



ISRA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF RENEWABLE ENERGY ENGINEERING

COURSE DESCRIPTION
of
RENEWABLE ENERGY ENGINEERING PROGRAM

Number of Credit Hours: 163 Cr. Hr.

Course Labeling Code

Faculty	Code	Department	Code	Year Level	Semester	Field Subject	Number
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Example:

0	4	0	8	4	2	6	2
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- 04 Faculty of Engineering Code.**
- 08 Department Code.**
- 4 Year Level.**
- 2 Semester**
- 6 Field subjects.**
- 2 Serial Number of the course in the Field.**

Course Information

Course Name {No. of Credit Hours} [Lectures – Contact Hours]

Example: Power Electronics {2} [2-2]

{3} 3 Credit Hours.

[3-3] 3 Lectures, 3 Contact Hours a week.

04021120 Engineering Workshops {1} [1 – 3]

Workplace safety and use of tools; Basic skills of measuring and machining; Basic skills of welding; Household electric circuit installation; Basics of carpentry and its tools.

Prerequisite: None

04032101 Engineering Drawing {3} [3 – 4]

Use of Instruments; Lettering; Graphic Geometry; Orthographic; Isometric Drawing and Sketching; Sectional Views; Computer Aided Design; Applications in Civil, Mechanical, Architectural and Electrical Engineering.

Prerequisite: None

04032102 Engineering Ethics {1} [1-1]

Engineering ethics; applied ethics and moral principles that apply to the practice of engineering; obligations on the shoulders of engineer towards society and towards its clients and his profession; ethics code engineering practice.

Prerequisite: 01101112 English Language

04033101 Technical Writing {2} [2-2]

General concepts of writing methods and forms, official writing in the fields of industry and business, public and government correspondence, types of writing in terms of efficiency and excellence, analysis of communication context, basic writing techniques, types of written communication, revision of writing, Writing, the principles of writing the technical report, the procedures for the design and preparation of the technical report in English, the preparation of the curriculum vitae, the practical experience in how to prepare the psychological and the good preparation for the interviews of the work.

Prerequisite: 01101112 English Language

04033102 Administration and Engineering Economy {3} [3 – 3]

Engineering Project Development; Decision Making; Basic Concepts of Capital Investment: Formulas and Applications, Rates of Return, Economic Feasibility of Projects (Net Future Value, Net Present Value, and Equivalent Uniform Cash Flow); Comparison of Mutually Exclusive Proposals; Benefit-Cost Ratio Method; Depreciation; Corporate Taxation; Resource Allocation.

Prerequisite: 11031101 Calculus (1)

11021101 General Physics (1) {3} [3-3]

Physics and Measurement; Motion in One Dimensions; Vectors; Motion in tow Dimensions; The Laws of Motion; Circular Motion; Applications of Newton's Laws; Energy of a System; Conservation of Energy; Linear Momentum and Collisions; Rotation of a Rigid Object about a Fixed Axis; Angular Momentum; Static Equilibrium and Elasticity; Universal Gravitation; Fluid Mechanics; Oscillatory Motion; Wave Motion; Sound waves; Superposition and Standing Waves; Temperature; The First Law of Thermodynamics; The Kinetic Theory of Gases; Heat Engines, Entropy, and the Second Law of Thermodynamics.

Prerequisite: None

11021202 General Physics (2) {3} [3-3]

Electric Fields; Gauss Law; Electric Potential; Capacitance and Dielectrics; Current and Resistance; Direct Current circuits; Magnetic Fields; Source of the Magnetic Field; Faraday's Law; Inductance; Alternating- Current Circuits; Electromagnetic Waves.

***Prerequisite:* 11021101 General Physics (1)**

11021111 General Physics Lab. {1} [1-2]

Experimental Error and Data Analysis; Measurements; Vectors; Kinematics; Newton's Second Law; Friction; Centripetal Force; work and Energy; Hooke's Law; Simple Pendulum; Specific Heat of Metals; Determination of the coefficient of viscosity by Stoke's law; Archimedes Principle and Specific Gravity; Ohm's Law; Kirchhoff's Law; Wheatstone Bridge & Resistivity; The Oscilloscope, RC circuit

***Co-requisite* 11021101 General Physics (1)**

11031101 Calculus (1) (1) {3} [3-3]

Review of basic algebra, functions, limits, continuity, derivatives of algebraic, trigonometric, exponential and logarithmic functions. curve sketching, related rates problems, maximum-minimum problems, indefinite integral, definite integral and applications with emphasis on engineering and pharmacy models.

***Prerequisite:* None**

11031202 Calculus (2) {3} [3-3]

Applications of the Definite Integral; Techniques of Integration; Hyperbolic Functions; Inverse Trigonometric Functions; L'hospital's Rule and Indeterminate Forms; Improper Integrals; Taylor's Formula; Sequences and Infinite Series and Applications with Emphasis on engineering models.

***Prerequisite:* 11031101 Calculus (1)**

04022110 Engineering Analysis (1) {3} [3-3]

Different Methods of Solving Ordinary Differential Equations Applicable to the First, Second and Higher-Order DEs, Linear and Nonlinear DEs, Homogeneous and Nonhomogeneous DEs. As an Engineering Application, Modeling of Some Engineering, Physical, and Social Problems will be given.

***Prerequisite:* 0112102 Mathematics (2) (to be passed)**

04022210 Engineering Analysis (2) {3} [3-3]

Linear Algebra: Matrices, Vectors, Determinants, Solution of Linear Systems of Equations, Inverse of a Matrix; Matrix Eigenvalues Problems: Eigenvalues, Eigenvectors, and Diagonalization; Complex Analysis: Complex Numbers and Functions, Analytic and Harmonic Complex Functions, Exponential, Trigonometric and Logarithmic Complex Functions.

***Prerequisite:* 04022110 Engineering Analysis (1)**

04022130 Electric Circuits (1) {3} [3 – 3]

Basic Components and Electric Circuits: Units and Scales, Current, Voltage, Power, Voltage and Current Sources, Ohm's Law; Voltage and Current Laws: Kirchhoff's Voltage, Kirchhoff's Current Laws; Nodal and Mesh Analysis; Techniques of Circuit Analysis: Linearity and Superposition, Source Transformations, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer; Energy Storage Elements: Capacitor, Inductor; Basic RL and RC Circuits: The Source Free RL Circuit, The Source Free RC Circuit, The Unit-Step Function; The RLC Circuit: The Source Free Parallel Circuit, The Over Damped Parallel RLC Circuit, Complete Response Analysis; Introduction to AC Circuits.

***Prerequisite:* 11021202 General Physics (2)**

04022131 Electric Circuits Lab. {1} [1 – 2]

DC Circuits: Kirchhoff's Voltage and Current Laws, Network theorems, Maximum Power Transfer; Transient Circuits: RL, RC, RLC; Resonant Circuits; Magnetically Coupled Circuits; Two-Port Networks.

***Co-requisite:* 04022130 Electric Circuits (1)**

04021220 Fundamentals of programming for engineers {3} [3-3]

The Basic Concepts of Programming using C++ language: C++ Programming; Controls Structures; Functions; Arrays; Pointers; An introduction to Classes and Objects.

***Prerequisite:* 01101151 Computer Skills**

04081211 General Chemistry {3} [3-3]

Descriptive chemistry, elements and compounds; basic chemical calculations, mole problems, stoichiometry, and solution concentrations; gas laws; thermo chemistry; electronic structure of atoms; periodic properties of the elements; chemical bonding.

***Prerequisite:* None**

04081212 General Chemistry Lab. {1} [1-3]

Descriptive chemistry,.

***Prerequisite:* 04081211 General Chemistry**

04082111 Engineering Statistics {3} [3-3]

Applications of Statistics in Engineering; Topics Include: Presentation and Treatment of Data; Introduction to Probability Theory and Probability Distribution (Discrete and Continuous); Counting Techniques; Sampling Theory; Statistical Estimation; Testing Hypothesis; Correlation; Regression Analysis.

***Prerequisite:* 11031101 Calculus (1)**

04082211 Numerical Analysis {3} [3-3]

General Numerical Methods: Equation Solving Via Iteration, Interpolation; Numerical Integration, and Numerical Differentiation; Numerical Methods in Linear Algebra, Gauss Elimination, Least Squares Method, Numerical Methods for Differential Equations.

***Prerequisite:* 11031202 Calculus (2)**

04082131 Applied Mechanics {3} [3-3]

Introduction, Forces Systems, Components, Resultants, Moments and Couples, Equilibrium, Structures (Trusses, Frames, and Machines), Distributed Load (Center of Weight, Center of Mass, Center of Area), Shear Forces & Bending Moment in Structures, Moment of Inertia.

***Prerequisite:* 11031101 Calculus (1), 11021101 General Physics (1)**

04083131 Dynamics & Vibrations {3} [3-3]

Kinematics of a Particle. Planar Kinematics of a Rigid Body. Planar Kinetics of a Particle & a Rigid Body: Equation of Motion, the principle of Work and Energy, the principle of Impulse and Momentum. Introduction to Mechanical Vibrations.

***Prerequisite:* 04082231 Materials science**

04082251 Electronics {3} [3-3]

Transformers: principles of operation (ideal and real), and the characteristics of its performance. Three-phase transformers. Energy Conversion Principles. Single and Poly-phase Transformers. DC Machines. AC Machines: Synchronous Generators and Synchronous Motors. Induction Motors. [Installation, Operation, Performance, Starting, and Speed Control].

***Prerequisite:* 04022130 Electric Circuits (1)**

04083151 Electrical Machines {3} [3 – 3]

Principles of Electromagnetic circuit; Single-phase transformers: ideal, practical transformer, equivalent circuit, auto-transformer; Three-Phase Transformer: Types, Connection; AC Machinery Fundamentals: Principle of work, rotating magnetic field; Three phase induction motors: Principle of work, properties an performance, starting, speed control; Synchronous Machines: Construction, Internal Generated Voltage, Equivalent Circuit; Operation Modes: Alone, Parallel; Synchronous Motors: Steady state operation, starting.

***Prerequisite:* 04022130 Electric Circuits (2)**

04083152 Electrical Machines Lab. {1} [1 – 3]

DC Machines: Motors, Generators; Transformers: Single phase, Three-phase Transformers; Three-phase Synchronous Machines: Motors, Generators; Three-phase Induction Motors: Squirrel Cage Rotor, Wound Rotor (Slip-ring); Single-phase Motors.

***Co-requisite:* 04083151 Electrical Machines**

04083141 Fluid Mechanics {3} [3 – 3]

Fluid properties, Fluids Statics and Dynamics. Buoyancy and Floatation, Fluid Flow Kinematics, Energy Considerations for Steady Flow, Applications of Motion and Forces in Fluid Flow. Compressible & Incompressible Steady Flow in Pipes, Friction losses and Minor losses, Multi-pipe systems and solution methods, Lift forces for Immersed Bodies in Compressible and Incompressible Flows.

***Prerequisite:* 04022110 Engineering Analyses (1)**

***Co-requisite:* 04082131 Applied Mechanics**

04083142 Fluid Mechanics Lab. {1} [1 – 3]

Practical experiments on the pressure in the Fluid Mechanics and Hydraulics, flow measurement and pressure in the pipes, the water and the fluid level in pipes and critical depths, pumps, Venturi Meters.

Co-requisite: 04083141 Fluid Mechanics

04083241 Thermodynamics {3} [3 – 3]

Introduction to thermodynamics: temperature, work, heat, internal energy and heat content. Arbitrary volume. Operations. Circuits. Units. Pure substances. State equations. Properties tables. First Law of Thermodynamics and analysis of open systems under steady and unsteady conditions. Thermal properties of pure materials, Materials Phases, Steady Equation, the second law of thermodynamics and cooling cycles. "Clausius" Statement. The principle of entropy.

Prerequisite: 04083141 Fluid Mechanics

04083242 Heat Transfer {3} [3 – 3]

Introduction to methods of heat transfer: basic concepts, heat conduction equation, steady heat conduction, forced convection: external and internal flow, free convection, heat exchangers, radiation heat transfer. Theoretical and analytical methods to solve heat transfer problems and computer applications.

Pre-requisite: 04083141 Fluid Mechanics

04083243 Heat Transfer Lab. {1} [1 – 3]

Heat transfer tests by conduction and by using computer, radiation tests. Thermal radiation within the heat exchanger, measuring temperature, heat pipe analysis.

Co-requisite: 04083242 Heat Transfer

04084163 Solar Thermal Energy Systems {3} [3 – 3]

The characteristics of sunlight. The utilization of solar thermal energy systems in domestic and industrial and commercial applications, topics in heat transfer, solar cells and flat-intensive collectors, methods of water heating, central heating and ventilation systems for buildings, solar thermal systems, thermal industrial processes, desalination.

Pre-requisite: 04083242 Heat Transfer and 04083241 Thermodynamics

04083161 Photovoltaic System {2} [2 – 2]

The use of photovoltaic energy systems and PV cell interconnection and module fabrication. Standalone photovoltaic system components. Designing stand-alone photovoltaic systems. analysis of efficiency of solar cells, PV power systems and solar energy: batteries, components, cells, shipping entrepreneur, capability, energy converters and specifications coefficient. Photovoltaic water pumping system components. PV water pumping system design.

Pre-requisite: 04082251 Electronics

04084261 Solar Energy Lab. {1} [1 – 3]

Sunlight energy; photovoltaic devices; energy conversion; Solar radiation measurement; solar cell characterization; Module characterization; Effect of shading; temperature; and dust; System design; implementation and testing, solar thermal energy systems, Concentrating Solar energy systems.

Co-requisite: 04083161 Photovoltaic System

04084161 Wind Energy Systems {2} [2 – 2]

Introduction to wind energy sources. Basic characteristics of wind. Site characterization. Statistical methods of wind analysis. Fundamental principles of wind turbines and types of turbines. Huge field turbines. Commercial and economic benefits and JACA Wind Energy

Pre-requisite: 04083131 Dynamics and Vibration and 04083241 Fluid Mechanics

04084162 Wind Energy Systems Lab. {1} [1 – 3]

The basics of aerodynamic characteristics of wind; dynamic behavior of wind turbine rotors and the generated wind energy, wind energy measurements.

Co-requisite: 04084161 Wind Energy

04083261 Analysis of Wind Speed and quality of the wind {3} [3 – 3]

Wind Measurements & Wind Speed. Displays, Recorders and Data loggers., Basic Measurement parameters. Wind speed data analysis. Wind Power Density. Maximum energy carrying by the wind speed. Extrapolation to higher heights.

Pre-requisite: 04083131 Dynamics & Vibrations and 04083141 Fluid Mechanics

04083231 Instrumentation & Measurements {3} [3 – 3]

Measurements and errors. System of Units. Analogue measuring devices Potentiometers. DC and AC current bridges. DC & AC indicating instruments. Galvanometers. Electrodynamometers. Applications of electrical and mechanical sensors, data acquisition and control applications of logical devices in power systems. Pulse counters. Hardware adapters. Oscilloscope. Spectrum analyzers.

Pre-requisite: 04082251 Electronics (1)

04084151 Automatic Control Systems {3} [3 – 3]

Concept of Control Systems; Open-loop and Closed-loop Systems; Mathematical Modeling of Physical Systems; Transfer Function and System Modeling Diagrams; Response Characteristics of Control Systems; Specifications of System Performance; Stability Analysis of Linear Control Systems; Routh's Stability Criterion; Time-domain Analysis of Control Systems; Design of Controllers and Compensators.

Pre-requisite: 04082211 Numerical Analysis and 04082111 Engineering Statics

04084152 Automatic Control System Lab. {1} [1 – 3]

Open and Closed Loop Systems. Position Control. Reversible Speed Control. Frequency Response Measurement. PI, PD and PID Controllers. Stability of Control Systems. Simulation in Matlab or Simpler. Level and liquid flow control.

Co-requisite: 04084151 Automatic Control Systems

04084281 Environ. Impact and Energy Protocols {3} [3 – 3]

Environmental chemistry, water and air pollution, pollutant transport modeling, pollution management, and risk assessment. Introduction to the physical, chemical, and biological systems relating to the quality of water, land and air environments. Factors influencing issues related to building construction, energy consumption and use of buildings. Primary energy resources and energy use. Energy transformation processes and process equipment. Electricity and heat distribution and usage. The environmental impacts of energy technology. Survey of initiatives, laws, treaties, and

agency derivatives used by government entities to promote development of, and commercial investment in, specific energy resources, technologies, or markets. Addresses the macroeconomic issues and technical viability of competing energy sources, and presents the concept of sustainability from the corporate, environmental, and social perspectives.

Prerequisite: None

04084171 Power Electronics {3} [3 – 3]

Power Semiconductor Devices. Diode Circuits and Rectifiers. Thyristor Rectifiers. AC Voltage Controllers. DC Choppers. PWM Inverters. DC Current Transformers to DC Current (Including alternative voltage transformers with pulse width modification, Electric wave transformers, Array Transformers). DC Current transformers to AC Current (Reverse Transformer), Power Source Connection/Disconnection.

Pre-requisite: 04082251 Electronics

04084172 Power Electronics Lab. {1} [1 – 3]

Single-Phase Half-Wave Rectifiers: Controlled, and Uncontrolled; Single-Phase Full-Wave Rectifiers: Controlled, and Uncontrolled, and Semi-Controlled; Three-Phase Half-Wave Rectifiers: Controlled, and Uncontrolled; Three-Phase Full-Wave Rectifiers: Controlled, and Uncontrolled, and Semi-Controlled; Regulators; Invertors.

Co-requisite: 04084171 Power Electronics

04084271 Transmission and Distribution Systems {3} [3 – 3]

Transmission and distribution systems parameters. Transmission and distribution systems planning. Overhead lines and cables. Power bulk transfer. Network transmission and distribution systems. Losses. DC transmission lines and HVDC. FACT. Distribution substations. Distribution networks: radial and interconnected. The cost of transmission and distribution of electricity. Reliability and control systems for the transportation and distribution.

Pre-requisite: 04084171 Power Electronics

04085171 Energy Conversion and Storage {3} [3 – 3]

Energy classifications, sources and utilization. Growth in energy consumption and economics. Basic principles of the most important types of batteries used in renewable energy systems, including fixed and mobile battery applications. Overview of renewable energy sources, focusing on solar and wind energy systems. Introduction to dc conversion systems of energy (thermal and photovoltaic converters and geothermal and fuel cells). Energy storage.

Pre-requisite: 04084171 Power Electronics, 04083241 Thermodynamics, and 04082231 Materials science

04085161 Design of Renewable Energy Systems {3} [3 – 3]

Study the use of solar energy in the heating and air conditioning of the buildings and include the following topics: solar radiation heating loads and air conditioning of buildings. Design and simulation of photovoltaic systems and various electrical loads through system efficiency and economic feasibility. Design and simulation of photovoltaic systems and applications, design and simulation of photovoltaic systems and applications.

Pre-requisite: 04084161 Wind Energy Systems, and 04083161 Photovoltaic Energy Systems

04085281 Energy Management and Conservation {3} [3 – 3]

Energy management principles, energy auditing and analysis; the rational use of energy in large plants; steam generation, distribution systems and electrical systems; energy demand and consumption; cogeneration; schemes total energy; insulation thermal management; energy storage, analysis of the practical applications of technological energy conservation and economic benefits. Energy law and regulation in Jordan and worldwide.

Pre-requisite: 04084171 Power Electronics

04085191 Graduation Project (1) {1} [1 – 3]

Pick a particular problem in energy engineering, and carry out an extensive study and suggest alternate solutions to the problem. They must show ability in effectively applying the fundamentals of mathematics, physics, chemistry, engineering, etc, in finding the alternate solutions.

Pre-requisite: Graduation Projects Instructions

04085291 Graduation Project (2) {2} [2 – 6]

Completion of the graduation project (1). Building project, writing documents, designing results and calculations, using a program to complete the project.

Pre-requisite: 04085191 Graduation Project (1)

04084391 Engineering Training

The student will conduct field training for period of (8 weeks) at an accredited engineering institution after passing (90 credit hours) and department approval.

Pre-requisite: Finish of 115 C.H

04085172 Hydrogen & Fuel Cells {3} [3 – 3]

Basics of fuel cell systems technology, fuel cell systems components; field flow. Portable devices, energy production and its facilities, and transmission and distribution systems. Fuel types and storage, and hydrogen production, storage, distribution, and methods of utilization. Hydrogen renewable energy transmission. Hydrogen economics and crisis.

Pre-requisite: 04081211 General Chemistry

04085162 Advanced Solar Cells Systems {3} [3 – 3]

Advanced Topics in solar cells, dynamic performance and design of solar cells, Efficiency improvements, maintenance and optimality of solar cell systems. system control and monitoring.

Pre-requisite: 04084261 Solar Energy Lab.

04085183 Bio-Energy {3} [3 – 3]

Introduction Bio-energy production, biomass energy as a reservoir of solar energy: agricultural residues, and residues of farms and forests. Chemistry & Biochemistry of biomass, Biodiesel, Bio-Methane, Bio-Ethanol & BioHydrogen, Bio-Energy Systems, Direct Biomass Combustion & Co-firing Technologies, Gasification & pyrolysis

Technologies, Analysis and evaluation of the Biotechnologies and policies and future of Bio-fuels and Bio-Energy.

Pre-requisite: 04083241 Thermodynamics

04085163 Solar Water Desalination {3} [3 – 3]

Desalination and water treatment Methods Description. Water and solutions properties. Detailed analytical study of system maintenance and design. Economic study of the energy requirements and the various processes of water desalination.

Pre-requisite: 04084261 Thermodynamics

04085281 Energy Systems and Arch. Sustainability {3} [3 – 3]

Integrated design of energy-efficient buildings. Application of laws and standards. Modeling, energy, simulation. Daylight and natural ventilation, Architectural monuments of passive solar buildings. Use of renewable resources, zero net designs. Sustainability of the built environment. Extensive professional, practical and consultative use of sustainable development in engineering projects to enhance linkage between skills, knowledge gained and working life. Topics including most recent issues in sustainability and corporate social responsibility, context of organizational planning for environmental projects and their applications in project management and the distribution of their responsibilities to all parties involved in completion of the project.

Co-requisite: 04085281 Energy Management and Conservation

04085271 Electric Power Conversion Devices {3} [3 – 3]

Power devices and electronic applications in renewable energy systems, electric power and energy converters, frequency devices, power flow and power factor regulator. Conversion of thermal energy into electrical power including thermoelectric converters and fuel cells, thermoelectric systems, electric generators and alternators.

Pre-requisite: 04085281 Energy Management and Conservation

04085261 Special Topics in Renewable Energy

This article aims to provide advanced and modern subjects in the field of renewable energy and engineering networks. Such topics change from year to year, depending on department decision.

Pre-requisite: 04084171 Power Electronics and 04085171 Energy Conversion and Storage