ENGINEERING SCIENCE PROGRAM: CONCENTRATIONS DESCRIPTIONS

CONCENTRATIONS AT CCU

Each concentration consists of a unique set of four courses. Therefore, all engineering majors complete a common course of study, then branch off to a series of four courses that offers specialization in:

1. Civil
2. Electrical
3. Innovation Design
4. Physics

CIVIL CONCENTRATION

Civil engineers design, build, and maintain the foundation for our modern society – our roads and bridges, drinking water and energy systems, sea ports and airports, and the infrastructure for a cleaner environment, to name just a few. https://www.asce.org/about_civil_engineering/

Courses of the Civil Concentration

1. **ENGR 265 Mechanics of Materials (pre-req: ENGR 234)**: This course emphasizes the fundamental concepts and application of strength of materials while developing student's analytical problem-solving skills.
2. **ENGR 365 Structural Analysis and Design I (pre-req: ENGR 265)**: This course covers the fundamental topics in Structural Analysis including: functions of structure, design loads, reactions and force systems; analysis of statically determinate structures including beams, trusses and arches. In addition, this coures also emphasizes on analysis and design of basis reforced concrete and steel structural members.
3. **ENGR 370 Environmental Engineering (pre-req: CHEM 111/L)**: Causes and effects of environmental problems and engineering methods to control them. This course is an overview of the major themes currently running through the field of environmental engineering. Major themes covered include the effect of human population growth and increased urbanization on the environment, energy consumption and production, water supply and treatment, air pollution and global climate change.
4. **ENGR 470 Water Resources Engineering (pre-req: ENGR 333)**: This course is designed to review the fundamentals and practices of water resources engineering with a focus on essential processes such as precipitation and runoff. Students will explore water resources engineering processes in the theoretical, and applied realm in the fields of closed conduit (pipe) flow, open channel flow, surface water hydrology, water quality analyses, and groundwater flow. The water resources engineering curriculum is designed to prepare interested students for future careers in water supply, wastewater, floodplain, stormwater, and groundwater management.

ELECTRICAL CONCENTRATION

Electrical engineering generally deals with the study and application of electricity, electronics, and electromagnetism. Electrical engineers design, develop, test and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems and power generation equipment. Electronics engineers design and develop electronic equipment, such

as broadcast and communications systems — from portable music players to global positioning systems (GPS). https://tryengineeringinstitute.ieee.org/what-is-electrical-engineering-anyway/

Courses of the Electrical Concentration

- **ENGR 321 Electronics (pre-req: ENGR/PHYS 235)**: This course covers the analysis, modeling and design of electrical circuits that contain electronic devices. Topics include: properties of electronic materials, behavior of devices such as p-n junction diodes, field effect transistors and bipolar junction transistors, operational amplifiers, and transistors in digital circuits. Electronics design principles via a systems approach is emphasized.
- **ENGR 315 Electric power and renewable energy (PHYS 214/PHYS 212)**: This course focuses on the role of renewable power generation in today's electricity power grid. This course has three main sections. The first section introduces the topology and operation of the current power grid. The second section is an in-depth analysis of wind, solar, and hydro, the three major renewable sources in use today, from an electrical engineering perspective. Finally, we conclude with the future of renewable energy: experimental technologies and the challenges of operating the power grid in the 21st century.
- **ENGR 317 Signals and systems (pre-req: MATH 320)**: This course covers signals and systems in both the time domain and in the frequency domain, including transformations such as Fourier, Laplace, and Z-transforms. Basic signal processing and controls concepts are introduced.
- **CSCI 270 Data Communication Systems and Networks**: Fundamentals of data communications, including hardware, basic components of communications, configurations, networks and applications, protocols and software are discussed.

INNOVATION DESIGN CONCENTRATION

The Innovation Design Concentration give students a complete array of tools and a systematic approach to creating, communicating and commercializing ideas in response to problems and opportunities in any field; they also learn how to lead the process of innovating within organizations – businesses, engineering firms, nonprofits, governments, educational institutions, arts organizations, etc.

Courses of the Innovation Design Concentration

1. **MGMT 324 Idea Generation in the Innovation Process:** This course provides a systematic approach to creativity, and the foundation for students to understand how to generate innovative ideas in any field. The course gives students the theories behind and practice using tools to generate meaningfully unique ideas. These tools engage creative stimuli, diversity, and mining for technology and economic, social and cultural trends. The course examines case histories that demonstrate how social and cultural contexts and human institutions have been influenced by innovative individuals who have realized original ideas in practice.
2. **MGMT 325 - Communicating Novel Ideas in Dynamic Settings (3 credits): (Pre-req or Co-req: MGMT 324)** This course combines elements of several disciplines to generate clear, precise and creative expression. Attention is given to narrative power of visual imagery as well as text; an emphasis is placed on writing as a method of prototyping and technology translation. Students learn to communicate the benefit, the uniqueness, and the credibility of a concept to others.

Students work with innovators to explore and translate the benefits of technical and specialized ideas to a target audience. Students will learn how to evaluate novel ideas through the process of articulation and to translate big ideas into words that persuade others to take action.

3. **MGMT 424 - Feasibility and Commercialization of Novel Ideas (3 credits): (Pre-req: MGMT 324 and MGMT 325)** Students work with real products and service ideas and create working prototypes to find the flaws of a design quickly and inexpensively. Topics include application of the scientific engineering design method to the prototyping process, sales forecasting, open source technology, patent searching, provisional patent writing and some elements of market research and funding.
4. **ENGR 356 – Engineering Supply Chain (3 credits): (Pre-req: ENGR 201 or permission of instructor)** This course utilizes mathematical modeling and solution tools for logistics and service operations. We study manufacturing and logistic activities across the global supply chain. Emphasis is on supply chain technical design, implementation, and safety functions. Topics include transportation and distribution networks, inventory requirements, demand planning, materials handling and warehousing, supply chain contracts, manufacturing flexibility, product design, and using available SAP or other ERP systems.

PHYSICS CONCENTRATION

Engineering with a Concentration in Physics prepares students to apply Physics concepts to tackle 21st century Engineering challenges, and Engineering principles to address 21st century questions in Physics. This Concentration, prepares students to work in the private sector or in national laboratories at the very forefront of technology, or to pursue an advanced degree in Engineering or prepares students to pursue an advanced degree in Physics.

Courses of the Physics Concentration

1. **PHYS 310 - Mathematical Methods for Physicists and Engineers (Pre-req:** PHYS 212 **or** PHYS 213 **or** ENGR 244 **and** MATH 161 **or** MATH 161B**)** Physics applications of vector calculus, infinite series, complex analysis, differential equations, orthogonal functions, integral equations, linear algebra, and calculus of variations.
2. **PHYS 351 - Computational Methods for Physicists and Engineers (Pre-req:** PHYS 212 **or** PHYS 214**)** This course introduces students to the computational tools that physicists routinely use to analyze and to codify the foundational principles of physics. By the end of the semester a student completing this course is able to perform order-of-magnitude calculations; design and write computer programs that simulate physical systems described by multiple variables; and analyze a set of noisy data. The communication and synthesis of scientific knowledge is highlighted throughout the course via formal written reports that describe the theoretical analysis of a physical system.
3. **PHYS 352 - Experimental Methods for Physicists and Engineers (Pre-req: PHYS 212 or PHYS 213 or PHYS 214)** This course focuses on the processes and methods in experimental physics. In particular, students acquire experimental data, recognize patterns and trends within the experimental data, develop models for physical processes, and fit these models to data. Observation, testing, and application experiments are discussed, and students are assessed on

their ability to design and conduct these types of experiments. Students also study and apply topics in error analysis, such as the proper reporting of uncertainties, error propagation, statistical analysis, and normal distributions. The communication and synthesis of scientific knowledge is highlighted throughout the course via formal written reports on experimental design and results

4. Choose **ONE** from the following (3 Credits):
    a. **ENGR 315 - Electric Power and Renewable Energy (Pre-req: A grade of 'C' or better in PHYS 212 or PHYS 214; or permission of the instructor)** This course focuses on the role of renewable power generation in today's electricity power grid. This course has three main sections. The first section introduces the topology and operation of the current power grid. The second section is an in-depth analysis of wind, solar, and hydro, the three major renewable sources in use today, from an electrical engineering perspective. Finally, we conclude with the future of renewable energy: experimental technologies and the challenges of operating the power grid in the 21st century.
    b. **ENGR 321 - Electronics (=PHYS 321) (Pre-req: ENGR 235 or PHYS 235)** This course covers the analysis, modeling and design of electrical circuits that contain electronic devices. Topics include: properties of electronic materials, behavior of devices such as p-n junction diodes, field effect transistors and bipolar junction transistors, operational amplifiers, and transistors in digital circuits. Electronics design principles via a systems approach is emphasized
    c. **ENGR 450 - Radiation Detection and Measurement (Pre-req: PHYS 212 or PHYS 214 and permission of the instructor)** A course in the fundamentals of radiation detection and measurement covering topics including nuclear instability, radioactive sources, interaction of radiation with matter, processing of radiation-induced signals, biological effects of radiation, dosimetry, attenuation of charged particles, gamma rays and neutrons and effectiveness of shielding methods