Department of Electrical & Electronic Engineering

Eastern Mediterranean University


# Biomedical Engineering (Undergraduate Program)

***Spring 2021- 2022***

**EASTERN MEDITERRANEAN UNIVERSITY**
**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

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# BIOMEDICAL ENGINEERING UNDERGRADUATE CATALOGUE

## INTRODUCTION

The Biomedical Engineering is one of the undergraduate programs offered by the Department of Electrical and Electronic Engineering. The department was one of the first departments to be established in the University. It has its own site on the University campus, with modern buildings and well-equipped laboratories. The Department aims at providing contemporary training in various fields of Electrical and Electronic Engineering as well as Information Systems Engineering. It offers programs of study leading to degrees of Bachelor of Science (BS), in Electrical and Electronic Engineering, Biomedical Engineering, Information Systems Engineering, and Electronics and Communications Engineering, and also Master of Science (MS), and Doctor of Philosophy (PhD) in Electrical and Electronic Engineering.

Biomedical engineering is a multidisciplinary program utilizing the application of engineering principles to the fields of biology and health care. This program is developed in coordination with Electrical and Electronic Engineering, Biological Sciences, Mathematics, Physics and Chemistry Departments as well as Faculty of Health Sciences and Medicine. Biomedical Engineering is a state-of-the-art interdisciplinary program which provides a common platform for collaboration among engineering, natural and medical sciences. In this context, electrical, electronic, computer and mechanical engineers collaborate with physiotherapists, biologists, medical doctors and pharmacists for healthier future of humanity

With an aging population, and diseases such as diabetes and obesity on the rise, our society is facing new challenges in health and well-being every day. Biomedical Engineering plays a pivotal role in developing solutions. There are countless opportunities for biomedical engineers to make a difference in our world and work in a wide range of application areas, including: Biomedical data analysis , Biomedical image analysis and pattern recognition , Medical device product design, Manufacturing, testing and management , Simulation and modeling of diseases and biological systems , Healthcare regulations , Design and engineering of sports equipment and testing , Research and development in medical devices and instrumentation.

In addition to industrial job prospects, the graduates can continue their education in postgraduate programs to specialize in certain research topics in our department or in famous institutions in the world.

## VISION STATEMENT

We envision a department that is one of the best in the region with a diverse and stimulating intellectual environment that provides leadership in the field through its education and research agenda.

## MISSION STATEMENT

Our mission is to serve society through excellence in education, research, and public service. We aspire to instill in our students the attitudes, values, and vision that will prepare them for professionalism and life-long learning. We strive to generate new knowledge and technology and aim to educate our graduates for following technological and theoretical developments, and use them to serve the society.

## EDUCATIONAL OBJECTIVES

- Successfully practice biomedical engineering to serve healthcare institutions, academia, and industry at regional, state, national and international levels
- Work professionally in one or more of the following areas: biomedical instrumentation, biomechanics, biomaterials, biotechnology, biocomputing and medicine.
- Achieve personal and professional success with commitment to ethical and social responsibility, both as individuals and in team environments.
- Engage in lifelong learning, including entering and succeeding in an advanced degree program in a field such as engineering, science, medicine and business.

## STUDENT OUTCOMES

The students in the Biomedical Engineering Program should attain the following outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics,
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors,
3. an ability to communicate effectively with a range of audiences,
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts,
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives,
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions,
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## ACADEMIC STAFF MEMBERS

**ABOU RAJAB Hasan**, Assistant Professor, BSc, MSc, PhD, Middle East Technical University.
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His current research interests are digital communication systems, coding theory and coded modulation techniques.

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Her current research interests are biomedical engineering, neuroscience, neurorehabilitation, signal and image processing.

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His current research interests include; resolution enhancement in images/video, facial expression recognition, pattern recognition, facial image processing, feature detection, tracking, segmentation and recognition.

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**KÜKRER Osman**, Professor, BSc, MSc, PhD, Middle East Technical University.
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His research interests include feedback control of single phase and three phase inverters, uninterruptible power supplies, PWM ac/dc converters, high power factor rectifiers, ac and dc drivers, adaptive filtering.

**ÖZKARAMANLI Hüseyin**, Professor [Dean], BSc, MSc, PhD, Tufts University.
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In the area of Digital Signal Processing: Construction of M-Band wavelet basis, multiple wavelets, Sub-band transforms and their applications in data/image compression and signal denoising. In the area of VLSI: Signal integrity problems associated with the different interconnect technologies in ultra high speed integrated circuits.

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**SIRJANI Reza,** Associate Professor [Vice Chair]**,** BSc, KNToosi University of Technology, MSc, Tehran Science and Research Branch of Islamic Azad University, PhD, The National University of Malaysia.
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His research interests include electric power systems, optimization techniques, power transmission lines, reactive power compensation, renewable energy, power quality improvement.

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His research interests include electrical demand, generation, transmission and its interaction with renewable energy technologies.

**UYGUROĞLU Mustafa K.**, Professor, BEng, Higher Technical Institute (EMU), MS, PhD Eastern Mediterranean University.
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He is conducting research in the field of robotics, mechatronics and mathematical modeling.

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Her research interests are Computational methods in electromagnetics, FDTD analysis of microstrip antennas, Rotman Lens antennas, implantable and wearable antennas for biomedical applications

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His research interests are microwave integrated circuits, design of microwave antennas, radar.

## ADMINISTRATIVE STAFF MEMBERS

| | | |
|---|---|---|
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## LABORATORIES

### *Basic Circuits Laboratory*

Intended to familiarize students with the fundamental laboratory procedures of electrical measurements. In addition to demonstrating the uses of voltmeters, ammeters, watt-meters, signal generators and oscilloscopes, experiments are designed to illustrate basic electrical circuit theory concepts for linear and non-linear DC circuits, simple time-invariant circuits, and single-phase and three-phase linear AC circuits.


### *Instrumentation and Measurement Laboratory*

Facilities for undergraduate education and training in electrical and electronic measurements and instrumentation.

### *Telecommunications Laboratory*

Equipped with analogue and digital communication kits, measuring instruments, signal generators and analyzers for undergraduate courses. There are also many HF to UHF frequency range transmitters and receivers.

### *Control Systems Laboratory*

Provides experimental facilities to help students grasp the theory and applications of feedback control systems. The equipment includes electro-pneumatic sets, electro-hydraulic sets, servo systems, a computer based servo fundamental training system, DC servo mechanism and other electronic apparatus that can be used as basic elements to construct open- or closed-loop systems of various orders. The set-up allows for a number of experiments to demonstrate techniques of system modeling, analysis and design in control engineering.

## *Electronics Laboratory*

Well equipped for undergraduate electronics experiments, this laboratory is used to familiarize students with electronic devices, amplifiers and analogue and digital electronic circuits. It also provides facilities for undergraduate and graduate research projects.

## *Electrical Machines and Power Electronics Laboratory*

Equipped for experiments on all types of rotating AC and DC machines, stepper motors, universal motors and single and three-phase transformers. Facilities are available for testing and measuring motor characteristics. Several types of generalized machine sets are available for undergraduate and graduate research studies. This laboratory is also equipped with several sets and rectifier/inverter units suitable for undergraduate power electronics experiments.

## *Microprocessor Laboratory*

Provides facilities for performing experiments on microprocessors and single-board microcomputers. The equipments include microprocessor development and training sets based on the true 16-bit 8086 microprocessor. The training sets incorporate RS232 serial port, two programmable peripheral interface (PPI), programmable interval timer (PIT) and programmable interrupt controller (PIC) chips. Application boards can be connected to the microprocessor training boards to provide real time interfacing by using the following I/O units: optical fiber receiver/transmitter, optical speed/position sensor, numerical keypad, heater/temperature sensor, dc motor, LED displays and speakers.

## *Logic Circuit Design Laboratory*

Intended for teaching the fundamentals of combinational and sequential logic circuits. The equipment includes a logic analyzer, several boards with power supplies, clock generators and LED displays.

## *Microwave and Antenna Laboratory*

Equipped with microwave and antenna training sets including gun oscillators, waveguide and wave propagation equipment sets, waveguide matching, lecher lines, transmitting antenna, receiving antenna and complex antenna systems for undergraduate courses.

## *Undergraduate Computer Laboratories*

There are two general purpose undergraduate computer labs housing a total of 50 PC based networked systems. These workstations allow access to the Departmental Lab and student server machine. A variety of engineering software is accessible from these workstations. Internet access is available from all workstations. A networked printing facility is also available. Lab classes or individual student study are available using these facilities. Late opening of these facilities is provided.

## *Computer Networks Research and UNIX Laboratory*

A laboratory/research facility intended to support graduate computer network studies and provide a platform for research and development in these areas. Several networking simulation software including OPNET is available in this laboratory for teaching and research. It also has 10 PC based Linux systems for UNIX and networking undergraduate laboratory studies.

## *Simulation Computer Laboratory*

A separate computer based simulation laboratory is provided which provides a platform consisting of 25 networked PCs for student based term projects as well as formal teaching of Integrated Circuit Design courses. A number of engineering software is available including the Xilinx Software for VLSI Design.

## *Multimedia Enabled Teaching Laboratories (MMETL)*

There are two general-purpose multimedia enabled teaching laboratories with a total of 52 networked multimedia PCs. A platform for Internet access and data projection system is available for technology based teaching to undergraduate and graduate classes.

## *Undergraduate Project Laboratory*

This is a new facility made available for student graduation projects. It houses number of equipment including testing, measurement, prototyping (breadboards) and PC based interfacing for project implementation.

## *Graduate Computer Research Laboratory*

Housing the departmental local area network servers and the Unix server, this laboratory is intended to provide a general purpose research center with wider computational facilities. It also incorporates 3 Unix workstations, 10 fast Pentium and other PCs including some with CD-ROM devices and two laser printers.

## *DSP and Multimedia Laboratory*

The DSP laboratory is intended to serve the undergraduate students in their courses and project related work. The lab is designed to provide services to students in three groups. These are the Signals and Systems course, which is a core course, Introduction to Digital Signal Processing, which is a technical elective and any multimedia systems related technical electives. The Lab will enable the students in these classes to acquire data (image, speech etc.) in digital format and provide them with the means to process their data using software tools such as MATLAB ® or C programming language. TI based TMS320 DSP hardware platforms are also available for practical implementations.

## *High Voltage Laboratory*

High Voltage Laboratory serves as independent, non-industrial, university center for high voltage engineering. The mission of the Laboratory includes research, evaluation, testing and education activities. The laboratory is equipped with 100 kV, 5 kVA test transformer, 100 kV, 5 kVA, 50 Hz AC test set, 140 kV, 20 mA DC test set.

# OTHER FACILITIES

## *IEEE Student Branch*

IEEE EMU student branch was established in January 1995 and currently has approximately 100 members from the Departments of Electrical and Electronic Engineering and Department of Computer Engineering as well as other related disciplines. It is the center of the information exchange between members of the Institute of Electrical and Electronics Engineering students in Eastern Mediterranean University.

## *Electronic Club*

The electronic club is established by the students in the department in order to share knowledge, experience and enthusiasm. The club has a dedicated office, which contains books, electronic parts and testing and monitoring equipment for the practical works of the students. The club creates an environment where the students can get together to talk about their profession and exchange views on different projects.


## *EESTEC (Electrical Engineering Students' European Association)*

The Electrical Engineering STudents' European assoCiation (EESTEC) is an organization of and for electrical engineering and computer science students from universities, institutes or technical schools in Europe that award an engineering degree. It was founded in Eindhoven, the Netherlands in 1986. Since 1995 it is a recognized association seated in Zürich, Switzerland. From year 2002 the EESTEC seat returned to the Netherlands, but now in Delft. A Local Committee is a local branch of EESTEC International. Currently there are 39 LCs in more than 20 countries with over 1700 members.

## *Student Representatives Office*

Through a democratic election system the students elect their representatives in the department. The student representatives are given opportunities to reflect the problems and requests of the students to the departmental administration. The student representations' Office is allocated for the use of the student representatives and all the students.

## *Multimedia Enabled Classrooms (MMEC)*

The department has 5 MMECs that use the latest instructional technology.

## *Departmental Library*

This is a Departmental Library is managed by the IEEE Student Branch in collaboration with the department and houses IEEE periodicals as well as a limited number of books.

It has a photo copying facility and an internet enabled PC for Library search operations. It also provides a quiet area for individual study.

## *EEE Amphitheater (Seminar/Conference Hall)*

A fully equipped modern amphitheater is available within the departmental building. This facility seats 150 people and is used mainly in seminar courses as well as seminar/conferences.

# THE BACHELOR OF SCIENCE (BS) IN BIOMEDICAL ENGINEERING

Biomedical Engineering program is developed in coordination with Electrical and Electronic Engineering, Biological Sciences, Mathematics, Physics and Chemistry Departments as well as Faculty of Health Sciences and Medicine. Biomedical Engineering is a state-of-the-art interdisciplinary program which provides a common platform for collaboration among engineering, natural and medical sciences. In this context, electrical, electronic, computer and mechanical engineers collaborate with biologists, medical doctors and pharmacists for healthier future of humanity. Specializations, concentrations, streams or options within the program are possible with 4 Area Elective Courses.

Students are required to successfully complete forty three courses including compulsory Graduation Design Project Proposal (BMED405) and Graduation Design Project (BMED406) in their last two semesters. Furthermore, they are required to complete at least forty working days of summer training in industry. The courses are distributed in eight semesters through four academic years, and core courses are taught at the rate of seventy hours per course, where about a quarter of this time is spent in laboratories. Successful candidates are awarded the degree of Bachelor of Science (BS) in Biomedical Engineering.

***Credit Rating:*** Each course is assigned a credit rating, e.g. (4,1) 4; where the first digit represent the weekly number of lecture hours, the second digit the weekly number of laboratory or tutorial hours the course entails and the final digit the number of credit hours allocated to the course for the semester.

## CURRICULUM

The **Biomedical Engineering** curriculum is based on the sound foundations of the ABET accreditation obtained by the Electrical and Electronic Engineering curriculum in its basic engineering approach. The curriculum, which is prepared in accordance with the ABET criteria, is given in the proceeding section.

# BIOMEDICAL ENGINEERING CURRICULUM

| First Year: Fall Semester | | | | | | |
|---|---|---|---|---|---|---|
| **Ref Code** | **Course Code** | **Full Course Title** | **Credit** | | | |
| | | | **Lec** | **Lab** | **Tut** | **Tot** |
| 2M711 | BIOL124 | Introduction to Molecular Biology and Genetics | 2 | 3 | 4 | 3 |
| 2M712 | CHEM101 | General Chemistry | 4 | 1 | 0 | 4 |
| 2M713 | PHYS101 | Physics -I | 4 | 1 | 0 | 4 |
| 2M714 | MATH151 | Calculus - I | 4 | 0 | 1 | 4 |
| 2M715 | ENGL191 | Communication in English I | 3 | 0 | 1 | 3 |
| | | | | | **Tot. Cr.** | **18** |
| **First Year: Spring Semester** | | | | | | |
| 2M721 | BMED102 | Introduction to Biomedical Eng. | 0 | 1 | 0 | 0 |
| 2M722 | EENG112 | Introduction to Programming | 4 | 1 | 0 | 4 |
| 2M723 | CHEM106 | Organic Chemistry | 4 | 1 | 0 | 4 |
| 2M724 | MATH152 | Calculus II | 4 | 0 | 1 | 4 |
| 2M725 | PHYS102 | Physics II | 4 | 1 | 0 | 4 |
| 2M726 | ENGL192 | Communication in English II | 3 | 0 | 1 | 3 |
| | | | | | **Tot. Cr.** | **19** |
| **Second Year: Fall Semester** | | | | | | |
| 2M731 | MDCN271 | Introduction to Human Anatomy and Physiology | 4 | 1 | 0 | 4 |
| 2M732 | EENG115 | Introduction to Logic Design | 4 | 1 | 0 | 4 |
| 2M733 | MATH241 | Linear Algebra with Differential Equations | 4 | 0 | 1 | 4 |
| 2M734 | INFE221 | Electrical Circuits | 4 | 1 | 0 | 4 |
| 2M735 | PHYT207 | Biomechanics and Kinesiology – I | 2 | 0 | 0 | 2 |
| | | | | | **Tot. Cr.** | **18** |

| Second Year: Spring Semester | | | | | | |
|---|---|---|---|---|---|---|
| 2M741 | BIOL260 | Human Biology and Biotechnology | 3 | 0 | 0 | 3 |
| 2M732 | MATH252 | Mathematical Methods for Engineers | 4 | 0 | 1 | 4 |
| 2M743 | PHYT206 | Biomechanics and Kinesiology – II | 2 | 0 | 0 | 2 |
| 2M744 | EENG226 | Signals and Systems | 4 | 1 | 0 | 4 |
| 2M745 | EENG234 | Electromagnetics | 4 | 1 | 0 | 4 |
| 2M746 | TUSL181 | Communication in Turkish (Other Students ) | 2 | 0 | 0 | 2 |
| | HIST280 | History of Turkish Reforms (Turkish Students) | | | | |
| | | | | | **Tot. Cr.** | **19** |
| **Third Year: Fall Semester** | | | | | | |
| 2M751 | CHEM339 | Biomaterials | 3 | 0 | 1 | 3 |
| 2M752 | INFE242 | Electronics | 4 | 1 | 0 | 4 |
| 2M753 | BMED327 | Biomedical Instrumentation-I | 4 | 1 | 0 | 4 |
| 2M754 | MATH322 | Probability and Statistical Methods | 3 | 0 | 1 | 3 |
| 2M755 | UE01 | University Elective – I | 3 | - | - | 3 |
| | | | | | **Tot. Cr.** | **17** |
| **Third Year: Spring Semester** | | | | | | |
| 2M761 | BMED328 | Biomedical Instrumentation-II | 4 | 1 | 0 | 4 |
| 2M762 | BIOL216 | Cellular and Molecular Physiology | 3 | 3 | 0 | 4 |
| 2M763 | EENG420 | Digital Signal Processing | 4 | 1 | 0 | 4 |
| 2M764 | UE02 | University Elective – II | 3 | - | - | 3 |
| 2M765 | ENGL201 | Communication Skills | 3 | 0 | 1 | 3 |
| | | | | | **Tot. Cr.** | **18** |
| **Forth Year: Fall Semester** | | | | | | |
| 2M771 | BMED405 | Grad. Design Project Proposal | 1 | 0 | 1 | 1 |
| 2M772 | BMED403 | Summer Training | 0 | 0 | 0 | 0 |
| 2M773 | BMED434 | Biomedical Imaging | 4 | 1 | 0 | 4 |
| 2M774 | UE03 | University Elective – III | 3 | - | - | 3 |
| 2M775 | AE01† | Area Elective – I | 4 | - | - | 3 or 4 |
| 2M776 | AE02 † | Area Elective – II | 4 | - | - | 3 or 4 |
| 2M777 | ECON231 | Fundamentals of Economics | 3 | 0 | 0 | 3 |
| | IENG420 | Fundamentals Engineering Economy | | | | |
| | IENG450 | Industrial Management | | | | |
| | | | | | **Tot. Cr.** | **17 to 19** |

| Forth Year: Spring Semester | | | | | | |
|---|---|---|---|---|---|---|
| 2M781 | BMED406 | Graduate Design Project | 1 | 4 | 0 | 3 |
| 2M782 | AE03 † | Area Elective – III | 4 | - | - | 3 or 4 |
| 2M783 | AE04 † | Area Elective – IV | 4 | - | - | 3 or 4 |
| 2M784 | BIOL414 | Systems Biology | 3 | 1 | 0 | 3 |
| 2M785 | IENG355 | Ethics in Engineering | 3 | 0 | 0 | 3 |
| | | | | | **Tot. Cr.** | **15 to 17** |

† : Area Elective Courses (AE). There are 4 AE courses, which are technical electives offered by the Electrical and Electronic Engineering Department, Computer Engineering Department and Department of Biological Sciences.

# A. Electives

## i. University Elective (UE) Courses

The Biomedical Engineering Program requires students to take four University Elective courses, which are Humanities/Art/Social Sciences Electives. These courses may be chosen based on the student's personal interests. The courses are chosen from the global list of University Electives according to the ABET guidelines satisfying the humanities and/or arts, and social sciences requirements. The list of available UE courses which are within the ABET guidelines is declared at the beginning of each registration period. One of the UE courses (UE03) is selected among the Economics, Finance, and Management courses offered by the departments of Business, Economy and Industrial Engineering.

## ii. Area Elective Courses (AE)

The Area Elective Courses are grouped for various areas of specialized study. Further specialized courses may be added as required. The Department generally announces which courses will be offered at the beginning of each semester. Students are expected to take Technical Elective Courses which are offered by the Electrical and Electronic Engineering Department, Computer Engineering Department and Department of Biological Sciences. The table below gives the list of the AE courses available.

### Semesters 7-8: Area Electives (4 courses)

| Course Code | Course Title | Credit | | | |
|---|---|---|---|---|---|
| | | Lec | Lab | Tut | Tot |
| BMED448 | Biomedical Nanotechnology | 4 | 1 | 0 | 4 |
| BMED469 | Biomedical Image Processing | 4 | 1 | 0 | 4 |
| BMED475 | Biomedical Cybernetics | 4 | 1 | 0 | 4 |
| BMED481 | Rehabilitation Engineering | 4 | 1 | 0 | 4 |
| BMED491 | Biosensors | 4 | 1 | 0 | 4 |
| BMED499 | Modeling and Control of Physiological Systems | 4 | 1 | 0 | 4 |
| BIOL412 | Immunology | 3 | 3 | 0 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| BIOL413 | Developmental Biology | 3 | 3 | 0 | 4 |
| BIOL416 | Bioethics of Genetics and Genomics | 3 | 0 | 0 | 3 |
| BIOL426 | Reproductive Biology | 3 | 0 | 0 | 3 |
| BIOL434 | Advanced Molecular Biotechnology | 3 | 0 | 0 | 3 |
| EENG320 | Control Systems I | 3 | 0 | 1 | 3 |
| EENG410 | Microprocessors I | 4 | 1 | 0 | 4 |
| EENG428 | Introduction to Robotics | 4 | 1 | 0 | 4 |
| EENG431 | Computational Methods in Electrodynamics | 4 | 1 | 0 | 4 |
| EENG432 | Microwave Theory & Design | 4 | 1 | 0 | 4 |
| EENG433 | Microwave Applications | 4 | 1 | 0 | 4 |
| EENG441 | Industrial & Power Electronics | 4 | 1 | 0 | 4 |
| EENG447 | Digital Integrated Circuit Design | 4 | 1 | 0 | 4 |
| MENG353 | Fluid Mechanics | 4 | 1 | 0 | 4 |
| EENG449 | Digital System Design | 4 | 1 | 0 | 4 |
| CMPE423 | Embedded System Design | 4 | 1 | 0 | 4 |
| CMPE 461 | Artificial Intelligence | 4 | 1 | 0 | 4 |

## B. Final Year Project (BMED405/406)

Students are required to do a practical design project in their final year of study. BMED405 and BMED406 are two consecutive courses that involve the introductory study, the practical implementation, testing and analysis of the project. The projects are assessed on the bases of a project proposal submitted to project supervisor, project report and the presentation of the project before a departmental jury.

### i. BMED405: Graduation Design Project Proposal

This is a one-credit course that can be taken in the 7th academic semester. It forms a preparation phase for the INFE406. Students are expected to familiarize with their projects, carry out literature survey and prepare materials, study components and relevant standards before the implementation phase in the following semester.

### ii. BMED406: Graduation Design Project

Design and practical works oriented projects will be given to students with an aim to stimulate application of theoretical knowledge to practical situations. BMED406 can be taken in the 8th academic semester. It provides experience in designing and implementing systems within multiple realistic constraints using conventional materials, components, equipment and software. Projects should be implemented conforming to relevant standards, ethical issues and environmental policies. (Prerequisite: BMED405)

## C. Additional Requirements

Further academic rules and regulations can be obtained through the departmental web page (http://www.ee.emu.edu.tr) and university's "Rules and Regulations" web page (http://mevzuat.emu.edu.tr/).

## D. Summer Training (BMED403)

In partial fulfillment of graduation requirements, each student is required to complete 40 working days of training during the summer vacations, normally at the end of the junior year, in accordance with rules and regulations set by the Department. Summer training involves full-time work experience in industry in the area of student career interest. A formal report and evaluation by work supervisor required. Prerequisite: Junior standing and consent of department

## E. Transfer

Students may transfer to the department from other universities (external transfer) or from other departments within the EMU (internal transfer). Transfer applications are made to the Transfer Committee of the department through the EMU Registrar's Office.

# F. Short Course Descriptions

## BMED102: Introduction to Biomedical Engineering (1,0) 0

A series of seminars are held in current topics and areas of specialization in Biomedical Engineering. Speakers are invited from different departments of EMU or other International Universities, Industry and Consulting firms, to deliver seminars in all aspects of biomedical engineering that are not normally covered in lectures. These include, safety at work, standards, quality control, engineering ethics, etc (Prerequisite: None)

## EENG112: Introduction to Programming (4,1) 4

Internal data representation, integers, reals, characters. Problem solving and algorithm design. Program structures. Sequencing, selection and iteration. Pseudo-code, flow-charts and other techniques. High-level programming environments. Variables, expressions and assignments. Introducing C programming. Structured programming; sequential, selective and repetitive structures. Function definition and function calls. Prototypes and header files. Recursive functions. Arrays and pointers. Dynamic memory management. Parameter passing conventions. Multi-dimensional arrays. Conditional compilation, modular programming and multi-file programs. Exception handling. File processing. Formatted I/O. Random file access. Index structures and file organization. (Prerequisite: None)

## EENG115: Introduction to Logic Design (4,1) 4

Variables and functions. Boolean algebra and truth tables. Logic gates, Karnaugh maps. Incompletely specified functions, Multilevel logic circuits. Tabular minimization. Number representation. Arithmetic circuits. Binary codes. Programmable logic devices. Multiplexers, decoders and encoders. Synchronous sequential circuits, flip-flops, synchronous counters. (Prerequisite: Non)

## INFE221: Electrical Circuits (4,1) 4

Circuit variables and circuit elements. Some circuit simplification techniques. Techniques of circuit analysis. The operational amplifiers. The natural and step response of RL and RC circuits. Natural and step responses of RLC circuits. Sinusoidal steady-state analysis. Introduction to the Laplace Transform. The Laplace Transform in circuit analysis. (Prerequisite: MATH151)

## EENG226: Signals and Systems (4,1) 4

Continuous-time and discrete-time signals and systems. Linear time-invariant (LTI) systems: system properties, convolution sum and the convolution integral representation, system properties, LTI systems described by differential and difference equations. Fourier

series: Representation of periodic continuous-time and discrete-time signals and filtering. Continuous time Fourier transform and its properties: Time and frequency shifting, conjugation, differentiation and integration, scaling, convolution, and the Parseval's relation. Representation of aperiodic signals and the Discrete-time Fourier transform. Properties of the discrete-time Fourier transform. (Prerequisites: INFE221)

## EENG234: Electromagnetics (4,1) 4

Static electric fields in vacuum, electric potential, conductors, static electric fields in material medium, dielectrics, polarization, dielectric boundary conditions, capacitance, static magnetic fields in vacuum, magnetic materials, magnetization, magnetic boundary conditions, inductance, magnetic vector potential, dynamic fields and Maxwell's equations, wave equations in free space and homogeneous media, plane waves, reflection and transmission at planar interfaces, time and frequency domain analysis of waves in transmission line circuits. (Prerequisites: MATH152, PHYS102)

## INFE242: Electronics (4,1) 4

Semiconductor devices, basic amplifier concepts, diodes, P-N junction diodes, Schottky diodes, Bipolar Junction Transistors (BJTs), Field-Effect Transistors: MOSFETs, JFETs, transistor biasing. (Prerequisite: INFE221)

## BMED327: Biomedical Instrumentation-I (4,1) 4

Basic biomedical instrumentation and physiological concepts. Basic sensors and principles: biological signals, biosensors, transducers, bioelectrodes. Amplifiers and signal processing: op amps, active filtering, impedance matching. Biopotentials: origin of biopotentials: ECG, EMG, EEG and MEG. Biopotential electrodes and amplifiers. Measurement of blood flow and pressure. (Prerequisite: INFE221)

## BMED328: Biomedical Instrumentation-II (4,1) 4

Measurement of flow and volume of blood. Cardiovascular system and hemodynamics. Respiratory system, measurements of the respiratory system. Chemical biosensors. Clinical laboratory Instrumentation. Processing of biological signals. Biomedical imaging systems. Therapeutic and prosthetic devices. Electrical hazards, electrical safety and bioethics.( Prerequisites: BMED327)

## BMED403: Summer Training (0,0) 0

In partial fulfilment of graduation requirements, each student is required to complete 40 continuous working days of training during the summer vacations, normally at the end of the junior year, in accordance with rules and regulations set by the Department. Special attention should be given to most but not necessarily all of the following areas of training: production, operation, maintenance, management and safety. A formal report describing the projects the student was involved in is to be submitted. (Prerequisites: DC)

## BMED405: Graduation Design Project Proposal (0,1) 1

This is a course that can be taken in the 7th academic semester. It forms a preparation phase for the BMED406 Graduation Design Project and it involves a design project proposal. Students are expected to familiarize themselves with their projects, carry out literature survey and prepare materials, study components and relevant standards before the implementation phase in the following semester. (Prerequisites: DC)

## BMED406: Graduation Design Project (0,3) 3

Design and practical works-oriented projects will be given to students with an aim to stimulate application of theoretical knowledge to practical situations. The Graduation Design Project can be taken in the 8th academic semester. It provides experience in designing and implementing systems within multiple realistic constraints using conventional materials, components, equipments and software. Projects should be implemented conforming to relevant standards, ethical issues and environmental policies. (Prerequisites: BMED405)

## EENG420: Digital Signal Processing (4,1) 4

Overview of digital signals and systems. Frequency and time representation of sampling, decimation, interpolation. Z-transform: Evaluation, region of convergence (ROC) and properties. Discrete time system structures: tapped delay line and lattice structures. Fast Fourier Transform (FFT). Digital filter design: Finite impulse response (FIR), infinite impulse response (IIR), windowing, Hilbert transform. (Prerequisites: EENG226)

## EENG434: Biomedical Imaging (4,1) 4

Fundamentals of X-ray. Interactions between X-rays and matter. Generation and detection of X-rays. X-ray diagnostic methods. Conventional X-ray radiography. Computed tomography. X-ray image characteristics. Fundamentals of acoustic propagation. Generation and detection of ultrasound. Ultrasonic diagnostic methods. Ultrasonic transmission methods and transmission tomography. Fundamentals of nuclear medicine. Generation and detection of nuclear emission. Radionuclide generators. Radionuclide imaging systems. Fundamentals of nuclear magnetic resonance. Generation and detection of NMR signal. The magnet, magnetic field gradients, the NMR coil / probe. Data acquisition. Imaging methods. Slice selection, frequency encoding, phase encoding, spin-echo imaging. Biological effects of magnetic fields. (Prerequisite: EENG234)

## BMED448: Biomedical Nanotechnology (4,1) 4

Introduction to nano, Nano-biomimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterisation of nanomaterials. DNA nanotechnology, Protein & glyco nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications. Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing. Nanotechnology in point-of-care diagnostics, Nanopharmacology & drug targeting, Cellular uptake mechanisms of nanomaterials, In vitro methods to study antibacterial and anticancer properties of nanomaterials, Nanotoxicology. (Prerequisite: None)

## BMED469: Biomedical Image Processing (4,1) 4

Sources of biomedical images: X-ray, computed tomography, magnetic resonance imaging, ultrasound, nuclear medicine and molecular imaging. Fundamental concepts in medical image processing: histogram processing, image enhancement in spatial and frequency domain, image restoration. Image Analysis: image segmentation, feature extraction and classification, 3D visualization, statistical metrics on medical images. Medical applications: computer aided detection/diagnosis, tumor imaging, angiography and brain imaging. (Prerequisites: EENG420)

## BMED475: Biomedical Cybernetics (4,1) 4

Applications of biological cybernetics; Functional properties of the basic units in neural and cellular systems; Gross feedback and feedforward control in simple organisms; Evolution of nervous systems; Different brains and their relative merits; Models for the activity of the brain; Mechanisms involved in the storage and retrieval of information; Models for the control systems in the cell ; Gross biological processes; Biological machines; Directed processes; Decision-making processes; Pattern and intelligence; The application of digital technologies to medicine , healthcare and wellbeing. (Prerequisite: None)

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## BMED481: Rehabilitation Engineering (4,1) 4

The term rehabilitation, Engineering concepts in sensory rehabilitation, Engineering concepts in speech rehabilitation, orthotic and prosthetic devices, wheelchair technologies, neural prosthetics based on functional electrical stimulation (FES), transfemoral prosthesis, visual system rehabilitation technologies, audio rehabilitation. (Prerequisite: None)

## BMED491: Biosensors (4,1) 4

An introduction to the field of biosensors and an in-depth and quantitative view of device design and performance analysis. An overview of the current state of the art to enable continuation into advanced biosensor work and design. Topics emphasize biomedical, bioprocessing, environmental, food safety, and biosecurity applications. (Prerequisite: None)

## BMED499: Modeling and Control of Physiological Systems (4,1) 4

The human body is a fascinating interconnection of organ systems that work together in complex ways. One aspect of bioengineering aims to utilize quantitative techniques to understand the function of the human body, both for basic science research as well as for diagnosis and treatment of disease. This course will introduce the basic concepts and tools for modeling physiological systems using engineering analogies, and discuss several practical applications. The course will involve hands-on modeling using JSIM, an intuitive physiological modeling tool. (Prerequisite: None)

## BIOL413: Developmental Biology (3,0) 4

The aim of the course to provide information on embryonic development. Cell division and differentiation, cell interactions during organ development are presented. Basic genetic mechanisms effective during development of organism are covered. (Prerequisite: None)

## BIOL416: Bioethics of Genetics and Genomics (3, 0) 3

The aim of the course is to provide detailed information about ethical, legal and social dimensions of genetics and genomics from various perspectives. (Prerequisite: None)

## CHEM101: General Chemistry (4,1) 4

Atoms, molecules and ions. Mass relations in chemistry. Gasses. The ideal gas law, partial pressures, mole fractions, kinetic theory of gases, electronic structure and periodic table. Thermochemistry, calorimetry, entalpy. The first law of thermodynamics. Liquids and solids. Solutions. Acids and bases. Organic chemistry. (Prerequisites: None)

## PHYS101: Physics I (4,1) 4

Physical quantities and units. Vectors kinematics of motion. Newton's laws of motion and their application. Work-energy theorem. Impulse and momentum. Rotational kinematics and dynamics. Static equilibrium. (Prerequisites: None)

## PHYS102: Physics II (4,1) 4

Kinetic theory of ideal gases. Equipartition of energy. Heat, heat transfer and heat conduction. Laws of thermodynamics, applications to heat engine cycles, Coulombs law and electrostatic fields. Gauss's law. Electric potential. Magnetic fields. Amperes law. Faraday's law. (Prerequisites: PHYS101)

## CHEM106: Organic Chemistry (4,1) 4

This course is designed to provide a fundamental overview of organic chemistry to students of biomedical engineering. Upon successful completion of this class, students will understand the relationship between structure and function of molecules, the major classes of reactions, reaction energetics and mechanisms, synthesis of organic compounds, and how to determine structure via various spectroscopic techniques. Several themes are prevalent in each unit of study: nomenclature, chemical and physical properties, structures, mechanisms, common molecules, and the diversity of organic molecules in plants, bacteria, and animals. The course also integrates the societal, pharmaceutical or industrial importance of specific compounds. (Prerequisites: CHEM101)

## BIOL124: Introduction to Molecular Biology and Genetics (2 ,0 ) 3

The course aims to introduce molecular biology and genetics. Mendel genetics and applications are presented besides molecular bases of modern genetics. Chemical structures of genetically important molecules, DNA and RNA, and other chromosome structures are covered. Transmission genetics, heredity and mutations are presented with gene expression and control. (Prerequisites: None)

## MATH150: Calculus with Precalculus (4,1) 4

Sets, set operations and numbers. Polynomials, factorization, equations and root finding. Real axis, labeling integers, rationals and some irrationals on the number axis. Cartesian coordinates. Lines. Graphs of equations and quadratic curves. Functions and graphs of functions. Limits and continuity. Derivatives. Rules of differentiation. Higher order derivatives. Chain rule. Related rates. Rolle's and the mean value theorem. Critical Points. Asymptotes. Curve sketching. Integrals. Fundamental Theorem. Techniques of integration.

Definite integrals. Application to geometry and science. Indeterminate forms. L'Hospital's Rule. Improper integrals. Infinite series. Geometric series. Power series. Taylor series and binomial series. (Prerequisites: None)

## MATH151: Calculus I (4,1) 4

Limits and continuity. Derivatives. Rules of differentiation. Higher order derivatives. Chain rule. Related rates. Rolle's and the mean value theorem. Critical Points. Asymptotes. Curve sketching. Integrals. Fundamental Theorem. Techniques of integration. Definite integrals. Applications of integrals. Indeterminate forms. L'Hospital's Rule. Improper integrals. (Prerequisites: None)

## MATH152: Calculus II (4,1) 4

Vectors in R3. Lines and Planes. Functions of several variables. Limit and continuity. Partial differentiation. Chain rule. Tangent plane. Critical Points. Global and local extrema. Lagrange multipliers. Directional derivative. Gradient, Divergence and Curl. Multiple integrals with applications. Triple integrals with applications. Triple integral in cylindrical and spherical coordinates. Line, surface and volume integrals. Independence of path. Green's Theorem. Conservative vector fields. Divergence Theorem. Stokes' Theorem. (Prerequisites: MATH151)

## TUSL181: Turkish as a Second Language (2,0) 2

TUSL181 is a basic Turkish course introducing the Turkish language. It incorporates all four language skills and provides an introduction to basic grammar structures. Students will be encouraged to develop their writing skills through a variety of tasks. The aim of this course is for students to be able to understand and communicate in everyday situations, both in the classroom and in a Turkish speaking environment. (Prerequisites: None)

## HIST280: History of Turkish Reforms (2,0) 2

This course is for Turkish students only. The aim of the course is to introduce the Ottoman Empire’s situation at the 19. Century, Trablus and Balkan Wars, I. World War and its consequences, Turkish Independence War, Mudanya Treaty, Lausanne Treaty, and Principles of Ataturk. (Prerequisites: None)

## ENGL191: Communication in English- I (3,1) 3

ENGL 191 is a first semester freshman academic English course. It is designed to help students improve the level of their English to B1 level, as specified in the Common European Framework of Reference for Languages. The course connects critical thinking with language skills and incorporates learning technologies such as Moodle. The purpose of the course is to consolidate students’ knowledge and awareness of academic discourse, language structures and lexis. The main focus will be on the development of productive (writing and speaking) and receptive (reading) skills in academic settings. (Prerequisites: None)

## ENGL192: Communication in English- II (3,1) 3

This course is designed to further help students improve their English to B2 level, as specified in the Common European Framework of References for Languages. The course aims to reconsolidate and develop students? knowledge and awareness of academic

discourse, language structures, and critical thinking. The course also incorporates use of technologies such as MOODLE. The course will focus on reading, writing, listening, speaking and introducing documentation, and will also focus on presentation skills in academic settings. (Prerequisites: ENGL191)

## ENGL201: Communication Skills (3,0) 3

ENGL 201 is a Communication Skills course for students at the Faculty of Engineering. The course aims to introduce a range of skills, including effective written and oral communication, research skills and study skills. Throughout the course the students will be involved in project work, intended to help them in their immediate and future academic and professional life. This will include library research, technical report writing and an oral presentation. By investigating a topic of their own choice students will develop an understanding of independent research skills. During the report writing process, students will improve their writing and develop the ability to produce organized, cohesive work. The oral presentation aims to enhance spoken fluency and accuracy and provide training in the components of a good presentation. (Prerequisites: ENGL192)

## PHYT207: Biomechanics and Kinesiology – I (2,0) 2

Biomechanical principles and application area, internal and external force types, stability and balance, biomechanics in rehabilitation; collagen, cartilage, bone, muscle and joint biomechanics, normal and pathological gait. (Prerequisites: None)

## PHYT206: Biomechanics and Kinesiology – II (2,0) 2

Biomechanics and pathomechanics of foot and ankle, knee joint, hip joint, pelvis, spine, shoulder joint, elbow joint, wrist and hand. (Prerequisites: None)

## BIOL216: Cellular and Molecular Physiology (3,3) 4

In this course the basic concepts of physiology and the use of physiology knowledge in the field of molecular biology and genetics are covered. Key functional features of different types of human cells and how they communicate are studied. Specifically, covered topics include homeostasis, cell membranes, membrane transport processes, and transportation of the molecules between the organelles, protein synthesis, vesicular trafficking, endocytosis and exocytosis. (Prerequisites: None)

## MATH241: Ordinary Differential Equations & Linear Algebra (4,1) 4

Systems of linear equations, elementary row operations, Echelon form, Gaussian elimination method; Matrices; Determinants, Adjoint and Inverse matrices, Cramer's rule; Vector spaces, linear independence, Bases and Dimension, eigenvalue problem. First-order differential equations, Separable differential equations, change of variables, Exact differential equations; Second-order differential equations, the method of undetermined coefficients, the Variation of parameters method; General results of First-order linear systems, homogeneous constant coefficient vector differential equations, variations of parameters for linear systems; Laplace transform method. (Prerequisites: MATH151)

## MATH252: Mathematical Methods for Engineers (4,1) 4

Complex numbers. Algebra of complex numbers. Polar representation. Complex functions. Limits and continuity. Analyticity. Analytic functions. Cauchy-Riemann equations. Line

integrals. Cauchy integral formula. Isolated singularities. Residue theorem. Numerical error. Solution of nonlinear equations. Convergence. Solution of linear systems of equations: direct and iterative methods. Interpolation. Curve fitting. Numerical differentiation and integration. (Prerequisites: MATH1152 & MATH241)

## BIOL260: Human Biology and Biotechnology (3,0) 3

Introduction to human biology and biotechnology; the Interdisciplinary study of human biology involving genetics, evolution, physiology, anatomy, epidemiology, ecology and nutrition as well as biotechnology. Basic anatomical and functional characteristics of the organ systems; Common diseases of the organ systems; Epidemiology and transmission of relevant disease; the foundations of modern biotechnology; An overview of recombinant DNA technology; the common methods and applications of biotechnology in the fields of medicine, and more specifically, genomic medicine; Ethical considerations. (Prerequisites: None)

## MDCN271: Introduction to Human Anatomy and Physiology (4,1) 4

This course is planned to provide a basic overview of human anatomy and physiology. After completion of the course, students will have a general understanding of the human body and its structural organization. Organ systems related to biomedical engineering are emphasized to provide the students with applicable knowledge on musculoskeletal, nervous, cardiovascular, respiratory, digestive, urinary and endocrine systems. (Prerequisites: None)

## MATH322: Probability and Statistical Methods (3 ,1) 3

Introduction to probability and statistics. Operations on sets. Counting problems. Conditional probability and total probability formula, Bayes' theorem. Introduction to random variables, density and distribution functions. Expectation, variance and covariance. Basic distributions. Joint density and distribution function. Descriptive statistics. (Prerequisites: MATH151)

## CHEM339: Biomaterials (3,1) 3

Introduction to Biomaterials; History and Present Day Status, the Interdisciplinary Nature of Biomaterials Science. Classes of Materials used in Medicine; Polymers, Metals, Ceramics, Hydrogels, Degradable and Resorbable Materials, Composites. Basic Testing Methods of Bulk and Surface Properties of Materials. Biological Responses to Biomaterials. Biocompatibility; the Concept and Evaluation of Biocompatibility. Biodegradation; Degradation of Materials in the Biological Environment. An overview of Fundamental Applications of Biomaterials; Cardiovascular Devices, Orthopedic and Dental Implants, Opthalmologic Applications, Wound Dressings, Sutures, Medical Biosensors, Drug Delivery Systems, Tissue Engineering Systems. Ethical Issues in Biomaterials and Medical Devices. (Prerequisites: CHEM101)

## MENG353: Fluid Mechanics (4,1) 4

Fluid static's and forces on submerged bodies Introduction to kinematics of fluid flow. Energy, continuity and momentum equations. Navier-Stokes equations. Viscous flow through closed conduits. Fundamentals of boundary layer analysis. Dimensional analysis. Potential flow. Introduction to hydraulic machinery. (Prerequisites: MATH241)

## BIOL412: Immunology (3,3) 4

Molecular basics of immunology, cell structure and function of immune system, molecular rearrangements and diversity in cells of the immune system, antibody development and variations besides molecular level control of immune system. (Prerequisites: MATH241)

## BIOL414 : Systems Biology (3,1) 3

This course aims to cover cellular networks and their bio-molecular dynamics. Different network patterns are presented. Computer driven models of biochemical systems are studied. (Prerequisites: None)

## IENG420: Engineering Economy (3,0) 3

An introduction to the basics of economic analysis for decisions in engineering design, in manufacturing, in manufacturing equipment, and in industrial projects. Time value of money. Cash flow analysis. Cost of capital. Return on investment. Elements of cost and cost estimation. Break-even analysis. Decision making among alternatives. Effects of depreciation. Taxes. Replacement analysis. Inflation. Prerequisite: senior standing, [Offered only to non-IE Engineering students]

## IENG450: Industrial Management (3,0) 3

This is a service course offered to senior non-IE engineering students. The aim is to prepare the engineering graduates to assume positions in industry as engineering managers. The topics covered include the historical development of industrial management, functions of technology management, managing technological change, managing engineering projects, and managing the engineering career. Prerequisite: senior standing, [Offered only to non-IE engineering students]

## IENG350: Ethics (3,1) 3

This course is designed to introduce moral rights and responsibilities of engineers in relation to society, employers, colleagues and clients. Analysis of ethical and value conflict in modern engineering practice. Importance of intellectual property rights and conflicting interests. Ethical aspects in engineering design, manufacturing, and operations. Cost benefit-risk analysis and safety and occupational hazard considerations. Prerequisite: consent of instructor [Offered also as a service course to non-IE engineering students]

## G. Scholastic Status

### (a) Satisfactory Students

A student is considered successful at the end of a semester, if the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) are at least 2.00 out of 4.00.

### (b) Honor and High Honor Students

Students registered to the normal course load of a program in a department and scores a GPA between 3.00 and 3.49 is designated an 'Honor', if the GPA is between 3.50 and 4.00 is designated a 'High Honor'.

### (c) Success for Undergraduate Programs (registered after 2007-08)

Students enrolled in an undergraduate program whose CGPA's are specified below are considered as 'successful', 'on probation' or 'unsuccessful'.

| End of Academic Term (**EAT**) | **Successful** Student | Students **On Probation** | **Unsuccessful** Student |
|---|---|---|---|
| 1st EAT | - | - | - |
| 2nd EAT | CGPA ≥1.50 | 1.00 ≤ CGPA< 1.50 | CGPA< 1.00 |
| 3nd EAT | CGPA ≥1.50 | 1.00 ≤ CGPA< 1.50 | CGPA< 1.00 |
| 4th EAT | CGPA ≥1.50 | 1.00 ≤ CGPA< 1.50 | *** |
| 5th EAT | CGPA ≥1.80 | 1.50 ≤ CGPA< 1.80 | CGPA< 1.50 |
| 6th EAT | CGPA ≥1.80 | 1.50 ≤ CGPA< 1.80 | CGPA< 1.50 |
| 7th EAT | CGPA ≥1.80 | 1.50 ≤ CGPA< 1.80 | CGPA< 1.50 |
| 8th and more EAT | CGPA ≥2.00 | 1.80 ≤ CGPA< 2.00 | CGPA< 1.80 |

*** Students who completed a minimum of 4 academic semesters (if the fourth semester is Spring Semester, then at the end of the Summer School) and who have a CGPA below 1.00 are dismissed from the program.

### (d) Registration of Students on "Probation"

Students who are "on probation" are obliged to repeat failed courses before registering for the new ones. The students are allowed to register for two new courses at most, on the condition that they do not exceed normal course load. (Students who wish to register in summer school or who have the part-time status are allowed to register only for one new course).

### (e) Registration of "Unsuccessful" Students

Students who are with "unsatisfactory" status are not allowed to register for a new course. During registration, these students must first register in the courses from which they received the grades: F, NG or D-. However, in the case that the courses from which (F), (NG) or (D-) grades were obtained are not offered, or the student's course

load being under the specified limit, the student can repeat courses from which a (D), (D+) or (C-) grade was obtained until the normal course load is met. Courses with (W) grades are considered as new and cannot be registered.

## (f) Course Withdrawal

In a semester, a student is allowed to withdraw from two registered courses at most, provided that the student does not get into part-time status. Course withdrawal should be done between the set dates specified on the academic calendar. The course instructor should be informed and recommendation of the academic advisor and the approval of the Department Chair or School Director are necessary. A student who withdraws from a course will receive the grade 'W'. This grade is not taken into consideration during the calculation of the CGPA and the GPA, but appears on the transcript.

## (g) The Letter Grades

Performance of a student for each course registered, is evaluated by the Course Instructor as a letter grade given below.

| Grade | Grade Point Equivalent | Description |
|---|---|---|
| A | 4.0 | Pass |
| A- | 3.7 | Pass |
| B+ | 3.3 | Pass |
| B | 3.0 | Pass |
| B- | 2.7 | Pass |
| C+ | 2.3 | Pass |
| C | 2.0 | Pass |
| C- | 1.7 | Conditional Pass |
| D+ | 1.3 | Conditional Pass |
| D | 1.0 | Conditional Pass |
| D- | 0.7 | Failure |
| F | 0.0 | Failure |
| NG | 0.0 | Nil Grade |
| S | - | Satisfactory |
| U | - | Unsatisfactory |
| I | - | Incomplete |
| W | - | Withdrawal |

A student who receives A, A-, B+, B, B-, C+, C, C-, D+, D or S from a course is considered to have succeeded in that course.

# E. Double Measure Programs

Eastern Mediterranean bylaws allow the outstanding Biomedical Engineering students to get a second undergraduate diploma by applying to the Double Measure Programs, http://mevzuat.emu.edu.tr/5-1-7-Rules-Doublemajorprgs.htm.

The department offers Biomedical Engineering - Electrical and Electronic Engineering Double Major Program to outstanding Biomedical Engineering students.