Maroun Semaan Faculty of Engineering and Architecture (MSFEA)

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Officers of the Faculty

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Imad El Hajj	Associate Dean
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Antoine Sabbagh	Interim Director of Admissions, ex-officio
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Faculty Administrative Support

Ghada Najm	Executive Officer
Alia Kazma Serhal	Student Services Manager
Sara Jibbaoui	Financial Officer

Historical Background

As early as 1913, the university recognized the need for engineering education and training in the Middle East, and courses in this field were offered in the School of Arts and Sciences. By 1944, sufficient additional courses had been added to permit the granting of the degree of Bachelor of Science in Civil Engineering. The last class in this program graduated in June 1954. In 1951, a separate School of Engineering was established and curricula were initiated in civil engineering, mechanical engineering, electrical engineering and architectural engineering. The years from 1951 to 1954 were a transitional period of continuous development toward the new curricula, which were established in 1954. In 1963, a program leading to the degree of Bachelor of Architecture was introduced, replacing the Bachelor of Architectural Engineering program, the last class of which graduated in June 1966. In that year, the school was renamed the Faculty of Engineering and Architecture. Since then, curricula have been under constant review with changes introduced as necessary to keep pace with modern technology, conform to sound developments in engineering and architecture education, and meet the evolving needs of the region. In 1986, a new undergraduate major in computer and communications engineering was added within the Department of Electrical and Computer Engineering. In 1992, a new major in graphic design was added within the Department of Architecture and Design leading to a Bachelor of Graphic Design. In 2006, the name of the degree was changed to Bachelor of Fine Arts in Graphic Design, and the name of the Bachelor of Engineering in Electrical Engineering degree was changed to Bachelor of Engineering in Electrical and Computer Engineering.

In 2009, two Bachelor of Science programs were introduced, the first in construction engineering, housed in the Department of Civil and Environmental Engineering, and the second in chemical engineering, housed in the Department of Mechanical Engineering. A Bachelor of Engineering program in chemical engineering was simultaneously launched in 2009 with the Bachelor of Science program. In 2014, a Bachelor of Engineering program in industrial engineering was introduced. The chemical engineering programs are now housed in the Department of Chemical and Petroleum Engineering, while the industrial engineering program is housed in the Department of Industrial Engineering and Management. The faculty was renamed Maroun Semaan Faculty of Engineering and Architecture in 2017.

In 2019, a Bachelor of Engineering program in computer science and engineering was started in the Department of Electrical and Computer Engineering.

Accreditation

The Bachelor of Engineering programs in chemical engineering, civil engineering, computer and communications engineering, electrical and computer engineering, and mechanical engineering, and the Bachelor of Science program in chemical engineering are accredited by the Engineering Accreditation Commission of ABET.

Mission

We offer world-class educational programs that prepare students for the engineering, architecture and design professions. Rooted in the liberal education model, our programs also prepare students to be engaged citizens and leaders, entrepreneurs and researchers who deploy their skills with ingenuity, integrity and a sense of responsibility towards future generations. Our faculty produces transformative knowledge and technology through internationally-recognized research and design, and seeks to leverage the special contexts of Lebanon and the region to define highly novel and relevant research programs. We impact policy and practice through our alumni and by directly engaging industry, government and the public at large.

Undergraduate Programs

The Maroun Semaan Faculty of Engineering and Architecture offers programs of study leading to the degrees of Bachelor of Architecture (BArch), Bachelor of Fine Arts (BFA) in Graphic Design and Bachelor of Engineering (BE), with majors in chemical engineering, civil engineering, computer and communications engineering, computer science and engineering, electrical and computer engineering, industrial engineering, and mechanical engineering; and Bachelor of Science (BS) with majors in chemical engineering and construction engineering. The curriculum of the BArch degree extends over 14 terms (ten 16-week terms and four eight-week summer terms), totaling 192 weeks. Although the program is completed in five calendar years, it is equivalent to a program of six academic years that does not include summers. The curriculum of the BE degree and that of the BFA degree are divided into 11 terms (eight 16-week terms and three eight-week summer terms), totaling 152 weeks. This duration is equivalent to five academic years without summers, but the program is completed in four calendar years. The curriculum of the BS degree extends over eight or nine terms (six 16-week terms and two or three eight-week summer terms).

The faculty reserves the right to make changes to the curriculum, course content, and regulations as it deems appropriate and without prior notice.

Admissions

Admission to First Year

Admission is by selection of a limited number of the most promising, eligible applicants. All candidates for admission to the Maroun Semaan Faculty of Engineering and Architecture must have completed the pre-professional educational requirements of the candidate's country and the approved freshman program in the Faculty of Arts and Sciences of this university as described in this catalogue, or a program recognized as equivalent. The certificates, recognized for admission to the first year in the Maroun Semaan Faculty of Engineering and Architecture, are listed in the Admissions section of this catalogue. Holders of the technical baccalaureate (BT) are only eligible for admission to the same major as that of their BT.

Admission of Transfer Students

Students attending recognized institutions of higher learning, including AUB, may apply for transfer to any of the undergraduate majors in the MSFEA, depending on availability of places and subject to the following conditions. Students admitted to the Architecture or Graphic Design programs can start in the Fall term only. Applicants must have:

- completed the equivalent of the sophomore class at the college or university from which they are transferring,
- attained a minimum cumulative GPA of 2.7 out of 4.0 (75 out of 100),
- taken at least 12 credits of math and basic science courses at the sophomore level or higher and attained a total average in these courses of at least 2.9 out of 4.0 (77 out of 100). This requirement does not apply to applicants to the Architecture and Graphic Design programs,
- and have satisfied the university English requirements for admission.

Applications of transfer students are evaluated and approved by the departments and the Undergraduate Admissions Committee of the faculty. The term in which the student is placed and the complete program of study in the major in which the student is admitted, are determined by the department concerned.

Residence Requirements

Students of the Maroun Semaan Faculty of Engineering and Architecture must meet the following minimum residence requirements:

- **Engineering or Graphic Design Majors:** A student must register in residence at the Maroun Semaan Faculty of Engineering and Architecture for the last four regular terms and should complete at least 50 credits during this period.
- **Architecture Major:** A student must register in residence at the Maroun Semaan Faculty of Engineering and Architecture for the last five regular terms and should complete at least 65 credits during this period.

Academic Rules and Regulations

University regulations apply with the following additional provisions:

- Students returning from an exchange program must have obtained a minimum grade of C on a course taken during the exchange in order to transfer it.
- Transfer students must have obtained a minimum grade of B to transfer a technical, math or science course or a minimum grade of C to transfer other types of courses.

Graduation Requirements

To be eligible for graduation with the bachelor's degree, a student must have passed all the required courses and must have:

- attained a minimum cumulative course average of 70 (GPA of 2.2),
- attained a minimum cumulative average of 70 (GPA of 2.2) in major courses as specified by the department,
- met the residence requirements,
- and satisfied the faculty with respect to the student's professional development and conduct.

Class Status

The class status of students is as follows:

A student's status is changed to that of a higher year if her/his cumulative number of failed, withdrawn or unregistered credits from the regular credit hour requirements does not exceed seven.

First Year	Terms I and II
Second Year	Terms III, IV and V
Third Year	Terms VI, VII and VIII
Fourth Year	Terms IX, X and XI
Fifth Year (Architecture)	Terms XII, XIII and XIV

Courses

FEAA 200 Introduction to Engineering and Architecture 3 cr.
The course is designed to familiarize first year students with the different disciplines in Engineering and Architecture, including: Architecture, Civil, Mechanical, Electrical, Chemical, Industrial and technologies used in the fields. The course takes a unique interdisciplinary approach to the field and introduces the related disciplines in the world of engineering and architecture. One key objective is to promote interdisciplinary interaction and innovative thinking. The course is organized into modules covering the different disciplines within the Maroun Semaan Faculty of Engineering and Architecture (MSFEA). The last module of the class showcases interdisciplinary projects demonstrating interactions among the different fields. The lectures explain as applicable to each discipline, through examples, notions of problem solving, design thinking, process of invention and innovation, environmental and civic responsibility, and measures of success in aesthetics and performance. The course project is a key component of the course. It is interdisciplinary in nature bringing ideas and solutions from all disciplines in engineering and architecture. *Annually.*

FEAA 501 Final-Year Project Accelerator I 0 cr.
This sequence of two courses provides selected Final-Year Project (FYP) students with the knowledge, tools, and mentorship needed to transform their technical FYP into a viable business by the time they graduate. Topics include design thinking, business planning, business modeling, team formation, marketing, finance, legal aspects, and pitching. *Annually in Fall term. Co-requisite: Final-Year Project in student home department.*

FEAA 502 Final-Year Project Accelerator II 3 cr.
This sequence of two courses provides selected Final-Year Project (FYP) students with the knowledge, tools, and mentorship needed to transform their technical FYP into a viable business by the time they graduate. Topics include design thinking, business planning, business modeling, team formation, marketing, finance, legal aspects, and pitching. *Annually in Spring term. Pre-requisite: FEAA 501.*

Biomedical Engineering Graduate Program

Coordinator:	Dawy, Zaher (Electrical & Computer Engineering, MSFEA)
Co-coordinator:	Jaffa, Ayad (Biochemistry & Molecular Genetics, FM)
Coordinating Committee Members:	Amatoury, Jason (Biomedical Engineering, MSFEA) Daou, Arij (Biomedical Engineering, MSFEA) Darwiche, Nadine (Biochemistry & Molecular Genetics, FM) Khoueiry, Pierre (Biochemistry & Molecular Genetics, FM) Khraiche, Massoud (Biomedical Engineering, MSFEA) Kobeissy, Firas (Biochemistry & Molecular Genetics, FM) Mhanna, Rami (Biomedical Engineering, MSFEA) Oweis, Ghanem (Mechanical Engineering, MSFEA)

Minor in Bioengineering Design (18 Credits)

The minor in Bioengineering Design aims at preparing students for design and innovation in the field of bioengineering. The minor will educate students on the process of designing engineering solutions with focus on biomedical and healthcare applications.

The minor in Bioengineering Design is open to AUB students from all majors who have completed their first academic year (non-engineering students) or their first two academic years (engineering students) and who have a cumulative average of 70 (GPA:2.2) or more. The minor will be indicated on the transcript of the student who completes all the requirements described below and obtains an average of 70 (GPA:2.2) or more in the minor courses.

The minor requirements are divided into a set of core courses and a set of elective courses with a total of 18 credits, as follows:

- BIOL 210 [3 cr.] (can be replaced by BIOL 202 or PHYL 246)
- BMEN 501 [3 cr.]
- BMEN 502 [3 cr.]
- BMEN 600 [3 cr.]
- One biomedical engineering advanced topics course from List A below [3 cr.]
- One elective course from either List A or List B below [3 cr.]

Elective Courses

- List A: BMEN 603/CHEN 675, BMEN 606, BMEN 609, BMEN 611.
- List B: INDE 412, BMEN 601/MECH 635, BMEN 602, BMEN 604/CHEN 673, BMEN 605, BMEN 607/MECH 633, BMEN 608/MECH 634, BMEN 610, EECE 601, EECE 602, EECE 603, EECE 605, MECH 607, MECH 631, MECH 705, BIOC 321 and BIOC 322 and 1 credit biomedical course (e.g., HUMR 310A lab), BIOC 326A and BIOC 326B and 1 credit biomedical course (e.g., HUMR 310A lab), BIOL 251, BIOL 310, EPHD 310.

BMEN 501 Bioengineering Design Fundamentals 3 cr.
The course aims to educate and train students in the process of utilizing engineering design concepts, methodologies, and tools for developing medical technologies. The course will teach the design process focused on development of engineering solutions in healthcare. This will include problem definition, identifying needs, setting specifications and translating them to prototypes, testing and design refinements. The material will be taught partly through active discussions in class of design topics, case studies, and design exercises. Also, in the final part of the course the students will be challenged to identify a problem and use the design process to develop the needs and specifications. In addition, students will learn about intellectual property, research ethics, and various regulations for biomedical technology and human safety considerations.

BMEN 502 Bioengineering Design Capstone 3 cr.
The course provides practical training in engineering design as students are placed within design groups to work through a real life iteration of the engineering design process they learned in BMEN501 for an idea either of their own or provided by faculty members. Interdisciplinary teams will typically be paired up with two faculty mentors, one from MSFEA and one from FM. Students will be challenged to innovate and improve clinical, diagnostic, or patient care technologies via need-based problem statements under the guidance of their faculty mentors. Each team will complete the course by delivering a prototype or a proof of concept of their engineering solution capable of demonstrating the required functions of the intended solution. Each team will present the outcome of their work in technical reports and oral presentations. *Prerequisite: BMEN501.*

BMEN 601/ MECH 635 Computational Modeling of Physiological Systems 3 cr.
This course focuses on the quantitative modeling of different physiological systems. It provides students with current concepts of the mathematical modeling, and different quantitative descriptions of cellular and organ physiology. At the subcellular/cellular level, we will examine mechanisms of regulation and homeostasis. At the system level, the course will cover basic aspects of anatomical and pathophysiological features of the nervous, neural, cardiovascular and respiratory systems. Several physiological processes are treated as case studies for increasing complexity in modeling dynamical systems. *Prerequisites: MATH 202 and PHYL 346, or consent of instructor.*

BMEN 602 Computational Modeling of Cardiovascular and Pulmonary Systems **3 cr.**

The need for better understanding the mechanics and tools for computational modeling of cardiovascular and respiratory systems in healthy and diseased conditions is constantly increasing. This is a result of the enormous advances made in the science and engineering of both surgical and therapeutic medicine. This course covers the modeling and simulation of cardiovascular and respiratory systems. It will provide the students with a thorough understanding of the anatomy, physiology and mechanics of cardiovascular and respiratory systems as well as the computational tools for modeling and simulation of cardiac, circulatory and respiratory systems in healthy and diseased conditions.

BMEN 603/ CHEN 675 Tissue Engineering **3 cr.**

In a world of aging population, an ever-increasing demand for improvement of healthcare services and need for replacement organs and tissues are arising. The limited pool of donors together with the problem of donor organ rejection is a strong driver for engineering tissues and other body parts. Tissue engineering is an interdisciplinary field that uses cells, biomaterials, biochemical (e.g. growth factors) and physical (e.g. mechanical stimulation) signals, as well as their combination to generate tissue-like structures. The goal of tissue engineering is to provide biological substitutes that can maintain, restore or improve the function of damaged organs in the body. This course will introduce interested students to the new field of tissue engineering and provide insight on cutting edge applications in this area.

BMEN 604/ CHEN 673 Engineering of Drug Delivery Systems **3 cr.**

This course focuses on recent advances in the development of novel drug delivery systems. The fundamentals of drug delivery are discussed. Various strategies to tune and control the release of active agents for optimized therapeutic outcomes are explored. The course covers polymers and techniques used to produce drug nanoparticles, with specific examples of nanoparticle-based drug delivery systems. *Prerequisites: CHEN 314 and CHEN 411, or consent of instructor.*

BMEN 605 Biomedical Imaging **3 cr.**

Biomedical imaging offers an unprecedented view into the structure and function of a living body, and as such plays an essential role in medical practice and research. This course will provide students with an overview of the key concepts underlying the primary diagnostic biomedical imaging modalities, including: ultrasound, x-ray, computed tomography, magnetic resonance and nuclear imaging. In particular, students will gain an understanding of the physical principles and theoretical bases governing the operation of each imaging modality, the technology that translates theory into practice, and the basic methods involved in image formation. Students will also learn the limitations of each imaging procedure, while being exposed to their vast applications in the clinic and research.

BMEN 606 Nanobiosensors 3 cr.
This course will provide a comprehensive analysis of the field of nanoengineering with a focus on biosensors including common modalities, basic theoretical considerations for sensor operation, physics of detection and applications in research and medical diagnostics. The course will cover the major types of electronic nanobiosensors for biological signal detection (potentiometric, amperometric, and mass based sensors) and their applications in the fields of neural engineering, DNA sequencing and cardiovascular early disease detection. The course will enable students to have a strong grasp of fundamentals of biosensor design, select sensors for various applications and evaluate new and emerging technologies. *Prerequisites: EECE 210 (or equivalent) and BIOL 210 (or equivalent); or consent of instructor.*

BMEN 607/ MECH 633 Biomechanics 3 cr.
A course on the study of the biomechanical principles underlying the kinetics and kinematics of normal and abnormal human motion. Emphasis is placed on the interaction between biomechanical and physiologic factors (bone, joint, connective tissue, and muscle physiology and structure) in skeleto-motor function and the application of such in testing and practice in rehabilitation. The course is designed for engineering students with no previous anatomy/physiology. *Prerequisites: CIVE 210, MECH 320 or CIVE 310; or consent of instructor.*

BMEN 608/ MECH 634 Biomaterial and Medical Devices 3 cr.
A course that examines the structure-property relationships for biomaterials and the medical applications of biomaterials and devices. The first part of the course focuses on the main classes of biomaterials, metal, ceramic, polymeric and composite implant materials, as well as on their interactions with the human body (biocompatibility). The second part of the course examines the various applications of biomaterials and devices in different tissue and organ systems such as orthopedic, cardiovascular, dermatologic and dental applications. Experts from the medical community will be invited to discuss the various applications. *Prerequisite: MECH 340 or consent of instructor.*

BMEN 609 Computational Neuroscience 3 cr.
The human brain, perhaps the most complex, sophisticated, and complicated learning system, controls virtually every aspect of our behavior. The central assumption of computational neuroscience is that the brain computes. What does that mean? Generally speaking, a computer is a dynamical system whose state variables encode information about the external world. In short, computation equals coding plus dynamics. Some neuroscientists study the way that information is encoded in neural activity and other dynamical variables of the brain. Others try to characterize how these dynamical variables evolve with time. The study of neural dynamics can be subdivided into two separate strands. One tradition, exemplified by the work of Hodgkin and Huxley, focuses on the biophysics of single neurons. The other focuses on the dynamics of networks, concerning itself with phenomena that emerge from the interactions between neurons. Therefore computational neuroscience can be divided into three subspecialties: neural coding, biophysics of neurons, and neural networks. This course will introduce engineers, physicists, computational scientists, mathematicians and other audiences to the neurosciences from the cellular level and the network level as seen from computational lenses. *Prerequisites: BIOL 201 (or equivalent) and Math 202, or consent of instructor.*

BMEN 610 Micro and Nano Neural Interfaces 3 cr.
Neural interfaces are micro and nano devices that form the connection between the biological neural tissue and the external electronic devices. These devices are designed for mapping, assisting, augmenting, or repairing neural pathways. The course will focus on physical, chemical and neurophysiological principles of neural interfaces, theoretical and functional basis for their design, micro and nano fabrication techniques and applications in neural prosthesis for Brain Machine Interface. Topics covered in class will include; Neural Engineering, Brain Machine Interface, Microfabrication, Nanofabrication, Soft-lithography, Electrokinetics, Electrochemistry, Neural probes, Biocompatibility, Microelectrodes, NeuroMEMS (neuro microelectromechanical systems, BioMEMS (biomedical microelectromechanical systems).

BMEN 611 Computational Modeling in Biomechanics 3 cr.
This course provides students with a glimpse into the world of computational finite element modeling and simulation in biomechanics to investigate and solve biomedical problems. Students will take a journey through the processes involved in producing a computational finite element model in the biomedical field; starting at construction of model geometry, particularly from medical imaging data (CT/MRI), through to model creation, simulation and visualization using finite element analysis software (ANSYS Workbench). Students will also be exposed to a selection of experimental lab techniques in biomechanics and physiology to acquire data required for model development and validation. In pursuit of developing an appreciation for the areas covered, the course will incorporate a mix of theory, demonstrations, practice, real-world modeling applications and research seminars. In addition to skills gained in modeling and basic experimentation, the course will provide students with an opportunity to enhance vital skills in scientific writing and oral communication.

Minor in Humanitarian Engineering

The Minor in Humanitarian Engineering and Public Health Innovations is offered jointly by the Faculty of Health Sciences and the Maroun Semaan Faculty of Engineering and Architecture.

The minor is open to undergraduate students from all majors. It is a multidisciplinary offering that provides undergraduate students with the knowledge of the humanitarian engineering field, and equips them with the skills required to find innovative design solutions for challenges faced by disadvantaged populations taking into consideration two complementary perspectives; public health perspective and engineering perspective.

Students who complete the minor will be able to:

1. Apply participatory needs assessment tools and analyze the different dimensions of a public health problem
2. Apply formal design methods to develop practical, feasible, scalable, and sustainable humanitarian engineering and public health innovations and interventions
3. Apply skills required to manage complex projects while working in multidisciplinary teams
4. Demonstrate entrepreneurial skills to take a solution/intervention from prototype to product
5. Articulate and adhere to ethical standards in the process followed and in the intervention designed
6. Present and document a problem and its solution to a diverse target audience

The minor in Humanitarian Engineering and Public Health Innovations consists of 15 credits, according to the following requirements:

- HEHI 201, "Foundations of Humanitarian Engineering and Public Health Innovations"
- HEHI 202, "Capstone: Humanitarian Engineering and Public Health Innovations"
- One design course from the following list: AGSC 330, ARCH 039, ARCH 061, ARCH 064, ARCH 344, BMEN 501, CHEN 471/571, CHEN 619, CHEN 798A, CIVE 552, CIVE 601, CIVE 628, CIVE 686, EECE 461, EECE 560, EECE 675, ENMG 663, ENMG 698E, ENSC 633, ENST 300, FSEC 310, FSEC 315, HPCH 204, HPCH 212, HPCH 237, INFO 205, LDEM 254, LDEM 633, MECH 530, MKTG 234, PBHL 303, URDS 664, URPL 641
- One ethics course from the following list: BUSS 215, INDE 410, MCOM 215, MHRM 304, PHIL 205, PHIL 209, PSYC 305
- One social entrepreneurship course from the following list: AGBU 229, ARCH 068, ENMG 654, ENTM 240, ENTM 320, INDE 412, MFIN 359

Students interested to enroll in the minor are encouraged to inform the coordinators of the program at healthengineering@aub.edu.lb to benefit from adequate advising on study plans and ensure completion of all requirements.

HEHI 201 Foundations of Humanitarian Engineering and Public Health Innovations 3 crs.

This is a multidisciplinary course that covers fundamentals of designing solutions for health challenges faced by disadvantaged populations. It introduces tools for identifying humanitarian and/or development needs and designing practical, scalable and sustainable solutions and interventions. The course is offered to students from all majors. Students will be exposed to health and health system challenges in addition to design fundamentals including participatory needs assessment, formal multidisciplinary design processes, and relevant technologies and tools with real world applications and case studies.

HEHI 202 Capstone: Humanitarian Engineering and Public Health Innovations Capstone 3 crs

The capstone project course is an interdisciplinary service learning design course focused on development and humanitarian engineering solutions for health challenges. The capstone is divided into two sub-courses, HEHI 202A (1cr.) and HEHI 202B (2cr.), and must be registered in 2 consecutive semesters. In the capstone, students apply all tools learned in HEHI 201. Students work in multidisciplinary teams with disadvantaged communities, under joint supervision of at least two mentors from MSFEA, FHS, and other faculties. *Prerequisite: HEHI 201*

Upon prior approval of the students' advisor and the coordinators of the Humanitarian Engineering Initiative, students who are required, as part of their degree requirement, to complete a capstone or final year project, can count that experience towards fulfilling the capstone requirement for the minor.

To graduate with the minor, a student must attain a cumulative average of 70 or more in courses taken to satisfy its requirements.

Certificate Option

Students can opt for a certificate in Humanitarian Engineering and Public Health Innovations.

The "Humanitarian Engineering and Public Health Innovations" certificate requirements are:

- HEHI 201, "Foundations of Humanitarian Engineering and Public Health Innovations"
- HEHI 202, "Capstone: Humanitarian Engineering and Public Health Innovations Capstone"
- An internship approved by the Humanitarian Engineering Initiative of at least 8 weeks full-time

Students should declare the certificate before completing the requirements.

Upon prior approval of the students' advisor and the coordinators of the Humanitarian Engineering Initiative, students who are required, as part of their degree requirement, to complete an internship or practicum, can also count that experience towards fulfilling the internship requirement for the certificate.