Bachelor Degree in Renewable Energy Engineering

1. University Graduation Requirements

To receive a bachelor's degree in Renewable Energy Engineering, a student must fulfill all requirements related to credit hours, grade point average, program of study, and courses.

2. Degree Requirements

Type of Requirement	Credit Hours
University Requirements	**30**
College Requirements	**37**
Specialization Requirements	**64**
Specialization Electives	**9**
Total	**140**

❖ First: University Requirements

- **A**: University Requirements consist of 30 credit hours distributed as follows:

Course Number	Course Title	Credit Hours	Prerequisite
ARAB 101	Arabic Communication Skills	3	
ARAB 201	Advanced Academic Arabic	3	ARAB 101
CSC 101	Introduction to Computing	3	
ENGL 101	Basic Academic English I	3	
ENGL 102	Basic Academic English II	3	ENGL 101
ENGL 203	Advanced Academic English I	3	ENGL 102
SOCS 101	Islamic Civilization I	3	
SOCS 202	World Civilizations	3	
Math 101	Calculus I	3	
	Free Elective	3	
Total		**30**	

- **B** Free Elective Course: 3 credit hours *to be chosen from the following list.*

Course Number	Course Title	Credit Hours	Prerequisite
ASTR 150	Introduction to Astronomy	3	
CHEM 150	Chemistry & Society	3	
FREN 101	Basic French 1	3	
SOCS 201	Islamic Civilization II	3	SOCS 101
PHED 101	Physical Education 1	3	

- **Second: College Requirements**: College Requirements consist of 37 credit hours distributed as follows:

Number	Title of the Course	Credit Hours	Pre-requisite
CHEM 101	General Chemistry I	3	
CHEM 101 L	General Chemistry Lab	1	CHEM 101
PHYS 101	General Physics I	3	
PHYS 102	General Physics II	3	PHYS 101
PHYS 103 L	General Physics Lab	1	PHYS 102
CIVE 205	Engineering Drawing	1	CSC 101
ELEE 230	Programming for Engineers	3	CSC 101
ENGL 206	Technical Writing	3	ENGL 203
MATH 102	Calculus II	3	MATH 101
MATH 201	Calculus and Analytic Geometry III	3	MATH 102
MATH 202	Differential equations	3	MATH 201
MATH 215	Linear algebra and Numerical Techniques	3	MATH 202
STAT 230	Probability and Statistics	3	MATH 201
COEN 300	Engineering Economy	3	STAT 230
COEN 401	Engineering Ethics	1	ENGL 203
Total		**37**	

- **Third: Program Specialization Requirements**: Program specialization requirements consist of 73 credit hours: 64 compulsory credit hours, 9 elective credit hours distributed as follows.

  - **A: Compulsory Specialization Requirements**: **64 credit** hours distributed as follows.

Course Number	Course Title	Credit Hours	Pre-requisite
MECH 225	Engineering Mechanics	3	PHYS 101
MECH 230	Engineering Materials	3	CHEM 101
MECH 342	Heat Transfer	3	REE 260
ELEE 350	Signals and Systems	3	REE 210, MATH 202
ELEE 360	Machines	3	REE 210
ELEE 380	Control Systems	3	ELEE 350
ELEE 480L	Control Systems Lab.	1	ELEE 480
ELEE 212	Circuits for non-Electrical Students	3	MATH 202
ELEE 242	Electronics for non-Electrical Students	3	ELEE 212
REE 250	Digital Systems	3	MATH 102
REE 245L	Circuit and Electronics Lab	1	REE 245
REE 260	Thermodynamics	2	MATH 202
REE 310	Fundamental of Power Electronics	3	REE 240
REE 320	Fundamental of Renewable Energy	3	ELEE 360
REE 340	Fundamental of Power Systems	3	ELEE 360
REE 350	Solar Thermal Energy Design	3	REE 310
REE 400	Summer internship training	1	*Last Summer*
REE 420	Renewable Engineering (1): Applied Photovoltaic	3	REE 320
REE 498	Final Year Project (1)	1	REE 320
REE 499	Final Year Project (2)	3	REE 498
REE 460	Renewable Engineering (2): Wind Energy	3	REE 320
REE 470	Renewable Engineering (3): Hydrogen Energy	3	REE 320
REE 475	Energy Economics and Managements	3	REE 310
REE 473	Life Cycle Assessment	3	REE 320
REE 460L	Photovoltaic Lab	1	REE 460
Total		**64**	

➢ B: Elective Specialization Requirements - **9 credit** hours to be chosen from the following list.

Course Number	Course Title	Credit Hours	Prerequisite
REE 465	Smart City Applications	3	REE 320
REE 471	Renewable Energy Policy and International Programs	3	REE 320
REE 472	Energy and Environment	3	REE 320
REE 474	Nuclear Energy	3	REE 320
REE 475	Nuclear Reaction	3	REE 320
REE 476	Principles of Green Building Design	3	REE 320
REE 477	Photovoltaic Energy System Design	3	REE 460
REE 478	Biomass	3	REE 320
REE 479	Wind Energy Converters	3	REE 420
REE 481	Sustainable Energy Developing Countries	3	REE 320
REE 482	Energy Efficiency	3	REE 320
REE 483	Advanced Photovoltaic Manufacturing	3	REE 460
REE 485	Operational Research	3	REE 260
REE 486	Low Energy Buildings and PV	3	REE 320
REE 487	Hydrogen Technologies and Fuel Cells	3	REE 470

Proposed Sequence of Study

Year I

First Semester		**18 Credit hours**		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	ARAB 101	Arabic Communication Skills	3	
	SOCS 101	Islamic Civilization I	3	
	CSC 101	Introduction to Computing	3	
	ENGL 101	Basic Academic English I	3	
	PHYS 101	Physics 101	3	
	MATH 101	Calculus I	3	
TOTAL 18				

Year I

Second Semester		**18 Credit hours**		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	ARAB 201	Advanced Academic Arabic	3	ARAB 101
	ENGL 102	Basic Academic English II	3	ENGL 101
	MATH 102	Calculus II	3	MATH 101
	PHYS 102	Physics II	3	PHYS 101
	CHEM 101	Chemistry I	3	
	ELEE 230	Programming for Engineers	3	CSC 101
TOTAL 18				

Year II

Third Semester		**18 Credit hours**		
	ENGL 203	Advanced Academic English I	3	ENGL 102
	MATH 201	Calculus and Analytic Geometry III	3	MATH 102
	MATH 202	Differential equations	3	MATH 102
	PHYS 103L	Physics Lab.	1	PHYS 102
	CHEM 101L	Chemistry Lab	1	CHEM 101
	CIVE 205	Engineering Drawings	1	MATH 102
	MECH 230	Engineering Materials	3	CHEM 101
	SOCS 202	World Civilizations	3	
TOTAL 18				

Year II

Fourth Semester		**17 Credit hours**		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	STAT 230	Probability and Statistics	3	MATH 101
	MATH 215	Linear algebra and Numerical Techniques	3	MATH 202
	REE 260	Thermodynamics	2	MATH 202
	ENGL 206	English Technical Writing	3	ENGL 203
	ELEE 212	Circuits for non-Electrical Students	3	MATH 202
	REE 250	Digital Systems	3	MATH 202
TOTAL 17				

Year III

Fifth Semester		**18 Credit hours**		
Code	Course	Title	Credits	**Pre-requisites**
	ELEE 360	Machines	3	REE 210
	ELEE 350	Signals and Systems	3	REE 210 + MATH 202
	REE 320	Fundamental of Renewable Energy	3	REE 210
	MECH 342	Heat Transfer	3	REE 260
	ELEE 242	Electronics for non-Electrical Students	3	ELEE 212
	COEN 300	Engineering Economy	3	MATH 202
Total 18				

Year III

Sixth Semester		**15 Credit hours**		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	ELEE 380	Control Systems	3	ELEE 350
	REE 310	Fundamental of Power Electronics	3	REE 240
	COEN 401	Engineering ethics	1	COEN 300
	REE 340	Fundamental of Power Systems	3	ELEE 360
	REE 420	Renewable Engineering (1): Applied Photovoltaic	3	REE 320
	REE 245L	Circuit and Electronics Lab	1	REE 245
	ELEE 480L	Control Systems Lab.	1	ELEE 480
Total 15				

Year IV

Seventh Semester		17 Credit hours		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	REE 350	Solar Thermal Energy Design	3	REE 310
	REE 498	Final Year Project (1)	1	REE 320
	REE 460	Renewable Engineering (2): Wind Energy	3	REE 320
	REE 460L	Photovoltaic Lab	1	REE 420
	REE 473	Life Cycle Assessment	3	
		Specialization Elective	3	-
		Specialization Elective	3	-
Total 17				

Year IV

Eighth Semester		18 Credit hours		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	REE 499	Final Year Project (2)	3	REE 498
	REE 465	Smart City Applications	3	REE 320
	REE 470	Renewable Engineering (3): Other Renewable Energies	3	REE 320
	REE 475	Energy Economics and Managements	3	REE 310
		Specialization Elective	3	-
		Free Elective	3	
TOTAL 18				

Year IV

Summer Semester		1 Credit hours		
Code	**Course**	**Title**	**Credits**	**Pre-requisites**
	REE 400	Summer internship training	1	
Total 1				

Course Description

Core Courses

ELEE 212 Circuits for non-Electrical Students **3(3, 0, 0)**

A course on fundamentals of electric circuits, basic elements and laws, Kirchhoff's current law (KCL), Kirchhoff's voltage law (KVL), techniques of circuit analysis: nodal and mesh analysis, superposition, source transformation, AC analysis, Thevenin and Norton equivalents; inductors and capacitors, A.C. Analysis, Phasor concept.

ELEE 242 Electronics for non-Electrical Students, 3(3, 0, 0)

A course on electronics; PN junctions, diodes and its applications, Bipolar junction transistors (BJT), BJT amplifiers, Small Signal Analysis of BJT amplifier, Field Effect Transistor (FET) with applications, and operational amplifiers (OP- AMPs) with applications.

ELEE 350 Signals and Systems **3(3, 0, 0)**

Signals and systems: definition, properties, and analysis; the Fourier series; the Fourier transform and its applications; the Laplace transformation and its applications; analysis and design of analog filters, MATLAB for analog signal processing. Prerequisite: MATH 202

ELEE 360 Machines **3(3, 0, 0)**

A course on three-phase circuits and power calculations; magnetic circuits; single-phase and three- phase transformers; DC and AC machines under steady-state: construction, equivalent circuit, and testing and performance characteristics. Prerequisite:

ELEE 380 Control Systems **3(3, 0, 0)**

A course that covers mathematical modeling (transfer functions, block diagrams, signal flow graph) of linear continuous single input/single output dynamical systems; Open-loop and Closed-loop systems analysis; First and second order systems, Systems Stability (Routh-Hurwitz criterion); Steady-state error analysis of unity-feedback control systems; Frequency response analysis (Bode plots, Nyquist, Root-locus method); Introduction to PID controllers. Prerequisite:

ELEE 480L Control Systems Lab. **1(0, 0, 2)**

A laboratory course that covers analysis of linear systems; second order systems; effects of poles and zeros on the transient response; effect of gain on response and stability; compensation implementation. Pre-requisite: ELEE 380.

MECH 225 Engineering Mechanics **3(3, 0, 0)**

A course outlining vector mechanics of forces and moments; free-body diagrams; equilibrium of particles and rigid bodies in two and three dimensions; plane and space trusses. Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems, Kinetics of

particles; Newton's second law, Central force motion. Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading. Thermal Stresses.

MECH 230 Engineering Materials 3(3, 0, 0)
The course introduces fundamental concepts in materials science as applied to engineering materials: crystalline structures; imperfections, dislocations, and strengthening, mechanisms; diffusion; phase diagrams and transformations. Ferrous and non-ferrous metal alloys, ceramics, and polymers. Structure-property relationships. Material selection case studies.

MECH 342 Heat Transfer 3(3, 0, 0)
A course investigating steady and transient heat conduction; extended surfaces; numerical simulations of conduction in one and two-dimensional problems; external and internal forced convection of laminar and turbulent flows; natural convection; heat exchanger principles; thermal radiation, view factors and radiation exchange between diffuse and gray surfaces as well as the use of computer packages in problem solving.

REE 250 Digital Systems 3(3, 0, 0)
Numbering systems and codes, Boolean algebra; combinational circuit, latches and flip-flops, sequential circuits, memories, microprocessor and microcontroller; internal architecture, programming, interfacing techniques, and performance evaluation. The course includes a design project.

REE 245L Circuit and Electronics Lab 1(0, 0, 2)
A laboratory course that covers the use of laboratory instruments: passive electronic components; voltage-divider circuits; sources and Thevenins's theorem; RC lead-lag networks, series resonance, and transformers, diode characteristics, diode applications; rectifier circuits; clamping and clipping; BJT characteristics; op-amp application; summer, integrator, and differentiator circuits

REE 260 Thermodynamics 3(3, 0, 0)
A course on the thermodynamic state and properties of a pure substance, system and control volume concepts, work and heat, the first law of thermodynamics, energy and mass conservation, entropy, the second law of thermodynamics; applications to closed setups and flow devices; simple vapor and gas cycles applications.

REE 310 Fundamental of Power Electronics 3(3, 0, 0)
A course on diodes; diode circuits and rectifiers; thyristors; controlled rectifiers; power transistors; DC choppers; pulse width modulated inverters; introduction to gate and base drive circuits; switching power supplies.

REE 320 Fundamental of Renewable Energy 3(3, 0, 0)
A course that covers several topics of renewable energy, energy units and energy carriers, Energy sources, renewable energy sources; wind, solar, hydro, biomass, and geothermal resources; resource assessment, electric drive options, control problems, environmental aspects of electricity generation, and stand- alone and utility applications.

REE 340 Fundamental of Power Systems 3(3, 0, 0)
Basic concepts and modeling of generation, transmission, and distribution systems; load flow analysis; economic load dispatch problem; symmetrical and asymmetrical short circuit studies; simplified power system stability analysis; introduction to power system

REE 350 Solar Thermal Energy Design 3(3, 0, 0)
Characteristics of solar radiation and solar collectors. Collector efficiency evaluation and prediction of long term performance. System modelling, energy storage; computer simulation and modelling of performance and economic worth.

REE 420 Renewable Engineering (1): Applied Photovoltaic 3(3, 0, 0)
This course will cover main factors to the operation, design and construction of solar cells and PV system design. Solar cell loss mechanisms, design features to improve efficiency of solar cells and modules. In addition, Application and design of PV systems. Remote Area PV Power Supply systems. Grid-Connected PV systems.

REE 460 Renewable Engineering (2): Wind Energy 3(3, 0, 0)
An overview of energy sustainability and wind energy history. Wind resources characteristics. Fundamentals of physical wind, basic meteorology of wind, extraction of energy from wind. Basic introduction to wind energy and energy conversion systems. Various types of wind energy, conversation systems and aerodynamics; blade and tower structural loads, kinematics of blades and meteorology. Wind plant development, and environment and ecological impact of wind energy plants.

REE 470 Renewable Engineering (3): Other Renewable Energies 3(3, 0, 0)
This course will cover other kinds of renewable energy in more details including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as nuclear, biomass (conversions), geothermal, and hydro. Energy conservation methods.

REE 473 Life Cycle Assessment 3(3, 0, 0)
This course will deal with life cycle analysis and its use for life cycle assessment of energy systems. Methodologies, boundary issues, data bases and applications will be studied. The uses of LCA will be illustrated with industrial case studies and with studies aimed at quantifying externalities associated with different electricity generation technologies.

REE 475 Energy Economics and Managements 3(3, 0, 0)
Energy management principles; energy conversion; energy auditing; analysis; formulation of energy management options; economic evaluation, implementation & control; energy conservation techniques-conservation in energy intensive industries; steam generation, distribution systems, integrated resource planning; demand-side management; cogeneration; thermal insulation; energy storage; economic evaluation of conservation technologies; and analysis of typical applications

REE 460L Photovoltaic Lab 1(0, 0, 2)

Introduction to photovoltaic cells, techniques used for processing and fabrication PV cells, and lab safety. Organic and inorganic solar cells design and simulation tools, and photovoltaic testing and measurement techniques to characterize solar cells. Calibration of solar cells.

Elective Courses

REE 465 Smart City Applications 3(3, 0, 0)
This course will cover the main definitions, needs, challenges and disciplines in smart and sustainable cities. Introducing the historical development, present and future sustainability deficits of metropolitan areas. The course introduce criteria to measure sustainability, and political guiding principles and action plans formulated in order to achieve smart sustainable cities.

REE 471 Renewable Energy Policy and International Programs 3(3, 0, 0)
This course will review objectives and strategies of renewable energy policy, focusing on sustainable energy transitions, and the integration of renewable energy into electricity markets. Policy drivers, policy processes and relevant aspects of energy market structure and regulation. Selection and design of policy instruments, including regulation, taxation, tariffs, targets, incentives and market-based schemes will be explored. Specific policy and regulatory approaches, the views of different stakeholders and interaction with the broader policy regulatory environment will be examined for specific policy case studies.

REE 472 Energy and Environment 3(3, 0, 0)
Energy System and Environment; conventional and renewable energy sources. The Impact of RE in reducing CO2 emissions. Pollution growth and its sequences; Air, Water, soil, thermal, noise pollution – cause and effect; Causes of climate change in the global, the regional and the local regions

REE 474 Nuclear Energy 3(3, 0, 0)
Introduction to nuclear energy. Atomic and nuclear physics, the interaction of radiation and matter. Nuclear reactor operation, reactor components, nuclear cycles, neutron diffusion and moderation. Reactor shielding. Fuel reprocessing and waste disposal. Reactor licensing and safety. Economics and environmental concerns.

REE 475 Nuclear Reaction 3(3, 0, 0)
Energetic and kinetics of nuclear reactions and radioactive decay, fission, fusion, and reactions of low-energy neutrons; properties of the fission products and the actinides; nuclear models and transition probabilities; interaction of radiation with matters

REE 476 Principles of Green Building Design 3(3, 0, 0)
This course will cover the principles of green building design and construction, including incorporating green principles in renovating and remodeling, and preservation of historic

structures as well as new buildings. Energy efficiency, indoor environmental quality, and sustainable building materials.

REE 477 Photovoltaic Energy System Design 3(3, 0, 0)
This course will cover the basic principles of the planning, design, installation, and operation of photovoltaic (PV) systems. Examination of PV system components, planning and design of grid-connected and stand-alone PV systems, analysis of PV systems at the residential scale through utility scale, including engineering, economic, and policy considerations.

REE 478 Biomass 3(3, 0, 0)
This course will introduce a range of biomass energy sources, including forestry, wastes and crops, as well as various technologies for capturing the stored chemical energy in biomass: direct combustion, pyrolysis, anaerobic digestion, gasification, fermentation, landfill gas and cogeneration.

REE 479 Wind Energy Converters 3(3, 0, 0)
This course will cover the principles of wind energy, design and operation of different types of wind energy converters. Water pumping machines, remote power supply and grid electricity generation. Wind energy site selection, monitoring and analyzing data, estimating output from wind generators, integrating wind generators into hybrid power systems or the grid, economics, standards and environmental impacts.

REE 481 Sustainable Energy Developing Countries 1(0, 0, 2)
This course covers many of the technical and non-technical issues relating to introducing photovoltaics and renewable energy systems and technology in developing countries. The course will cover various Recommended Practice Guides developed by industry expert groups in the areas of financing and investment mechanisms, capacity building, implementation models and quality assurance. Considering practical components related to design, implementation and maintenance of photovoltaic and renewable energy systems in developing countries and case studies will be also considered herein.

REE 482 Energy Efficiency 3(3, 0, 0)
This course will cover current and predicted energy use and associated GHG emissions; residential and commercial passive solar design; energy management programs; building management systems; heating, ventilation and air conditioning; and consumer products and office equipment. Impacts of transport, Opportunities to reduce transport energy with efficient engines, public transport, and urban design. Industrial systems examined include heat recovery; cogeneration; compressed air and steam distribution; and motor systems, pumps and fans. Barriers to improved energy efficiency such as up-front cost, lack of information are also covered.

REE 483 Advanced Photovoltaic Manufacturing 3(3, 0, 0)
Solar cells operating. Manufacturing of silicon solar cells. Trends in commercial, manufacturing process of environmental aspects of cell technology. Tools/methods used to improve solar cell performance and reduce solar cell cost in manufacturing, namely statistical decision making, cost modelling and regression modelling. Production processes for both screen-printed solar cells and buried contact solar cells. Quality control techniques used for PV manufacturing

REE 485 Operational Research 3(3, 0, 0)

This course will cover the topics of linear programming, Graphical and Algebraic solutions, Simplex Method. Duality and Sensitivity analysis. Transportation and assignment problems. Network analysis. Queueing theory.

REE 486 Low Energy Buildings and PV 3(3, 0, 0)

Greenhouse gas production, climate-appropriate building design, implementing energy efficiency measures. Prediction of building thermal, lighting, and solar access. PV modules in greenhouse building envelope. Technical aspect of the use of PV in buildings and the urban environment, such as heat transfer processes, partial shading, and mismatch and system siting, sizing and configuration will be investigated. System performance assessment and prediction.