جامعة الإمام عبدالرحمن بن فيصل
IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY
College of Engineering كلية الهندسة

Bachelor of Science in Biomedical Engineering

Study Plan

2017 – 1439

IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY COLLEGE OF ENGINEERING BIOMEDICAL ENGINEERING DEPARTMENT

BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING STUDY

PLAN

1438H (2017G)

Contents

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Vision:

Innovating nationally and internationally as a leader department in education excellence, industry partnership, quality basic and applied research in biomedical engineering.

Mission:

Enriching the bioengineering paradigm with highly qualified, well-trained and solid basis graduates to enhance the profession of biomedical engineering in healthcare.

Program Educational Objectives:

The program educational objectives (PEOs) for Biomedical Engineering program reflects University of Dammam (CoE and BMED) mission(s). They are important for successful professional practice and the ability to pursue advanced degrees. The Biomedical Engineering Departmental Program with its various constituents discussed in successive meetings the ABET requirements for the development of the Program Educational Objectives (PEOs) by focusing on the main elements of the university's mission such as: creative knowledge, research and professional community services. All those elements are the key focus-points of PEOs of the program and those PEOs can help us to envision the future of our prospective and current students. After several departmental meetings, the department, with help and consultation of its constituents, had approved the PEOs.

The graduates of the Biomedical Engineering program will attain the following during a few years after graduation:

1. Meet the expectations of their employers in the biomedical engineering field or in other professional careers.
2. Pursue postgraduate degrees in biomedical engineering or other disciplines.
3. Practice the profession as responsible engineers to advance community healthcare system.

Student Outcomes:

The BMED has met, studied and discussed ABET Engineering Accreditation Commission "a"- to-"k" general criteria Student Outcomes (SOs) and the program criteria and came to the conclusion that ABET outcomes a-k along with program criteria sufficiently meet the program requirements. The Department adopted SOs "a"-to-"k" with the program criteria in a department meeting as prescribed in ABET report. The SOs along with program criteria are constitute a predetermined set of competencies that students should demonstrate at the time of graduation. These competencies are accomplished through various courses taken by the students during the course of the program. However, performance measures would have to be specified for all SOs to make them measurable and relevant to the Biomedical Engineering program. Before graduation, students of the Imam Abdulrahman Bin Faisal University's Biomedical Engineering program will demonstrate:

a. An ability to apply knowledge of mathematics, science, and engineering;
b. An ability to design and conduct experiments, as well as to analyze and interpret data;

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

d. An ability to function on multidisciplinary teams;

e. An ability to identify, formulate, and solve engineering problems;

f.   An understanding of professional and ethical responsibility;

g. An ability to communicate effectively;

h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;

i.   A recognition of the need for, and an ability to engage in life-long learning;

j.   A knowledge of contemporary issues; and

 k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

1.   BSc. Program Curriculum

Biomedical Engineering program consists of four years (136credits) plus a preparatory year (32 credits), during which a student takes courses in English language, math, physics, computer skills, learning and searching skills, and basic design studios . Language of instruction is English because a program graduate will end up working within international team and because English is the language of the profession.

One credit is translated into 50 minutes of lecturing and 100 minutes of practical/laboratory. The program is distributed among eight semesters after the preparatory year. The first two semesters are common to all programs and are dedicated basic sciences and engineering such as calculus, physics, chemistry, engineering drawing, and computer programming. The sequence of courses with detailed information is listed in Table 1 and in Tables 2-1 to 2-9 below:

COLLEGE OF ENGINEERING

BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING

Study Plan

جامعة الإمام عبدالرحمن بن فيصل
IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY

Table 1: Biomedical Engineering B.Sc. Curriculum
Total Credit Hours 168: (32 Preparatory + 136 Program)

1st Year: Preparatory		2nd Year: Freshman		3rd Year: Sophomore		4th Year: Junior		5th Year: Senior	
1st Semester	2nd Semester	1st Semester	2nd Semester	1st Semester	2nd Semester	1st Semester	2nd Semester	1st Semester	2nd Semester
General English Language (IP)	General English Language (7 Cr)	Faith Morals (2 Cr)	Calculus II (4 Cr)	Economic System in Islam (2 Cr)	Political System in Islam (2 Cr)	Technical Writing (2 Cr)	Research Methodology (1 Credit)	Professional Practice & Ethics (2 Cr)	Social System in Islam (2 Cr)
Math I (3 Cr)	English for Academic and Specific Purpose (3 Cr)	Library Skills (1 Cr)	Physics II (4 Cr)	Oral Communication & Public Speaking (1 Cr)	Physiology & Anatomy for Engineers (3 Cr)	Probability and Statistics (3 Cr)	Engineering Economics (2 Cr)	Project Management (1 Credit)	Global Business Culture (2 Cr)
Basic Design Studio (1) (3 Cr)	Math II (3 Cr)	English Composition (3 Cr)	Computer Programming (2 Cr)	Differential Equations (3 Cr)	Linear Algebra (3 Cr)	Fluid Dynamics (2 Cr)	Intr. To Communication Systems & Networks (2 Cr)	Design of Medical Devices (2 Cr)	Senior Design Project II (4 Cr)
Learning & Searching Skills (2 Cr)	Basic Design Studio (2) (3 Cr)	General Chemistry (3 Cr)	Engineering Drawings (3 Cr)	Biology for Engineers (3 Cr)	Biochemistry and Molecular Biology (2 Cr)	Digital Design (3 Cr)	Biomedical Instrumentation Design (3 Cr)	Senior Design Project I (2 Cr)	Elective II ** (3 Cr)
Physical Education (1 Cr)	Physics (3 Cr)	Calculus I (4 Cr)	Statics (3 Cr)	Dynamics (2 Cr)	Electronic Devices & Circuits (3 Cr)	Biomaterials (2 Cr)	Microprocessors (3 Cr)	Control Systems in BME (3 Cr)	Elective III ** (3 Cr)
	Communication Skills (2 Cr)	Physics I (4 Cr)		Electrical Circuits (3 Cr)	Thermodynamics (3 Cr)	Biomed. Electronics & Measurement (3 Cr)	Safety & Maintenance in Healthcare (2 Cr)	Biomedical Equipment (4 Cr)	Elective IV ** (3 Cr)
	Computer Skills (2 Cr)	Introduction to Engineering (1 Cr)		Advanced Computer Programming (2 Cr)	Foundation of Biomechanics (2 Cr)	Signals & Systems in BME (3 Cr)	Numerical Methods (3 Cr)	Elective I ** (3 Cr)	
(9 Cr)	**(23 Cr)**	**(18 Cr)**	**(16 Cr)**	**(16 Cr)**	**(18 Cr)**	**(18 Cr)**	**(16 Cr)**	**(17 Cr)**	**(17 Cr)**
					Summer Training I * (0 Credit)		Summer Training II * (0 Credit)		

Out of 136 Credits: Humanities: 18 Credits (13%)   Basic Sciences: 39 Credits (29%)   Engineering: 79 Credits (58%)

* Taken during following summer   ** The selection of technical elective course should be done under the supervision of the student advisor.
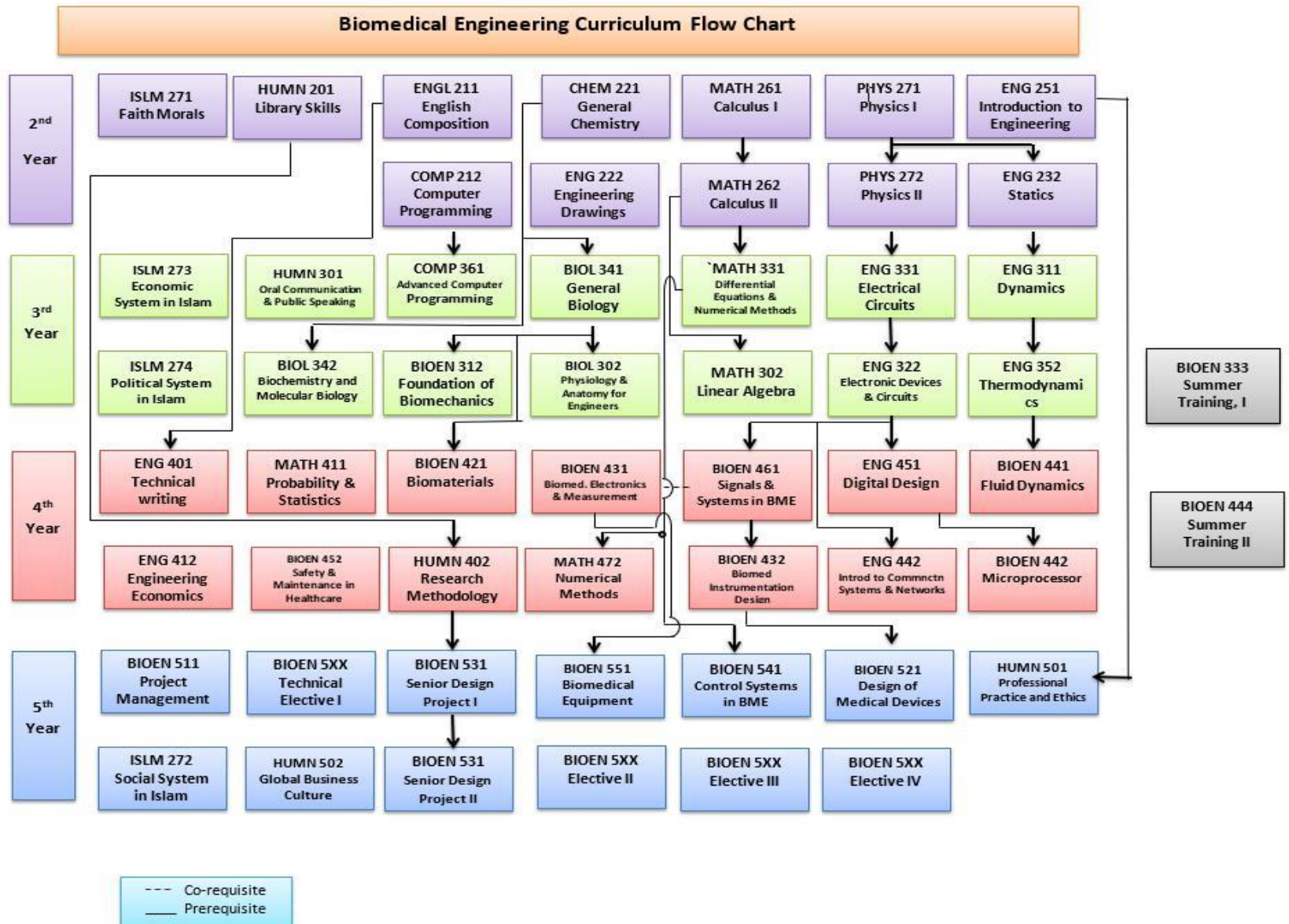
Biomedical Engineering Curriculum Flow Chart

2nd Year

- ISLM 271 Faith Morals
- HUMN 201 Library Skills
- ENGL 211 English Composition
- CHEM 221 General Chemistry
- MATH 261 Calculus I
- PHYS 271 Physics I
- ENG 251 Introduction to Engineering

- COMP 212 Computer Programming
- ENG 222 Engineering Drawings
- MATH 262 Calculus II
- PHYS 272 Physics II
- ENG 232 Statics

3rd Year

- ISLM 273 Economic System in Islam
- HUMN 301 Oral Communication & Public Speaking
- COMP 361 Advanced Computer Programming
- BIOL 341 General Biology
- `MATH 331 Differential Equations & Numerical Methods
- ENG 331 Electrical Circuits
- ENG 311 Dynamics

- ISLM 274 Political System in Islam
- BIOL 342 Biochemistry and Molecular Biology
- BIOEN 312 Foundation of Biomechanics
- BIOL 302 Physiology & Anatomy for Engineers
- MATH 302 Linear Algebra
- ENG 322 Electronic Devices & Circuits
- ENG 352 Thermodynamics
- BIOEN 333 Summer Training, I

4th Year

- ENG 401 Technical writing
- MATH 411 Probability & Statistics
- BIOEN 421 Biomaterials
- BIOEN 431 Biomed. Electronics & Measurement
- BIOEN 461 Signals & Systems in BME
- ENG 451 Digital Design
- BIOEN 441 Fluid Dynamics

- ENG 412 Engineering Economics
- BIOEN 452 Safety & Maintenance in Healthcare
- HUMN 402 Research Methodology
- MATH 472 Numerical Methods
- BIOEN 432 Biomed Instrumentation Design
- ENG 442 Introd to Commnctn Systems & Networks
- BIOEN 442 Microprocessor
- BIOEN 444 Summer Training II

5th Year

- BIOEN 511 Project Management
- BIOEN 5XX Technical Elective I
- BIOEN 531 Senior Design Project I
- BIOEN 551 Biomedical Equipment
- BIOEN 541 Control Systems in BME
- BIOEN 521 Design of Medical Devices
- HUMN 501 Professional Practice and Ethics

- ISLM 272 Social System in Islam
- HUMN 502 Global Business Culture
- BIOEN 531 Senior Design Project II
- BIOEN 5XX Elective II
- BIOEN 5XX Elective III
- BIOEN 5XX Elective IV

--- Co-requisite
____ Prerequisite

Table 2-1: Biomedical Engineering Curriculum - First Year – Preparatory

1ˢᵗ Semester			
Course #	**Course Title**	**Cr & Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
ENGL 101	General English Language*	7 ; 15 ; 5 (IP)	Admission
MATH 111	Math I	3 ; 3 ; 0	Admission
ARCH 121	Basic Design Studio (1)	3 ; 0 ; 4	Admission
LRSK 141	Learning & Searching Skills	2 ; 2 ; 0	Admission
PHEDU 162	Physical Education	1 ; 0 ; 2	Admission
	Total Credits & Contact Hours:	**9 ; 21 ; 11**	
2ⁿᵈ Semester			
Course #	**Course Title**	**Cr & Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
ENGL 101	General English Language*	7 ; 8 ; 0	Admission
ENGL 102	English for Academic and Specific purpose	3 ; 12; 0	ENGL 101
MATH 112	Math II	3 ; 3 ; 0	MATH 111
ARCH 122	Basic Design Studio (2)	3; 0 ; 4	ARCH 121
PHYS 132	Physics	3 ; 3 ; 0	Admission
LRSK 142	Communication Skills	2 ; 2 ; 0	Admission
COMP 131	Computer Skills	2 ; 0 ; 4	Admission
	Total Credits & Contact Hours:	**23 ; 28 ; 08**	

Cr: Credit Hours   Lc: Lecture Hours;   Tr: Tutorial Hours;   Lb: Laboratory Hours
*: General English Language course is on annual basis.

Table 2-2: Biomedical Engineering Curriculum - Second Year – Freshman

1st Semester			
Course #	**Course Title**	**Cr & Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
ISLM 271	Faith Morals	2 ; 2 ; 0	None
HUMN 201	Library Skills	1 ; 0 ; 2	None
ENGL 211	English Composition	3 ; 3 ; 0	None
CHEM 221	General Chemistry	3 ; 2 ; 2	None
MATH 261	Calculus I	4 ; 3 ; 2	None
PHYS 271	Physics I	4 ; 3 ; 2	None
ENG 251	Introduction to Engineering	1 ; 0 ; 2	None
Total Credits & Contact Hours:		**18 ; 13 ; 10**	
2nd Semester			
Course #	**Course Title**	**Cr & Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
MATH 262	Calculus II	4 ; 3 ; 2	MATH 261
PHYS 272	Physics II	4 ; 3 ; 2	PHYS 271
COMP 212	Computer Programming	2 ; 1 ; 2	None
ENG 222	Engineering Drawings	3 ; 1 ; 4	None
ENG 232	Statics	3 ; 3 ; 0	PHYS 271
Total Credits & Contact Hours:		**16 ; 11 ; 10**	

Cr: Credit Hours   Lc: Lecture Hours;   Tr: Tutorial Hours;   Lb: Laboratory Hours

Table 2-3: Biomedical Engineering Curriculum - Third Year – Sophomore

1st Semester			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
ISLM 273	Economic System in Islam	2 ; 2 ; 0	None
HUMN 301	Oral Communication & Public Speaking	1 ; 0 ; 2	None
MATH 331	Differential Equations	3 ; 2 ; 2	MATH 262
ENG 311	Dynamics	2 ; 2 ; 0	ENG 232
BIOL 341	Biology for Engineers	3 ; 2 ; 2	CHEM 221
ENG 331	Electrical Circuits	3 ; 2 ; 2	PHYS 272
COMP 361	Advanced Computer Programming	2 ; 1 ; 2	COMP 212
	Total Credits & Contact Hours:	**16 ; 11 ; 10**	

2nd Semester			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-requisite**
ISLM 274	Political System in Islam	2 ; 2 ; 0	None
MATH 302	Linear Algebra	3 ; 2 ; 2	MATH 262
BIOL 302	Physiology & Anatomy for Engineers	3 ; 2 ; 2	BIOL 341
BIOL 342	Biochemistry and Molecular Biology	2 ; 1 ; 2	CHEM 221
ENG 322	Electronic Devices & Circuits	3 ; 2 ; 2	ENG 331
ENG 352	Thermodynamics	3 ; 3 ; 0	ENG 311
BIOEN 312	Foundation of Biomechanics	2 ; 1 ; 2	BIOL 341
	Total Credits & Contact Hours:	**18; 13 ; 10**	

1st Summer Training – One Month			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
BIOEN 333	Summer Training I	0 ; 0 ; 0	Dpt Consent

Cr: Credit Hours   Lc: Lecture Hours;   Tr: Tutorial Hours;   Lb: Laboratory Hours

Table 2-4: Biomedical Engineering Curriculum - Fourth Year – Junior

1st Semester			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
ENG 401	Technical Writing	2 ; 2 ; 0	ENGL 211
MATH 411	Probability & Statistics	3 ; 2 ; 2	None
BIOEN 441	Fluid Dynamics	2 ; 1 ; 2	ENG 352
ENG 451	Digital Design	3 ; 2 ; 2	ENG 322
BIOEN 421	Biomaterials	2 ; 2 ; 0	BIOL 341
BIOEN 431	Biomed. Electronics & Measurement	3 ; 2 ; 2	CR: BIOEN 461
BIOEN 461	Signals & Systems In BME	3 ; 2 ; 2	ENG 322
	Total Credits & Contact Hours:	**18 ; 13 ; 10**	

2nd Semester			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-requisite**
HUMN 402	Research Methodology	1 ; 1 ; 0	HUMN 201
ENG 412	Engineering Economics	2 ; 2 ; 0	None
ENG 442	Introduction to Communication Systems & Networks	2 ; 2 ; 0	ENG 322
BIOEN 432	Biomed Instrumentation Design	3 ; 2 ; 2	BIOEN 461
BIOEN 442	Microprocessors	3 ; 2 ; 2	ENG 451
BIOEN 452	Safety & Maintenance in Healthcare	2 ; 2 ; 0	None
MATH 472	Numerical Methods	3 ; 3 ; 0	MATH 331
	Total Credits & Contact Hours:	**16; 14 ; 4**	

2nd Summer Training – Two Months			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
BIOEN 444	Summer Training II	0 ; 0 ; 0	Dpt Consent

Cr: Credit Hours   Lc: Lecture Hours;   Tr: Tutorial Hours;   Lb: Laboratory Hours

Table 2-5: Biomedical Engineering Curriculum - Fifth Year – Senior

1st Semester			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-Requisite**
HUMN 501	Professional Practice and Ethics	2 ; 2 ; 0	ENG 251
BIOEN 511	Project Management	1 ; 1 ; 0	None
BIOEN 521	Design of Medical Devices	2 ; 1 ; 2	BIOEN 432
BIOEN 531	Senior Design Project I	2 ; 0 ; 4	HUMN 402
BIOEN 541	Control Systems in BME	3 ; 2 ; 2	ENG 331
BIOEN 551	Biomedical Equipment	4 ; 3 ; 2	BIOEN 431
BIOEN 5xx	Technical Elective I*	3 ; Varies	**
	Total Credits & Contact Hours:	**17 ;** Varies	

2nd Semester			
Course #	**Course Title**	**Cr Cont Hrs** Cr ; Lc ; Tr/Lb	**Pre-requisite**
ISLM 272	Social System in Islam	2 ; 2 ; 0	None
HUMN 502	Global Business Culture	2 ; 2 ; 0	None
BIOEN 532	Senior Design Project II	4 ; 0 ; 8	BIOEN 531
BIOEN 5xx	Elective II*	3 ; Varies	**
BIOEN 5xx	Elective III*	3 ; Varies	**
BIOEN 5xx	Elective IV*	3 ; Varies	**
	Total Credits & Contact Hours:	**17 ;** Varies	

Cr: Credit Hours   Lc: Lecture Hours;   Tr: Tutorial Hours;   Lb: Laboratory Hours

* Selection of technical electives should be done under the supervision of the student advisor.

** Specific course pre-requisite should be fulfilled.

Table 2-6: Biomedical Engineering Curriculum – Electives (All are 3 Credit Hours)

Electives (All are 3 Credit Hours)		
Course #	**Course Title**	**Pre-Requisite**
BIOEN 503	Digital System Design	Dpt Consent
BIOEN 513	Biomedical Digital Signal Processing	Dpt Consent
BIOEN 533	Digital Control Systems	Dpt Consent
BIOEN 523	Biomedical Electromagnetic	Dpt Consent
BIOEN 585	Medical Laser	Dpt Consent
BIOEN 595	Entrepreneurial Issues in Biomedical Engineering	Dpt Consent
BIOEN 506	Advanced topics in Biomedical Engineering	Dpt Consent
BIOEN 553	Biomedical Imaging Systems	Dpt Consent
BIOEN 563	Medical Image Processing & Communication	Dpt Consent
BIOEN 573	MRI	Dpt Consent
BIOEN 583	Ultrasound	Dpt Consent
BIOEN 593	X-ray and CT	Dpt Consent
-BIOEN 504	Introduction to Biomedical Optics	Dpt Consent
BIOEN 514	Bio-Optical Imaging	Dpt Consent
BIOEN 554	Software Engineering	Dpt Consent
BIOEN 564	Networks & Distributed Processing	Dpt Consent
BIOEN 594	Introduction to Safety Engineering	Dpt Consent

* Selection of technical electives should be done under the supervision of the student advisor.
** Specific course pre-requisite should be fulfilled.

Course Catalogue

2.1 Second Year Courses (Freshman)

Second Year - First Semester

ISLM 271: Faith in Morals

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: None

This course covers the definition of the Islamic faith, its status, its characteristics, and levels of religion: Islam, faith, and charity. It also covers the belief in God Almighty: the unification of Godliness, the unification of divinity, and the testimony that there is no god but God: its meaning, its conditions, its elements, and worship: its definition, types, conditions and elements, and the unification of names and attributes. Faith in angels, books, apostles, and the Last Day, and judgment and power will be studied. the course will highlight the warning of the shortcomings of faith: the biggest shirk, the greatest disbelief, the greater hypocrisy, and the danger of atonement. The course will cover the faith's tenders: smaller polytheism, infidelity, hypocrisy, and sin. The obligation of respecting the companions of the Prophet (Sallallahu Alaihi wa Sallam) and his family, and the duty of obedience to the rulers of the matter, and the prohibition of exiting them will all be studied. Finally, the course will show the statement of loyalty and innocence in Islam, and the warning of innovation.

HUMN 201: Library Skills

Credit Hours: 1 Lectures: 0 Lab/Practical: 2 Prerequisite: None Distinguish among various library and information resources, recognize citation elements, search databases, use print indexes, locate books in a classified system. Use of libraries and information sources, both print and electronic, including locations and services of the University Library with an emphasis on basic library research tools and information literacy concepts. Library skills. Library research. Brainstorming. Library orientation. Call Numbers. Library cataloguing & Classification System (Library of

Congress & Dewey Decimal). General care and maintenance of books and other library. Library language. Finding a book using the library computer. Introduction to Databases and efficient use of it for research purposes.

ENGL 211: English Composition

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: None

This course will enable the student to improve his ability to write expository essays. The course topics include: Investigation of topic-selection processes, development of thesis statements, outlining as it relates to support for a selected thesis statement, both in sentence and slug-style, and practice and emphasis on critical thinking skills.

CHEM 221: General Chemistry

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: None

This course will introduce the student to the basic vocabulary used in different branches of chemistry, and to major concepts in the field (e.g. stoichiometry, thermochemistry, …) with emphasis on problem solving. The course topics include: Chemical foundations (units of measurement, uncertainty in measurement, significant figures and calculations, dimensional analysis, temperature, density, classification of matter); Atoms, molecules and ions, fundamental chemical laws, atomic structure, periodic table and periodicity; Nomenclature of compounds, percent composition, determining the formula of a compound, type of reactions and stoichiometry of reaction and calculations; Solution and solubility, properties of solutions, strong and weak, electrolytes, acid–base reactions, oxidation–reduction reactions, balancing oxidation–reduction equations, titrations; Molecular theory of gases, gas laws, effusion and diffusion, real gases, chemistry in the atmosphere; Thermochemistry, enthalpy and calorimetry, Hess's law; General concept of bonding and types of chemical bonding in molecules and ions. Basic concepts of organic chemistry including polymers.
Laboratory: Qualitative and quantitative aspects of general chemistry.

MATH 261: Calculus I

Credit Hours: 4	Lectures: 3	Lab/Practical: 2	Prerequisite: None

To introduce students to the basic concepts and methods of Calculus. Topics include: Functions and graphs, polynomials, exponential, logarithmic and trigonometric functions, Limits, continuity, and differentiability of functions of one variable. Techniques of differentiation. Implicit Differentiation. Local extrema, first and second derivative for local extrema. Concavity and inflection points. Curve sketching. Applied extrema problems. L'Hopital's rule, and applications. Integration, definite and indefinite integrals, fundamental theorem of calculus, integration by substitution, integration by parts, improper integrals, and applications.

PHYS 271: Physics I

Credit Hours: 4	Lectures: 3	Lab/Practical: 2	Prerequisite: None

This is an introductory course in Classical Mechanics. PHY 271 is the first of a two-semester general physics course. The primary subject of this course is Mechanics. Topics includes motions in multiple dimensions, vectors, forces and the laws of motion, circular motion, energy, momentum, and rotational motion. Elements of this subject material are found in all parts of nature. This is a four-credit hour course.

ENG 251: Introduction to Engineering

Credit Hours: 1	Lectures: 0	Lab/Practical: 2	Prerequisite: None

This course is designed to allow students to explore engineering through case studies, and problem-solving using computers. Students will learn about the various aspects of the engineering profession and acquire both technical skills and non-technical skills. The course topics include: Engineering profession, broad overview of the different fields of engineering, including professional societies and their student chapters, professional licensing and registration, professional codes of ethics, introduction to engineering design, and problem solving techniques. Students learn design, teamwork, written and oral communication skills through participation in a conceptual design project.

Second Year - Second Semester

MATH 262: Calculus II

Credit Hours: 4	Lectures: 3	Lab/Practical: 2	Prerequisite: MATH 261

The course topics include: Analytic geometry in calculus, polar coordinates, area in polar coordinates, tangent lines and arc length, conic sections. Three dimensional space, vectors, parametric equations of lines and planes. Vector-valued functions, unit tangent, normal and binomial vectors, curvature. Partial derivatives, limits and continuity, chain rule, directional derivatives, gradients, maxima and minima of functions of two variables, Lagrange multipliers. Multiple integrals, double and triple integrals.

PHYS 272: Physics II

Credit Hours: 4	Lectures: 3	Lab/Practical: 2	Prerequisite: PHYS 271

This is an introductory course in Electricity and Magnetism. PHY 272 the second course in the calculus-based physics sequence covering introductory electricity and magnetism. Topics include Coulomb's Law, electric fields, Gauss' Law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's Law and induction. This is a four-credit hour course.

COMP 212: Computer Programming

Credit Hours: 2	Lectures: 1	Lab/Practical: 2	Prerequisite: None

This course aims at the provision of the concepts of algorithm, programming language, and program and developing basic problem solving skills to the learner. The course topics include: Overview of computer programming and programming languages (machine, assembly and High-level languages). Programming principles of algorithm and flow of control, including sequential execution, selection, iteration, and subroutine. Basics of a typical programming language (e.g. Matlab). Introduction to computer methods and algorithms for analysis and solution of engineering problems using numerical methods in a workstation environment (Numerical integration, roots of equations, simultaneous equation solving and matrix analysis).

ENG 222: Engineering Drawings

Credit Hours: 3	Lectures: 1	Lab/Practical: 4	Prerequisite: None

Students are introduced to fundamentals of engineering graphics and drawings (lines, curves and polygons) with the basics of manual drafting techniques and the use of drafting equipment, visualization of engineering drawing views or sections (plan, elevation and side view) from three dimensional isometric shapes such as machines and civil works, and principles of computer aided drafting and modeling using AutoCAD. Practice in creating and evaluating typical designs drawn from different specialty areas that include steel structures (components and connections), mechanical and electrical works.

ENG 232: Statics

Credit Hours: 3	Lectures: 3	Lab/Practical: 0	Prerequisite: PHYS 271

This course enable the students to learn the tools necessary to have a deeper understanding of the principles of applied mechanics and the modeling of force systems in engineering statics. The course topics include: Analysis of forces on engineering structures (particles and rigid bodies) in equilibrium. Properties of forces, moments, couples, and resultants. Equilibrium conditions, friction, evaluation of section properties (centroids, area moments of inertia).

2.2 Third Year Courses (Sophomore)

Third Year - First Semester

ISLM 273: Economics System in Islam

Credit Hours: 2 Lectures: 2 Lab/Practical: 0	Prerequisite: None

This course defines the Islamic economic system, its importance, its characteristics and its origins in ownership in Islamic economic. It also covers the methods of gaining private property, means of property protection, restricted economic freedom, and Economic activity should be legitimate. The course studies the Riba: its definition, its types, its evidence of the prohibition, and its harmful effects. The definition of Al-Gharar and its controls influential with its contemporary examples will be studied. Cheating, Negation, fraud, concealment of defects, contemporary commercial fraud, Facilitator and gambling, Monopolization, pricing, Exaggeration, squandering and extortion will be studied with some examples. The course will cover the intervention of the state in economic activity, social solidarity, banking transactions in the Islamic economy, and the role of the Islamic economy in the treatment of contemporary economic problems.

HUMN 301: Oral Communication and Public Speaking

Credit Hours: 1 Lectures: 1 Lab/Practical: 0	Prerequisite: None

In this course the students will develop their ability to speak confidently and effectively in a variety of public speaking situations. Students will prepare and present several different types of speeches that arts managers are often required to make. Particular attention is paid to style, persuasion, and credibility in public speaking.

MATH 331: Differential Equations

Credit Hours: 3 Lectures: 3 Lab/Practical: 0	Prerequisite: MATH 262

This Course is devoted to the solutions of linear 1st, 2nd and higher order differential equations by using different direct methods; Laplace transforms method, power series method and matrix methods for solving linear differential systems.

BIOL 341: General Biology

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: CHEM 221

This introductory course is designed for biomedical engineering students. It covers the fundamental biological principles and skills. Biological structure and function at the cellular and systemic level is particularly emphasized. The course also establishes the main connections within biology principles with biomedical engineering and its applications. Includes two hours of laboratory sessions illustrating basic laboratory techniques and the structures and functions of the human body's composite systems.

ENG 311: Dynamics

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: ENG 232

In this course the student are introduced to engineering dynamics principles through applications involving problem solving and creation of design solutions to engineering scenarios. The course topics include: Analysis of motions of particles and rigid bodies encountered in engineering in terms of kinematics (position, velocity, acceleration, absolute and relative motion) and kinetics that includes forces, work, energy, impulse, and momentum. Introduction to mechanical vibration.

ENG 331:   Electrical Circuits

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: PHYS 272

Students learn electric circuits techniques for the analysis and simulation of linear electric circuits, and measurements of their properties. The course builds upon the student's background gained in physics and calculus courses and prepares students for learning Electronic devices and circuits, Signals and Systems. The topics include: Models of circuit elements; circuit analysis using Ohm's and Kirchoff's laws; nodal and mesh analysis; Thevenin and Norton equivalent circuits, solution of first and second order circuits; phasor-based solutions to AC circuits; elementary frequency response. Includes laboratory work.

ENG 361: Advanced Computer Programming

| Credit Hours: 2 | Lectures: 1 | Lab/Practical: 2 | Prerequisite: ENG 212 |

This course builds upon the student's background gained in computer programming course (ENG 212). It presents an advanced view of computer programming, mainly using object oriented programming. The course topics include: Introducing the fundamental ideas behind the object-oriented approach to programming; through a computer programming language (e.g C++, Java or Visual Basic). Concentrating on aspects that best demonstrate object-oriented principles and good practice, student will gain a solid basis for further study of object-oriented software development. Student will need to have experience of writing small computer programs, such as that gained through prior study of ENG 202.

Third Year - Second Semester

ISLM 274: Political System in Islam

| Credit Hours: 2 | Lectures: 2 | Lab/Practical: 0 | Prerequisite: None |

In this course, the Islamic political system is defined as well as its Characteristics and objectives. It will cover explanation of the rules of the Islamic political system (Shura - hearing and obedience - justice - freedom). the statement of the pillars of the Islamic state will be covered: Pillar I: the rule of God revealed. The second pillar: commandant and the third pillar: the people.
  In addition, the course will explain the Political authorities in Islam (the regulatory authority - the judiciary - the executive branch) and the ministry in the Islamic state. It covers the warning against regimes contrary to the Islamic political system such as Secularism; liberalism; and Democracy. The course will highlight in details of these regimes including their definition, their bad effects on Islam, and their future in the world. Political globalization will be studied in details to cover its definition. The attitude of secularists, the legitimate rule in globalization, and its future. Finally, Terrorism is the last subject and the course will cover its concept, governance and images of direct terrorism from individuals, organized groups and images of indirect terrorism.

MATH 302: Linear Algebra

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: None

Systems of linear equations, row reduction and echelon forms, solution sets of linear systems, linear transformations. Matrix algebra, matrix operations, inverse of a matrix, matrix factorizations, subspaces of the Euclidean n-space, dimension and rank. Determinants, Cramer's rule. Eigenvalues and eigenvectors, diagonalization. Inner product, length, and orthogonality, Gram-Schmidt process.

BIOL 302: Physiology and Anatomy

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: BIOL 341

This is one semester course designed for biomedical engineering students. It is a study of the function and the structure of human organ systems from an integrative perspective. Systems to be studied include integumentary, skeletal, muscular, cardiovascular, lymphatic, nervous, digestive, endocrine and respiratory systems. In addition, the course will emphasize on developing an understanding of the engineering approach toward understanding biological function. Includes two hours of laboratory sessions which provides a hands-on learning experience for exploration of human system components and basic physiology.

BIOL 342: Biochemistry & Molecular Biology

Credit Hours: 2	Lectures: 2	Lab/Practical: 1	Prerequisite: BIOL 221

The course introduces biomedical engineering students with little background in biology to fundamentals of biochemistry, molecular biology and genetics. Topics include: Physiochemical principles, chemistry of carbohydrates, fats and proteins, minerals, yeasts and vitamins, hormones and hormonal assay and their role in regulating vital functions. Enzymes and enzyme assay, Nucleotides and nucleic acids (DNA & RNA) chemistry and function. Nucleic acid: synthesis, Genetic Code and genetic transcription.

ENG 322: Electronic Devices and Circuits

Credit Hours: 3 Lectures: 2 Lab/Practical: 2	Prerequisite: ENG 331

This course presents a solid foundation for the students in the structure and function of semiconductor devices. Students learn to examine the design of some circuits that utilize these devices. Topics include: Principles of diode, Bipolar Junction Transistor (BJT), and Metal Oxide Semiconductor Field Effect transistor (MOSFET) devices and circuits. Graphical and analytical means of analysis. Linear modeling; amplifiers; digital inverters and logic gates. Biasing and small-signal analysis. Time-domain and frequency domain analysis and design. Operational amplifiers, frequency response, differential amplifier structure and design, active filters and oscillators, and power devices.

ENG 352: Thermodynamics

Credit Hours: 3	Lectures: 3	Lab/Practical: 0	Prerequisite: ENG 311

This course offers basic definitions of thermodynamic systems, control volume, working fluid, processes and cycles, Work, Heat and other types of energy, ideal gas and equation of state, also definition of internal energy, specific heat and enthalpy. Topics include: Pure substance and phase change, thermal equilibrium, phase diagram. First law of thermodynamics for closed and open systems, applications of first law in thermal engineering systems. Heat engine, Heat pump and Refrigerator, Entropy and Second law of thermodynamics. Basic principles of heat transfer, Conduction, Convection, Radiation, and combined modes. Applications of combined heat transfer modes in modern engineering systems. Application of thermodynamic principles in construction and biomedical engineering.

BIOEN 312: Foundation of Biomechanics

Credit Hours: 2   Lectures: 2   Lab/Practical: 0   Prerequisite: BIOL 341

This course provides a background in musculoskeletal anatomy and principles of biomechanics. The course builds on the concepts gained in Statics and Dynamics for human activities from onside , and biology and biochemistry from the other side. Topics include: Introduction about biomechanics and solving biomechanical problems. Modeling human performance (static, quasi- static, and dynamic approaches). The overall loading of the musculoskeletal system during functional activities. Methods of estimation of forces in the joints and muscles and evaluation of the endurance of human tissues under traumatic loading conditions. The course includes basic experiments of biomechanics (testing the mechanical properties of biological tissues)

BIOEN 333: Summer Training I

Credit Hours: 0 Lectures: 0 Lab/Practical: 0 Prerequisite: Dpt Consent In the summer of Sophomore level, every Biomedical Engineering student is obliged to make a summer practice of 20 working days (8 Hours/day) in a specialized workshop either onsite or offsite where students learn to work safely in a workshop. Students are introduced to the use of hand tools, the lathe, the milling machine, drill press, saws, and precision measuring tools. Students should also gain basic skills required to build simple electrical and electronic circuits. Students apply these skills by completing a project. Observations from the summer practice must be documented and presented in the form of a clear and concise technical report.

2.3.Fourth Year Courses (Junior)

Fourth Year - First Semester

ENG 401: Technical Writing

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: ENG 211

This course focuses on effective process of written, oral, and visual technical communication for academic settings. Topics include: Various forms of academic and personal essay-writing. Original essay writing and class criticism and discussion. Model essays and essays on the craft of writing reading and discussion for verbal logic, communicative power, and visceral appeal.

MATH 411: Probability and Statistics

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: None

In this course students will acquire an understanding of probability and statistics through mathematical formulas, and examination of data. Students will apply probability and statistics concepts through class activities and projects related to the engineering field. Topics include: Presentation of data, textual, tabular and graphical, sampling techniques. Measures of central tendency, mean, median, mode. Measures of variation, range, variance, standard deviation. Probability distributions, counting techniques, uniform, binomial, normal, and exponential distributions. Test of hypothesis, test concerning means, variation, and proportion. Analysis of variance, combinatorial mathematics, fundamental principles of counting, binomial theorem.

BIOEN 441: Fluid Dynamics

Credit Hours: 2 Lectures:1 Lab/Practical: 2 Prerequisite: ENG 352 Fundamental concepts of fluid mechanics, fluid properties, fundamentals of fluid statics, fluid dynamics and general equations of motion, types of flow, continuity and Bernoulli equations, flow through pipes and nets, open channel flow, stream-flow measurements and calculations, pumping tests.

ENG 451: Digital Design

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: ENG 322 In this course the students will learn the fundamental concepts, methods of analysis, and design of digital logic devices and systems. Topics include: Boolean algebra, binary numbers, logic gates, introduction to CMOS and TTL logic families, Combinational and sequential Circuit analysis and design, Digital circuit design optimization methods using random logic gates, Multiplexers, Decoders, Registers, Counters, and Programmable Logic Arrays. Design, simulation, and testing of digital circuits using Computer aided tools.

BIOEN 421: Biomaterials

Credit Hours: 2   Lectures: 2   Lab/Practical: 0   Prerequisite: BIOL 341

This course surveys materials intended for medical applications. It also covers specific characteristics related to the selection, processing, and testing (*in vitro* and *in vivo*) of biomaterials (e.g. metals, stainless steel, polymers, ceramics, composites and titanium) in dental, orthopedic, and ophthalmic applications. Properties of biomaterials including; physical and mechanical properties will be covered. Moreover, the course will provide an overview about the interactions between the implant material and the physiological environment (biocompatibility) with an overview about host reaction to biomaterials.

BIOEN 431: Biomedical Electronics and Measurements

Credit Hours: 3 Lectures: 2 Lab/Practical: 2	Co-Requisite: BIOEN 461

Introduces students to the principles that allow engineers to make precise measurements of physiological signals. Students will learn how to interpret and manipulate the output of a sensor in terms of its frequency response and frequency content, how to determine the filtering properties of a circuit. The course topics include: Physiological signals, origin of biopotentials (ECG, EMG, EEG, EOG, ERG…). Biomedical electrodes. Biomedical signal detection, amplifications, and filtering. Electrical safety in medical environment. Measurement and measurement errors. Measurement methods and global static and dynamic characteristics of measuring instrumentation. Includes Electronics and measurements lab:

Electronics part: This part introduces students to the widespread application of electronics and electronic devices in biomedical engineering. Hands-on experimentation related to biomedical applications.

Measurement part: This part introduces students to the measurement of physiological signals. Students will collect and analyze specific signals. Students should demonstrate skills in measurement techniques and potential data analysis.

BIOEN 461: Signals and Systems in BME

Credit Hours: 3 Lectures: 2 Lab/Practical: 2	Prerequisite: ENG 322

This course serves to introduce the students to fundamentals of signal and systems analysis and manipulation and their application in the medical field. This course also reinforces mathematical knowledge in differential calculus and adding universal quantitative analysis tools such as Fourier analysis. The course topics include: Laplace transforms, Fourier (series & integral), convolution and the response of linear systems, frequency response, Bode diagrams and Polar Plots. Sampling, Discrete-time signals; frequency analysis of discrete-time signals, spectral estimation, data records and digital filters; and compression of **biomedical signals** through time-domain and frequency domain coding. Includes laboratory and computational experiences with biomedical applications (e.g Model Based Analysis of Physiological Signals. Modeling the Nerve Action Potential and estimation of signals in noise).

Fourth Year – Second Semester

HUMN 402: Research Methodology

Credit Hours: 1	Lectures: 1	Lab/Practical: 0	Prerequisite: HUMN 201

In this course students learn the tools to be familiar with their theses in terms of research questions and design, methodology, data collection and analysis. Topics include: Research methodology concepts and definition. Research ethics. Problem identification. Research plan preparation. Data gathering and collection. Data presentation and analysis. Design of research report. Case study.

ENG 412: Engineering Economics

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: None

The course is designed to educate the students about the principles of economics when applied to engineering field. Topics include, basic concepts of engineering economics, economic equivalence, time value of money. In this course, students will learn how to formulate single cash-flow, equal payment series and gradient series. Nominal and effective interest rates, debt management. The students will perform analysis on engineering economic projects and will evaluate between different alternatives using traditional engineering economic analysis techniques. Students will learn the concepts of depreciation, income taxes and will prepare simple financial statement while performing the project cash flow analysis.

ENG 442: Introduction to Communication Systems & Networks

Credit Hours:2	Lectures: 2	Lab/Practical: 0	Prerequisite: ENG 322

In this course the students will learn the important methods, architectures, and implementations of communication systems and networks. The course topics include Analysis and design of analog communication systems: AM and FM modulation and demodulation. Noise in AM and FM systems. Digital communication systems: Sampling, quantization and encoding. PCM and

PAM systems. Digital modulation and demodulation/detection techniques. Time and Frequency Division Multiplexing. Probability of error in digital communication systems. Basics of point-to-point, primarily digital, physical-layer communications with sampling, quantization, multiplexing, and modulation theory and design. Presentation and analysis of Elements of local area networks and packet communication at the network services layers.

BIOEN 432: Biomedical Instrumentation Design

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: BIOEN 461

This course introduces the students to the basic design concept required to acquire, process and interpret biological and medically relevant signals. Emphasis is placed on recognizing and accommodating limitations inherent in sensor and their associated electronics. Topics include: design of biomedical instrumentation including different sensor types and their associated electronics. Mathematical models of sensor ranging including resistive sensors and biosensors. The design of the signal conditioning electronics. Practical application on specific cases where students will be able to demonstrate their skills on evaluating a biomedical instruments using MATLAB/LabVIEW/Multisim software..

BIOEN 442: Microprocessors

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: ENG 451

This course is designed to provide the student with a basic understanding of microprocessor operation, programming, interfacing, interrupts, and troubleshooting. Topics include: Microprocessors: architecture- registers- types and function of address, data, and control buses-Clock- Input and output ports- modes of addressing- control unit RISC- Evolution and applications of microprocessors. Microprocessor interfacing: Characteristics of peripheral units- memory (EPROM & RAM) interface- decoders- peripheral programmable interface (8255) serial interface- RS232 protocol –A/D and D/A interface-stepper motor interface- serial to USB conversion- parallel to serial conversion. Includes lab.

BIOEN 452: Safety and Maintenance in Health Care

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: None

A study of codes, standards, and management principles. Emphasis is on the proper use and application of safety test equipment, preventive maintenance procedures, hospital safety. Course topics include: Definition of safety. Electrical, gas, and

fire safety. Safe environment for patients, medical personnel and attendants. Medical Equipment life cycle (Planning,

Acquisition, Test, Maintenance, Decommissioning). Generation of a computer database for equipment, suppliers, dealers and manufacturers (Medical Equipment Record MER). Using Medical Equipment service manual. Preventive maintenance procedures. Corrective maintenance, repair and amendment of existing equipment. Basic troubleshooting principles.

MATH 472: Numerical Methods

Credit Hours: 3	Lectures: 3	Lab/Practical: 0	Prerequisite: MATH 331

This Course is devoted to find the numerical solutions a given function by using several methods such as Fixed- point, Bisection, Fasle, Newton- Raphson and Secant methods. Furthermore, this course is devoted also to find the numerical solutions of systems of linear and non-linear equation by using several methods such as iterative methods of Jacobi, Gauss-Seide, SOR, Qaussian elimination technique and LU- Factorization. Finally, the numerical integration, numerical solutions of first-order differential equations by using Taylor's, Runge-Kutta, Euler's and Admas Bashforth methods and numerical solutions the Parabolic, Hyperbolic and Elliptic partial differential equations will be covered in this course.

BIOEN 444: Summer training II:

Credit Hours: 0	Lectures:0	Lab/Practical: 0	Prerequisite: Dpt Consent

In the summer of Junior level, every Biomedical Engineering student is obliged to make a summer training of 40 working days (8 Hours/day) in a professional institution, laboratory or project design organization doing biomedical engineering applications. Observations from the summer practice must be documented and presented in the form of a clear technical report. Students aiming to specialize in clinical engineering should get some training in hospital-based experience in medical systems, technical knowledge, clinical engineering management, technology assessment, and hospital management. The student work with team members include a physician, nurse, psychologist, physical, occupational, speech , therapists and a social worker. Students aiming to specialize in Rehabilitation engineering should get training under the direct supervision of a professional engineer experienced in rehabilitation engineering, the students learn hand-on engineering approaches to management of head injury,

amputation, and spinal cord injury in out- patient and in-patient rehabilitation. Students are expected to design and build a number of devices meeting rehabilitation needs.

2.4. Fifth Year Courses (Senior)

Fifth Year – First Semester

HUMN 501: Professional Practice and Ethics

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: None

This course examines ethical frameworks and moral issues related to the profession. Topics include: Examination of the non-technical issues dealt with by design professional, including: professional ethics, marketing and business development, professional engagement, personnel and project management, risk management, professional liability insurance, and dispute resolution.

BIOEN 511: Project Management

Credit Hours: 1	Lectures: 1	Lab/Practical: 0	Prerequisite: None

Explanation of the Project Management principles and main tools through the example of a simple four phases Project Life Cycle. The course is compliant with Project Management Institute standard.

BIOEN 521: Design of Medical Devices

Credit Hours: 2	Lectures: 1	Lab/Practical: 2	Prerequisite: BIOEN 432

This multidisciplinary problem based learning module is design to bridge the technical knowledge with the broader practical design and commercial challenges and aims to advance the students' knowledge and skills in the area of medical device design through case studies. It will enable students to develop a critical understanding and awareness of effective implementation strategies for new and emerging technologies utilizing the appropriate design routes.

BIOEN 531: Senior Design Project I

Credit Hours: 2	Lectures: 0	Lab/Practical: 4	Prerequisite: HUMN 402

Individual research in a field of special interest under the supervision of a faculty member as a requirement for the B.Sc. degree, culminating in a written report/thesis. The central goal of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. The Graduation Project is divided between two semesters. Methodology is developed and pre-data are collected in the first semester. Experiment is run, data is analyzed, and conclusions are sought in the second semester

BIOEN 541: Control Systems in BME

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: ENG 331

Introduction to analysis and design of feedback control systems, Classical control theory in the time and frequency domain, Modeling of physical and biological information systems using linear and nonlinear differential equations, Stability and performance of interconnected systems, Use of block diagrams, Bode plots, Nyquist criterion, and Design of feedback controllers.

BIOEN 551 Biomedical Equipment

Credit Hours: 3	Lectures: 3	Lab/Practical: 2	Prerequisite: BIOEN 431

This course covers the principles structure, clinical needs, function and operation of a wide range of medical equipment (diagnostic and therapeutic) that can be found in a clinical environment. Topics include diagnostic and therapeutic equipment: electrocardiograph, pacemakers, external defibrillators, implantable cardioverters defibrillators, heart valves, hemodialysis delivery systems, ventilators, and pulse oximetry. In addition, the course covers equipment's key features from engineering standards.

Fifth Year - Second Semester

ISLM 272: Social System in Islam

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: None

The course will cover the following subjects: the concept of the Muslim community and the foundations of its construction and characteristics, human In Islam (its status, function and rights, in comparison to international conventions), reasons for strengthening social ties, promotion of Virtue and prevention of Vice, the most important social problems and means of prevention and treatment, the importance of the family and its status in Islam, the international conventions against the Muslim right, the status of women in Islam, family protection factors, the sermon and its general provisions, marriage and its purposes and provisions, effects of the marriage contract, marital problems (its causes, effects and treatment), and marriage teams.

HUMN-502: Global Business Culture

Credit Hours: 2	Lectures: 2	Lab/Practical: 0	Prerequisite: None

This course enhances the student's awareness and understanding of cross-cultural communication in a business context and to develop the student's cross-cultural analytical skills. Topics include: Trade, Trade finance management, Logistics and supply chain, e-Business, International marketing and trade compliance. Cultural diversity, cultural awareness for business, global market place, clients' specific business needs, successful interaction with international teams, International Business Skills, Building International Teams, Generic Cultural Awareness, manners, and cross cultural, or intercultural communication. e-Business, International marketing and trade compliance.

BIOEN 532: Senior Design Project II

Credit Hours: 4	Lectures: 0	Lab/Practical: 8	Prerequisite: BIOEN 531

Individual research in a field of special interest under the supervision of a faculty member as a requirement for the B.Sc. degree, culminating in a written report/thesis. The central goal of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. The Graduation Project is divided between two semesters.

Methodology is developed and pre-data are collected in the first semester. Experiment is run, data is analyzed, and conclusions are sought in the second semester.

2.5 Elective Courses

All electives are 3 credits. Lectures and lab/practical credits are to be determined by the instructor, depending on course requirements.

BIOEN 503: Digital System Design

Credit Hours: 3 Lectures: 2 Lab/Practical:2 Prerequisite: Dpt Consent Introduction to digital systems design with hardware description languages (HDL), programmable implementation technologies, electronic design automation design flows, design considerations and constraints, system on a chip designs, digital system design examples and applications. Computer organization and design.

BIOEN 513: Biomedical Digital Signal Processing

Credit Hours: 3 Lectures: 2 Lab/Practical:2 Prerequisite: Dpt Consent The aim of this course is to provide students with a background and understanding of the biomedical digital signal processing. Moreover, a broad overview of state-of-the-art topics and cutting-edge research in the area of digital signal processing in medicine and biology will be presented.

BIOEN 533: Digital Control Systems

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent Analysis and design of digital control systems using state-space techniques. State feedback and observers. Laboratory includes computer simulation and hardware implementation of control laws for electromechanical systems with emphasis into biomedical applications. This course is taught as is for students in "Rehabilitation Engineering" track.

BIOEN 523: Biomedical Electromagnetics

Credit Hours: 3 Lectures: 3 Lab/Practical: 0 Prerequisite: Dpt Consent Electrodynamics based on Maxwell's equations. Energy storage and flow in electromagnetic fields. Transmission lines, waves and radiating systems. Impact of electromagnetic waves on tissue. Cellular effects.

BIOEN 585: Medical Laser

Credit Hours: 3	Lectures: 2	Lab/Practical: 2	Prerequisite: Dpt Consent

Basics: Fundamentals of light, laser terminology, specular and diffuse reflections, laser output and types.
Laser in healthcare: Medical laser delivery devices, laser bio-effects on the eye and skin, medical surveillance, anesthesia practices and controls, surgical smoke, medical laser standards and regulations.
Laser Safety: Medical safety control measures and practices, laser hazard classification, Maximum Permissible Exposure (MPE) and Nominal Hazard Zone (NHZ), laser accidents.

BIOEN 595: Entrepreneurial Issues in Biomedical Engineering

Credit Hours: 3	Lectures: 3	Lab/Practical: 0	Prerequisite: Dpt Consent

Academic / Industry taught course.

BIOEN 506: Advanced Topics in Biomedical Engineering

Credit Hours: 3	Lectures: 3	Lab/Practical: 0	Prerequisite: Dpt Consent

Advanced subjects related to the selected track within biomedical engineering tailored to fit the requirements of a small group.

BIOEN 553: Biomedical Imaging Systems

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent The course introduces students to the basic physics and instrumentation concepts of of main biomedical imaging modalities such as X- Ray, Radiography, Computed Tomography, Ultrasound and Magnetic Resonance Imaging (MRI). Student will learn the fundamental concept of radiation and image formation processes along with the safety issues of different imaging modalities. The focus of the course is a series of labs using PHYWE training units and Gate 4 simulation software and home works that will enable students to perform useful biomedical imaging experiments that in turns not only will help them to understand the principle of imaging systems but also will familiarize them with basic parameters that matter most for clinical applications.

BIOEN 563: Medical Image Processing & Communication

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent This course provides students with an overview of computational and mathematical aspects of medical image processing and communication. Students will learn the fundamentals behind image processing and analysis methods and algorithms with an emphasis on biomedical applications. It covers principles and algorithms for processing both deterministic and random signals presented in images. Topics include filtering, coding, feature extraction and modeling. The focus of the course is a series of labs and home works that provide practical experience in processing of real medical images using MATLAB.

BIOEN 573: MRI

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent Introduces physics of magnetic resonance. Principles and technological implementation of MRI. Image formation, acquisition and processing – Hardware/Instrumentation – Functional MRI – Included are special applications in some contemporary issues like RF safety aspects.

BIOEN 583: Ultrasound

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent Basic principles and technological implementation of ultrasound imaging system. Image formation in Ultrasound. pulse-echo ultrasound instrumentation; image storage and display; Doppler instrumentation; color doppler and color flow imaging; image characteristics and artifacts; bio-effects; safety regulations. Applications and future trends.

BIOEN 593: X-ray and CT

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent Basic principles and technological implementation of x-ray and CT. Image formation in Radiology, Computed Tomography. X-Ray Equipment - X-Ray Projection Angiography – Mammography – CT Instrumentation - CT Reconstruction Principles- future trends.

BIOEN 504: Introduction to Biomedical Optics

Credit Hours: 3 Lectures: 3 Lab/Practical: 0 Prerequisite: Dpt Consent The aim of this course is to provide students with a background and understanding of the fundamentals of optical engineering and to expose them to some exciting current research in this field. The propagation of light in tissue, optical components, fluorescence, Raman, two-photon, spectral microscopy, and confocal microscopy, polarization in tissue, and spectroscopy will be studied. Moreover, a broad overview of state-of-the-art topics and cutting-edge research in the area of optics and lasers in medicine and biology will be presented.

BIOEN 514: Bio-Optical Imaging

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent Optical imaging techniques for detection of structures and functions of biological tissues; basic physics and engineering of each imaging technique.

BIOEN 554: Software Engineering

Credit Hours: 3 Lectures: 3 Lab/Practical: 0 Prerequisite: Dpt Consent Software engineering, the software lifecycle, qualities of software; design, specification and verification of software, programming environments and tools, object oriented programming.

BIOEN 564: Networks and Distributed Processing

Credit Hours: 3 Lectures: 2 Lab/Practical: 2 Prerequisite: Dpt Consent Types of computer networks. Logical, virtual and transparent facilities. Layers of control. Physical link control. Network management. Standard and CCITT recommendations. Network mechanisms. High-Level Data Link Control (HDLC) and Synchronous Data Link Control (SDLC) protocols. Packet switching. X.25. Distributed processing and distributed databases. Security and privacy.

BIOEN 594: Introduction to Safety Engineering

Credit Hours: 3 Lectures: 3 Lab/Practical: 0 Prerequisite: Dpt Consent System Safety: Role of system safety, the language of system safety, and programs for achieving safety, such as the problem solving process, safety criteria, safety training, hazard analysis, and uncertainty in safety measurements. Hazard classification, hazard probability, survival rate, distributions applied to human performance. Product safety: Product Liability, Safety Costs and Losses, Modern Concepts of Accident Prevention, Hazardous Characteristics of Product, Environmental Factors in Product Safety, Operator Error, Minimizing accidents and their effects.