

Courses for Engineering Physics and Biomedical Engineering at UCO

MATH COURSES

MATH 2315 Calculus 1/2 for Scientists and Engineers

This is the first course of a three-semester sequence of differential and integral calculus with applications. The course covers limits and continuity, derivatives and their applications, basic theory of Riemann integration in one variable, the fundamental theorem of calculus, techniques and applications of integration, and the transcendental functions and their inverses. Prerequisite(s): MATH 1513 and 1593 or 1555.

MATH 2333 Calculus 3

This is the third course of a four-semester sequence of differential and integral calculus with applications. The course covers infinite series, conic sections, parameterized curves, polar coordinates, vectors and analytic geometry in space, vector-valued functions, the TNB-frame, curvature and torsion. Prerequisite(s): MATH 2323.

MATH 2243 Calculus 4

This is the fourth course of a four-semester sequence of differential and integral calculus with applications. The course covers the calculus of functions of several real variables, including Green's theorem, Stokes' theorem, and the divergence theorem. Prerequisite(s): MATH 2333.

MATH 3103 Differential Equations

This course introduces the theory of ordinary differential equations, method of undetermined coefficients, variation of parameters, operators, series solutions, Laplace transforms, numerical solutions, and their applications. Prerequisite(s): MATH 2343.

PHYSICS COURSES

PHY 2014 Physics for Scientists and Engineers I and Laboratory

This course is the first in a two-semester calculus-based introduction to physics, and covers the fundamentals of mechanics, waves, heat, and thermodynamics. Laboratory experience is a principal component of this course. Prerequisite(s): MATH 2323, or Concurrent Enrollment in MATH 2323.

PHY 2114 Physics for Scientists and Engineers II and Laboratory

This course is the second in a two-semester calculus-based introduction to physics, and covers the fundamentals of electricity, magnetism, and optics. Laboratory experience is a principal component of this course. Prerequisite(s): PHY 2014, MATH 2333 or concurrent enrollment in MATH 2333. Concurrent enrollment in PHY 2114L is required.

PHY 3103 Modern Physics

This course presents an introduction to topics in physics which have developed primarily since about 1900. These topics include special relativity, quantum mechanics, and the physics of atoms, molecules, solids, and nuclei. Prerequisite(s): PHY 2114 and MATH 2343 or concurrent enrollment in MATH 2343.

PHY 3183 Electricity and Magnetism

This course provides an introduction to electrostatic and magnetostatic fields and sources, solutions of boundary value problems, and the development of Maxwell's equations with engineering applications. Prerequisite(s): PHY 3884.

PHY 3263 Optics

This course provides an introduction to geometrical and physical optics. Topical coverage includes reflection, refraction, mirrors, lenses, optical instruments, interference, diffraction, polarization, and coherence. Prerequisite(s): PHY 2114

PHY 3884 Mathematical Physics I

This course is an introduction to mathematical physics for sophomore and junior-level physics, chemistry, engineering and applied mathematics majors. It is intended for students who have completed one year of calculus and one year of a calculus-based university physics course. Its purpose is to develop a basic competence in the areas of applied mathematics that are most often used in the upper level courses in physics, chemistry, and engineering. The emphasis will be on the application of mathematical concepts to systems of physical interest. The course will cover applications of the following mathematics to systems of interest to engineering and physics. Prerequisite(s): MATH 2185 and PHY 2114 or permission of instructor.

PHY 4003 Mathematical Physics II

A continuation of PHY 3884, this course discusses in more depth the mathematical preparation required for solutions to boundary value problems found in electrostatics, mechanics, heat transfer, quantum mechanics, and acoustics. The mathematical topics may include curvilinear coordinates, Fourier analysis, Fourier transforms, partial differential equations, Green's functions, and excursions into tensor analysis, and group theory. Prerequisite(s): 6 hours of physics above PHY 2114, MATH 3103.

PHY 4163 Analytical Mechanics

This course provides an introduction to particle dynamics in one, two, and three dimensions. Analytic and numerical problem solving techniques are applied to the study of time- and velocity-dependent forces, harmonic oscillators, oscillating systems, and central forces. Prerequisite(s): PHY 3884

PHY 4173 Classical Mechanics

Variational formulations of mechanics including Lagrangian and Hamiltonian methods will be introduced and applied to classical systems. Topics covered will include small oscillations and normal modes, rotation of rigid bodies, non-inertial reference frames, Poisson brackets, Kepler problem and scattering theory. Prerequisite(s): PHY 4163.

PHY 4183 Electromagnetic Radiation

Introduction to the application of electromagnetic theory (Maxwell's Equations) to time-dependent electromagnetic fields. Applications to transmission lines, wave guides, microwave communications, antenna theory, and fiber optics are studied in some detail. Prerequisite(s): PHY 3884

PHY 4203 Quantum Mechanics

The acquisition of a rigorous conceptual and operational familiarity with introductory quantum mechanics which allows students of diverse interest and background to have a better understanding of problems in many areas. Prerequisite(s): PHY 3104 and nine additional hours of Physics 3000 level or above, and MATH 3103.

ENGINEERING COURSES

ENGR 1112 Introduction to Engineering

This course provides an introduction to engineering disciplines, problem-solving techniques, engineering homework skills, engineering ethics, and university resources. A design project is an integral component of the course. As part of the project, students will function as part of an engineering team, use computer applications, write a report, and make an oral presentation. Prerequisite(s): PHY 1003 or High School Physics and MATH 1593 or concurrent enrollment in MATH 1593.

ENGR 1213 Engineering Computing

This course introduces computational skills required by engineers in their profession including use of engineering spreadsheets, scientific programming and algorithms, and use of mathematical or other simulation packages to solve engineering problems. Team design projects are an integral component of the course. Prerequisite(s): ENGR 1112 and PHY 2014 or concurrent enrollment in PHY 2014.

ENGR 2033 Statics

This course provides an introduction to basic engineering mechanics and examines the laws which describe the response of objects to applied forces and torques. Prerequisite(s): PHY 2014, MATH 2333 or concurrent enrollment in MATH 2333.

ENGR 2143 Strength of Materials

This course provides an introduction to solid mechanics, including concepts of stress and strain, mechanical behavior of engineering materials, and analysis of loaded-bearing members. Prerequisite(s): ENGR 2033.

ENGR 2304 Electrical Science and Laboratory

This course teaches analysis techniques for electrical circuits which consists of resistors, capacitors, and inductors. The circuits analyzed are driven by constant and sinusoidal voltage and current sources. Students must also enroll in the laboratory portion of this course ENGR 2304L. Prerequisite(s): PHY 2114, MATH 2343, and ENGR 2304L or concurrent enrollment in MATH 2343. Concurrent enrollment in ENGR 2304L is required.

ENGR 3063 Dynamics

This course provides an introduction to the dynamics of particles and bodies, including the principles of work, energy, impulse, and momentum applied to translating and rotating rigid bodies. Prerequisite(s): ENGR 2033 Statics and MATH 2333 or concurrent enrollment in MATH 2333.

ENGR 3203 Thermal Fluid Engineering I

This course provides an introduction to the laws of thermodynamics applied to control volumes, definitions of thermodynamic properties, behavior of ideal gases, modes of heat transfer, fluid statics, and use of Bernoulli's equation to solve basic fluid flow problems. Prerequisite(s): PHY 2014, MATH 3103 or concurrent enrollment in MATH 3103, and CHEM 1103.

ENGR 3302 Introduction to Engineering Experimentation

This course provides an introduction to general characteristics measurement systems, statistical analysis of experimental data, experimental uncertainty analysis, data acquisition and control software, and computer software for statistical analysis of experimental data. Prerequisite(s): ENGR 2304.

ENGR 3314 Signals and Control Systems and Laboratory

This course focuses on techniques to represent signals mathematically, and design systems that process these signals. Topics covered in this course are the analysis of continuous and discrete-time linear systems including convolution, impulse and pulse responses, step responses, continuous and discrete Fourier transforms, frequency responses, and Laplace and z-transform. Introduction to feedback control, including concepts of stability and robustness, is also included. Students must also enroll in the laboratory portion of this course ENGR 3314L. Prerequisite(s): ENGR 2304, MATH 2323, PHY 3884, and ENGR 3314L.

ENGR 3404 Analog Electronics and Laboratory

This course provides an introduction to analog electronics, including theory and application of passive devices, bipolar junction transistors, field effect transistors, and operational amplifiers. Laboratory experience is a principal component of this course. Prerequisite(s): PHY 2114 or 1214. Concurrent enrollment in ENGR 3404L is required.

ENGR 3443 Thermal Fluid Engineering II

This course covers the application of thermodynamics to power and refrigeration cycles, dimensional analysis, application of the momentum equation to fluid flow, pipe flow, drag, lift, transient conduction heat transfer, forced convection heat transfer, natural convection heat transfer, and radiative heat transfer. Prerequisite(s): ENGR 3203 and MATH 3103.

ENGR 3503 Mechanical Engineering Laboratory

This course is intended to provide an experimental background in subject areas covered by several other courses. These subject areas include solid mechanics and thermal-fluid engineering. Additional experiments in other areas of mechanical engineering may be included. This course is also intended to provide team design experience that focuses on an area in mechanical engineering. Prerequisite(s): ENGR 3203 and MATH 3103.

ENGR 3604 Digital Electronics and Laboratory

This course provides an introduction to the design and analysis of digital circuitry, and to the design of circuitry and software for computer data acquisition and process control. Laboratory experience is a principal component of this course. Prerequisite(s): COMSC 1513 and PHY 2114 or 1214.

ENGR 3703 Computational Methods in Engineering

This course introduces general-purpose numerical methods and linear algebra concepts for solving problems in science and engineering. Students should develop an understanding of the strengths and limitations of standard numerical techniques applied to problems in engineering, such roots of nonlinear equations and systems of linear equations. The course will also cover numerical differentiation and integration, initial-value and boundary-value problems. The course will also discuss concepts and methods of scientific and engineering computing, mathematical modeling, and engineering design. Prerequisite(s): MATH 3103.

ENGR 4023 Advanced Heat Transfer

This course includes advanced coverage of conduction, convection, and radiation heat transfer. This course emphasizes specification of problem and boundary conditions along with interpretation of results from the successful use of numerical and analytical techniques. Some

recent developments in computational heat transfer and fluid flow will be covered with particular emphasis on algorithms and implementation of numerical solvers for incompressible flow and heat transfer.

Prerequisite(s): ENGR 3443, MATH 3103, and ENGR 3703.

ENGR 4113 Principles of Biomedical Engineering

This course provides an introduction to applications of physics and engineering principles to biomedical systems. Biological functions of the human body will be studied using mechanics, electricity and magnetism, optics, and thermodynamics. Responses of human biological functions to different bioengineering applications will also be studied. Prerequisite(s): BIO 2604; CHEM 3303/3312; MATH 3103 or PHY 3884; ENGR 3063.

ENGR 4233 Biomedical Instrumentation

This course introduces students to the principles, applications, and design of the medical instruments most commonly used in hospitals. Introduction to theory of measurement and analysis of biological systems. Instruction will be provided in the use of transducers, design integrated circuits to process biological signals, signal display and analysis, data acquisition and controls, and electrical safety. Prerequisite(s): ENGR 2304, ENGR 3404, ENGR 3314, PHY 3884.

ENGR 4223 Biomedical Imaging

The first part of this course is an overview of biomedical imaging systems and analysis including how images are formed and what types of information they provide by examining various imaging systems such as X-ray, ultrasound, and MRI. The second part of the course introduces students to the image processing of medical images, such as reconstruction, enhancement, segmentation, registration and representation and analysis. Prerequisite(s): PHY 2114, ENGR 2304, ENGR 3314, PHY 3884.

ENGR 4323 Digital and Analog Communication

This course addresses selected theoretical and practical aspects of digital and analog communications systems such as amplitude modulation, frequency modulation, pulse code modulation, and multiplexing. It develops the engineering mathematics and techniques to describe the physical transmission of information over point-to-point links, taking account of channel characteristics and the presence of noise and distortion. Prerequisite(s): PHY 3884 and ENGR 3314.

ENGR 4333 Digital Image Processing

This course introduces basic concepts and techniques in digital image processing: image acquisition and display using digital devices, property of human visual perception, sampling and quantization, image enhancement, two-dimensional Fourier transforms, filtering and noise removal, image deblurring, edge detection, Wavelets and multiresolution processing, and image compression. Students will learn to implement some image processing algorithms on computers using MATLAB. Prerequisite(s): ENGR 3314, PHY 3884, and ENGR 3703.

ENGR 4412 Senior Engineering Design I

Through discussions with the course instructor and other faculty members, students will determine a design-related engineering problem they wish to study. A detailed written project proposal will be submitted and approved by the chosen faculty project director. Working as individuals or in teams, students will apply the design process by developing projects from the proposal stage to the test, evaluation, and implementation stages. Students are expected to follow this course with ENGR 4422 Senior Engineering Design II. Prerequisite(s): ENGR 3314.

ENGR 4422 Senior Engineering Design II

This course is a continuation of ENGR 4412 Senior Engineering Design I. Prerequisite(s): ENGR 4412

ENGR 4533 Thermal Systems Design

This course develops the concepts and methodology of system design, energy analysis, and optimization applied to thermal-fluid systems. Topics include simulation of systems in which the system components are known and system parameters such as flow, temperature, and pressure are to be determined and design of systems involving the selection of right type, size and combinations of equipment to optimize system performance. A discussion of engineering ethics and economics relevant to design topics covered is included in this course. Prerequisite(s): ENGR 3443 and MATH 3103.

ENGR 4613 Photonics

The ray, wave, and photon formulations of optics are used to understand and design laser systems. Prerequisite(s): PHY 3103 and PHY 3263.

ENGR 4633 Intro to Solid State Devices

The physical principles of operation of the p-n junction, metal semiconductor contact, bipolar junction transistor, MOS capacitor, MOS and junction field-effect transistors, and related electro-optical devices are presented. First-order device models reflecting the underlying physical principles are developed. Prerequisite(s): PHY 3103 and PHY 3183; ENGR 3404.