Faculty of Engineering

Department of Renewable Energy Engineering

Study Plan of the Bachelor's Degree

In: Renewable Energy Engineering

Academic Year: 2020 / 2021

Vision of the Department:

Entrepreneurship and distinction in Renewable Energy engineering, teaching, research, and application.

Mission of the Department:

To produce creative Renewable Energy engineers, able to sustain comprehensive sustainability and development.

Objectives of the Department:

1. Provide students with basic and professional knowledge and skills in the basics of renewable energy.
2. Enable students to achieve basic knowledge to make progress in the field of renewable energy engineering competencies to meet local and regional market needs.
3. Provide students with communication and teamwork skills.
4. To establish students' professional ethics and the principles of practice.
5. Continuing development of study programs according to the needs of the labor market.
6. Motivate teaching staff and students to scientific research and continuing education.
7. To support professional, industrial, economic and technical development by providing intensive learning opportunities and the method of experimentation and direct application of knowledge in the field of renewable energy engineering.
8. To prepare students to take charge of continuing learning, including completion of graduate studies.
9. Building bridges of cooperation with companies, engineering and consulting offices, and strengthening the link with the departments and colleges of engineering in local, regional and international universities.

Intended Learning Outcomes (ILOs):

The Renewable Energy Engineering Program is outlined so that its students will be able to:

1. Optimal recruitment and storage of renewable energy sources.
2. Design and develop renewable energy systems to promote sustainable energy economy and energy security.
3. Keep abreast of information technology and software needed for renewable energy engineering.
4. Practice the profession within the laws and frameworks governing it
5. Adhering to professional responsibilities and ethics.
6. Management of renewable energy projects, preparation of technical reports, papers, drawings.

Framework

Framework of the bachelor's degree in Renewable Energy Engineering (160 Cr. Hrs.)

Sequence	Classification	Credit Hours	Percent %
1st	University Requirements	27	16.88
2nd	Faculty Requirements	26	16.25
3rd	Compulsory Department Requirements	78	48.75
4th	Elective Department Requirements	9	5.62
5th	Ancillary Courses	20	12.5
Total		160	100%

Course Numbering

6	0	4	x	x	x	x	x
Faculty Code	Dept. Code		Cognitive Domains	Course Level		sequence	
Engineering	Renewable Energy Engineering			year	semster		

Cognitive Domains

Number	Cognitive Domain	Credit Hours
01	Mathematics and Sciences	30
02	Basic Engineering Sciences	16
03	Engineering Mechanics	21
04	Thermal and Fluids	11
05	Electrical Engineering	8
06	Renewable energy sources	11
07	Transform and store energy	12
08	Energy Economics and Management	9
09	Graduation Project and Field Training	6

1. University Requirements: (27 Credit Hours)

A. Compulsory Requirements: (15 Credit Hours)

Course No.	Course Title	Cr. Hr.	Prerequisite
50511102	Arabic Language (1)	3	50511108
50511103	English Language (1)	3	50511109
50511108	Arabic Language Pre-requisite	0	
50511109	English Language Pre-requisite	0	
50511110	Computer Basics Pre-requisite	0	
50511206	National Education	3	-
50511308	Military Sciences	3	-
50541103	Computer Skills	3	50511110
Total		**15**	

B. Elective Requirements: (12 Credit Hours) from the following list:

Course No.	Course Title	Cr. Hr.	Prerequisite
50511204	Life Skills	3	-
50511306	Entrepreneurship and Creativity	3	-
50521101	Arabic Language (2)	3	50511102
50521102	English Language (2)	3	50511103
50521203	Principles of Psychology	3	-
50521204	Human Rights	3	-
50531101	Islamic Culture	3	-
50531205	Jerusalem and The Hashemite Guardianship		
50541203	Environment and Society	3	-
50541206	Health of Individuals and Society	3	-
50541307	Communications and The Internet	3	-
50541308	Foreign language	3	-

2. Faculty Requirements: (26 Credit Hours)

A. Compulsory Requirements: (26 Credit Hours)

Course No.	Course Title	Cr. hr.	Theoretical	Practical	Prerequisite
50211104	Calculus (1)	3	3	-	-
50211202	Calculus (2)	3	3	-	50211104*
50551101	General Physics (1)	3	3	-	-
50551102	General Physics Lab (1)	1	-	2	50551101*
60221101	Engineering Drawing	2	-	4	-
60222102	Introduction to Engineering	1	1	-	-
60224204	Engineering Economy	3	3	-	50211104
60363203	Computer Skills in Engineering	3	3	-	50541103
60372201	Communication Skills and Profession Ethics	3	3	-	50511103
60375102	Project Management	3	3	-	60224204
60311204	Engineering Workshop	1	-	2	-
Total		**26**	22	8	

* Or Co-requisite

3. Department Requirements (87 Credit Hours)

A. Compulsory Requirements: (78 Credit Hours)

Course No.	Course Title	Cr. hr.	Theoretical	Practical	Prerequisite
60241201	Static	3	3	-	50551101
60232204	Materials Science	3	3	-	50551103
60242203	Dynamics	3	3	-	60241201
60242102	Strength of Materials	3	3	-	60241201
60453101	Measurement Devices	3	3	-	60243104
60453102	Measurement Devices Lab.	1	-	2	60453101*
60453103	Automatic Control	3	3	-	60453105+ 50222218
60453105	Automatic Control Lab.	1	-	2	60453103*
60243104	Fluid Mechanics	3	3	-	60241201
60243105	Fluid Mechanics Lab.	1	-	2	60243104*
60443101	Thermodynamics	3	3	-	60242203

60443102	Heat Transfer	3	3	-	60443101+ 50222218
60443103	Heat Transfer Lab.	1	-	2	60443102*
60453105	Electric machines	3	3	-	60453107
60453106	Electric machines Lab.	1	-	2	60453105*
60453107	Electric Circuits	3	3	-	50551201
60453108	Electric Circuits Lab.	1	-	2	60453107*
60463201	Renewable Energy	3	3	-	60463106
60464102	solar energy	3	3	-	60463201
60464103	solar energy Lab.	1	-	2	60464102*
60464104	Wind Energy	3	3	-	60463201
60464105	Wind Energy Lab.	1	-	2	60464104*
60474101	Power electronics	3	3	-	60453107
60463106	Types and sources of energy	3	3	-	60232204
60474102	Production and conversion of energy	3	3	-	60463106

Course No.	Course Title	Cr. hr.	Theoretical	Practical	Prerequisite
60474203	Energy storage	3	3	-	60474102
60485101	Energy management and protocols	3	3	-	60375102
60484202	Environment and Energy	3	3	-	60474102
60485103	Energy efficiency and economy	3	3	-	60224204
60495102	Graduation Project (1)	1	1	-	60494301
60495203	Graduation Project (2)	3	3	-	60495102
60494301	Renewable Energy Engineering Practical Training	3	3	-	Completion of 115 Cr. Hrs.
		78	69	18	

* Or Co-requisite

B. Elective Requirements: (9 Credit Hours)

Course No.	Course Title	Cr. hr.	Theoretical	Practical	Prerequisite
60484204	Simulation and prediction	3	3	-	60464102
60475104	Energy transfer and storage systems	3	3	-	60474203
60484205	Control and protection of energy systems	3	3	-	60474102
60474205	Energy Saving Design	3	3	-	60474102
60484206	Green Buildings	3	3	-	60463201
60464207	Fuel cells and hydrogen	3	3	-	60463201
60464208	Bioenergy	3	3	-	60463201
60464209	Solar thermal systems	3	3	-	60464102
60464210	Design of renewable energy systems	3	3	-	60463201
60464211	Design of wind power systems	3	3	-	60464104
60464212	Special Topics in renewable energy	3	3	-	Department approval

4. **Ancillary Courses** (20 Credit Hours):

Course No.	Course Title	Cr. hr.	Theoretical	Practical	Prerequisite
50551103	General Chemistry	3	3	-	-
50551104	General Chemistry Lab.	1	-	2	50551103*
50551201	General Physics (2)	3	3	-	50551101
50551202	General Physics Lab. (2)	1	-	2	50551201*
50223121	Numerical Analysis	3	3	-	50211202
50231129	Principles of Statistics and Probability	3	3	-	50211202
50222218	Differential Equations	3	3	-	50212106
50212106	Linear Algebra	3	3	-	50211202
Total		**20**	18	4	

* Or Co-requisite

Advisory Study Plan for the Bachelor's Degree in

First Year				
First Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
50211104	Calculus (1)	3	-	-
50551101	General Physics (1)	3	-	-
50551102	General Physics Lab. (1)	1	-	50551101
50551103	General Chemistry	3	-	-
50551104	General Chemistry Lab.	1	-	50551103
---	Compulsory/ Elective University Requirement	3	-	-
---	Compulsory/ Elective University Requirement	3	-	-
Total		17		

Second Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
50551201	General Physics (2)	3	50551101	-
50551202	General Physics Lab. (2)	1	-	50551201*
50211202	Calculus (2)	3	50211104	-
60221101	Engineering Drawing	2	-	-
60241201	Static	3	50551101	-
60311204	Engineering Workshops	1	-	-
---	Compulsory/ Elective University Requirement	3	-	-
Total		16		

Second Year				
First Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60222102	Introduction to Engineering	1	-	-
50212106	Linear Algebra	3	50211202	-
60453107	Electric Circuits	3	50551201	
60453108	Electric Circuits Lab.	1		60453107
60232204	Materials Science	3	50551103	-
60242203	Dynamics	3	60241201	
---	Compulsory/ Elective University Requirement	3	-	-
Total		17		

Second Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60372201	Communication Skills and Profession Ethics	3	50511103	-
50222218	Differential Equations	3	50212106	-
60242102	Strength of Materials	3	60241201	
60243104	Fluid Mechanics	3	60242203	
60243105	Fluid Mechanics Lab.	1		60243104
---	Compulsory/ Elective University Requirement	3	-	-
Total		16		

Third Year				
First Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
50223121	Numerical Analysis	3	50211202	-
60453101	Measurement Devices	3	60243104	
60453102	Measurement Devices Lab.	1		60453101
60453105	Electric machines	3	60453107	
60453106	Electric machines Lab.	1		60453105
60443101	Thermodynamics	3	60242203	
60463106	Types and sources of energy	3	60232204	
Total		17		

Second Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60363203	Computer Skills in Engineering	3	50541103	-
50231129	Principles of Statistics and Probability	3	50211202	-
60443102	Heat Transfer	3	60443101	
60443103	Heat Transfer Lab.	1		60443102
60453103	Automatic Control	3	60453101	
60453105	Automatic Control Lab.	1		60453103
60463201	Renewable Energy	3	60463106	
Total		17		

* Or Co-requisite

Fourth Year				
First Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60474101	Power electronics	3	60453107	
60464102	Solar energy	3	60463201	
60464103	Solar energy Lab.	1		60464102
60474102	Production and conversion of energy	3	60463106	
60464104	Wind Energy	3	60463201	
60464105	Wind Energy Lab.	1		60464104
---	Compulsory/ Elective University Requirement	3	-	-
Total		17		

Second Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60224204	Engineering Economics	3	50211104	-
60484202	Environment and Energy	3	60474102	
60474203	Energy storage	3	60474102	
---	Compulsory/ Elective University Requirement	3	-	
---	Elective Department Requirement	3	-	-
Total		15		

Summer Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60494301	Renewable Energy Engineering Practical Training	3	Completion of 115 Cr. Hrs.	-
Total				

* Or Co-requisite

Practical training for eight consecutive weeks

Fifth Year				
First Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60375102	Project Management	3	60224204	-
60495102	Graduation Project (1)	1	60494301	-
60485103	Energy efficiency and economy	3	60224204	-
---	Elective Department Requirement	3	-	-
---	Compulsory/ Elective University Requirement	3	-	-
Total		13		

Second Semester				
Course No.	Course Title	Cr. hrs.	Prerequisite	Co-requisite
60495203	Graduation Project (2)	2	60495102	-
60485101	Energy management and protocols	3	60375102	
---	Elective Department Requirement	3	-	-
---	Compulsory/ Elective University Requirement	3	-	-
Total		11		

* Or Co-requisite

Description of Courses offered by the

Course Number	Course Title	Credit Hours	(Prerequisite)

50211104 Calculus (1) 3 Credit hrs. Prerequisite: None

Limits, continuity, and their applications: chain rule, Implicit differentiation, related rates, increase decrease, concavity. Extrema. Newton's method, Roll's theorem, Mean-Value Theorem, definite and indefinite integrations, fundamental theorem of calculus, Area and volume, inverse functions, Exponential and logarithmic functions with their derivatives, conic sections.

50211202 Calculus (2) 3 Credit hrs. Prerequisite: 50211104

Inverse trigonometric and hyperbolic functions. Techniques of integration, by parts, trigonometric integrals, trigonometric substitutions, partial fractions, quadratic expressions, general substitutions. Improper integrals. Infinite series, convergence and divergence, convergence tests, Maclaurin and Taylor series. Polar coordinates: definition, arc length, area, conic sections.

50551101 General Physics (1) 3 Credit hrs. Prerequisite: None

Motion in One Dimension, Vectors, Motion in Two Dimensions, The Laws of Motion, Circular Motion and Other Applications of Newton's Laws, Work and Kinetic Energy, Potential Energy and Conservation of Energy, Linear Momentum and Collisions, Rotation of a Rigid Object About a Fixed Axis, Rolling Motion and Angular Momentum.

50551102 General Physics Lab (1) 1 Credit hrs. Prerequisite: 50551101*

Collection and Analysis of Data, Measurements and Uncertainties, Vectors: Force Table, Kinematics of Rectilinear Motion, Force and Motion, Newton's laws, Collision in Two Dimensions, Rotational Motion & Simple Harmonic Motion: Simple Pendulum, The Behavior of Gases with Changes in Temperature and Pressure, Measuring the coefficient of viscosity of liquid, Specific Heat Capacity of Metals.

60221101 Engineering Drawings 2 Credit hrs. Prerequisite: None

Instruments of Drawing, Graphic geometry (Lines, Letters, Numbers, Tangency Construction), Intersections, Types of Projection, Dimensioning, Plane Sectioning. Steel Structure Drawing, Reinforced Concrete Beams Drawing, Highway Projection (Curves, Slopes, Earth Works and their projection), Bridge Drawing (Retaining Walls, Abutments, and Piers), Projection of Water Structure at Water-way Intersection.

60222102 Introduction to Engineering 1 Credit hrs. Prerequisite: None

Topics include goal setting and career assessment, ethics, public safety, the engineering method and design process, written and oral communication, interpersonal skills and team building, and computer applications.

60224204 Engineering Economics 3 Credit hrs. Prerequisite: 50211104

Major elements of feasibility studies, Principles of engineering Economy. Equivalence and compound.

60363203 Computer Skills In Engineering 3 Credit hrs. Prerequisite: 50541103
Definition of computer and its system, computer programs, computer programs (Microsoft Office), computer drawing programs (AutoCAD); Learn the skills to draw 2D graphics.

60372201 Communication Skills and Profession Ethics 3 Credit hrs. Prerequisite: 50511103
General ideas about the writing styles and forms, writing in business, industry and government, adequacy and excellence. Analyzing the communication context, basic writing techniques, types of written communication, revising for excellence, college writing and professional writing, major types of on-job writing, writing categories, report design report writing procedures, preparing own resumes and CV's, practical experience on how to perform and attend interviews of work.

60375102 Project Management 3 Credit hrs. Prerequisite: 60224204
The project manager nomination and responsibilities, Project initiation, Project budgeting, Development of project work plan, Task preparing, Techniques for project planning and scheduling, Project progress measurement and project tracking by using earned value techniques, Project cost and time evaluations, Project close out procedures, Management skills for engineering projects, safety management.

60311204 Engineering Workshops 1 Credit hrs. Prerequisite: None
Includes theoretical and practical topic covering : four workshops turning , carpentry , electricity and blacksmithing; manual work of art, the settlement and the formation, gathering wood together , all kinds of welding, the mechanism of welding machine, an arc welding electroplating, welding wire, specifications and types of electrical circuits , house electrical wiring , electric current and resistance estimating, use of production machines for metals , precision instrument , types of turnings, the development in turnings, hand tools : Saw , Drill, Lathe, stone grinding

60241201 Static 3 Credit hrs. Prerequisite: 50551101
Introduction to static forces and Newton's laws, SI units, Vectors and operations on vectors (summation, dot product, cross product), System of forces, resultant, definition of moment, couples, equilibrium, Distributed loads, Types of supports, Reactions (beams, frames, and trusses), center of area, center of mass, Internal forces for trusses by joints and sections, Moment of inertia for different shapes.

60242203 Dynamics 3 Credit hrs. Prerequisite: 60241201
Study the motion of transition and rotational bodies with and without acting forces, Newton's second law, and central movement of forces, the equation of energy, work, momentum, collision, conservation of energy and momentum, applications on the motion system. Acceleration and relative speed, nonlinear center, analysis in terms of variables.

60232204 Materials Science 3 Credit hrs. Prerequisite: 50551103
The field of materials science and engineering and the essential background required to follow the specialized topics that follow. The content of the course is as follows; Historical Perspective, Classification of Materials, Atomic Structure and Interatomic Bonding, The Structure of Crystalline Solids, Imperfections in Solids, Mechanical Properties of Metals, Failure, Phase Diagrams, Polymer Structures and mechanical behavior, Thermal Properties.

60242102 Strength of Materials 3 Credit hrs. Prerequisite: 60241201

Concepts and types of stresses and strains. Stress-Strain diagram, mechanical properties of materials (modulus of elasticity, Poisson's ratio, and shear modulus. Axial (stress, strain, deformation, and compatibility). Internal forces for beams (axial, shear, and bending moment diagrams). Bending and Shear stress and strain. Torsion stresses, strains, and deformations. Compound stresses and strains. Maximum and minimum stresses, strains, and Mohr circle. Buckling of compression members (Euler differential equation). Deflection of beams by double integration method.

60432101 Strength of Materials Lab. 1 Credit hrs. Prerequisite: 60242102*

The measuring and/or determination of some material properties (strain and stress, yield stress, ultimate stress, fracture stress). Nondestructive testing of materials (NDT), micro and macro examination of materials and phase diagrams for steel. It is equipped with machines for conducting tests, such as: Tension, impact fatigue, bending, creep, hardness, and photo elasticity tests.

60453101 Measurement Devices 3 Credit hrs. Prerequisite: 60243104

Applications of Electrical and Mechanical Sensors. Data Acquisition and Applications of Logic Controllers in Power Systems. Identify the Physical Information Needed to Control and Record Data. Methods of Calibration and Correction.

60453102 Measurement Devices Lab. 1 Credit hrs. Prerequisite: 60453101*

Experiments on: Oscillations. Measurement of Ground Resistance. Data Acquisition. Signal Generators. Overlap and Isolation. Open and Closed-Circuit Systems. Speed feedback on system Performance. Frequency Response Measurements.

60453103 Automatic Control 3 Credit hrs. Prerequisite: 60453105+ 50222218

System modeling. Transfer functions, block diagrams and signal flow graph. Time domain analysis, transient response, steady-state error, stability and sensitivity. Routh's stability criterion. Root locus. Frequency domain analysis Bode plots. Control system design by compensation.

60453105 Automatic Control Lab. 1 Credit hrs. Prerequisite: 60453103*

Experiments that are related to: First and second order system analysis control experiments. Servo systems. Stability of dynamical systems. System identification. Design and tuning of a PID controller in closed loop systems. Simulation of systems using Simulink or Matlab.

60243104 Fluid Mechanics 3 Credit hrs. Prerequisite: 60241201

Main topics covered are; Introduction, fluid properties, basic units, fluid statics, pressure and its measurements, forces on plane and curved submerged surfaces, buoyancy & floatation, fluids in motion, flow kinematics and visualization, basic control volume approach, differential and integral continuity equation. Euler's and Bernoulli's equations, applications of Bernoulli equation, hydraulic and energy grade lines, momentum principle and its applications, Navier-Stokes equations, dimensional analysis and simulation, surface resistance and introduction to boundary layer theory. Flow in conduits, laminar and turbulent flows, frictional and minor losses and piping systems.

60243105 Fluid Mechanics Lab. 1 Credit hrs. Prerequisite: 60243104*
Center of pressure on a plane surface, stability of a floating body, Venturi and orifice meters, impact of jets, flow over a rectangular notch, flow over a weir, head loss through pipes, critical depth and specific energy, flow under a sluice gate, roughness of open channel, hydraulic jump, performance of impulse and reaction turbines, performance characteristics of a centrifugal pump.

60443101 Thermodynamics 3 Credit hrs. Prerequisite: 60242203
Properties and behavior of a pure substance, work and heat, first law and second law analysis of closed & open systems, Availability and Irreversibility. Vapor and air-standard power and refrigeration cycles. Thermodynamic relations. Ideal and real mixtures and solutions. Chemical reactions, phase and chemical equilibrium.

60443102 Heat Transfer 3 Credit hrs. Prerequisite: 60443101+ 50222218
Introduction to modes of heat transfer; one-dimensional steady state conduction; unsteady state conduction, lumped heat capacity system; introduction to convection, flow and thermal boundary layers. laminar and turbulent boundary layers; convection in internal and external flows; empirical relations for forced convection heat transfer; natural convection systems; condensation and boiling; introduction to thermal radiation.

60443103 Heat Transfer Lab. 1 Credit hrs. Prerequisite: 60443102*
Experimental work in heat transfer covering: Measurement of thermal conductivity, Natural and forced convection, Radiation, Boiling and condensation. Heat exchangers.

60453105 Electric machines 3 Credit hrs. Prerequisite: 60453107
Transformers. DC Motors. DC Generators. Single-Phase and Three-Phase Induction motors. Three-Phase Synchronous Generators. AC Series Motor. Repulsion Motor.

60453106 Electric machines Lab. 1 Credit hrs. Prerequisite: 60453105
Transformers. DC Motors and Generators. Single-phase and Three-Phase Induction Motors. Single-phase and Three-Phase Synchronous Generators. AC Series Motors.

60453107 Electric Circuits 3 Credit hrs. Prerequisite: 50551201
Circuit definition, circuit laws, Kirchhoff's voltage law, Kirchoff's current law, voltage distribution law, current division law, nodal analysis, circular analysis, direct current theories, waveforms, current circuits, direct current, Three-phase induction motors, single-phase induction motors, harmonic generator, properties of semiconductor materials, Pn (positive-negative) diodes, junction structure, bias circuits and applications, field effect transistors, pumps Data types and applications of differential pumps, frequency response pumps, pumps capacity, nutrition circles relapsing and Oscillators.

60453108 Electric Circuits Lab. 1 Credit hrs. Prerequisite: 60453107*
Resistors and color codes, direct and parallel circuits of direct current, methods of analysis of direct current circuits, oscilloscope and resistance, induction and capacitance instruments, direct ring circuits, mechanical properties of direct current motors, load properties of direct current generators, mechanical properties of single phase motors, load properties of harmonic generator, The properties of diode, calendar, circuit breakers, voltage regulation, properties of bipolar transistors and their applications, transistors properties, field effects and applications, process pumps, power pumps, Diodes for pumps, Oscillators.

60463201 Renewable Energy 3 Credit hrs. Prerequisite: 60463106
Renewable energy sources including, solar, wind, biomass, hydroelectric and geothermal. Electric power solar, wind and future energy alternatives.

60464102 solar energy 3 Credit hrs. Prerequisite: 60463201
Introduction to the solar energy, Solar radiation; Review of the basics of thermodynamics and heat transfer, Power plant Technologies; Types of CSP systems including CSP parabolic trough systems, CSP dish technology, CSP Fresnel technology and Solar tower; Heat storage systems; Hybridization; Secondary use of CSP systems; Operation and maintenance of CSP systems; Power quality control and grid integration; CSP plant project planning: economic, social and environmental considerations and site assessment.

60464103 solar energy Lab. 1 Credit hrs. Prerequisite: 60464102*
Sun Radiation Measurements. Properties of Photovoltaic Devices. Open Circuit Voltage and Short Circuit Current. Maximum Power Point (MPP). The Efficiency of Solar Cells. Parallel and Series Solar Cells. Shadow, Temperature and Dust Effect. Battery Charging and Control. Off-grid Connection. On-grid Connection.

60464104 Wind energy 3 Credit hrs. Prerequisite: 60463201
Basic characteristics of wind, site characterization, Statistical methods of wind analysis, wind resources assessment, fundamental principles of wind energy utilization, aerodynamics, mechanical and electrical design aspects. Wind machine technologies and wind turbines performance analysis. Wind power integration into the power systems, environmental impact of wind power utilization.

60464105 Wind energy Lab. 1 Credit hrs. Prerequisite: 60464104*
Conversion of Kinetic Wind Energy into Electrical Energy. Study of the Conversion of Kinetic Wind Energy into Electrical Energy. Determination of the Typical Parameters of The Aerogenerator (Short Circuit Current, Open-Circuit Voltage, Maximum Power), and I-V Curve. Study of Voltage, Current and Power in Function of Different Loads and the Influence of the Load Variation on the Aerogenerator. Study of the Power Generated by the Aerogenerator Depending on the Incident Angle of the Air. Study of The Aerogenerator Operation in Function of the Blade Configuration (Aerogenerator with 6, 3 Or 2 Blades), and the Optimum Number of Blades. Study of the Efficiency of a Wind Power Unit. Study of the Connection of Loads to Alternating Voltage of 220V. Study of the Inverter Connected to the Grid Simulator.

60474101 Power electronics 3 Credit hrs. Prerequisite: 60453107
Introduction to High-Power Semiconductor Devices. AC-DC converters: Single-phase half-wave rectifiers (uncontrolled, controlled). Single phase and bi-phase full-wave Rectifiers: Uncontrolled, fully controlled, half-controlled. Three-phase bridge rectifiers: Uncontrolled, fully controlled. DC-DC converters: Step-down, step-up, step-down/up. DC-AC converters: Single-phase inverters: PWM inverter; Three-phase inverter. AC-AC converters: Single-phase cycloconverter, single-phase transformer tap changer. The Applications of the different Converters.

60463106 Types and sources of energy 3 Credit hrs. Prerequisite: 60232204
Types of energy: solar energy, hydropower, hydropower, ... etc. Renewable energy sources, tidal phenomena, runoff, wind intensity, sustainable biofuels, non-renewable energy sources.

60474102 Production and conversion of energy 3 Credit hrs. Prerequisite: 60463106
Forms of energy. Fossil fuels including, petroleum, coal, oil shale and tar sand, natural gas and hydrogen power. Principles of nuclear power. Renewable energy sources including, solar, wind, biomass, hydroelectric and geothermal. Conversion of thermal energy into electrical power including thermoelectric converters and fuel cells, thermoelectric systems, electric generators and alternators. Environment and sustainable development at urban, national and international levels. Development and environment: implications for sustainable development. Technical, economic, ethical and philosophical aspects of sustainable development.

60474203 Energy storage 3 Credit hrs. Prerequisite: 60474102
Methods of storing energy chemically, electrically and thermally and ways to connect them to the main network. Evolution in energy transfer and cost versus efficiency.

60485101 Energy management and protocols 3 Credit hrs. Prerequisite: 60375102
Environmental legislations in Jordan and Environmental Management Systems (ISO 14000). Pollution. Land Use. Waste and Resource Recovery. Pesticides and Toxic Substances. Energy. Global Environmental Law. Principles of Environmental Impact Assessment. Writing of Environmental Impact Assessment Reports. Environmental Requirements for New Industries License.

60484202 Environment and Energy 3 Credit hrs. Prerequisite: 60474102
Theory and practice of environment and sustainable development at urban, national and international levels. Environmental degradation by deforestation, loss of biodiversity, air pollution, global warming, soil erosion, decreasing quality and quantity of water, poor sanitation services and poor urban conditions; CO2 emissions and global warming, interactions among society. Development and environment: implications for sustainable development. Technical, economic, ethical and philosophical aspects of sustainable development.

60485103 Energy efficiency and economy 3 Credit hrs. Prerequisite: 60224204
Principles of Energy Management. Energy Conservation. Energy Auditing and Analysis. Formulation of Energy Management Options. Economic Assessment and Conservation Technology of Energy. Energy Saving in Big Industries. Steam Generation. Electric and Distribution Energy Systems Management. Integral Planning for the Resources. Demand Management. Cogeneration. Total Power Schemes.

60495102 Graduation Project (1) 1 Credit hrs. Prerequisite: 60494301
Directed readings in the literature of mechanical engineering, Introduction to research methods, seminar discussions dealing with special engineering topics of current interest. It is the first phase of the entire project.

60495203 Graduation Project (2) 2 Credit hrs. Prerequisite: 60495102
Planning, design, construction and management of a mechanical engineering project. As defined and outlined in the first phase, writing a technical report, Preparation of technical engineering drawings.

60494301 Renewable energy Engineering Practical Training 3 Credit hrs. Prerequisite: Completion of 115 Cr. Hrs.
Practical training in a Mechanical Engineering Project or any other places approved by the department, and according to the regulations drafted by the college of Engineering Training Committee.

50551103 General Chemistry 3 Credit hrs. Prerequisite: None
Periodicity table, electronic composition and electronic distribution. The connectivity and periodic properties for the element. Chemical calculations, Oxidation and reduction system. Chemical equilibrium, Thermo-chemistry and Electrochemistry.

50551104 General Chemistry Lab. 1 Credit hrs. Prerequisite: 50551103*
Physical properties, specifying the element and molecule form the molecule weight. Calculating water crystallization, calculating equilibrium heat and formation heat. Solution titration, Chemical reaction speed, chemical cell voltage.

50551201 General Physics (2) 3 Credit hrs. Prerequisite: 50551101
Continuation of University Physics 1. Topics include mechanics of materials, basic thermodynamics, fundamentals of electricity and magnetism

50551202 General Physics Lab. (2) 1 Credit hrs. Prerequisite: 50551201*
Covers such topics as electricity, magnetism, electromagnetic waves, optics, and modern physics.

60484204 Simulation and prediction 3 Credit hrs. Prerequisite: 60464102
Physical Model. Symbolic Model. Methodological Modeling: Analysis and Formulations of Solution Strategy and Verification, Certificate Validation. Intermittent Simulation. Simulation Continuation. Oriented Approach Process, Random Number and Random Variables. Simulation Language. Analysis And Study Induction and Prediction Methods Using Computer for Available Data.

60475104 Energy transfer and storage systems 3 Credit hrs. Prerequisite: 60474203
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.

60484205 Control and protection of energy systems 3 Credit hrs. Prerequisite: 60474102
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.

60474205 Energy Saving Design 3 Credit hrs. Prerequisite: 60474102
Integrated principles, design energy-saving buildings. Application of laws and standards. Modeling, energy, simulation. Daylight and natural ventilation, architectural features of passive solar buildings. Use of renewable resources, zero net designs. Economic life cycle analysis.

60484206 Green Buildings 3 Credit hrs. Prerequisite: 60463201
The use of solar energy in the heating and air conditioning of buildings and include the following topics: solar radiation, heating loads and air conditioning in buildings. Energy efficiency, heating and cooling using solar energy, standard implementation of thermal mass.

60464207 Fuel cells and hydrogen 3 Credit hrs. Prerequisite: 60463201
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.

60464208 Bioenergy 3 Credit hrs. Prerequisite: 60463201
Introduction to Biomass Energy. Bioenergy systems. Organic Materials (Plants etc.). Biomass Energy. Waste power. Transfer of Solid Material to Gas, Gas collection Technologies Burning and Digestion of Wet Wastes. Biomass as a Source of Renewable Energy.

60464209 Solar thermal systems 3 Credit hrs. Prerequisite: 60464102
Introduction of Solar Thermal Energy. Residential. Commercial and Industrial Applications. Solar Radiation. Heat Transfer. Plane and Concentrated Collectors. Water Heating Applications. Heating and Cooling the Buildings. Thermal Industrial Applications Water Desalination. Solar Thermal Energy System.

64044218 Design of renewable energy systems 3 Credit hrs. Prerequisite: 64043206
Scientific and technological foundations of renewable energy sources Negative and positive solar systems (high, medium, low temperature solar thermal and photovoltaic complexes); wind energy; biomass and bioenergy; management of intentions; hydrogen production; hydropower; geothermal energy. Development, exploitation and monitoring, introduction to the social, legal and market challenges of potential systems restoration, factors affecting the deployment of renewable energy, renewable energy systems.

60464211 Design of wind power systems 3 Credit hrs. Prerequisite: 60464104
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. Using Computer Software for Wind Energy Analysis.

60464212 Special Topics in renewable energy 3 Credit hrs. Prerequisite: Department approval
Advanced topics in renewable energy with the approval of the department on subjects and content.