave principles to sound, hearing, and music.
4. Relate wave principles to light, vision, color, and art.
5. Understand and make predictions involving polarization, interference, diffraction, reflection, and refraction.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.
2. Students will watch PowerPoint presentations on various topics and will be responsible for understanding their content.
3. Students will watch video presentations, take notes on them, and be responsible for understanding their content.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing assigned projects and review materials.

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PHY 21041 - Physics in Entertainment and the Arts Laboratory

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Use several kinds of laboratory test equipment to measure and analyze waves.
2. Explore and study wave phenomena at home using simple and inexpensive equipment.

In-class Activities:

1. Students will complete twelve laboratory activities to explore basic properties of waves, sound, light, and digital communication.
2. Students will submit laboratory reports after each activity.

Out-of-class Activities:

1. Students will complete four laboratory activities at home to study the physical phenomenon of beats, to measure the speed of sound and the speed of light, and to explore color mixing.
2. Students will submit laboratory reports after each activity.

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PHY 21430 – Frontiers in Astronomy

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. To understand how the Scientific Method is applied in Astronomy.
2. Have a basic understanding of the Solar System and the nature of its major elements.
3. Understand the nature of the entities that make up the Cosmos and our place in it.
4. Be familiar with elements of Cosmology, the origin and fate of the Universe.
5. Understand and relate news about current research to classroom material.

In-class Activities:

1. Students will listen to lectures and/or watch PowerPoint presentations on various topics and will be responsible for understanding their content.
2. Students will watch video presentations and participate in discussions.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for completing assigned projects and/or take interactive self-guided tutorials.

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PHY 21431 – Frontiers in Astronomy Laboratory

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Use simple tools in clever ways to measure astronomical distances and times.
2. Explain how scientists can support the claims they make about astronomical phenomena.
3. Feel comfortable and at home with the night sky, and recognize what they see there.
4. Identify reliable and beautiful patterns in the sky, and make accurate predictions from them.
5. Explain how the mass of a star determines its properties, its evolution, and its eventual fate.

In-class Activities:

1. Students will complete a variety of graphing exercises and mathematical tables on the motion of planets and the nature of stars.
2. Students will use computer programs to obtain data from simulations and remote-access laboratory experiments.

Out-of-class Activities:

1. Students will construct a small telescope and use it to observe the Moon and visible planets.
2. Students will observe and chart the positions of stars over extended periods.

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PHY 22564 - Introduction to Materials Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain how the molecular composition of materials lead to the diverse macroscopic properties found in crystalline, polymeric, and ceramic materials.
2. Demonstrate knowledge of the basic physical descriptions of electrical, mechanical, and transport properties of materials.
3. Identify basic structure of crystalline solids and explain how this structure is determined experimentally.
4. Explain how crystal structure defects can be exploited to manipulate electrical, mechanical, and transport properties of materials.
5. Describe basic structural and macroscopic properties of polymeric and ceramic materials.

In-class Activities:

1. Students will take notes and will be responsible for asking questions when clarification is needed.

Out-of-class Activities

1. Students will be responsible for reading relevant textbook chapters and assigned additional reading materials from supplementary texts.
2. Students will be responsible for solving weekly homework assignments.
3. Typically, students will research an approved topic of their choice and communicate their finding to the class in an oral or poster presentation.

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PHY 23101 – General University Physics I

Learning Outcomes:

Upon successful completion of this course, the students will be able to:

1. Demonstrate proficiency with principles of mechanics including kinematics, Newton’s laws, dynamics, work and energy, fluids, and gravitation, as well as, heat, waves, and sound.
2. Effectively apply knowledge to explain, analyze and solve a large variety of qualitative and quantitative problems using appropriate mathematical techniques and concepts.
3. Form the solid basis of general knowledge of classical physics needed for successful completion of upper level courses as well as future career objectives in science, industry and education.
4. Demonstrate proficiency with experimental processes including designing an investigation. Identify and explain the scientific method in a lab setting, evaluate scientific information, collaborate and perform team activities.

In-class Activities:

1. Students will take notes and be responsible for asking questions when clarification is needed.
2. Students should participate in in-class group activities (such as interactive demonstrations), and discussions of relevant topics and problems as part of both the lecture and the recitation.
3. For the Lab component of this course students are expected to participate in lab activities such as: setting up experimental investigations addressing the principles and applications of an appropriate physics topic, collecting and analyzing data of physical phenomena using computer based technology, identifying possible sources of random and systematic error, making comparisons between experiment and theoretical models and interpreting and presenting the results in a written format.

Out-of-class Activities:

1. Students are required to read sections of the course textbook and the instructor handouts, and consult other reference material as a preparation for class activities, homework, and tests.
2. Students are assigned regular homework sets consisting of quantitative problems and/or topics to be investigated.
3. For each Lab: Students are expected to study the relevant Introduction section of the Lab Activities Textbook, complete the Pre-Lab portion of the lab and write laboratory reports as needed.
4. Students are expected to meet with the instructor for assistance with course topics, homework, or in preparation for tests.

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PHY 23102 - General University Physics II

Learning Outcomes:

Upon successful completion of this course, the students will be able to:

1. Demonstrate satisfactory level of knowledge of principles of electricity and magnetism including Maxwell’s equations and electromagnetic waves, optics and wave phenomena, and topics of modern physics.
2. Effectively apply knowledge to explain, analyze and solve a big variety of qualitative and quantitative problems using appropriate mathematical techniques and concepts.
3. Form the solid basis of general knowledge of classical physics needed for successful completion of upper level courses as well as future career objectives in science, industry and education.
4. Demonstrate proficiency with experimental processes including designing an investigation. Identify and explain the scientific method in a lab setting, evaluate scientific information, collaborate and perform team activities.

In-class Activities:

1. Students will take notes and be responsible for asking questions when clarification is needed.
2. Students should participate in in-class group activities (such as interactive demonstrations), and discussions of relevant topics and problems as part of both the lecture and the recitation.
3. For the lab component of this course students are expected to participate in lab activities such as: setting up experimental investigations addressing the principles and applications of an appropriate physics topic, collecting and analyzing data of physical phenomena using computer based technology, identifying possible sources of random and systematic error, making comparisons between experiment and theoretical models and interpreting and presenting the results in a written format.

Out-of-class Activities:

1. Students are required to read sections of the course textbook and the instructor handouts, and consult other reference material as a preparation for class activities, homework, and tests.
2. Students are assigned regular homework sets consisting of quantitative problems and/or topics to be investigated.
3. For each Lab: Students are expected to study the relevant Introduction section of the Lab Activities Textbook, complete the Pre-Lab portion of the lab and write laboratory reports as needed.
4. Students are expected to meet with the instructor for assistance with course topics, homework, or in preparation for tests.

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PHY 30020 – Intermediate Physics Laboratory

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Have reinforced the physical concepts covered in the course work.
2. Demonstrate a satisfactory level of familiarity with new physical concepts introduced to the students in this course.
3. Become proficient with modern laboratory measurement techniques and the use of computers.
4. Become proficient in the interpretation of experimental data including data reduction and error analysis.

In-class Activities:

1. Students will be assigned experiments from a growing inventory depending on their needs, physics background, experience, and interests.
2. Students will set up the equipment and perform the experiments.
3. Students will use computers for taking data and for the general analysis of the data.

Out-of-class Activities:

1. Students will be responsible for reading the experimental description of the experiment to be performed, and to study the background material, text, or library material required to understand the experiment to be performed during the following week.
2. Students will write weakly lab reports for which they are expected to use computer to type their report and analyze and present their data.
3. Students are expected to meet out of class with the instructor for clarification on lab material and assistance with writing the lab reports, as necessary and appropriate.
4. Students will prepare and defend a poster (based on one of the experiments performed) during the poster presentation at the end of the semester.

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PHY 30095 – Special Topics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate knowledge and understanding of major concepts and/or theoretical principles in the topic area.
2. Communicate effectively in a variety of formats as appropriate to the topic.
3. Engage in critical discussions about the topic.
4. Use the concepts, language, and major theories of the discipline.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

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PHY 32511 – Electronics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Analyze both DC and AC circuits.
2. Have the capability of using mesh theory to solve complex circuits with many loops and many voltage sources.
3. Understand the effect on a circuit as sine wave AC frequency is varied.
4. Under solid-state components including the diode, transistor, and linear amplifiers.

In-class Activities:

1. Students will work many math problem examples.
2. Students will participate in a 4-hr. weekly lab (two 2-hr. labs) dealing with in-class material.

Out-of-class Activities:

1. Students will be responsible for solving assigned homework problems.
2. Students will prepare written lab reports.

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PHY 34000 – Cosmology

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate knowledge of modern models of the structure and evolution of the Universe.
2. Quantitatively compute fundamental physical quantities such as the density and temperature for the Universe at various times in its history.
3. Demonstrate the required basic knowledge of tools such as general relativity.
4. Recognize the most important limitations of, and questions left unanswered by, the currently prevailing cosmological models, as well as possible solutions.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving regularly assigned homework problems.

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PHY 35101 – Classical Mechanics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate a satisfactory level of familiarity with basic concepts of Classical Mechanics, with applications to central-force motion, coupled oscillations, rigid body motion and motion in non-inertial reference frames.
2. Solve quantitative fundamental problems of dynamics of single particles or systems of particles, using both Lagrangian and Hamilton formulations and applying differential and integral calculus as well as ordinary and partial differential equations.

In-class Activities:

1. Students will take notes, be responsible for asking questions when clarification is needed, and participate in discussion topics posed by the instructor.
2. The course credit is based mostly on student performance on a midterm and a final exam.

Out-of-class Activities:

1. Students are required to read sections of mandatory or recommended textbooks and consult other reference material.
2. Students are assigned homework problem sets weekly, which mostly consist of quantitative problems.
3. Students are expected to meet out of class with the instructor for clarification on course material and assistance with homework or test preparation, as necessary and appropriate.

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PHY 36001 - Introductory Modern Physics

Learning Outcomes:

Upon successful completion of this course, the students will be able to:

1. Demonstrate satisfactory knowledge of physics in the early 20th century and in particular: special relativity, wave and particle duality, the Rutherford-Bohr model of the atom, Schroedinger’s quantum mechanics, the hydrogen atom and many-electron atoms.
2. Effectively apply knowledge to solve a big variety of quantitative problems using appropriate mathematical techniques and concepts.
3. Demonstrate understanding of scientific literature such as journal articles and reference materials relevant to the topics discussed.

In-class Activities:

1. Students will take notes and be responsible for asking questions when clarification is needed.
2. Students should participate in in-class discussions and group activities on relevant topics and problems.
3. This course does not have a lab component, but, students will work in groups on simulations in a computer lab setting to investigate relevant physics topics such as the photo-electric effect, quantum tunneling, models of the atom etc.

Out-of-class Activities:

1. Students are required to read sections of the course textbook and the instructor handouts, and consult other reference material as a preparation for class activities, homework, and tests.
2. Students are assigned regular homework sets consisting of quantitative problems and/or topics to be investigated by consulting scientific literature, using simulations or hands on demonstrations.
3. Students are expected to meet with the instructor for assistance with course topics, homework or in preparation for tests.

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PHY 36002 – Applications of Modern Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate a satisfactory level of familiarity with basic concepts of atomic physics, molecular structure and bonding, statistical physics, solid state physics including superconductivity, nuclear structure and radioactivity, nuclear fission and fusion, elementary particles, cosmology and astrophysics.
2. Solve relevant quantitative fundamental problems of modern physics.

In-class Activities:

* 1. Students will take notes, be responsible for asking questions when clarification is needed, and participate in discussion topics posed by the instructor.

Out-of-class Activities:

1. Students are required to read sections of mandatory or recommended textbooks and consult other reference material.
2. Students are expected to meet out of class with the instructor for clarification on course material and assistance with homework or test preparation, as necessary and appropriate.

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PHY 40020 – Advanced Physics Laboratory

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Have reinforced the physical concepts covered in the course work.
2. Demonstrate a satisfactory level of familiarity with new physical concepts introduced to the students in this course.
3. Become proficient with modern laboratory measurement techniques and the use of computers.
4. Become proficient in the interpretation of experimental data including data reduction and error analysis.

In-class Activities:

1. Students will be assigned experiments from a growing inventory depending on their needs, physics background, experience, and interests.
2. Students will set up the equipment and perform the experiments.
3. Students will use computers for taking data and for the general analysis of the data.

Out-of-class Activities:

1. Students will be responsible for reading the experimental description of the experiment to be performed, and to study the background material, text, or library material required to understand the experiment to be performed during the following week.
2. Students will write weakly lab reports for which they are expected to use computer to type their report and analyze and present their data.
3. Students are expected to meet out of class with the instructor for clarification on lab material and assistance with writing the lab reports, as necessary and appropriate.
4. Students will prepare and defend a poster (based on one of the experiments performed) during the poster presentation at the end of the semester.

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PHY 40060 – Physical Literature

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Execute a literature search that involves an effective use of the university library and relevant search engines.
2. Demonstrate the ability to present and discuss their project in-depth and communicate the critical issues and key factors of the project.
3. Identify basic principles and knowledge related to their project.
4. Summarize their learning experiences in written form.

In-class Activities:

1. Students will typically give a written presentation about their project.

Out-of-class Activities:

1. Students will be responsible for working constructively with their course supervisor.
2. Students will perform a literature search on a specified topic in physics and typically prepare a written report on their findings.

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PHY 40092 – Internship in Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Execute a project that involves a structured approach to problem solving, planning, and project management.
2. Demonstrate the ability to present and discuss their project in-depth and communicate the critical issues and key factors of the project.
3. Identify basic principles and knowledge related to their project.
4. Summarize their learning experiences verbally.

In-class Activities:

1. Students will give a public PowerPoint (or equivalent) presentation about their project.

Out-of-class Activities:

1. Students will be responsible for working constructively with their internship supervisor.
2. Students will develop a PowerPoint (or equivalent) presentation summarizing their project.

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PHY 40095 – Special Topics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate knowledge and understanding of major concepts and/or theoretical principles in the topic area.
2. Communicate effectively in a variety of formats as appropriate to the topic.
3. Engage in critical discussions about the topic.
4. Use the concepts, language, and major theories of the discipline.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

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PHY 40096 – Individual Investigation

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Execute a project that involves a structured approach to problem solving, planning, and project management.
2. Demonstrate the ability to present and discuss their project in-depth and communicate the critical issues and key factors of the project.
3. Identify basic principles and knowledge related to their project.
4. Summarize their learning experiences verbally or written.
5. Work constructively with a faculty mentor.

In-class Activities: N/A

Out-of-class Activities:

1. Students will carry out a faculty supervised research project.
2. Students will typically write a paper summarizing their project.

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PHY 40099 – Senior Honors Thesis

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Execute a project that involves a structured approach to problem solving, planning, and project management.
2. Demonstrate the ability to present and discuss their project in-depth and communicate the critical issues and key factors of the project.
3. Identify basic principles and knowledge related to their project.
4. Summarize their learning experiences verbally and written.
5. Work constructively with a faculty mentor.

In-class Activities:

1. Students will give a public presentation about their thesis project at their thesis defense.

Out-of-class Activities:

1. Students will carry out a faculty supervised research project.
2. Students will write a thesis summarizing their project.

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PHY 40195 – Special Topics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate knowledge and understanding of major concepts and/or theoretical principles in the topic area.
2. Communicate effectively in a variety of formats as appropriate to the topic.
3. Engage in critical discussions about the topic.
4. Use the concepts, language, and major theories of the discipline.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

PHY 41010 – Biophotonics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

*Physics:*

1. Understand the fundamental properties of light.
2. Understand optical elements by building and testing systems of lenses to magnify a specimen.
3. Explain how polychromatic light can be separated into light of specific wavelengths.
4. Design and build a collection of lenses/filters to examine light of different wavelengths and relate this to the properties and use of fluorescent molecules.
5. Demonstrate an understanding of energy conservation as it applies to fluorescence.
6. Understand the optical properties of fluorescent molecules.

*Physical Chemistry:*

1. Understand how the fluorescent properties of molecules are altered in different environments.
2. Understand and be able to use advanced fluorescence spectroscopy methods like resonance energy transfer, fluorescence quenching and fluorescence anisotropy measurements.
3. Understand the difference between steady state and fluorescence lifetime measurements and how fluorescence lifetime experiments can be used to obtain information about biomolecules.

*Organic Chemistry:*

1. Understand how molecular structure and photonic properties are related.
2. Outline the syntheses of fluorescent dyes and discuss the implications of altering their structure.
3. Understand how molecular structure and intracellular targeting of the fluorophore are related.

*Microscopy Applications in Biology:*

1. Describe and demonstrate the use of the light microscope and image formation without and with contrast enhancement.
2. Understand the basics of sterile cell culture and requirements for cell growth.
3. Demonstrate an understanding of scale for organs, tissues, cells, and subcellular structures.
4. Explain the basic structural features and functions of intracellular organelles.
5. Explain epifluorescence and design a system for a specific fluorescent probe.
6. Explain the principles of confocal microscopy and produce images illustrating its utilization.
7. Describe the interactions light might have with biological systems.
8. Show knowledge of advanced current methods and techniques in Biophotonics.

*General Aspects:*

1. Identify personal or common misconceptions about light or its interactions with matter, including biological materials.
2. Understand the methods of science and experimental design by identifying a problem, designing an experiment, collecting data, and interpreting the results.
3. Become more adept at working with others to solve problems.
4. Become proficient at presenting scientific concepts and experimental results in oral and written work.

In-class Activities:

1. Listening to lecture.
2. Taking note during lecture.
3. Group discussion.
4. Hands-on laboratory exercises.
5. Electronic portfolio documenting successful completion of the learning objectives.

Out-of-class Activities:

1. Reading outside class.
2. Studying.
3. Writing assignments.
4. Lab reports.
5. Group projects.
6. Portfolio development.

PHY 44600 - Introduction to Biological Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Describe the chemical and physical properties of basic molecular components of living cells, as well as elementary processes in cellular biology.
2. Use simple physical models to develop a quantitative understanding of biological processes.
3. Apply ideas from statistical mechanics to understand the equilibrium and near-equilibrium properties of a variety of biologically relevant systems.

In-class Activities:

1. Students will take notes and will be responsible for asking questions when clarification is needed.

Out-of-class Activities

1. Students will be responsible for reading relevant textbook chapters and assigned additional reading materials from supplementary texts or journal articles.
2. Students will be responsible for solving weekly homework assignments.
3. Typically, students will research an approved topic of their choice and communicate their finding to the class through oral or poster presentation.

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PHY 44802 – Astrophysics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Describe the regular features of the Solar System.
2. Explain how scientists determine planetary and stellar masses.
3. Describe how stellar spectra are used to determine temperatures and compositions of stars.
4. Explain how stars form and evolve.
5. Demonstrate an understanding of the different types of stellar remnants, including white dwarfs, neutron stars, and black holes.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification on discussion topics.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters.
2. Students will be responsible for solving chapter related homework problems.

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PHY 45201 – Electromagnetic Theory

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate a satisfactory level of familiarity with classical electromagnetism, especially with Maxwell’s equations in both integral and differential form, and in explicitly relativistic form.
2. Solve a good variety of quantitative problems of the type that are customarily assigned in standard textbooks on electromagnetism aimed at the senior undergraduate level.
3. Have a good familiarity with the GRE Subject Test curriculum, of which nominally 18% of the questions are based on the material covered in this course.

In-class Activities:

1. Students will take notes and be responsible for asking questions when clarification is needed.
2. All students should participate in in-class discussion of problem-solving strategies when sample problems are being worked.
3. There is no laboratory activity in this course, but there are occasional in-class demonstrations of electromagnetic phenomena in which students are encouraged to take an active role.
4. A major fraction of the total course credit is based on student performance on in-class tests and on a comprehensive final exam.

Out-of-class Activities:

1. Students are required to read sections of the assigned textbook and consult other reference material as a preparation for class activities, homework, and tests.
2. Students are assigned regular homework sets, which mostly consist of quantitative problems. Homework problems often include more lengthy problems that would be impractical to assign on an in-class test or on the final exam.
3. Students are expected to meet with the instructor during office hours whenever they have difficulty with homework or with test preparation.

PHY 45301 - Thermal Physics

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Demonstrate a satisfactory level of familiarity with basic concepts of Thermal Physics, with application to heat engine and refrigerators, and phase transformations.
2. Solve quantitative fundamental problems of the type that are customarily assigned in standard textbooks on thermal physics aimed at the senior undergraduate level, using appropriate mathematical techniques and concepts.
3. Have a good familiarity with the GRE Subject Test curriculum, of which nominally 10% of the questions are based on the material covered in this course.

In-class Activities:

1. Students will take notes and will be responsible for asking questions for clarification and participate in discussion topics posed by the instructor.
2. Students will participate in in-class discussions of relevant topics and problems.
3. Students will work with teaching assistants to practice solving content-related mathematical problems.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters and assigned additional reading materials from supplementary texts.
2. Students will be responsible for solving weekly quantitative homework assignments.
3. Students are expected to meet out of class with the instructor for clarification on course material and assistance with homework or test preparation, as necessary and appropriate.

PHY 45401 - Mathematical Methods in Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Solve problems and derive theorems involving of differential and integral multi-variable calculus.
2. Solve problems and derive theorems involving linear algebra, tensors, and group theory.
3. Solve problems and derive theorems involving ordinary differential equations.
4. Solve problems and derive theorems involving functions of complex variables.

In-class Activities:

1. Students will take notes and will be responsible for asking questions when clarification is needed.

Out-of-class Activities

1. Students will be responsible for reading relevant textbook chapters and assigned additional reading materials from supplementary texts.
2. Students will be responsible for solving weekly homework assignments.

PHY 45403 - Data Analysis and Computational Physics Techniques

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate proficiency with data reduction and error analysis techniques in physical measurements, the Monte Carlo simulation method, and basic computational physics techniques.
2. Solve quantitative fundamental problems of data analysis with emphasis in mean calculation and error estimation, simulation of discrete and continuous probability distributions, and fitting of experimental data using least-squares regression.

In-class Activities:

1. Students will take notes, perform calculations using computer software (scientific-level spreadsheet and/or high-level programming language), be responsible for asking questions when clarification is needed, and participate in discussion topics posed by the instructor.
2. Course is taught in a computer laboratory environment.
3. The course credit is based mostly on student performance on in-class and homework problem assignments, in-class midterm exam, and a comprehensive take-home exam.

Out-of-class Activities:

1. Students are required to read sections of mandatory or recommended textbooks and consult other reference material.
2. Students are assigned homework problem sets weekly, which mostly consist of quantitative problems.
3. Students are expected to meet out of class with the instructor for clarification on course material and assistance with homework or test preparation, as necessary and appropriate.

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PHY 45501 – Electromagnetic Waves and Modern Optics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Describe both qualitatively and quantitatively electromagnetic waves in materials from both the microscopic and macroscopic views. This includes the microscopic origin of the refractive index and dispersion.
2. Analyze reflection, refraction, and scattering of electromagnetic waves at interfaces using Maxwell’s equations.
3. Apply geometric optics to real-world optical systems, including an understanding of the limits of such systems in terms of aberrations and diffraction.
4. Understand and apply the wave properties of light including interference, diffraction, scattering, polarization, and master the Fourier transform description of these wave properties.
5. Understand how light is used as a primary tool to explore the universe around us.

In-class Activities:

1. Students will take detailed lecture notes, ask questions for clarification on lecture topics, and solve problems in class individually and in groups.
2. Students will actively participate in demonstrations and laboratory activities that illustrate important concepts in optics and their application.
3. Students will present a topic of their choice related to modern optics at the end of the semester.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters and supplementary readings.
2. Students will be responsible for weekly homework assignments including qualitative discussions of optical phenomena, quantitative problems, and the analysis of optical data that develop analytic skills and reinforce critical physics concepts in optics.
3. Students will prepare a presentation and paper on the application of optics to the topic of their choice.

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PHY 46101 – Quantum Mechanics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate a satisfactory level of familiarity with the basic concepts and mathematical structure of Quantum Mechanics, with emphasis upon the Schrodinger wave function.
2. Apply these to one-dimensional potentials including the harmonic oscillator, realistic three-dimensional systems including the quantum description of angular momentum. Use time-independent perturbation theory and identical two-particle systems are also treated.
3. Derive explicit solutions of the Schrodinger equation as a differential equation, and in the case of the harmonic oscillator derive the solution by the algebraic method of raising and lowering operators. Obtain the solution of selected first and second order perturbation problems. Apply and derive the fundamental commutation relations of the uncertainty principle and angular momentum.

In-class Activities:

1. Students will take notes, be responsible for asking questions when clarification is needed, and participate in discussion topics posed by the instructor.
2. The course credit is based on student performance in regularly assigned homework, two midterm exams and a final exam.

Out-of-class Activities:

1. Students are required to read sections of mandatory or recommended textbooks and consult other reference material.
2. Students are assigned homework problem sets weekly, which consist of conceptual and quantitative problems.
3. Students are expected to meet out of class with the instructor for clarification on course material.

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PHY 46301 - Introduction to Nuclear Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate a satisfactory level of familiarity with basic concepts of Nuclear Physics, including properties of the atomic nucleus, nuclear models, nuclear decay, fission and fusion, and elementary particles.
2. Solve quantitative fundamental problems of subatomic physics with emphasis on radioactivity, experimental techniques, nuclear structure, and nuclear/particle reaction kinematics.

In-class Activities:

1. Students will take notes, be responsible for asking questions when clarification is needed, and participate in discussion topics posed by the instructor.
2. There is no laboratory activity in this course.
3. The course credit is based mostly on student performance on a midterm and a final exam.

Out-of-class Activities:

1. Students are required to read sections of mandatory or recommended textbooks and consult other reference material.
2. Students are assigned homework problem sets weekly, which mostly consist of quantitative problems.
3. Students are expected to meet out of class with the instructor for clarification on course material and assistance with homework or test preparation, as necessary and appropriate.

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PHY 46401 - Introduction to Solid State Physics

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand crystal lattice structures underlying solids, their representations, and how they are determined experimentally.
2. Understand vibrations of the lattice and be able to calculate associated phonon modes and their thermodynamic and other properties.
3. Understand the role of electrons in solids using basic quantum mechanics and be able to calculate contributions of electrons to thermal, electromagnetic, and optical properties of solids.
4. Understand electronic band structures and the origin of band gaps, and be able to calculate the most basic electronic band structures.
5. Have a basic understanding of semiconductors, their role in everyday life, and understand their charge transport properties.
6. Appreciate how to synthesize knowledge of the basic elements of physics – mechanics, electromagnetism, quantum mechanics, thermodynamics -- for the purpose of understanding properties of solids.

In-class Activities:

1. Students will take detailed lecture notes, ask questions for clarification on lecture topics, solve problems in class individually and in groups.

Out-of-class Activities:

1. Students will be responsible for reading relevant textbook chapters and assigned additional reading materials from supplementary texts.
2. Students will be responsible for solving weekly homework assignments comprised of problems, derivations, and short essays.

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