Master of Science Program (M.Sc.)
in Renewable Energy Engineering in Qassim University

Introduction:

The world is facing the reality that the global energy demand is increasing significantly over the coming years. Energy demand is projected to increase by more than 30 percent in the coming 25 years. A large proportion of the world's population has denied access to modern energy services. The use of renewable energy sources will not only provide access, but also help in creating economic and job opportunities. It will improve environment, enhance energy security, support sustainable development, and aid in achieving the other Millennium Development Goals (MDGs).

The Kingdom of Saudi Arabia, is blessed with high level of solar radiation all over the year beside the abundant wind, biomass and geothermal resources. Solar energy is considered to be one of the most important means of producing and generating both thermal and electrical energy. Renewable energy encompasses many different types of technologies at different stages of development and commercialization, from photovoltaic for electricity generation to wind-generated electricity to processes such as biomass gasification for electricity generation and geothermal energy treatment. Renewable energy field is rarely covered in the syllabus of the universities at undergraduate and graduate levels. So, it is very crucial to fill the knowledge gap in this field.

The great development plans of the kingdom necessitated the recognition of the advanced renewable technologies, and increasing their applications to substitute the conventional energy sources. Qassim University established an expert panel to design a proposal for Master of Science in the renewable energy engineering field. The program will help in exploring and identifying the most important renewable energy resources, environment protection and the appropriate technologies for use in various types of energy systems. It allows engineers and scientists to make informed decisions on the suitability of renewable energy sources to meet demand for electricity, and acquaints the participants an insight into design principles and operation on specific renewable energy systems.

This master degree accepts who hold a bachelor degree in mechanical and electrical engineering disciplines from Saudi universities or equivalent universities. The program includes courses and thesis. The total number of required credit hours is 30; 24 credit hours for courses and 6 credit hours for the thesis.

Vision:

A locally and regionally distinguished academic program in renewable energy engineering education and research that supports the sustainable development in the Kingdom.

Mission:

Renewable Energy Engineering Program seeks to offer accredited developed graduate studies to satisfy the needs of the kingdom, and to provide research services which support the sustainable development in the Kingdom and contribute to the knowledge economy.

Objectives of the program:

1 - Preparing graduates to effectively support the sustainable development and contribute to establishing the knowledge economy in the Kingdom.
2- Preparing graduates to have a successful career in universities, research centers and energy production companies.
3- Preparing graduates to effectively participate in the development and operation of renewable energy plants.
4- Encouraging graduates to develop their professional performance through self learning and graduate studies.

Degree Name:

Master of Science in Renewable Energy Engineering

Admission requirements:

1- The program may accept the following Applicants:
   a- Applicants who have a bachelor degree of science in Electrical Engineering ort Mechanical Engineering with overall GPA (3.25 out of 5.00) or equivalent from any recognized academic institution .
   b- Applicants who have a bachelor degree in applied engineering in Electrical Engineering or Mechanical Engineering with overall GPA (3.75 out of 5.00) or equivalent from any recognized academic institution .
2- Passing a written test in engineering fundamentals.
3- Passing the English language test (TOEFL) with score of 475 in the paper-based system or any equivalent.
4- Supplementary courses might be required for applicants with deficiencies.

Degree requirements:

1. Successful completion of 24 credit hours of graduate courses distributed as follows:
a) 12 credit hours: 4 compulsory courses.
b) 12 credit hours: 4 courses are selected from elective courses. Selection is under the supervision of the program academic supervisor.
2. Successful completion of a thesis (6-credit hours).

Program Structure:

The program is conducted in four semesters, where the semester lasts for 15 weeks besides a thesis as partial fulfillment. The academic load is based on the credit hours system. Language of instruction is English.

List of Courses for the Renewable Energy Program:

	Course code	Course Title	Units		
			Th.	Pr.	Credits
	A- Compulsory Courses: (12 credit hours = 4 Courses)				
1	*Math 621*	*Engineering Mathematics*	3	0	3
2	*GE 605*	*Modeling and simulation of engineering systems*	3	0	3
3	*GE 608*	*Experimental Methods and Analysis.*	3	0	3
4	*REE 611*	*Introduction to renewable energy Engineering*	2	2	3
	B- Elective Courses: 12 credit hours = 4 Courses (should be selected from the following list)				
1	REE 621	*Solar Thermal Energy Applications*	3	0	3
2	REE 622	*Concentrated Solar Energy Plants*	3	0	3
3	REE 630	*Energy Conversion*	3	0	3
4	REE 631	*Energy Storage systems*	3	0	3
5	REE 633	*Energy and Environment*	3	0	3
6	REE 635	*Energy efficiency*	3	0	3
7	REE 640	*Biomass Energy*	3	0	3
8	REE 650	*Wind Energy*	3	0	3
9	REE 660	*Photovoltaic Energy Systems*	3	0	3
10	REE 665	*Electrical Systems Related to Renewable Energy*	3	0	3
11	REE 680	*Geothermal energy*	3	0	3
12	REE 680	*Renewable Energy Economics and Planning*	3	0	3

	Course code	Course Title	Units		
			Th.	Pr.	Credits
13	REE 690	*Selected topics in renewable energy*	3	0	3
	C- Thesis *REE 699 Thesis*		6	0	6
	Total				

Program Schedule:

First Semester:

Course Code	Course Title	Credits
Math 621	*Engineering Mathematics*	3
GE 605	*Modeling and Simulation of Engineering Systems*	3
REE 611	*Introduction to renewable energy*	3
Total		**9**

Second Semester:

Course Code	Course Title	Credits
From the elective course list	*1st Elective course*	3
From the elective course list	*2nd Elective course*	3
From the elective course list	*3rd Elective course*	3
Total		**9**

Third Semester:

Course Code	Course Title	Credits
From the elective course list	*4th Elective course*	3
GE 608	*Experimental Methods and Analysis*	3
REE 699	*Thesis*	6
Total		**12**

Fourth Semester:

Course Code	Course Title	Credits
REE 699	*Thesis* (continue).	6
Total		**6**
Total Hours of the Program		**30**

Courses Description:

A-Compulsory Courses:

1- Modeling and Simulation of Engineering Systems, GE 605

Importance of modeling and simulation, Continuous and discrete models, The model components, descriptive variables and interaction rules , The concept of model state, Experimental frames and simplified models, Classification of dynamic systems, random numbers generators, Monte Carlo simulation ,Object- and agent-oriented simulation, Signal Flow Graphs, Bond graphs, System Dynamics and System thinking.

2- Experimental Methods and Analysis, GE 608

Part I: Design of Experiments: Introduction to industrial experimentation, Fundaments of design of experiments, Understanding key interactions, Mean effect plots, Interaction plots, Full factorial design, Partial factorial design, Error and variance.

Part II: Statistical techniques: Basic statistical measurements and their application in Engineering, Statistical analysis of data. P-value plots, α-plots. Probability distributions, sampling distributions, estimation and confidence intervals for parameters of statistical distributions, hypothesis testing, design and analysis of variance for estimation and confidence intervals for parameters of non-statistical models. Single and multiple-factor experiments, regression analysis. Part III: Use of Commercial Software for Analysis of Experiments (LabView & MiniTab) in Design of Experiments and Statistical Techniques.

3- Advanced Mathematics, MATH 621

Fourier analysis, Partial Differential Equations, Complex Analysis, Complex Integration, Power and Taylor Series, Conformal Mapping, Potential Theory

4- Introduction to Renewable Energy Engineering, REE 611

Introduction meteorology, the sun as a radiation source, solar geometry, interaction of solar energy with atmosphere, measurement and prediction of solar irradiance, spectrum, global distribution, seasonal variation, tilt angle effects, modeling, origin of the atmospheric motion, fundamental forces, balances of the horizontal wind field, wind climatology, wind flow in the atmospheric boundary layer, resource assessment, temperature, pressure and humidity, measuring devices, dust problems.

B-Elective Courses:

1- Solar Thermal Energy Applications, REE 621

Solar radiation, its measurement and precision, solar collectors, Solar thermal heating, components of solar thermal plants, solar swimming pools, Solar thermal cooling and solar thermal air conditioning, absorption cycles, other thermally driven cooling systems, desalination, cooking, examples of installed systems, simulation tools for solar thermal systems, monitoring and optimization, standards and norms.

2- Concentrated Solar Energy Plants, REE 622

Concentrated Solar Plants (CSP) collectors, line and point focusing collectors, concentrators, tracking mechanisms, general energy balance and explanation of different terms, evaluation of thermal losses, storage effect, transient effect, analysis of specific types of reflective concentrators, parabolic trough, Fresnel concentrators, temperature distributions, performance indices, central-tower receiver, economical and environmental impacts, assessment of CSP potentials, quantify renewable electricity potentials.

3- Energy Conversion REE, 630

Energy classification, Solid, liquid and gaseous fuels, sources, utilization, energy conversion to thermal, electrical, and mechanical energies, applications, economics, impacts, fuel cells fundamentals, technologies and applications of fuel cells.

4- Energy Storage systems, REE 631

Types of energy storage systems, sensible and latent heat storage, some areas of application of energy storage, description of thermal storage system for short and long time, storage materials, power to gas, batteries, hydro power and air storages, efficiency of the conversion, costs for different technologies, calculation of capacity and costs of energy storage system.

5- Energy and Environment, REE 633

Earth energy systems, ecological principles, environmental impact assessment, and consequences of energy use and production, air pollution, water use and pollution, natural

disasters, sea level rise, migration, land use change and climate change, global warming, political framework, risk management, ISO and national norms, sustainability.

6- Energy Efficiency, REE 635

Energy management systems, energy auditing procedure, energy conservation technologies, energy balance and analysis of thermal systems, power factor correction, heat pumps, cogeneration, thermal insulation, air conditioning and ventilation, combustion control steam systems, high efficiency motors and generators, high efficiency lighting, moisture problem and solutions, passive and green home, energy efficiency in transport-services-commercial sectors, energy codes, standards and norms.

7- Biomass Energy REE 640,

Formation of biomass, resources and classification, chemical and physical characteristics of biomass, energy generation from wastes, biomass conversion processes, hydrogen energy, bio fuels, emissions in the burning process, utilization of the specific characteristics of bio energy systems with other renewable energies, applications.

8- Wind Energy, REE 650

History of Wind Power, Wind Characteristics and Resources, Aerodynamics of Wind Turbines, Dynamics of wind turbines, Electrical Aspects of Wind Turbines, Wind Turbine Materials and Components, Wind Turbine Design and Testing, Wind Turbine Control, Wind Turbine Siting, System Design, and Integration, Wind Energy System Economics, Environmental Aspects and Impacts

9- Photovoltaic Energy Systems, REE 660

The Photo-voltaic and Hybrid Electrical systems course will provide students with the fundamentals of PV and Hybrid systems, charge controllers, inverters, system sizing, mechanical and electrical integration, hybrid systems configurations and components performance, applications, cabling, protection, utility interconnection, permitting, commissioning, maintenance, troubleshooting and economic analysis of PV and Hybrid systems.

10- Electrical Systems Related to Renewable Energy, REE 665

Asynchronous generator construction, Operational ranges of asynchronous machines, Modeling and simulation, Design aspects. Synchronous generator construction, Operational ranges of synchronous machines, Modeling and simulation, Design aspects. Power electronics converters for renewable energy: Soft starters switched capacitor banks, Rectifier, Inverters, AC voltage controller. Transfer of electrical energy to power grid: Power conditioning, Grid protection, Resonance effects, Remedial measures, Grid control.

11- Geothermal Energy, REE 670

high and low temperature geothermal areas, utilization of geothermal around the world, geological-, geophysical- and geochemical methods in assessing well testing, drilling technology, design of well heads and well equipment, two-phase flow in vertical and horizontal pipes, steam separators and safety equipment, pipe lines control, corrosion and sealing problems in geothermal systems, design of geothermal utilization systems, direct and indirect heat exchangers multi-purpose use of geothermal energy, ground heat pump, environmental aspect and impacts of geothermal utilization.

12- Renewable energy economic and planning, REE 680

This course provides an overview of the entire renewable energy sphere, while still functioning as a go-to information source for students when they need answers about a specific technical issue. This course is structured around three parts in order to assist students in focusing on the issues that impact them the most for a given project or question. PART I covers the basic scientific principles behind all major renewable energy resources and its financial issues, such as solar, wind and biomass. PART II provides in-depth information about how these raw renewable sources can actually be converted into useful forms, transmitted into the grid and stored for future utilization. Finally, PART III undertakes the aspects of energy planning, environmental impacts and socio-economic issues on regional and global levels.

13- Selected topics in renewable energy, REE 690

Developing the knowledge of the students in selected advanced and up-to-date topics that are not covered in other courses.

C- Thesis , REE 699

The master thesis covers a research which is preferably done in conjunction with companies or institutions dealing with renewable energy utilization, energy efficiency, energy economics, environment aspects or other related topics.

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