ABDULLAH AL SALEM UNIVERSITY (AASU)

Graduate Academic Programs

Biomedical 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
ENG 501	Advanced Mathematics and Statistics for Engineers	(3 credits)	3		
ENG 502	Systems Modeling, Simulation and Optimization	(3 credits)	3		
ENG 503	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
BME697	Thesis Proposal	(3 credits)	Not specified	Completion of at least 6 credits with a GPA of 2.67 or higher.	ENG 503
BME698	Thesis Continuation	(0 credits)	Not specified	BME697	
BME699	Thesis	(6 credits)	Not specified	BME697 OR BME698	

Biomedical Engineering

Program Overview

The Master's in Biomedical Engineering program at AASU is an advanced graduate program designed to equip students with the expertise to address complex healthcare and biomedical challenges. This interdisciplinary program integrates principles from engineering, science, medicine, and technology to provide a comprehensive understanding of biomedical systems, healthcare innovations, and medical device design. Through rigorous coursework, hands-on laboratory experience, and research opportunities, students engage with cutting-edge technologies and industry practices, preparing them to lead advancements in healthcare and biomedical engineering.

Program Objectives:

a. Develop advanced technical skills in biomedical systems analysis, medical device design, bioinstrumentation, and computational modeling of biological processes.

b. Foster interdisciplinary understanding by integrating engineering principles with knowledge from biology, medicine, and material science to solve complex biomedical problems.

c. Cultivate research skills and innovative thinking to drive advancements in areas such as medical imaging, tissue engineering, biomechanics, and biomaterials.

d. Promote healthcare sustainability by emphasizing the importance of accessible, affordable, and efficient medical technologies that benefit diverse populations.

e. Develop leadership and communication skills to collaborate effectively with multidisciplinary teams, including engineers, healthcare professionals, and researchers.

f. Instill ethical responsibility and awareness of societal impacts, ensuring graduates prioritize patient safety, regulatory compliance, and equitable access to healthcare innovations.

g. Foster a commitment to lifelong learning and professional development to adapt to emerging trends, technologies, and regulatory requirements in the dynamic field of biomedical engineering.

Program Requirements

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

Table 3: Program requirement coursework (9 CHs).

Course Code	Course Title	Credit hours	Contact hours	Pre-requisite	Co-requisite
BME501	Biological Systems and Bioengineering	(3 credits)	3		
BME502	Biotechnology: Techniques and Applications	(3 credits)	3		
BME503	Clinical Trials and Regulatory Affairs	(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 Master's in Biomedical Engineering program at AASU (9 CHs).

Course Code	Course Title	Credit hours	Contact hours	Pre-requisite	Co-requisite
BME504	Fields and Waves in Medicine	(3 credits)	3	BME501	
BME505	Microwave and RF Engineering in Medicine	(3 credits)	3	BME501	
BME506	Antennas for Biomedical Applications	(3 credits)	3	BME501	
BME507	Medical Device Design	(3 credits)	3	BME501 & BME502	
BME508	Sensors and Actuators for Biomedical Applications	(3 credits)	3	BME501& BME502	
BME509	Biomedical Signal Processing	(3 credits)	3	BME501 & BME502	
BME601	Biomedical Imaging	(3 credits)	3	BME501	
BME602	Advanced Biomechanics	(3 credits)	3	BME501	
BME603	Advanced Biomaterials	(3 credits)	3	BME501	
BME604	Tissue Engineering	(3 credits)	3	BME501	
BME605	Computational Modelling in Biomedical Systems	(3 credits)	3	BME501	
BME606	Micro/Nanotechnology in Medicine	(3 credits)	3	BME501 & BME502	
BME607	Quantitative Physiology	(3 credits)	3	BME501	
BME608	Bioinformatics	(3 credits)	3		
BME609	Biostatistics	(3 credits)	3		
BME610	Advanced Topics in Biomedical Engineering	(3 credits)	3	BME501 & BME502	

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: BME 501
Course Title: Biological Systems and Bioengineering
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course provides a foundational understanding of human biological systems from an engineering perspective. Topics include cellular and molecular biology, physiology of major organ systems (cardiovascular, respiratory, neural, and musculoskeletal), and the principles of homeostasis. The course emphasizes how engineering tools and models can be applied to analyze, simulate, and design systems in biomedical applications. By bridging biology with quantitative methods, students gain the necessary background to address complex problems in bioengineering and healthcare innovation.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 502
Course Title: Biotechnology: Techniques and Applications
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course provides a multidisciplinary introduction to modern biotechnology along with core engineering principles that underpin biomedical systems. Topics include molecular biology techniques, genetic engineering, protein expression, and cell culture methods, combined with foundational engineering concepts from mechanical, electrical, and systems engineering. Students will explore topics such as biomaterials, fluid dynamics in biological systems, biomechanics, sensor technologies, signal acquisition, and basic circuit and system modeling. The course emphasizes the integration of biological and engineering knowledge for the design and analysis of biomedical technologies. Case studies from drug delivery systems, diagnostic devices, and bioinstrumentation highlight real-world applications at the intersection of biotechnology and engineering.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 503
Course Title: Clinical Trials and Regulatory Affairs
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course provides a comprehensive overview of clinical trial design, execution, and regulatory frameworks governing biomedical products and medical devices. Students will learn the phases of clinical trials, ethical considerations, data management, and statistical analysis methods used in evaluating medical interventions. The course also covers regulatory pathways in the US (FDA), EU (EMA), and other international frameworks, along with quality assurance and compliance standards such as

GCP and ISO. By the end of the course, students will be prepared to contribute to the development and approval of medical technologies within regulated environments
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 504
Course Title: Fields and Waves in Medicine
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course covers the fundamental principles of electromagnetic fields and waves, including wave propagation, electric and magnetic fields, Maxwell's equations, and wave behaviour in different media. Topics include wave interference, diffraction, reflection, refraction, and the electromagnetic spectrum from static fields to X-rays and gamma rays. The course also explores the applications of these principles in medicine, focusing on medical imaging techniques (e.g., MRI, X-rays, ultrasound) and therapeutic methods like radiation therapy, emphasizing how electromagnetic waves interact with biological tissues for diagnosis and treatment.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 505
Course Title: Microwave and RF Engineering in Medicine
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course covers the fundamentals of microwave and radio frequency (RF) engineering, including wave propagation, transmission lines, impedance matching, and the design of microwave and RF circuits. Topics include antennas, filters, oscillators, amplifiers, and signal modulation and detection, with a focus on system analysis and design using simulation tools. The course also explores the application of microwave and RF technologies in medicine, particularly in diagnostic imaging, cancer treatment through microwave ablation, and wireless medical devices.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 506
Course Title: Antennas for Biomedical Applications
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course delves into the fundamental principles of antenna engineering, focusing on the design, analysis, and implementation of various antenna types. Topics include antenna theory, radiation patterns, impedance matching, polarization, and propagation mechanisms. Students will explore advanced antenna designs, such as microstrip and phased array antennas, and learn about the impact of material properties and environmental factors on performance. In addition, the course highlights innovative uses in medicine, such as wearable antennas for health monitoring, implantable devices for diagnostics and treatment, and imaging systems for disease detection
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 507
Course Title: Medical Device Design
Course Prerequisite: BME501; BME502
Course Co-requisite: None
Course Description: This course provides a comprehensive introduction to the process of designing medical devices, from concept to market. Topics include regulatory requirements, standards for safety and performance, and the design and prototyping of devices. Students learn about various device categories, including diagnostic tools, therapeutic devices, and implantable systems. The course emphasizes human-centered design, usability testing, and innovation in addressing unmet medical needs. Students engage in team projects to develop prototypes, integrating principles of engineering, biology, and clinical practice.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 508
Course Title: Sensors and Actuators for Biomedical Applications
Course Prerequisite: BME501; BME502
Course Co-requisite: None
Course Description: This course explores the principles, design, and application of sensors and actuators used in biomedical systems. Students learn about sensor types such as optical, chemical, mechanical, and biosensors, along with their role in monitoring physiological parameters. Actuator technologies for medical devices, including microfluidic systems and robotic surgery tools, are also covered. The course emphasizes miniaturization, biocompatibility, and the integration of sensors and actuators into complex medical systems. Applications include wearable health monitors, lab-on-chip devices, and advanced prosthetics.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 509
Course Title: Biomedical Signal Processing
Course Prerequisite: BME501; BME502
Course Co-requisite: None
Course Description: This course provides an in-depth exploration of the techniques and tools used to analyze physiological signals for medical applications. Students learn to process signals such as electrocardiograms (ECG), electroencephalograms (EEG), electromyograms (EMG), and other bioelectric signals. The course covers topics including signal acquisition, noise reduction, filtering, feature extraction, and time-frequency domain analysis. Advanced methods like wavelet transforms, machine learning, and pattern recognition for biomedical signal interpretation are also introduced. Emphasis is placed on practical applications, such as diagnosing diseases, monitoring patient health, and developing medical devices. Real-world case studies and hands-on projects reinforce the theoretical concepts, preparing students for careers in biomedical engineering and healthcare technology.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 601
Course Title: Biomedical Imaging
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course covers the physics, engineering, and clinical applications of biomedical imaging technologies. Topics include X-ray imaging, computed tomography (CT), ultrasound, MRI, and nuclear medicine techniques like PET and SPECT. Students explore image acquisition, processing, and analysis methods, along with the underlying principles of each imaging modality. Emphasis is placed on understanding the strengths, limitations, and safety considerations of each technique. Real-world case studies are used to demonstrate the impact of imaging in diagnosis and treatment planning.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 602
Course Title: Advanced Biomechanics
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course delves into the mechanical behavior of biological tissues and systems, integrating engineering principles with anatomy and physiology. Topics include the analysis of forces, stress, and strain in bones, muscles, and soft tissues. Students study advanced concepts such as fluid-structure interactions in the cardiovascular system, joint biomechanics, and injury mechanisms. The course also explores the development and testing of prosthetics, orthotics, and biomechanical models. Applications in sports science, rehabilitation, and medical device design are highlighted.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 603
Course Title: Advanced Biomaterials
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course examines the development and application of biomaterials for medical use. Topics include the properties, synthesis, and biocompatibility of metals, ceramics, polymers, and composites. Students learn about the use of biomaterials in implants, tissue engineering scaffolds, and drug delivery systems. Emphasis is placed on material characterization, degradation mechanisms, and regulatory aspects of biomaterials. Case studies of innovative biomaterial applications, such as 3D-printed implants and bioresorbable materials, are included.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 604
Course Title: Tissue Engineering
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course focuses on the principles and techniques of tissue engineering for repairing or regenerating damaged tissues and organs. Topics include scaffold design, cell sourcing, bioreactors, and the role of growth factors in tissue development. Students explore applications in regenerative medicine, including skin grafts, cartilage repair, and organ regeneration. The course emphasizes interdisciplinary approaches, combining engineering, biology, and clinical science. Ethical considerations and challenges in translating research to clinical practice are also discussed.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 605
Course Title: Computational Modelling in Biomedical Systems
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course introduces computational techniques for modeling and simulating biological systems and medical devices. Topics include finite element analysis, multiscale modeling, and numerical methods for solving biomedical problems. Applications include modeling blood flow, tissue mechanics, and the interaction of medical devices with biological tissues. Students learn to use computational tools to analyze and optimize designs, predict outcomes, and enhance system performance. The course emphasizes the importance of model validation and integration with experimental data.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 606
Course Title: Micro/Nanotechnology in Medicine
Course Prerequisite: BME501; BME502

Course Co-requisite: None
Course Description: This course explores the applications of micro/nanotechnology in healthcare, focusing on diagnostics, therapeutics, and drug delivery systems. Topics include micro/nanoparticle design, targeted drug delivery, micro/nanosensors, and micro/nanostructured biomaterials. Students learn about the unique properties of micro/nanoscale materials and their interaction with biological systems. The course also addresses challenges such as toxicity, regulatory issues, and scalability for clinical use. Examples of successful micro/nanotechnology-based medical products and their impact on patient care are discussed.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 607
Course Title: Quantitative Physiology
Course Prerequisite: BME501
Course Co-requisite: None
Course Description: This course provides an in-depth quantitative analysis of physiological systems, emphasizing mathematical modeling and system-level understanding. Topics include cardiovascular, respiratory, neural, and musculoskeletal systems, with a focus on their dynamic behavior and regulation. Students explore the application of engineering tools to analyze physiological data and develop models of organ function. The course also highlights how these models are used in the design of medical devices and simulation of disease processes.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 608
Course Title: Bioinformatics
Course Prerequisite: None
Course Co-requisite: None
Course Description: This course introduces the principles and tools of bioinformatics with a focus on their applications in biomedical research and engineering. Students will explore methods for analyzing biological data, including DNA and protein sequences, gene expression profiles, and biological networks. Core topics include sequence alignment, genome assembly, molecular evolution, structural bioinformatics, and functional annotation. The course also covers databases (e.g., NCBI, Ensembl), algorithmic approaches, and computational tools such as BLAST, Clustal, and basic scripting in Python or R. Emphasis is placed on solving real-world problems in genomics, personalized medicine, and systems biology using computational techniques.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 609
Course Title: Biostatistics
Course Prerequisite: None

Course Co-requisite: None
Course Description: This course introduces statistical methods essential for analyzing biomedical and health-related data. Topics include descriptive statistics, probability distributions, hypothesis testing, confidence intervals, regression analysis, analysis of variance (ANOVA), non-parametric methods, and survival analysis. Emphasis is placed on experimental design and the interpretation of results in the context of biomedical research. Students will gain practical experience using statistical software (e.g., R, SPSS, or Python) to analyze real-world datasets and communicate findings effectively. The course prepares students to critically evaluate biomedical literature and design statistically sound experiments.
Credit Hours: 3
Weekly Contact Hours: 3

Course Code: BME 610
Course Title: Advanced Topics in Biomedical Engineering
Course Prerequisite: BME501; BME502
Course Co-requisite: None
Course Description: This course explores advanced techniques and cutting-edge methodologies in biomedical engineering. Emphasis is placed on the application of these techniques to solve complex biomedical challenges, including areas such as medical imaging, biomaterials, biomechanics, and bioinstrumentation. Through a combination of theoretical foundations and practical case studies, students will gain a comprehensive understanding of how to apply advanced engineering principles to innovate in healthcare and biomedical research.
Credit Hours: 3
Weekly Contact Hours: 3