Philadelphia University

Faculty of Engineering and Technology

Renewable Energy Engineering Department

Study Plan 2024-2025 Course description

Calculus (1) (216111)

The course covers the following main topics: the distinction between algebraic and transcendental functions, an introduction to analytic geometry, applications of differentiation, and a brief introduction to integration.

Calculus (2) (250102)

This course presents advanced principles of calculus to provide the necessary foundation for student progression. It covers the following main topics: techniques of integration, sequences and series, conic sections, and polar coordinates**.**

General Physics (1) (216131)

This course is for first-year students majoring in engineering, physics, or other sciences. It introduces students to the basic language and ideas of physics that are found in all branches of science and technology. It provides a clear and logical presentation of the fundamental concepts and principles of physics, enhancing their understanding through a wide range of interesting real-world applications.

General Physics (2) (216132)

The course covers the main concepts, principles, methods, and results of classical physics. It primarily covers Newtonian mechanics, with topics including vectors, the dynamics and motion of a single particle in one, two, and three dimensions, and circular motion. Newton's laws of motion, work, energy and force, conservation of energy, linear momentum, rotational motion, angular momentum, general rotation and static equilibrium; elasticity and fracture.

General Chemistry (1) (216141)

This course introduces the basic theories of chemistry and covers the atomic nature of matter, stoichiometry, the periodic table, aqueous solution and concentrations, and oxidation-reduction reactions.

Manual Engineering Drawing (660131)

Instruments and their use, graphic geometry, lettering, orthographic and isometric drawing and sketching, sectional views, introduction to descriptive geometry, surface intersections and developments, and computer (ACAD).

Computer Engineering Drawing (660132)

Instruments and their use, graphic geometry, lettering, orthographic and isometric drawing and sketching, sectional views, introduction to descriptive geometry, surface intersections and developments, and computer (ACAD).

Engineering Workshop (1) (620171)

Developing basic skills in the fields of manual filing, turning (lathe work), welding, piping and plumbing, carpentry, sand casting, glasswork, sheet metal fabrication, and metal forming.

Programming Language (610263)

Data types and constant/variable types. Types of operations. Input and output statements. Arithmetic, logical, and relational expressions. Type conversion. Control statements. Loop statements. Functions. Arrays. Pointers. Strings. Files. Structures. Introduction to object-oriented programming.

Engineering Skills (640253)

Understanding the definition of engineering. Analyzing basic engineering problems. Proposing and evaluating design solutions. Communicating effectively within a team environment. Reading research papers and writing technical reports. Understanding professionalism and being aware of ethical responsibility. Understanding the basics of project management and planning for managing simple projects.

Entrepreneurship (610550)

Basic Concepts of macro & micro economics, Economy architecture, production process, The effect of Science and Technology on production, The use of Science and Technology in production, Skills, Free business, Services and commodities production, Methods of project propagation, Marketing studies, Export, import and interior market consumption, Project forming, project requirements, economic appraisal studies, project financing, banking, companies, Cost studies, Project management, Marketing.

Electrical Circuits (610218)

Definitions and units, basic concepts(Charge, Current, Voltage, &Power Energy), circuit elements (independent and dependent voltage and current sources), KVL and KCL, mesh and nodal circuit analysis, network theorem, transient analysis of RL, RC, and RLC circuits, introduction to AC circuits.

Electrical Circuits Lab (610216)

Experiments include DC circuits, KVL and KCL, mesh and nodal circuit analysis, network theorems, transient analysis of RL, RC, and RLC circuits, and AC circuit analysis.

Solid mechanics (620213)

Axial Loads, Material Properties Deduced from Tension Experiment, Stresses and Strains Due to Axial Loads, Dimensional Change of a Bar Due to Axial Load, Primitive Bending Theory, Solid and Hollow Shaft, Thin-walled Tubes, Quadrilateral Sections, Symmetric Bending Theory, Stresses in a Bar Subjected to Bending Moments, Transverse Loads, and Composite Loads, Heterogeneous and Composite Beams, Two-Dimensional Stress Analysis, Transport Equations, Mohr's Circles, Thin Compression Containers, Buckling of Bars by Integral Method.

Machine Design (620434)

This course involves an introduction to the design process. Design considerations, tolerances, fits and surface finish, selection of materials, mechanical properties of engineering materials, stress analysis of machine elements, deflection equations, failure of machine elements under static loads, shaft design, and limits and fits.

Statics (620211)

Introduction to rigid body mechanics, basic principles of force and vector analysis, force systems, parallel force systems, static equilibrium, analysis of simple structures, friction, geometric properties, center of gravity and moment of inertia.

Dynamics (620212)

Review of particle dynamics, equilibrium of rigid bodies, distributed forces, moment of inertia, dynamics of rigid bodies, Newton's second law, impulse and momentum of rigid bodies, work and energy of rigid bodies, vibrations.

Electronics (6502421)

Pn-diode circuit analysis, half-wave and full-wave rectifier circuits, zener diodes, trimmer and binder circuits. Bi-junction transistor (BJT) characteristics and modeling, biasing circuits, common emitter amplifier, common base amplifier, common collector amplifier. Design of BJT amplifier circuits. Junction type (JFET) and MOSFET field effect transistor (FET), their operating characteristics and biasing circuits. JFET amplifiers, design of JFET amplifier circuits. Introduction to operational amplifiers (OP-amps) and their applications.

Measuring devices (610332)

Applications of electrical and mechanical sensors, data acquisition, and logic controllers in power systems. Determine the physical information required for control and data recording, and calibration and correction methods.

Electrical machines (610310)

Three-phase and single-phase motors, single-phase and three-phase transformers, AC generators and machines, induction generators and motors, synchronous generators and motors, AC series motor and repulsion motor.

Fluid Mechanics (1) (620320)

Hydrostatics, steady and unsteady flow, continuity equation, ideal incompressible flow, latent flow, Bernoulli's equation, one-dimensional Auer's equation, energy equation, principles of impulse and torque, dimensional analysis, introduction to the boundary layer, flow in pipes, friction in pipes.

Fluid Mechanics Lab (620429)

Experiments related to the material covered in the Fluid Mechanics course (1)

Thermodynamics (1) (620323)

The student implements the project identified by the department in light of the results achieved in the first phase. Principles of engineering thermodynamics, first law, second law, systems analysis and volumetric control, properties and behavior of pure fluids.

Heat transfer (1) (620420)

Methods of heat transfer, heat transfer by conduction in a steady state in one dimension, heat conduction in an unsteady state, the system of integral heat capacity, heat transfer by convection, experimental and practical relations for heat transfer by convection, heat transfer by free convection, condensation and evaporation, introduction to heat exchangers, introduction to heat transfer by radiation.

Thermal Laboratory (620427)

Experiments related to the material covered in the heat transfer course.

Properties of Engineering Materials (620373)

This course provides a fundamental understanding of materials and their structures at different levels (from the crystal lattice to the bulk structure) and phase transformations, and how these affect their mechanical, electrical, optical, and magnetic properties from a basic science perspective. The course also covers material failure, mechanical properties of materials, and heat treatment processes.

Introduction to Renewable Energy (611341)

The course presents the various sources of renewable energy including wind, solar, hydro, ocean and biomass as potential sources of energy. The course will also investigate the contribution these renewable sources can make to the energy profile of the nation.

The technology used to harness these resources will also be covered. Discussions of economic, environment, politics and social policy are integral components of the course

Automatic control (610414)

Introduction to feedback systems, review of system equations, block diagrams and signal flow graphs, system time response and closed loop performance, Routh's stability criterion, the root locus method, frequency methods, compensation techniques, and introduction to sampled control systems.

Electrical power systems (611430)

System representation, per-unit system, power system components, generators (synchronous networks, transient response, operating limits), power transformers, transmission lines, symmetrical and unsymmetrical fault analysis.

Energy Economics and Management (611312)

This course introduces the concepts of economic analysis and Life Cycle Costing, Economic feasibility of projects, economics of different energy sources, energy management, energy auditing and analysis, energy management in industrial systems.

Energy legislation (611411)

It focuses on the legislative frameworks that shape Jordan's regional and international energy provision. It also gives an analysis of the fundamental safety issues that are important for all renewable energy technologies.

Solar thermal energy (611421)

This course deals with all aspects of solar thermal energy. Topics covered start with the sun-earth geometry relationship. The solar constant and extraterrestrial radiation are then explained and calculated. The course then proceeds to the effect of earth atmosphere on sun radiation. The available solar radiation on earth is calculated on horizontal as well as tilted surfaces. Physics properties of Opaque and transparent materials are covered in the context of their use in solar thermal energy systems. The course finally covers the construction, modeling, and performance evaluation of flat plat collectors as a basic solar thermal energy collector.

Photovoltaic energy systems (611422)

Introduction to energy and historical overview, methods of energy conversion, renewable energy carriers, solar radiation, Radiometric properties of light, solar spectra, Semiconductor materials for solar cells, doping, drift, diffusion, Optical properties, Semiconductor Junctions Solar cell structure, The p-n junction under illumination, Solar cell external parameters, The equivalent circuit of solar cell, Conversion efficiency limiting factors, Solar cell optical properties, Design rules for solar cells, Types of solar cells, Crystalline silicon solar cells, Fabricating solar cells, High-efficiency concepts, Thin-film solar cells, The design of thin-film silicon solar cells, Chalcogenide solar cells, Organic Photovoltaics, Photovoltaic Systems, Stand-alone systems, Grid-connected systems, Hybrid systems, Components of a PV system, PV modules, Series and parallel connections in PV modules, PV module parameters, Maximum power point tracking, Photovoltaic Converters, Batteries, Charge.

Engineering Project (1) (611440)

Theoretical discussion, practical application, or both, under the supervision of a faculty member from the college. A detailed report and an oral examination are required.

Environmental impact of energy (611511)

This course provides an in-depth exploration of the environmental consequences associated with different forms of energy production, distribution, and consumption. Students will examine the environmental impact of conventional and renewable energy sources, focusing on pollutants (water, air, soil, solid waste, radioactive, noise and thermal). introduction to chemical, physical and biological related to quality of water, air and earth environment, parameters that affect energy consumption, basic resources and utilization of energy. Energy conversions, distribution and utilization of electricity and heat, environment impact of energy technology.

Wind energy systems (611531)

Historical Applications of Wind Energy. Electrical Power From The Wind and the Batteries. Wind Energy System (Rotor Blades, the Tower, Mechanical Drive, Electrical System, etc). Physical Principles of Wind Energy Conversion. Basic Concepts of Wind Energy Converters (Turbines). Aerodynamics of Turbines. Electrical Power from Wind Energy. Electrical Aspects of Wind Turbines. Wind Turbine Design. Wind Turbine Control. Wind Turbine Installation, Siting, System Design, Integration and Operation. Offshore and Onshore Wind Turbines. Wind Turbine Costs. Environmental Impact. Wind Turbine Economics.

Solar Energy Lab (611526)

This laboratory assists students in learning about Sun radiation measurements, the properties of photovoltaic devices, open-circuit voltage, short-circuit current, maximum power point (MPP), and the efficiency of solar cells. They also explore parallel and series solar cell configurations, as well as the effects of shadow, temperature, and dust. The lab covers battery charging and control, off-grid connection, and on-grid connection.

Wind Energy Lab (611536)

This lab focuses on understanding how kinetic wind energy is converted into electrical energy and analyzing the performance of aerogenerators. It assists students in learning the fundamentals of energy conversion devices and systems, including vertical and horizontal axis wind turbines, as well as on-grid/off-grid systems.

Power electronics (610530)

The course introduces the principles, operation, and design of power electronics converter circuits. Students will learn converter topologies, control techniques, and applications. Also, learn the analysis and design aspects of converters and understand losses and protection of power semiconductor devices.

Energy Storage Systems and Fuel Cells (611533)

This course introduces students to energy storage systems and provides a broad understanding and appreciation of the scientific principles that underpin the operation of such systems. The emphasis is on grid-scale energy storage as a means of addressing the intermittency of renewable energy. The course also focuses on fuel cells as an emerging technology that utilizes the storage technology of hydrogen. This part of the course aims to introduce students to fuel cells and developing the basics of thermodynamics, electrochemistry, and other disciplines needed to explain fuel cell behavior. The course also covers the use of fuel cells in stationary application and transportation (specially in electric vehicles).

Engineering Project (2) (611540)

It introduces the students to conduct some aspects of scientific research, which include the objective statement, design steps, simulation, prototyping, testing, verifying, and final product. The student implements the project in light of the proposal in the first phase.

Engineering Training (611499)

After completing 115 credit hours in industry (inside or outside Jordan), the student undergoes an eight-week training period under the supervision of a faculty member in the department. The student is required to submit periodic reports, a final report, and present a field training presentation. This course aims to prepare students to study ideas for engineering projects and propose innovative engineering solutions to be implemented in the next coming project course.

Engineering Workshop (2) (620172)

Home electrical circuits, fluorescent lamp circuits, series and parallel circuits, switch installations, fuses, electronic soldering, electronic device maintenance, and circuit board design.

General Chemistry (1) lab (216143)

Practical chemistry typically includes titration techniques such as acid-base titration and determination of the equivalence point, preparation of laboratory materials, study of physical properties such as solubility and adsorption, analysis of samples to determine their components, and laboratory safety concepts

Linear Algebra and Calculus (250205)

Systems of linear equations, matrices, determinants, Cramer's rule, vector spaces, linear transformations, eigenvalues and eigenvector.

Calculus (3) (250202)

This course is a second-year course, and it is oriented to math and engineering students. It covers the following main topics: Rectangular Coordinates in 3-Space: Spheres; Cylindrical Surfaces; Vectors; Dot Product; Projections; Cross Product; Parametric Equations of Lines; Planes in 3-Space; Quadratic Surfaces; Cylindrical and Spherical Coordinates. Vector-Valued Functions: Calculus of Vector-Valued Functions; Change of Parameter; Arc Length; Unit Tangent, Normal, and Binormal Vectors; Curvature. Functions of Two or More Variables: Limits and Continuity; Partial Derivatives; Differentiability, Differentials, and Local Linearity; The Chain Rule; Directional Derivatives and Gradients; Tangent Planes and Normal Vectors; Maxima and Minima of Functions of Two Variables; Lagrange Multipliers. Double Integrals: over Nonrectangular Regions; in Polar Coordinates; Triple Integrals; Triple Integrals in Cylindrical and Spherical Coordinates.

Engineering Analysis (1) (650260)

Basic Concepts and ideas, first Order Differential Equations. Second and higher order Differential Equations, Power Series Method, and Laplace Transform.

Engineering Analysis (2) (610262)

Introduction to numerical analysis. Develop a basic understanding of numerical algorithms and skills in implementing algorithms to solve mathematical problems on a compute.

Engineering statistics (611301)

Data presentation and processing, probability theory, random variables, probability distribution, modeling theory, statistical estimation, hypothesis testing, statistical analysis.

Bioenergy systems (611541)

This is an elective course for the Renewable Energy Engineering students. Bioenergy is a renewable energy extracted or produced from biological sources, with an end result as gas, liquid, or solid fuels. With the diminishing supply and rising prices of fossil fuel, bioenergy arises as one of the most important renewable energy sources of the future and is experiencing rapid growth.

geothermal energy (611542)

This is an elective course for the Renewable Energy Engineering students. It covers the principles of heat transfer and underground thermal processes, along with the study of different geothermal heat exchange systems. Also the application of thermodynamics and heat transfer in the analysis, design, and operation of geothermal heating and cooling systems. The course also explores resource assessment and environmental considerations of Geothermal resources.

Hydraulic and wave power (611543)

The course aims at providing an understand to the behavior of hydraulic infrastructures that are used for hydroelectric energy production. Basics and Hydropower history are first introduced. The hydrology cycle with processes and mechanisms will then be explained. Hydropower drivers and deterrents are clarified. The main, structural, and auxiliary parts will be explained. The course will also cover the topic of turbines; their classification, applications and operating theory. Turbine design will be illustrated covering procedure and a worked example. Wave energy; worldwide potential, types of wave plants, obstacles to wave power commercialization will also be covered by the course.

Special Topics in Renewable Energy Engineering (611544)

This course covers selected advanced topics in renewable energy engineering that complement and extend the core curriculum. The specific content varies each semester depending on current developments and faculty expertise. The course aims to deepen students' understanding of specialized areas and emerging trends in renewable energy systems.

Smart Grids (611546)

This is an elective course for the Renewable Energy Engineering Students. The course covers an introduction to modern smart grid systems and their role in integrating renewable energy sources. Topics include grid communication, control, energy storage, demand side management, and the use of digital technologies to improve efficiency, reliability, and sustainability of power systems.

Modeling and Simulation (640329)

Introduction, physical model, symbolic model, systematic modeling: analysis, solution strategy formulation and verification, validation of certificates, discrete simulation, simulation continuity, process-oriented approach, random number and random variations, simulation language. Analysis and study of computer-generated induction and prediction methods for available data.