ABDULLAH AL SALEM UNIVERSITY (AASU)

Graduate Academic Programs

Energy Systems Engineering

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General Introduction

Abdullah Al-Salem University (AASU) proudly offers Master's programs that align closely with Kuwait's Vision 2035, across three distinguished colleges: the College of Engineering and Energy, the College of Computing & Systems, and the College of Business and Entrepreneurship. Rooted in a tradition of academic excellence and driven by a commitment to innovation, these programs are designed to equip students with the knowledge, skills, and experience needed to excel in their chosen fields.

In the College of Engineering and Energy, students engage in rigorous coursework and groundbreaking research, guided by esteemed faculty members who are experts in their respective disciplines. With access to state-of-the-art laboratories and research facilities, students have the opportunity to explore emerging technologies and tackle complex engineering challenges. From renewable energy to sustainable infrastructure, graduates emerge prepared to lead the way in shaping the future of engineering and energy solutions.

Meanwhile, in the College of Computing & Systems, Abdullah Al-Salem University empowers students to thrive in the digital age. Through a blend of theoretical instruction and hands-on practice, students delve into the latest advancements in computer science, artificial intelligence, and information systems. With access to cutting-edge computing facilities and research centers, students collaborate with faculty members on innovative research projects and gain valuable industry insights. Graduates emerge with the skills and expertise to drive technological innovation and address the complex challenges of our interconnected world.

In the College of Business and Entrepreneurship, Abdullah Al-Salem University fosters a culture of creativity, innovation, and enterprise. Our Master's programs provide students with a comprehensive understanding of business principles, coupled with practical experience and real-world application. Through internships, case studies, and entrepreneurial projects, students develop the skills needed to thrive in a competitive business environment. With access to cutting-edge research centers and entrepreneurial incubators, graduates emerge as agile thinkers and visionary leaders, prepared to make a lasting impact in the global marketplace.

The Vision

AASU shall be an institution of choice that will contribute to the socio-economic development of Kuwait by promoting innovation in education, world-class research, creativity, and entrepreneurship.

The Mission

To establish strong and balanced academic programs, research, and outreach programs, that contribute to the development and advancement of Kuwait and the region.

Programs' Development

AASU has meticulously crafted its academic programs in accordance with the comprehensive framework portrayed by Kuwait Vision 2035. These programs are tailored to meet the dynamic demands of the contemporary job market, informed by extensive research conducted by prominent institutions such as the Supreme Council for Planning and Development (SCPD), the Kuwait Foundation for the Advancement of Sciences (KFAS), and the World Bank. Moreover, the university has conducted thorough analyses of requisite skill sets for the workforce, drawing insights from research conducted by the Kuwait Institute for Scientific Research (KISR) and consultations with key stakeholders from both the public and private sectors.

The curriculum of AASU's programs is enriched by a diverse range of specializations, fostering a multidisciplinary approach that aligns with Kuwait's broader educational objectives. Furthermore, the university is committed to enhancing its regional and global presence within academic circles. Through these concerted efforts, Abdullah Al-Salem University ensures that its programs are not only forward-thinking but also responsive to the evolving needs of the modern world.

Graduate Attributes

AASU is dedicated to cultivating the following set of attributes that empower graduates to excel in their academic pursuits and thrive in their professional endeavors:

- Job-ready professionals who can quickly contribute to their workplace by applying acquired core concepts and skills to relevant job fields.
- Creative thinkers and problem solvers who can use their intellectual curiosity and critical thinking to find sustainable solutions to complex, real-life problems.
- Effective collaborators who can communicate professionally, adapt, debate, and act as team players.
- Entrepreneurial individuals who can identify an opportunity and transform concepts into reality.
- Responsible global citizens and lifelong learners who can act in a manner that promotes professionalism, ethical behavior, accountability, and social responsibility, and engage in a self-motivated pursuit of knowledge for either personal fulfillment or professional growth.

College of Engineering & Energy Programs

Graduating with a Master of Science (M.Sc.) in the following programs necessitates the successful completion of a total of 33 credit hours (CH). These credit hours are distributed across college, and program requirements, encompassing courses that are essential as well as those that can be chosen based on stream preference.

The 33 credit hours are distributed as follows:

- 6 CHs: College requirements (Table 1).
- 9 CHs: Thesis work (Table 2).
- 9 CHs: Program requirements (Table 3).
- 9 CHs: Program electives (Table 4).

* Thesis defense must be passed before graduation according to working regulations.

* Based on the qualifications of the admitted applicants, additional coursework might be suggested in addition to the program requirements if deemed necessary by the program scientific committee.

Table 1 shows the list of university course requirements for the graduate programs at AASU:

Table 1: College Requirement course work (6 CHs).

Course Code	Course Title	Credit hours	Contact hours	Pre-requisite	Co-requisite
ENG501	Advanced Mathematics and Statistics for Engineers	(3 credits)	3		
ENG502	Systems Modeling, Simulation, and Optimization	(3 credits)	3		
ENG503	Research Seminar	(0 credits)	1		

Table 2 below shows the list of the thesis requirements for the graduate programs at AASU:

Table 2: Thesis requirements for Graduate Programs at AASU (9 CHs).

Course Code	Course Title	Credit hours	Contact hours	Pre-requisite	Co-requisite
ESE697	Thesis Proposal	(3 credits)	Not specified	Completion of at least 6 credits with a GPA of 2.67 or higher.	ENG503
ESE698	Thesis Continuation	(0 credits)	Not specified	ESE697	
ESE699	Thesis	(6 credits)	Not specified	ESE697 OR ESE698	

Energy Systems Engineering

Program Overview

The Master in Energy Systems Engineering program at AASU is an advanced graduate program tailored to equip students with the expertise needed to tackle the complex challenges of the global energy sector. This interdisciplinary program blends principles from various engineering fields, environmental science, and policy to provide a comprehensive understanding of energy systems, sustainability, and the shift toward renewable energy sources. Through a mix of rigorous coursework, hands-on projects, and research opportunities, students engage with cutting-edge technologies and industry practices, preparing them to lead in the field of energy engineering.

Program Objectives

a. Develop advanced technical skills in energy systems analysis, design, optimization, and management across various energy sources and distribution systems.
b. Foster interdisciplinary understanding by integrating knowledge from engineering, environmental science, economics, and policy to address complex energy challenges comprehensively.
c. Cultivate research skills and promote innovative thinking to drive technological advancements, energy efficiency improvements, and sustainable practices within the energy sector.
d. Promote sustainability principles and environmental awareness, emphasizing the importance of mitigating carbon emissions and promoting renewable energy sources.
e. Develop leadership and communication skills to collaborate effectively with diverse stakeholders toward achieving energy sustainability goals.
f. Instill ethical responsibility and social awareness, encouraging graduates to consider the societal implications of energy-related decisions and prioritize equitable access to clean energy.
g. Foster a commitment to lifelong learning and professional development to adapt to emerging technologies and regulatory changes in the dynamic field of energy engineering.

Program Requirements

Table 3 below shows the list of Program course requirements for the Master's in Energy Systems Engineering program at AASU:

Table 3: Program requirement coursework (9 CHs).

Course Code	Course Title	Credit hours	Contact hours	Pre-requisite	Co-requisite
ESE501	Foundations of Power and Energy Systems	(3 credits)	3		
ESE502	Alternative Energy Systems	(3 credits)	3		
ESE503	Energy Resources, Policy, and Economics	(3 credits)	3		

With pre-approval from their advisors, students are required to select a minimum of 9 credits from the program's coursework, as outlined in Table 4. Additionally, they have the option (with the advisor's pre-approval) to take up to 6 credits from other programs within the university to fulfill graduation requirements.

Table 4: Program Electives Coursework for the Master's in Energy Systems Engineering Program at AASU (9 CHs).

Course Code	Course Title	Credit hours	Contact hours	Pre-requisite	Co-requisite
ESE504	Energy Generation, Transmission, and Distribution	(3 credits)	3	ESE501 ESE502	
ESE505	Environmental Life Cycle Assessment for Energy Systems	(3 credits)	3	ESE501 ESE502 ESE503	
ESE506	Energy in Buildings	(3 credits)	3	ESE501 ESE502	
ESE508	Hydrogen Technologies	(3 credits)	3	ESE501 ESE502	
ESE601	Advanced Topics in Energy Storage	(3 credits)	3		
ESE604	Advanced Electric Drives	(3 credits)	3		
ESE606	Energy Efficiency	(3 credits)	3		
ESE607	Devices and Materials for Energy Systems	(3 credits)	3		
ESE608	Advanced Topics in Energy Systems Engineering	(3 credits)	3	Supervisor Approval	
ESE609	Nuclear Energy	(3 credits)	3	ESE501 ESE502	
ESE610	Smart Grids and Electrical Energy Conversion	(3 credits)	3	ENG501 ESE502 ESE505	
ESE611	Advanced Solar Energy Systems	(3 credits)	3	ESE501 ENG502	
ESE612	Advanced Power Plant Engineering	(3 credits)	3	ESE501 ESE502	

Course Descriptions

College of Engineering & Energy

Course Code: ENG 501
Course Title: Advanced Mathematics and Statistics for Engineers
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course provides graduate engineers with mastery over advanced mathematical and statistical techniques fundamental to modern engineering practice and research. It builds the theoretical and practical foundation needed to tackle complex system analysis, simulation, and data interpretation challenges. Key topics include: advanced linear algebra (vector spaces, eigenvalues/vectors) for large system representation; ordinary and partial differential equations for modeling dynamic and distributed systems; numerical methods for computational solutions; probability and statistical inference for quantifying uncertainty and testing hypotheses; regression analysis for empirical modeling; and design of experiments for efficient investigation.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ENG 502
Course Title: Systems Modeling, Simulation and Optimization
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course provides an in-depth exploration of modeling, simulation, and optimization techniques applied to complex systems across various fields. Students will learn to develop and analyze models to simulate real-world processes, optimizing system performance using mathematical and computational methods. Emphasis will be placed on formulating models, selecting appropriate simulation methods, and implementing optimization techniques. Practical examples will be conducted using Python or MATLAB, equipping students with hands-on experience in applying these tools to real-world challenges. By the end of the course, students will be proficient in designing, simulating, and optimizing models to solve diverse engineering and scientific problems.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ENG 503
Course Title: Research Seminar
Course Prerequisite: None
Course Co-requisite: None
Course Description: Introduces graduate students to research methodologies, literature review techniques, research ethics, technical writing, and presentation skills. Students will be exposed to ongoing research within the college and develop skills necessary for preparing their thesis proposal and conducting research. Serves as a co-requisite for both ESE 697 or BME 697.

Credit Hours: 0
Weekly Contact Hours: 1

Course Code: ESE 501
Course Title: Foundations of Power and Energy Systems
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course provides a fundamental understanding of energy principles and power systems. Topics include thermodynamic cycles (Rankine, Brayton, Otto, Diesel), fundamentals of chemical processes relevant to energy conversion (e.g., combustion basics, stoichiometry), fluid mechanics relevant to energy conversion, basic electrical circuit theory, AC/DC power concepts, energy conversion principles, and an overview of energy transmission and distribution concepts. Emphasis on foundational laws, basic material and energy balances, and analysis techniques.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 502
Course Title: Alternative Energy Systems
Course Prerequisite: None
Course Co-requisite: None
Course Description: Provides the breadth overview. Explores the principles, technologies, and integration challenges of various renewable and alternative energy sources. Covers solar energy (photovoltaics and thermal basics), wind energy, hydropower, geothermal energy, biomass energy, ocean energy, and potentially other emerging technologies. Includes resource assessment, basic system design considerations, environmental impacts, and grid integration issues.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 503
Course Title: Energy Resources, Policy, and Economics
Course Prerequisite: None
Course Co-requisite: None
Course Description: Examine the critical intersection of energy systems with resource management, policy, and economics. Master tools and frameworks to analyze global energy challenges, from resource assessment, supply/demand dynamics, and global trends to energy security, climate policy, and market structures. Students evaluate project finance (LCOE, NPV), policy efficacy, socio-economic impacts, and the economic implications of sustainable energy transitions, preparing for leadership roles in the energy sector.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 504
Course Title: Energy Generation, Transmission, and Distribution
Course Prerequisite: ESE 501; ESE 502
Course Co-requisite: None
Course Description: Focuses on the infrastructure and operation of electrical power systems beyond the generation source. Covers power system components, network modeling (power flow, fault analysis), transmission system design and operation, distribution system topologies, grid stability and control, system protection, substation design, and the integration of distributed generation.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 505
Course Title: Environmental Life Cycle Assessment for Energy Systems
Course Prerequisite: ESE 501; ESE 502; ESE 503
Course Co-requisite: None
Course Description: Master Environmental Life Cycle Assessment (LCA) (ISO 14040/44) to quantify the cradle-to-grave environmental impacts of energy technologies. Covers goal/scope definition, inventory collection, impact assessment (carbon footprint, resource depletion, etc.), and interpretation. Apply LCA principles to evaluate renewables, storage, and conventional systems. Gain practical skills to identify environmental hotspots, critically assess energy options, and support sustainable system design and policy development.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 506
Course Title: Energy in Buildings
Course Prerequisite: ESE 501; ESE 502
Course Co-requisite: None
Course Description: Analysis of energy consumption and efficiency opportunities in residential and commercial buildings. Topics include building physics, heat transfer through envelopes, HVAC systems analysis and design, lighting technologies, building energy modeling software, passive design strategies, building automation systems, net-zero energy buildings, and relevant codes and standards.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 508
Course Title: Hydrogen Technologies
Course Prerequisite: ESE 501; ESE 502
Course Co-requisite: None
Course Description: This course explores hydrogen as a pivotal energy carrier in a decarbonized landscape. Students gain a deep understanding of the complete hydrogen value chain, from diverse production methods like water electrolysis (green hydrogen) and reforming, to various storage (compression, liquefaction, solid-state) and transport solutions. Utilization in fuel cells, direct combustion for power and mobility, and as an industrial feedstock is thoroughly examined. Key aspects include safety protocols, infrastructure requirements, integration with renewables, sector coupling, alongside policy frameworks and economic drivers shaping the emerging hydrogen economy.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 601
Course Title: Advanced Topics in Energy Storage
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course offers a comprehensive study of diverse energy storage technologies, crucial for enabling flexible and resilient modern energy systems. It delves into electrochemical systems like advanced batteries (Li-ion, flow), supercapacitors, and fuel cells, examining their design, materials, and operation. Mechanical (pumped hydro, CAES), thermal (sensible/latent heat), and hydrogen-based storage solutions are also explored. From a systems perspective, applications in grid stability, renewable energy integration, and electric mobility are analyzed. Students will evaluate techno-economic viability, performance metrics, lifecycle impacts, and strategic integration of these critical technologies to address contemporary energy challenges.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 604
Course Title: Advanced Electric Drives
Course Prerequisite: None
Course Co-requisite: None
Course Description: In-depth study of modern electrical machines and the power electronic drives used to control them. Covers AC and DC machine theory (induction, synchronous, permanent magnet, DC motors/generators), power electronic converters (rectifiers, inverters, choppers) used in drives, scalar and vector control strategies, and applications in electric vehicles, renewable energy generation (wind/hydro), and industrial processes.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 606
Course Title: Energy Efficiency
Course Prerequisite: None
Course Co-requisite: None
Course Description: Covers principles and practices for improving energy efficiency across various sectors beyond buildings. Topics include energy auditing techniques, industrial process efficiency (pinch analysis, waste heat recovery, efficient motors/boilers), combined heat and power (CHP) systems, energy management standards (ISO 50001), and policy mechanisms promoting efficiency. Analysis of efficiency potential and economic benefits.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 607
Course Title: Devices and Materials for Energy Systems
Course Prerequisite: None
Course Co-requisite: None
Course Description: Explores the materials science and engineering principles underlying key energy conversion and storage devices. Covers semiconductor physics for photovoltaics, materials for advanced batteries and fuel cells, catalysts for chemical conversions (electrolysis, reforming), thermoelectric materials, materials for extreme environments (nuclear, high-temperature turbines), and advanced characterization techniques relevant to energy materials.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 608
Course Title: Advanced Topics in Energy Systems Engineering
Course Prerequisite: Supervisor Approval
Course Co-requisite: None
Course Description: Explores current research frontiers, emerging technologies, or specialized subjects within Energy Systems Engineering not covered in other courses. Topics will vary depending on faculty expertise and current industry trends, potentially including areas like advanced grid modeling, specific renewable technologies, energy policy analysis, or novel energy storage solutions.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 609
Course Title: Nuclear Energy
Course Prerequisite: ESE 501; ESE 502
Course Co-requisite: None
Course Description: Principles and engineering aspects of nuclear power generation. Covers nuclear physics fundamentals, reactor types (PWR, BWR, CANDU, advanced reactors), the nuclear fuel cycle (mining, enrichment, reprocessing, waste disposal), reactor safety, radiation protection, nuclear policy, and the role of nuclear energy in the global energy mix.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 610
Course Title: Smart Grids and Electrical Energy Conversion
Course Prerequisite: ENG 502; ESE 501; ESE 505
Course Co-requisite: None
Course Description: Examines the technologies and concepts enabling modern, intelligent electrical grids. Covers advanced metering infrastructure (AMI), distribution automation, demand-side management, microgrids, integration of renewables and electric vehicles, grid communication technologies, cybersecurity aspects, and the role of power electronics (converters, inverters) in interfacing distributed resources and controlling power flow.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 611
Course Title: Advanced Solar Energy Systems
Course Prerequisite: ESE 501; ENG 502
Course Co-requisite: None
Course Description: In-depth study of solar energy conversion technologies and system design. Covers advanced photovoltaic (PV) device physics, manufacturing, characterization, performance modeling, Balance-of-System components (inverters, mounting), design of grid-tied and off-grid PV systems. Also covers solar thermal systems including collectors (flat plate, evacuated tube, concentrating), design of solar water heating, industrial process heat systems, and concentrating solar power (CSP) plants. Includes economic analysis and resource assessment.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: ESE 612
Course Title: Advanced Power Plant Engineering
Course Prerequisite: ESE 501; ESE 502
Course Co-requisite: None
Course Description: Detailed analysis and design principles of modern large-scale power generation facilities. Covers advanced thermodynamic cycle analysis (Rankine, Brayton, combined cycles), design and operation of key components (turbines, boilers/steam generators, condensers, generators), combustion systems, emissions control technologies, plant control and instrumentation, efficiency enhancement strategies, and operational considerations for thermal (coal, gas, nuclear, biomass, geothermal) and hydroelectric power plants.
Credit Hours: 3
Weekly Contact Hours: 3