



## دبلوم علوم وهندسة الطاقة المتجددة

### Diploma of Renewable Energy Science and Engineering

من خلال البرنامج سوف تنمى القدرة لدى الطلاب لإكتساب ركيزة المفاهيم العلمية الاساسية والمشاكل المتواجده حاليا بسبب نفاذ الطاقه والتي تعاني منها دول العالم والعمل علي حلها من خلال استبدالها بمصادر طاقه نظيفه ومتجدده، واكتساب الوعى بالتطبيقات الجديده للطاقه المتجدده من خلال إستخدام الطرق المعملية والتدريبيه، خاصة في مجالات الخلايا الشمسيه وخلايا الوقود.

#### الأهداف ومخرجات التعلم المقصودة:

1. توفير تعليم وتدريب ذو جودة عالية من اجل إمداد الطالب بأاساسيات علوم الطاقه البديله والمتجدده، بالإضافة إلى إمداده بالتطورات الحديثه في مجالات أبحاث وسوق الطاقه البديله والمتجدده.
2. تزويد الطالب بمعرفه واسعه في مجال تقنيات الطاقه المتجدده.
3. رفع وعى الطلاب حول دور الطاقه في العالم الحديث، بالإضافة إلى الآثار البيئية والمجتمعية الناجمه عن التلوث البيئي الناتج من استخدام مصادر الطاقه الحاليه كالنفط والفحم (ويتضمن ايضا الادله المؤيده والمعارضه لتغير المناخ ) وأهمية توفير سبل لإيجاد طاقه بديله نظيفه ومتجدده للحد من أي آثار سلبيه تنتج عن استخدام الطاقه.
4. إكساب الطلاب المهارات التحليلية والمعملية لتقييم واختيار تقنية الطاقه المتجدده المناسبه للبيئه أو المكان، مع التركيز على بعض مجالات الطاقه المتجدده مثل طاقة الرياح والطاقه المائية والطاقه الشمسية والطاقه الناجمه عن استخدام الوقود الحيوى وغاز الهيدروجين.
5. توفير الفهم الكافى للطلاب عن الكفاءات المختلفه لأنظمة وتقنيات الطاقه المتعدده، مع التركيز بشكل خاص على استخدامها في البيئه المحيطه والمجتمع.



## Program Courses

### 1. Compulsory Courses:

First Semester							
Course code	Course title		Total Credit Hours	Lecture Credit Hours	Lab Credit Hours	Exam Duration (hour)	Final grades out of
	English	Arabic					
RE501	Energy and Environment	الطاقة والبيئة	1	1	0	1	50
RE502	Energy Conversion and Storage	تحويل وتخزين الطاقة	3	2	1	2	150
RE503	Renewable Energy and Society	الطاقة المتجددة والمجتمع	1	1	0	1	50
RE504	Photovoltaic Systems Technology	تقنية النظم الكهروضوئية	3	2	1	2	150
RE505	Energy Economics and Policies	اقتصاديات وسياسيات الطاقة	1	1	0	1	50
RE506	Hydrogen Production and Storage	انتاج وتخزين الهيدروجين	3	2	1	2	150
Second Semester							
Course code	Course title		Total Credit Hours	Lecture Credit Hours	Lab Credit Hours	Exam Duration (hour)	Final grades out of
	English	Arabic					
RE509	Fuel Cells	خلايا الوقود	3	2	1	2	150
RE510	Biogas Technology	تكنولوجيا الغاز الحيوى	1	1	0	1	50
RE511	Renewable Hybrid Systems	النظم المختلطة للطاقة المتجددة	2	2	0	2	100
RE512	Design and Applications Of Photovoltaic Systems	تصميم وتطبيقات النظم الكهروضوئية	3	2	1	2	150
RE513	Materials Preparation and Characterization	إعداد وتوصيف المواد	3	2	1	2	150



## 2. Elective courses:

Elective Courses							
Course code	Course title		Total Credit Hours	Lecture Credit Hours	Lab Credit Hours	Exam Duration (hour)	Final grades out of
	English	Arabic					
RE507	Power Semiconductor Converters	اشباه موصلات محولات القوى	2	2	0	2	100
RE508	Hydropower Technology	تقنيه الطاقه الكهرومائيه	2	2	0	2	100
RE514	Renewable Energy Market and Commercialization	سوق الطاقه المتجدده وسبل تسويقها	2	2	0	2	100
RE515	Photochemistry	الكيمياء الضوئيه	2	2	0	2	100

**For graduation you should complete total credit hours = 28**

**[Compulsory Courses (24 credit hours) + Elective Courses (4 credit hours)]**



## Course Specifications

### RE501 Energy and Environment

Introduction to Life Cycle Assessment (LCA) of energy technologies; calculation of carbon intensity of national energy generation systems and Greenhouse Gas (GHG) savings; and global environmental benefits of Renewable Energy Technology projects. Introduction to international climate and environmental conventions; carbon markets and clean development mechanism (CDM); Introduction to CDM Methodologies for Renewable Energy and energy efficiency projects.

### RE502 Energy Conversion and Storage

Analysis of thermo-mechanical, thermo-chemical, electrochemical, and photoelectric processes and technologies of renewable energy conversion and storage systems; on-shore and off-shore energy conversion; innovative energy storage devices; energy carriers, synthesized fuels, and fuel reforming. Emphasis on advanced energy technologies, energy efficiency, systems performance, innovative grid connections, and minimizing environmental impacts. The course includes lab work for providing the students with relevant hands-on experiments.

### RE503 Renewable Energy and Society

Awareness on renewable energy and its environmental and social impact on society, public participation in developing and managing renewable energy projects as well as low carbon society.

### RE504 Photovoltaic Systems Technology

Introduction about renewable energy resources and the most widely utilized renewable Energy technologies. Introducing the electrical power engineering basics, in addition to the solar energy fundamentals. Following that, the PV modules fundamentals and PV systems



and components will be introduced, as well as the PV performance analysis. The basic sizing principles of PV systems will be presented, as well as the most common and widely used fabrication methods.

### **RE505 Energy Economics and Policies**

Energy Policies Development and Trends Subsidies, Incentives and Taxes; Policies for Renewable Energy Promotion; Climate Mitigation Policies and Renewable Energy; Sustainable development, Economic Decision Making of Renewable Energy Project.

### **RE506 Hydrogen Production and Storage**

Chemical Production of hydrogen, Electrochemical Hydrogen Evolution, Solar hydrogen evolution, Partial Oxidation, Steam Reforming, Thermal Decomposition, Syngas, Shift reaction, Methanation, Hydrogen Purification, Desulfurization, CO<sub>2</sub> Removal, Electrolytic Hydrogen, Liquid Electrolyte Electrolyzers, Solid Polymer Electrolyte Electrolyzer, Ceramic Electrolyte Electrolyzer, Photolytic Hydrogen, Solar Photolysis. Storage of Hydrogen by Adsorption, Storage of Hydrogen in Chemical Compound, Metal/Metal oxide Hydrides, Hydrogen Storage Materials, carbon Nanofibres, Sponge Iron, Glass Microspheres, Carbon nanotubes, Aerogels. Materials selection, Catalyst Preparation including nano catalysts, Characterization of catalysts, Infrastructure, and distribution of hydrogen, Economic aspects of using hydrogen, Innovation in hydrogen technology. The course includes lab work for providing the students with relevant hands-on experiments.

### **RE507 Power Semiconductor Converters**

Semiconductor devices: Driving, snubber and protection circuits; Resonant converters; Switching D.C power supplies; Power conditioners; Applications in the fields of electrical energy utilization.

### **RE508 Hydropower Technology**

Introduction to hydropower, status of large and small hydropower development in the



MENA region and the world in terms of potential, installed capacities and on-going projects in the context of rural electrification and agriculture (run-off-river, canal fall based, dam toe, small hydropower, micro hydropower, and Pico hydropower).

### **RE509 Fuel Cells**

Introduction to fuel cells, difference between fuel cells, batteries and other energy storage applications. Characteristics of fuel cells (energy efficiency, environmental issues, operating performance, etc.). Fuel cells basics: (thermodynamics and kinetics of electrochemical reactions, types of overpotentials, electrodes reactions in fuel cells, gas diffusion electrode, electrocatalysis, fuel cell efficiency). Fuel Cell electrode based material, catalyst material selection. Nano catalyst fabrications, Characterization of catalysts and investigation of catalyst performance. Fuel cell design and configurations, stack components, Types of Fuel Cell systems: (Phosphoric Acid Fuel Cells, Molten Carbonate Fuel Cells, Solid oxide Fuel Cells, Polymer Electrolyte Fuel Cells, Direct Methanol Fuel Cells, and Alkaline fuel cells). Fuel Cell Applications: Stationary Power Plants, Automotive Power Plants, other Applications. The course includes lab work for providing the students with relevant hands-on experiments.

### **RE510 Biogas Technology**

Introduction to anaerobic digestion, benefits and costs of the biogas plant, Uses of biogas and digested effluent, quality assessment of digested slurry, components of a biogas system, Types and models of simple and advanced biodigesters. Household and institutional plants, biolatrines, scaling and design of biogas plants. Planning, construction, and management of biogas plants. Biogas technology and the Millennium Development Goals, developing CDM proposals focusing on anaerobic waste treatment, Field visits.

### **RE511 Renewable Hybrid Systems**

Systems that comprise renewable energy technologies, as well as renewable energy technologies with non-renewable ones, such as the PV-diesel systems. Application of



Renewable Hybrid Systems in Rural Electrification, as well as introducing the concept of minigrids. An overview on the design and optimization methodologies of renewable hybrid systems will be presented, as well as some case studies from literature.

### **RE512 Design and Applications of Photovoltaic Systems**

Introduction to photovoltaic systems and applications. The difference between standalone/off grid and grid connected/on grid system will be presented, as well as the basic design concepts of each system, comprising the manual calculations as well as the use of advanced software programs within the laboratory hours. An introduction about solar water pumping will be presented as well, in addition to an overview about other widely used application of PV systems.

### **RE513 Materials Preparation and Characterization**

Fundamentals of nanoscience, Preparation of nanomaterials by different techniques. Structural characterization (XRD, XRF, XPS, SAX, Auger, SIMS, etc.), Electrochemical characterization (CV, EIS, E-I curves, etc.), Morphological characterization (SEM, TEM, AFM, STM, etc.), Thermal and mechanical properties, Spectroscopic characterization (UV, VIS, IR, Raman, etc.), Electrical properties and Optical properties. The course includes lab work for providing the students with relevant hands-on experiments.

### **RE514 Renewable Energy Market and Commercialization**

Introduction to renewable energy markets and status. The concepts of marketing and sales (consumer behaviors, managing sales, marketing plans, business negotiations) and how to use them in marketing and selling renewable energy technologies.

### **RE515 Photochemistry**

Photochemistry principles. Application of photochemistry reactions to organic synthesis. Heterogeneous photocatalysis.