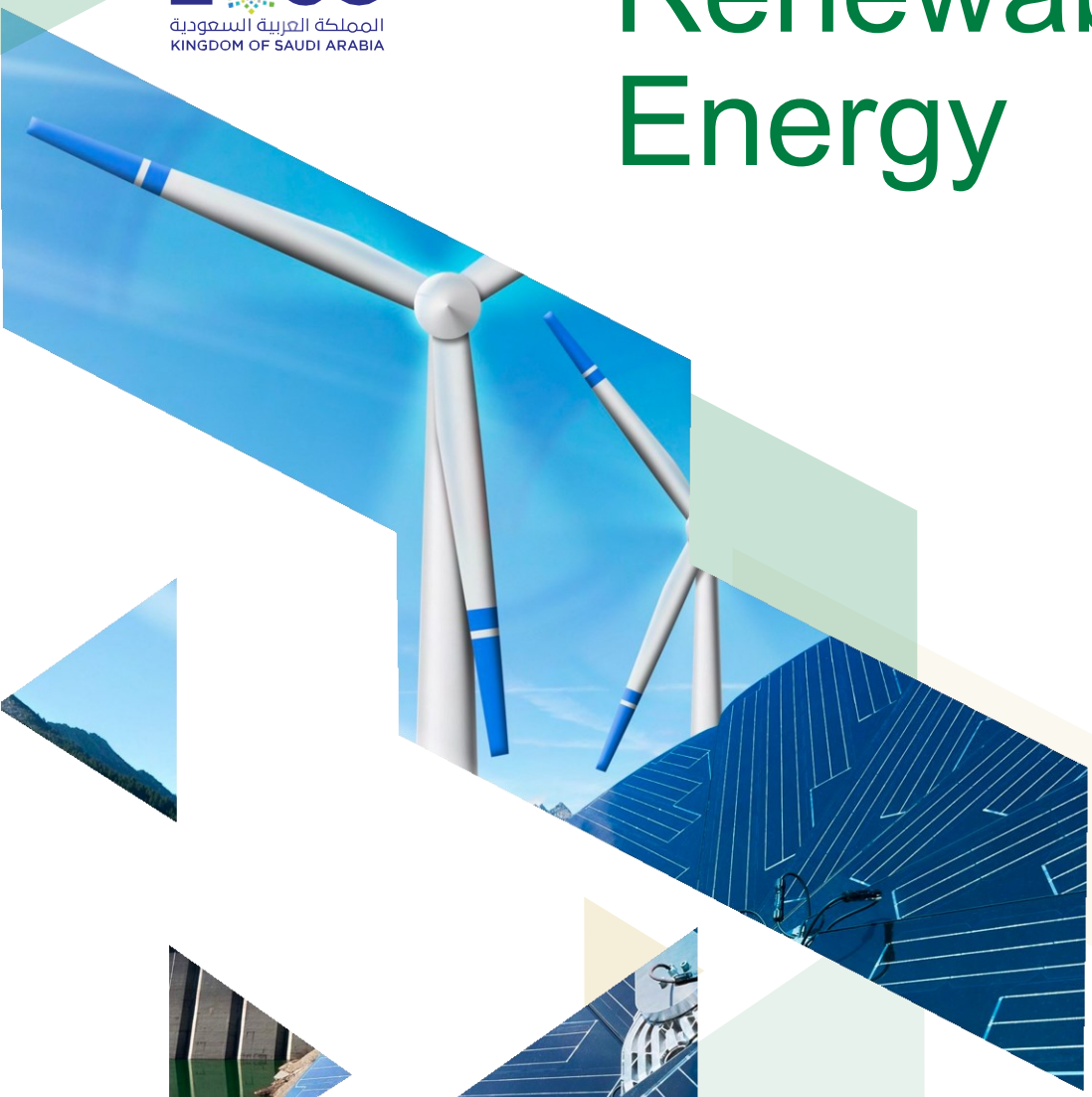
KFUPM

VISION رؤية 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

MASTER OF ENGINEERING

Sustainable and Renewable Energy



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The electric energy sector in Saudi Arabia is experiencing record growth in demand requiring significant investments throughout the full supply chain. A great opportunity exists to significantly influence the sector growth plans through embedding the principles of sustainability as a national strategic necessity. Such influence requires professionals and leaders with the skills necessary to model the support systems of policy makers, business developers and technical experts.

Program Description

The Master of Engineering Program in Sustainable and Renewable Energy builds on the success of KFUPM's undergraduate education with its emphasis on research and study of advanced and specialized subjects. The general objective of the program is to prepare professionals and leaders with the skills required to address the challenges of transforming the Kingdom's electric energy sector into a highly efficient, reliable entity. The program graduates will have acquired state-of-art knowledge, critical thinking, and problem-solving skills to address the technical, economic and environmental issues in the design of renewable and sustainable energy systems. Moreover, the graduates will have attained the methodical attributes to operate, control, evaluate, and manage the renewable and sustainable energy systems of the future. Hence, they will advance and lead the Kingdom's renewable and sustainable electric energy sector into a highly efficient, reliable entity.

The general objective of the program is to prepare professionals and leaders with the knowledge, skills, and competence required to address the challenges of transforming the Kingdom's electric energy sector into a highly efficient, sustainable and reliable entity. The specific objectives are:

- The graduates will have acquired state-of-art knowledge, critical thinking, and problem-solving skills to address the technical, economic and environmental issues in the design of renewable and sustainable energy systems.
- The graduates will have acquired state-of-art knowledge, critical thinking, and problem-solving skills to address the technical, economic and environmental issues in the design of renewable and sustainable energy systems.
- The graduates will have attained the methodical attributes to operate, control, evaluate, and manage the renewable and sustainable energy systems of the future.
- The graduates will advance and lead the Kingdom's renewable and sustainable electric energy sector into a highly efficient, reliable entity.

Duration, Timeline, and Delivery Format

KFUPM understands that many engineers would enroll on this program on a part-time basis and would only be able to attend lectures during after-hours sessions. Consequently, the duration of the program and delivery format are influenced by this.

- The program will be delivered during the weekends (Fridays and Saturdays).
- Each cohort will have twenty-four months to complete all courses, including the project.
- Each course would be covered over 45 contact hours.
- The courses are taught by faculty from various departments and by invited speakers from industry and academia.
- The program starts annually in the Fall semester only.

Degree Plan

Conferment of a Master of Engineering in "Sustainable and Renewable Energy" requires successful completion of 30 credit hours of graduate level courses and a written graduation project. The project will be directed by industrial and academic advisors. The degree plan spans four semesters over a period of 24 months.

IN SUMMARY, THE COURSE WORK IS DISTRIBUTED AS FOLLOWS:

- 18 credit hours of core courses
- 9 credit hours of technical elective courses
- 3 credit hours for Project (SEN 600)

CORE COURSES:

- Electric Energy Systems
- Sustainable and Renewable Energy Systems
- Advanced Energy Conversion
- Renewable Energy Integration
- Solar Photovoltaic Systems
- Energy Economics, Policies, and Regulations

ELECTIVE COURSES:

- Electricity Markets
- Nuclear Engineering
- Solar Thermal Energy
- Wind Energy Engineering
- Smart Grids
- Energy Efficiency
- Energy Storage
- Sustainable Buildings and Cities
- Energy Project Management & Leadership
- Special Topics in Sustainable and Renewable Energy

Time Table

1ST TERM

- SEN 540: Electric Energy Systems
- SEN 541: Sustainable and Renewable Energy Systems
- SEN 542: Advanced Energy Conversion

2ND TERM

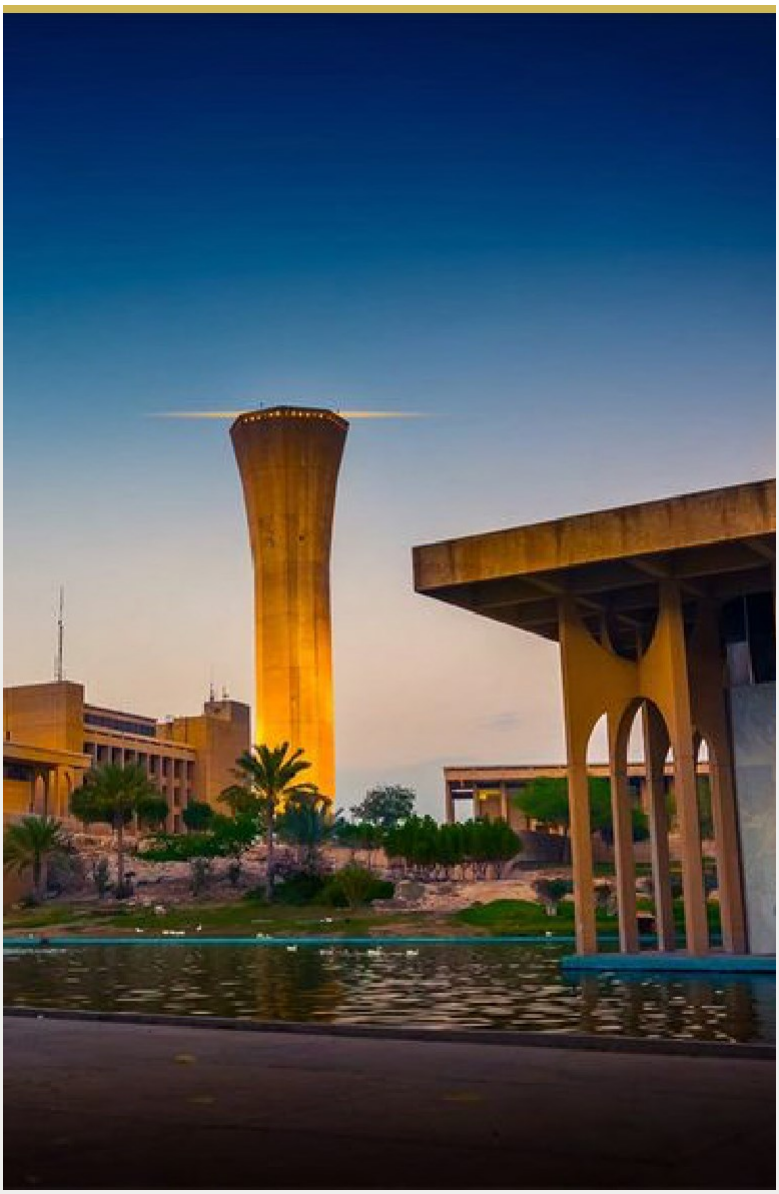
- SEN 543: Renewable Energy Integration
- SEN 544: Solar Photovoltaic Systems
- SEN 545: Energy Economics, Policies, and Regulations

3RD TERM

- Elective 1
- Elective 2

4TH TERM

- Elective 3
- Graduation Project



Program Schedule and Fees

PROGRAM START

September of each year

DURATION

2 Years

LANGUAGE

English

TUITION FEES

SAR 90,000 + VAT
(SAR 45,000 + VAT / Year)

LOCATION

Dhahran

Admission Requirements

To apply to the program, candidates must have a bachelor's degree in engineering from a recognized institution with a high academic reputation. The minimum requirements for possible admission are as below:

- The program is open for males and females
- A Bachelor (B.Sc.) Degree in engineering from a recognized institution
- A Grade-Point Average (GPA) of 2.5 or higher on a scale of 4.00 or equivalent. Official transcripts and degree certificates are required for final admission
- Completion of TOEFL with a minimum score of 520 (PBT), 190 (CBT) or 68 (IBT). IELTS is also acceptable (minimum band-6.0)
- At least two letters of recommendation, where one letter can be from industry
- Passing an admission interview

Note

- Satisfying the minimum admission requirements does not guarantee admission into the program, as the final admission is subject to an evaluation of the entire application, and the admission interview.

- Based on the assessment of the applicant file and the admission interview, the admission committee might offer conditional acceptance for students who need to take deficiency courses.

Mandatory documents for application (without which the application will not be processed):

1. Application Form
2. Copy of identification (National ID for Saudi nationals / Passport for international applicants/ Iqama for residents of Saudi Arabia)
3. Complete official transcripts for B.Sc. degree
4. Statement-of-Purpose (a one-page essay focusing on career and research goals)
5. Two Recommendation Letters
6. Proof of English proficiency
7. CV

For more information, please contact:

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Courses Description

SEN 540: Electric Energy Systems (3-0-3)

Fundamentals of power systems. Power grid in KSA. Electricity markets. Quality and reliability of power systems. Modeling of power grids components. Basics of optimization and computational techniques. Per-unit analysis. Load flow analysis.

Fault studies. Transient stability analysis. Operation and planning of power systems. Frequency regulation and automatic generation control. Security and contingency analysis. Power system monitoring and state estimation.

Prerequisite:
- Graduate Standing

SEN 541: Sustainable and Renewable Energy Systems (3-0-3)

Fundamentals of Sustainable and Renewable Energy Systems. Energy outlook and the environment. Global warming and fossil fuels. Solar energy systems. Wind energy systems. AC-DC converters. Batteries and charge controllers. Techno-economic analysis of sustainable and renewable energy systems.

Prerequisite:
- Graduate Standing

SEN 542: Advanced Energy Conversion (3-0-3)

Fundamentals of thermodynamics as applied to energy conversion systems. Conventional and renewable sources of energy. Analysis of conventional and renewable technologies for generating electricity with emphasis on performance and environmental impact. Renewable electrical power generation will include concentrated solar power generation, photovoltaic and geothermal energy. Basic principles of fuel cells and carbon capture. Different forms of energy storage, optimal source utilization and life cycle analysis.

Prerequisite:
- Graduate Standing

SEN 543: Renewable Energy Integration (3-0-3)

Modeling of renewable sources. Characteristics of renewable generation. Power system analysis of bulk power grids with integrated renewable sources. Operational challenges with high renewable penetrations. Mathematical models of power system planning considering renewable resources. Uncertainties representation of renewable resources. The impact of inverter based generation on bulk power system dynamics and short-circuit performance. Integration impact of renewable power plants in the generation and transmission expansion planning.

Prerequisite:
- SEN 540: Electric Energy Systems,
- SEN 541: Sustainable and Renewable Energy Systems

SEN 544: Solar Photovoltaic Systems (3-0-3)

Photovoltaic system characteristics. Modelling and prediction of PV module energy yield. Building-integrated photovoltaics. Stand-alone photovoltaic systems. System design and operation of large-scale photovoltaic power plants. Environmental impact of PV systems.

Prerequisite:
- SEN 541: Sustainable and Renewable Energy Systems

SEN 545: Energy Economics, Policies, and Regulations (3-0-3)

Fundamentals of microeconomics. Energy demand, supply, markets, and public policies affecting energy markets. Aspects related to oil and natural gas, electricity, nuclear power, and renewable sectors. Energy regulation and taxing, energy efficiency, and policies for emission control. Subsidies and tariffs.

Prerequisite:
- Graduate Standing

SEN 550:
Electricity Markets (3-0-3)

Principles, structure, and design of deregulated electricity markets. Perfect and imperfect competition. Strategies for conventional and renewable participants in electricity markets. Network considerations, transmission congestion, locational marginal prices, and ancillary services. Market regulations and policies for sustainable electricity supply. Generation and transmission planning in a deregulated market environment.

Prerequisite:
- Graduate Standing

SEN 551:
Nuclear Engineering (3-0-3)

Reactor physics and technology. Nuclear power plant theory. Design principles. Thermal hydraulics. Nuclear fuel cycle. Integration of nuclear energy into energy systems. Operation and control. Safety and reliability. Nuclear power plant equipment and performance. Economics and environmental issues. Nuclear fuel management. Nuclear techniques in medicine and industry, and advanced topics in nuclear engineering.

Prerequisite:
- SEN 542: Advanced Energy Conversion

SEN 552:
Solar Thermal Energy (3-0-3)

Design consideration of various concentrating collectors for thermal and photovoltaic applications. Solar thermal/electric power conservation. Solar thermal energy storage. Solar thermal design methods: chart utilizability. Solar space conditioning design and computer simulation models such as TRNSYS. Economic considerations. Solar desalination and other applications. Design projects in selected areas.

Prerequisite:
- SEN 541: Sustainable and Renewable Energy Systems,
- SEN 542: Advanced Energy Conversion

SEN 553:
Wind Energy Engineering (3-0-3)

Introduction of meteorological aspects. Basic meteorological measurements. Characteristics of wind parameters. Wind power resource assessment. Wind turbines technology and power. Mechanical aspects. Control and protection. Wind turbine generator models. Integrated wind power aspects.

Prerequisite:
- SEN 541: Sustainable and Renewable Energy Systems

SEN 554:
Smart Grids (3-0-3)

Fundamentals of smart grids including definitions, technology, architecture and design criteria. Distributed generation systems. Smart grid technologies and its applications. Operation and planning of future power distribution networks. Smart metering. Demand side management. Distribution automation equipment. Electric vehicles. Main components of a microgrid. Grid connected and islanded modes of microgrids. DC and AC microgrids. Structure of microgrids. Centralized and decentralized microgrid controllers.

Prerequisite:
- Graduate Standing

SEN 555:
Energy efficiency (3-0-3)

Fundamental energy concepts. Load characterization. Utility rates and potential identification of efficiency enhancement. Scientific background of lighting. Heating and air-condition systems. Energy conservation codes. Standards and constraints. Investigating the economic, regulatory and infrastructure factors. Energy management strategies. Design techniques to minimize energy consumption of building architectural, mechanical and electrical systems.

Prerequisite:
- Graduate Standing

SEN 556:
Energy Storage
(3-0-3)

Renewable power integration issues. Need for energy storage. Principles and technologies. Energy storage systems. Distributed storage. Modeling and control of battery energy storage systems. Super capacitors. Fuel cells. Flywheels. Pumped hydroelectric storage. Hybrid energy storage systems. Power control and management. Storage sizing methodologies. Degradation and losses. Optimal operation and performance indices. Storage for electric vehicles and applications of energy storage. Cost analysis. Future of energy storage.

Prerequisite:
- Graduate Standing

SEN 557:
Sustainable Buildings and Cities
(3-0-3)

Ecologically sustainable strategy, designing for sustainable buildings and cities, regulatory environment, green building rating, material selection, indoor environmental quality (air, light, and noise), water treatment & efficiency systems, ventilation systems, building economics, and staff productivity. Transportation planning processes, use of optimization techniques in transportation. Water Resources and Environmental Engineering. Evaluation of wastewater treatment plants. Applications of system engineering techniques to water and environmental problems.

Prerequisite:
- Graduate Standing

SEN 558:
Energy Project Management & Leadership (3-0-3)

Fundamentals of project management. Technical, economic, and policy considerations related to achieving a profitable reduction in fossil fuels. Specific characteristics of energy projects from planning point of view. Energy conservation. Energy data collection, recording, processing and analysis. Statistical analysis.

Building the project framework. Components of the project plan. Project scope statement and its importance. Utilizing the Work Breakdown Structure and the project schedule. Components of schedule development. Energy management and audit. Risk management techniques. Stakeholders, their roles and responsibilities. Effective project leaders. Computer applications as tools in energy management.

Prerequisite:
- Graduate Standing

SEN 590:
Special Topics in Sustainable and Renewable Energy

The contents of this course will be in one of the areas of renewable and sustainable energy systems. The specific contents of the special topics course will be given in detail at least one semester in advance of that in which it is offered.

Prerequisite:
- Consent of the Instructor

SEN 554:
Smart Grids (3-0-3)

Fundamentals of smart grids including definitions, technology, architecture and design criteria. Distributed generation systems. Smart grid technologies and its applications. Operation and planning of future power distribution networks. Smart metering. Demand side management. Distribution automation equipment. Electric vehicles. Main components of a microgrid. Grid connected and islanded modes of microgrids. DC and AC microgrids. Structure of microgrids. Centralized and decentralized microgrid controllers.

Prerequisite:
- Graduate Standing

SEN 555:
Energy efficiency
(3-0-3)

Fundamental energy concepts. Load characterization. Utility rates and potential identification of efficiency enhancement. Scientific background of lighting. Heating and air-condition systems. Energy conservation codes. Standards and constraints. Investigating the economic, regulatory and infrastructure factors. Energy management strategies. Design techniques to minimize energy consumption of building architectural, mechanical and electrical systems.

Prerequisite:
- Graduate Standing

SEN 591:
Special Topics in Sustainable and Renewable Energy

The contents of this course will be in one of the areas of renewable and sustainable energy systems. The specific contents of the special topics course will be given in detail at least one semester in advance of that in which it is offered.

Prerequisite:
- Consent of the Instructor

SEN 600:
Sustainable and Renewable Energy Project (0-0-3)

This course gives the students an opportunity to complete a project related to the sustainable and renewable engineering program. Apply knowledge gained during the previous semesters and practice a variety of skills such as researching for technical information, organization, planning, looking up sources, designing and testing, and delivering oral and written presentations. Graded on a pass or fail basis.

Prerequisite:
- Graduate Standing.
- Only open to the Master of Engineering in Sustainable Energy students.

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