ENGINEERING PHYSICS (ENGP)

ENGP 1005 Introduction to Electronics with Lab (3)
Introductory course designed for high school students enrolled in the TSSP summer program.

ENGP 1010 Introduction to Maker Space (3)
The course will focus on practical application and a "hands-on" lab approach to learning design software and creating working models using the tools of the MakerSpace. Limited to high school students.

ENGP 1015 Introduction to Engineering Design (3)
The objective of this courses is to introduce high school students to the product design process. Through team projects geared toward creating physical solutions for real world problems, students will be challenged to begin thinking critically and applying physical fundamentals to complex systems. Daily lectures will highlight phases of the design process, including problem identification, conceptual design, and early prototyping. Additionally students will gain experience with computer-aided design and be provided an introduction to rapid prototyping. This will be a 2 week course, and will only be open to high school students.

ENGP 1410 Statics (3)
Statics of particles and rigid bodies. Concepts of force, moments, free body diagrams, equilibrium and friction with engineering applications.

Prerequisite(s): PHYS 1310.

ENGP 1940 Transfer Coursework (0-20)
Transfer Coursework at the 1000 level. Department approval may be required.

Maximum Hours: 99

ENGP 2010 Electric Circuits (3)
A fundamental course dealing with electric charge, current, voltage, power, energy, and passive and active circuit elements. Response of linear circuits to steady state and time dependent signals, differential equations, circuit laws, network analysis, frequency response, phasors, and transfer functions.

Prerequisite(s): PHYS 1320 and (MATH 1220 or 1310).
Corequisite(s): ENGP 2011.

ENGP 2011 Electric Circuits Lab (1)
This course is intended to provide an understanding of the basic principles of electronics, including the design and application of electronic projects to real-world objectives. The course will focus on practical application and a "hands-on" lab approach to electronics. Some computer programming will also be included.

Prerequisite(s): ENGP 2010*.
* May be taken concurrently.

ENGP 2020 Computing Concepts and Applications (4)
This course introduces students to the foundations of algorithm development and programming, the basics of matrix algebra, numerical analysis, and solving ordinary differential equations.

Corequisite(s): ENGP 2021.

ENGP 2021 Computing Concepts and Applications Lab (0)
Lab for ENGP 2020.

Corequisite(s): ENGP 2020.

ENGP 2120 Engineering Thermodynamics (3)
This course provides a comprehensive introduction to the principles of engineering thermodynamics with a strong focus on practical applications and real-world examples. Topics include First and Second Law analysis, power and refrigeration cycles, and basic HVAC processes.

Prerequisite(s): MATH 2210*, CHEM 1070 and PHYS 1310.
* May be taken concurrently.

ENGP 2310 Product and Experimental Design (3)
The objective of this course is to introduce students to the design process as they are starting their engineering studies. Through team projects geared toward translating bench research into product development, students will be challenged to begin thinking critically and applying physical fundamentals to complex systems. Weekly lectures will highlight phases of the design process, including problem identification, conceptual design, and early prototyping. Additionally, in the context of product and experimental design, students will gain experience with computer aided design and be provided an introduction to statistics. Course restricted to ENGP and PHYS majors, or by permission of the instructors.

Corequisite(s): ENGP 2311.

ENGP 2311 Product and Experimental Design Lab (0)
Lab section for ENGP 2310.

Corequisite(s): ENGP 2310.

ENGP 2420 Engineering Dynamics (3)
Kinematics and kinetics of particles and rigid bodies. Work-energy and impulse-momentum methods applied to particles and rigid bodies. Mechanical vibrations.

Prerequisite(s): (MATH 1220 or 1310) and ENGP 1410.

ENGP 2430 Mechanics of Materials (3)
Concepts of stress and strain. Generalized Hooke's Law. Mohr's circle. Formulations for axial, shear, bending, torsion, and combined stresses applied to tension members, pinned points, symmetric and unsymmetric beams, and shafts. Euler buckling criteria for columns.

Prerequisite(s): ENGP 1410 and (MATH 1220 or 1310).

ENGP 2730 Electronics (4)
Rectifiers, filters, regulators and power supplies. Analog amplifiers and active filters of interest for medical devices. Combinational and sequential digital logic design techniques and circuits. Brief overview of modulation, encoding, and interfacing. Electrical safety. Extensive weekly lab projects.

Prerequisite(s): ENGP 2010.
Corequisite(s): ENGP 2731.

ENGP 2731 Electronics Lab (0)
Lab section for ENGP 2730

Corequisite(s): ENGP 2730.

ENGP 2890 Service Learning (0-1)
Students complete a service activity in the community in conjunction with the content of a three-credit co-requisite course. Course may be repeated up to unlimited credit hours.

Maximum Hours: 99

ENGP 2940 Transfer Course Work (3)
Course may be repeated up to unlimited credit hours.

Maximum Hours: 99

ENGP 3120 Materials Science and Engineering (3)
The structure and properties of engineering materials are considered. Coverage includes basic atomic and microscopic structure, testing methods, phase relationships, and strengthening techniques. Emphasis is placed on common industrial materials. Thermodynamics and kinetics aspects of material science are discussed.

Prerequisite(s): CHEM 1070 and PHYS 1320.

ENGP 3130 Introduction to Power Systems (3)
This course is an introduction to electric power systems. It covers basic elements of power system calculations, including three phase circuit analysis, transformers, synchronous machines, and transmission lines. This course also focuses on the basic theories and numerical techniques for understanding the fundamental design of smart power grid renewable energy systems.

Prerequisite(s): ENGP 2010.

ENGP 3140 Digital Logic Systems (3)
An introduction to digital circuits, logic and system design. Topics include digital representation of information, logic circuits, combinational logic design, logic building blocks, arithmetic design, sequential logic and timing analysis, clocks and synchronization, finite state machines, and digital system design.

Prerequisite(s): ENGP 2010.

ENGP 3160 Probabilistic Systems and Signal Processing (3)
Many real-world phenomena and systems are probabilistic in nature, where the outcome of an experiment has uncertainty. Examples can be found everywhere including medical diagnosis and spread of disease, electronic devices, communication and information systems, internet traffic and social networks, gambling, financial markets, polling and elections, renewable energy, sports, etc. The modeling and analysis of probabilistic systems involve the fields of probability theory, statistics, machine learning, and statistical signal processing. This course covers the basic concepts and techniques of probability theory with application to statistics, machine learning, and statistical signal processing. Topics include probability and counting, conditional probability, Bayes rule, independence, random variables and processes, expectation and correlation, variance and covariance, conditional expectation, signal estimation, limit theorems, minimum mean square error estimation, linear estimation, and confidence intervals. Coursework includes computational problems in MATLAB with automatically generated and real data.

Prerequisite(s): (BMEN 2020 or ENGP 2020) and MATH 1220.

ENGP 3170 Computnl Physics & Engr (3)
An introduction to the use of computational methods in physics and engineering. Writing computer code and using data visualization techniques to solve experimental and theoretical problems. Data analysis and modeling, Monte Carlo simulations, numerical differentiation and integration, ordinary and partial differential equations, electrostatics, nonlinear dynamics and chaos, fast Fourier transform, noisy signal processing, quantum spectra, thermodynamics.

Prerequisite(s): PHYS 2350 and (MATH 2210 or 2240).

ENGP 3180 Introduction to Feedback Control and Control Theory (3)
This course introduces tools for controlling systems via a feedback loop, which power the world around us – from consumer products to ecological and economic systems. The presented mathematical principles are illustrated using MATLAB and a variety of examples. No prior experience with MATLAB and programming is required. The topics covered include the control of nonlinear systems via Lyapunov theory, linearization of nonlinear dynamics, controllability and observability, the Kalman filter, transfer functions, stability, and robustness, as well as the proportional-integral-derivative controller.

Prerequisite(s): MATH 2210.

ENGP 3230 Quantum information Sci & Eng (3)
This survey course introduces students to the new world of quantum information, quantum communication, and quantum computing. The course is intended for advanced undergraduates and beginning graduate students in physics, engineering, and mathematics. Topics include: Quantum states, operators, and linear algebra; Bits and qubits; Ensembles and density operators; Unitary transformations; Gates and circuits; Information and entropy; POVM measurement; Multipartite systems; Bell inequality, Bell states, and non-locality; Measures of entanglement; Quantum communication and cryptography; Teleportation; Superdense coding; Quantum noise and error correction; Classical and quantum computational complexity; Quantum algorithms: Deutsch-Jozsa, Grover, Shor; DiVincenzo criteria; Physical realizations of quantum computers: trapped ions, solid state qubits; Quantum optics and quantum internet; Topological quantum computation; Quantum biology.

Prerequisite(s): PHYS 2350 and (MATH 2210 or 2240).

ENGP 3290 Computational Materials Scienc (3)
Computational Materials Science and Engineering: This course will cover theories, implementations, and applications of common quantum mechanical software for computational study of materials. State-of-the-art computational methods will be introduced for materials research with emphasis on the atomic and nano scales and hands-on modeling on PCs and supercomputers. The class is aimed at beginning graduate students and upper level undergraduate students, and will introduce a variety of computational methods used in different fields of materials science. The main focus is quantum mechanical methods with a short overview of atomistic methods for modeling materials. These methods will be applied to the properties of real materials, such as electronic structure, mechanical behavior, diffusion and phase transformations. Computational design of materials using materials database via high-throughput and machine learning methods will also be covered.

Prerequisite(s): PHYS 2350 and 2360.

ENGP 3350 Kinetics of Material Systems (3)
This course covers all aspects of kinetics in material systems. Topics include thermodynamics, steady state and time dependent diffusion, phase transformations, statistical mechanics, structure evolution, boundaries and interfaces, solidification, and precipitation effects.

Prerequisite(s): ENGP 3120.

ENGP 3360 Structure of Materials (3)

The properties of matter depend on which of the about 100 different kinds of atoms they are made of and how they are bonded together in different crystal structures; specifically, the atomic structure primarily affects the chemical, physical, thermal, electrical, magnetic, and optical properties of materials. Metals behave differently than ceramics, and ceramics behave differently than polymers. Students will learn the different states of condensed matter and develop a set of tools for describing the crystalline structure of all of them. They will gain a better understanding of the principles of structure common to all materials. Key concepts, such as symmetry theory will be introduced and applied to provide a common viewpoint for describing structures of ceramic, metallic, and polymeric materials and the latter includes optical microscopy, electron optics, x-ray diffraction and some surface analytical techniques. Structure-sensitive properties of real materials will also be introduced.

ENGP 3370 Processing of Biomaterials (3)

Processing of biomaterials gives an overview of the most advanced techniques to process biomaterials into structures that satisfy next generation applications. All materials classes will be covered including polymers, ceramics, metals, composites and cells and tissues. In each case, the material-specific processing and the properties and potential applications will be covered.

ENGP 3380 Materials for Energy (3)

The course begins with a history of our understanding and utilization of different sources of energy and a review of thermodynamics. In all cases, the most effective materials used are discussed as well as the relevant fundamental equations used and approaches for improving the figure-of-merit. The 5 different forms of energy are introduced - mechanical, electromagnetic, thermal, chemical, and nuclear - and discussed. Materials and techniques used for energy applications are discussed including thermoelectrics, fossil fuels, nanoparticles, different approaches for energy storage, fuel cells, nuclear energy (fission and fusion), energy biological systems - from cellular scale and ATP and catabolism/anabolism to biomass conversion, and magnetohydrodynamics. Techniques for energy conversion, biomimetics, energy and the environment and material issues for energy transformation are discussed. The sun is also discussed as a source of energy for photosynthesis, photovoltaics, and photothermal power generation.

Prerequisite(s): ENGP 3120.

ENGP 3390 Synthesis of Nanomaterials (3)

This course focuses on the fundamentals of nanomaterials synthesis mechanisms and characterization. The course gives an introduction for nanomaterials classes and their importance for today's world, followed by basics of physical chemistry of solid surfaces. Then, top-down and bottom-up synthesis approaches for nanomaterials systems including gas, liquid and solid phase processes are covered. Characterization techniques of special importance for nanomaterials are taught. During the semester students will study and review scientific articles focused on nanomaterials synthesis and characterization.

Prerequisite(s): ENGP 3120.

ENGP 3430 Prof Develop Engineers I (2)

This course is designed to inform students in engineering physics of the wide variety of career paths available in engineering and related fields, and help with development of professional skills essential for building a productive and fulfilling career. Overview of career profiles, portfolio building, elements of project management, economic analysis, professional certifications, intellectual property, entrepreneurship, ethics, research and professional communication.

ENGP 3440 Prof Develop Engineers II (1)

This course is designed to inform students in engineering physics of the wide variety of career paths available in engineering and related fields, and help with development of professional skills essential for building a productive and fulfilling career.

Prerequisite(s): ENGP 3430.

ENGP 3460 Tech Ethics: What is a Better Future? (3)

What is the good life? What does that mean for you personally, and in society overall, in a world defined by technology and innovation? How do we define and measure worthwhile progress? Who prospers and who gets hurt? What should we hope for and what ventures and inventions should we create based on those hopes? What do we do when technology risks raise significant concerns? This course will address these and other core questions alongside insights from technologists, religious leaders, innovators, and ethicists throughout history. The course begins by asking together the core questions necessary to form a personal vision of what a good life and collective future looks like. We will then address specific technological questions, surveying their risks and promise in forming the good future that we seek. Such technologies address artificial intelligence, bioinnovation (genetic engineering and brain-human interfaces), energy and climate, social media, weapons and war, space exploration, and more. We will also explore what it looks like to form a good team and a good company to create this good future and how such a future impacts our career choices. This course is neither triumphalist nor defeatist about innovation; instead, we will sit with the questions, test their assumptions, reflect on ancient wisdom, and debate all sides in pursuit of a better future "Not For Oneself, But For One's Own."

ENGP 3530 Advanced Laboratory I (3)

Advanced experiments in modern physics and engineering, particularly nuclear physics and engineering, emphasizing research techniques and analysis of data using computers.

Prerequisite(s): PHYS 2350.

ENGP 3560 Photonic Materials & Devices (3)
This course will cover the theory, design, fabrication, characterization, and application of photonic materials and devices. The course will start with a review of the fundamentals of photonics, including ray optics, wave optics, and nanophotonics/quantum optics. The course will then focus on light-matter interactions and photonic materials, including dielectrics, semiconductors, metals, metamaterials, and photonic crystals. Using these principles and materials, we will explore a number of device architectures, including LEDs, lasers, photodetectors, photovoltaics, etc. We will then discuss fabrication methods for making these materials and devices and common optoelectronic characterization techniques. The course will conclude with exploration of cutting edge topics in photonics research.

Prerequisite(s): PHYS 2350.

ENGP 3570 Semiconductor Devices (3)
An introduction to the physics and technology underlying semiconductor electronic and optoelectronic devices, including electrons and holes in semiconductors, energy-band diagrams, carrier transport, metal-semiconductor contacts, p-n junctions, and heterostructures. Device examples include bipolar transistors, MOSFETs, LEDs, and solar cells.

Prerequisite(s): PHYS 1320, MATH 1220 and PHYS 2350.

ENGP 3600 Nanoscience & Technology (3)
Nanoscience and technology is often branded the science of the 21st century. It has been promised that nanotechnology will have similar stimulating effects on the world's economy and society as the industrial-and microelectronics- revolution. Nanoscience is an interdisciplinary effort with the aim to manipulate and control matter at length scales down to single molecules and atoms and thus to create materials and devices with novel properties. With diminishing dimensions material properties are being governed by quantum mechanics. The description and exploitation of quantum phenomena in novel devices is the quintessence of nanophysics. Consequently, the main emphasis of this course is to give an overview of the physics of low dimensional solid state systems. This course is supplementary to courses in solid state physics and surface science but can be taken independently.

Prerequisite(s): PHYS 2350.

ENGP 3620 MicroFab and Nanotech (3)
Nano/micro-electromechanical devices (N/MEMS) require knowledge of a broad range of disciplines, from the fundamental physics of mechanics andelectromagnetism to practical nano/microfabrication processes and techniques. This course is opened for the introduction of this interdisciplinaryengineering field, using examples and design projects drawn from real-word N/MEMS applications. Lectures will cover nano/micro-fabricationtechnologies, material properties at different scaling, physical principle and behaviors of nano/microstructural behavior, piezoresistive and capacitivesensing, electrostatic actuation, fluid damping, noise, and feedback systems.

Prerequisite(s): PHYS 2360.

ENGP 3660 Special Topics (1-3)
Special Topics. Course may be repeated up to unlimited credit hours.

Maximum Hours: 99

ENGP 3665 Special Topics Lab (1-3)
Special Topics Lab.

Maximum Hours: 99

ENGP 3700 Electrnc Prop of Materls (3)
Quantum physics, electronics and energy bands in crystals, electronic transport in materials, photoconductivity, Hall effect, quantum Hall effect, superconductors and their applications, magnetic properties of material and their applications, thermal properties of materials and dielectric properties of materials.

Prerequisite(s): PHYS 2350.

ENGP 3720 Mechanic Behavior of Materials (3)
The course covers the general foundations of elasticity and plasticity theory, dislocation theory, and strengthening mechanisms. Basics of materials forming processes are studied. An overview for non-destructive testing of materials is taught. The course emphasis is on destructive mechanical testing of materials including; tension, torsion, hardness, fatigue and creep tests, in addition to fracture mechanics and failure analysis.

Prerequisite(s): ENGP 3120, 2430 and MATH 2210.

ENGP 3730 Signals and Systems (3)
Fundamentals of systems and signals analysis, and introduction to control systems. Topics include Laplace and Fourier transforms, the convolution theorem, time- and space-frequency-domain systems analysis, signal analysis, signals and noise, the mathematics of imaging, and examples and applications. The use of MATLAB and Simulink to analyze signals and systems will be reinforced.

Prerequisite(s): (ENGP 2020 or BMEN 2020) and (ENGP 2010 or MATH 2240).

ENGP 3760 Thermodynamics of Materials (3)
The course covers the general foundation of both statistical thermodynamics and classical thermodynamics, including thermodynamics laws, auxiliary functions, and behavior of gases and solutions. In addition, special attention is dedicated to equilibria of reactions and phase diagrams of materials. Computer-based programs will be used to solve thermodynamics problems for complicated materials.

Prerequisite(s): ENGP 3120.

ENGP 3890 Service Learning (0-1)
Students complete a service activity in the community in conjunction with the content of a three-credit co-requisite course. Course may be repeated up to unlimited credit hours.

Corequisite(s): ENGP 3120.

Maximum Hours: 99

ENGP 3892 Materials Engineering for Sustainable Development (1)
In this service-learning course students will learn and apply the principles of sustainable development in materials engineering to serve local communities. The topics covered include assessing sustainable developments, social responsibility and sustainability, materials supply-chain risk, a circular materials economy. The service options include working with communities to recycle materials, as well as designing and conducting K-12 STEM activities to educate students about materials and sustainability.

ENGP 3940 Transfer Coursework (0-20)
Transfer Coursework at the 3000 level. Department approval may be required.

Maximum Hours: 99

ENGP 3950 Engineers for Int'l Deve (1)
Engineers for International Development at Tulane University exists for students to participate in community-driven development programs worldwide through the design and implementation of sustainable engineering projects, while fostering responsible leadership. We work both internationally and locally to build and educate communities about their basic infrastructure systems such as drinking water, sanitation, and safe homes.

ENGP 4310 Team Design Project & Prf Pr I (3)
Design project taken in the fourth year of study with student teams. Advanced treatment of engineering design principles and project management. Students are presented with a choice of project proposals, and they must build teams, prepare a project plan, develop a prototype, and iterate on the design process. Prerequisites: senior standing, 22 hours of ENGP coursework, or approval of instructor.

Prerequisite(s): ENGP 2020, 2310 and 3440.

ENGP 4320 Team Design Project & Prf P II (3)
Design project taken in the fourth year of study with student teams. Continuation of ENGP 4310. Notes: Capstone requirement for majors.

Prerequisite(s): ENGP 4310.

ENGP 4660 Special Topics (1-3)
Special Topics. Course may be repeated up to unlimited credit hours.

Maximum Hours: 99

ENGP 4890 Service Learning (0-1)
Students complete a service activity in the community in conjunction with the content of a three-credit co-requisite course. Course may be repeated up to unlimited credit hours.

Corequisite(s): ENGP 4320.

Maximum Hours: 99

ENGP 4910 Independent Study (1-3)
Independent Studies. Prerequisites: Approval of instructor and chair of department. Course may be repeated for up to 6 credits.

Maximum Hours: 6

ENGP 4940 Transfer Coursework (0-20)
Transfer coursework at the 4000 level. Departmental approval required.

Maximum Hours: 99

ENGP 4990 Honors Thesis (3)
For especially qualified seniors with approval of the faculty director. Students are generally expected to have a minimum of a 3.400 overall grade-point average and a 3.500 grade-point average in the major.

ENGP 5000 Honors Thesis (4)
For especially qualified seniors with approval of the faculty director. Students are generally expected to have a minimum of a 3.400 overall grade-point average and a 3.500 grade-point average in the major.

Prerequisite(s): ENGP 4990.

ENGP 5380 Study Abroad (1-20)
Courses taught abroad by non-Tulane faculty. Does not count toward Tulane GPA. Course may be repeated up to unlimited credit hours

Maximum Hours: 99

ENGP 5390 Study Abroad (1-20)
Courses taught abroad by non-Tulane faculty. Does not count toward Tulane GPA. Course may be repeated up to unlimited credit hours.

Maximum Hours: 99