German Jordanian University

School of Applied Medical Sciences
Department of Biomedical Engineering
Bachelor of Science in Biomedical Engineering

Study Plan 2019

I. Program Vision

Our vision includes innovative and quality in biomedical engineering applicable education and research at the German Jordanian University.

II. Program Mission

Utilizing the German dimension equipping the students with a solid biomedical engineering knowledge base, advancing the German Jordanian University through applied biomedical scientific research, and linking the university with biomedical industry by keeping up to date with current developments in the BME field in the local and international markets. In addition to serving the BME profession and the different BME related healthcare facilities through the academic advancement and skill development of BME students, as well as, technology transfer to industry and continuous workforce training in Jordan and Germany.

III. Program General Description

The degree program in Biomedical Engineering (BME) is described as courses. Each course has a specific weight (credit hours) ranging from 1 (mainly laboratories) to 3. The course weight represents the actual teaching time per week. To obtain the degree, students are required to complete 180 credit hours through 5 years (10 semesters). These are grouped to different categories: University Compulsory requirements (21 hours), University Elective requirements (6 hours), Faculty Compulsory requirements (27 hours), Department Compulsory requirements (114 hours) and Department Elective requirements (12 hours).

Biomedical Engineering was created in response to continual changes and emergence of new areas of expertise commensurate with rapid advances in technology. Some of the well-established specialties within the field of biomedical engineering include: bioinstrumentation, biomaterials, biomechanics cellular, tissue and genetic engineering, clinical engineering, medical imaging, orthopedic surgery, rehabilitation engineering, and systems physiology. Based on the student interest passion and the job-market needs, the BME students can easily shape and tailored their skills and experience by taking various elective courses. Furthermore, BME students at GJU have to spend one year (fourth or fifth year) in Germany as part of their bachelor's degree. This year is divided into two semesters. In the first semester, students register for 12 credit hours of elective courses at one of our German partner universities. In the second semester, they train in German industry for 5 months. Additionally, the BME program gives its students the opportunity to conduct their graduation projects in Germany.

The BME department offers several laboratory facilities that enable students to design, conduct experiments, analyze data and verify advanced theoretical concepts. These include laboratories for anatomy and physiology, biomaterials, biomechanics & rehabilitation, medical instrumentation, biomedical sensors and transducers, medical electronic, and biocomputing laboratories.

Biomedical Engineer can perform a variety of jobs such as:

a) Research Engineer
b) Device Design Engineer
c) Medical Quality Assurance and Quality Control Engineer
d) Marketing/Sales Engineer
e) Management Engineer
f) Educational Engineer

IV. Program Objectives

The biomedical engineering program emphasizes the application of technologies and tools in the short term, and the ability to discover, acquire, and adapt new knowledge and skills in the long term, such that our graduates are prepared to:

a. Perform advanced studies leading to research or professional practice in biomedical engineering.
b. Perform Advanced studies leading to research or professional practice in the Health and Medical Sciences.
c. Apply the knowledge and skills in biomedical engineering industries or related technical and professional fields available in Jordan and at our partners in Germany.
d. Create an excellence in undergraduate education, meaningful and innovative research, and service dedicated to advancing the field of Biomedical Engineering.

V. Learning Outcomes

Biomedical Engineering program graduate's bachelor's students with an understanding of fundamental biomedical engineering concepts, methodologies, and technologies as demonstrated by:

a. The ability to apply the principles of chemistry, physics, mathematics, and engineering in the development of various processes in the biomedical engineering and technology industries.
b. The ability to communicate effectively through proficiency in more languages (Arabic, English, and German) and applying various communication skills.
c. The ability to work in various labor markets, such as the Jordanian, German and international market.
d. The ability to apply ethical and professional principles in the presented technical solutions.
e. The ability to work in teams and cooperate to achieve plans and tasks.
f. The ability to analyze data, draw conclusions and use present new solutions.
g. The ability to learn continuously.

VI. Framework for B.Sc. Degree (Credit Hours)

Classification	Credit Hours			ECTS		
	Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	21	6	27	31	6	37
School Requirements	27	0	27	43	0	43
Program Requirements	114	12	126	200	20	220
Total	**162**	**18**	**180**	**274**	**26**	**300**

1. University Requirements: (27 credit hours)

1.1. Prerequisite courses (6 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Prerequisites / Co-requisites
				Lect	Lab	
ARB099	Arabic 99[a]	0	0	3	-	-
ENGL099	English II[a]	0	0	3	-	-
	Total	**0**	**0**	**6**	**0**	

1.2. Compulsory: (21 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites/ Co-requisites
					Lect	Lab	
ARB100	Arabic	3	3	Online	3	-	ARB099
ENGL101	English III	1	3	F-to-F	3	-	ENGL099
ENGL102	English IV	1	3	F-to-F	3	-	ENGL101
ENGL201	English V	2	3	F-to-F	3	-	ENGL102
ENGL202	English VI	2	3	F-to-F	3	-	ENGL201
GERL101B1	German I B1 track	3	6	F-to-F	9	-	-
GERL102B1	German II B1 track	3	6	F-to-F	9	-	GERL101B1
GERL102B2	German II B2 track	3	6		9	-	GERL101B1
MILS100	Military Science	3	2	Online	3	-	-
NE101 NEE101	National Education National Education (English)	3	2	Online	3	-	-
	Total	**21**	**31**		**39**	**0**	

1.3. Elective: (6 Credit Hours) (two courses out of the following)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites/ Co-requisites
					Lect	Lab	
BE302	Business Entrepreneurship	3	3	Online	3	-	ENGL101
DES101	Arts' Appreciation	3	3	Online	3	-	ENGL101, ARB099
EI101	Leadership and Emotional Intelligence	3	3	Online	3	-	ENGL101
IC101	Intercultural Communications	3	3	Online	3	-	ENGL101
PE101	Sports and Health	3	3	Online	3	-	ARB099
SE301	Social Entrepreneurship and	3	3	Online	3	-	ENGL101

	Enterprises						
SFTS101	Soft Skills	3	3	Online	3	-	ENGL101
TW303	Technical and Workplace Writing	3	3	Online	3	3	ENGL102
	Total	**6**	**6**		**6**	**0**	

[a] Not required for students who pass placement test

2. School Requirements: (27 Credit Hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites/ Co-requisites
					Lect	Lab	
GERL201B1	German III B1 track	3	4	F-To-F	6	-	GERL102B1
GERL201B2	German III B2 track	3	4		6	-	GERL102B2
GERL202B1	German IV B1 track	3	6	F-to-F	9	-	GERL201B1
GERL202B2	German IV B2 track	3	6		9	-	GERL201B2
MATH99	Pre-Math	0	0	Blended	3	-	-
MATH101	Calculus I	3	5	Blended	3	-	MATH99
MATH102	Calculus II	3	5	F-to-F	3	-	MATH101
PHYS103	Physics I	3	5	Blended	3	-	-
PHYS104	Physics II	3	5	F-to-F	3	-	PHYS103
PHYS106	Physics Lab	1	2	Blended	0	3	PHYS104
CS116	Computing Fundamentals	3	6	F-to-F	3	-	-
CS1160	Computing Fundamentals Lab	1	0	Blended	0	3	CS116
CHEM103	General Chemistry	3	5	F-to-F	3	-	-
CHEM106	General Chemistry Lab	1	0	Blended	0	3	CHEM103
	Total	**27**	**43**		**36**	**9**	

3. Program Requirements (126 credit hours)

3.1. Program Requirements (Compulsory): (114 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites/ Co-requisites
					Lect	Lab	
GERL301B1	German V B1 track	3	6	F-to-F	9	-	GERL202B1
GERL301B2	German V B2 track	3	6		9		GERL202B2
GERL302REG	German VI Regular	3	6	F-to-F	6	-	GERL301B1
GERL302INT	German VI Intensive	3	6		9		GERL301B1
GERL302B2	German VI B2 track	3	6		6		GERL301B2
BM105	Engineering Drawing for BM	1	2	Blended	0	3	-
IE121	Engineering Workshop	1	2	F-to-F	0	3	-
BIO111	Human Biology	3	5	Blended	3	0	-
BM211	Anatomy and Physiology	3	5	F-to-F	3	0	BIO111
BM213	Anatomy and Physiology Lab	1	0	Blended	0	3	BM211
BM227	Bioorganic Chemistry for BM	3	5	F-to-F	3	0	CHEM103, BIO111
BM229	Bioorganic Chemistry for BM Lab	1	0	Blended	0	3	BM227
ENE211	Electrical Circuit I	3	5	F-to-F	3	0	PHYS104
ENE213	Electrical Circuits Lab.	1	2	F-to-F	0	3	ENE211
ECE241	Electronics I	3	6	F-to-F	3	0	ENE211

ECE2410	Electronics I Lab	1	0	Blended	0	3	ECE241
IE211	Probability and Statistics	3	5	F-to-F	3	0	MATH102
MATH203	Applied Mathematics for Engineers	3	5	F-to-F	3	0	MATH102
MATH205	Differential Equations	3	5	F-to-F	3	0	MATH102
CE331	Signals and Systems	3	5	Blended	3	0	MATH203
BM2021	Introduction to Biomedical Engineering	1	4	F-to-F	1	0	ENGL 102
ECE321	Communication System I	3	5	Blended	3	0	CE331
BM321	Medical Signal Processing	3	5	F-to-F	3	0	CE331
BM323	Medical Signal Processing Lab	1	0	Blended	0	3	BM321
BM322	Medical Imaging Systems	3	5	Blended	3	0	CE331
BM326	Medical Image Processing Lab	1	0	Blended	0	3	BM323
BM3255	Physiological Modelling and Control Systems	3	6	Blended	3	0	MATH205; PHYS104
BM3288	Physiological Modelling and Control Systems Lab.	1	0	Blended	0	3	BM3255
BM242	Biofluid mechanics and transport phenomena	3	4	Blended	3	0	MATH203, BM211
BM331	Biomaterials	3	5	Blended	3	0	BM211, BM227
BM333	Biomaterials Lab	1	0	Blended	0	3	BM331
BM341	Biomechanics and Rehabilitation I	3	5	F-to-F	3	0	MATH203, PHYS103
BM3421	Biomechanics and Rehabilitation II	2	5	F-to-F	2	0	BM341
BM344	Biomechanics and Rehabilitation Lab	1	0	Blended	0	3	BM3421
BM352	Biomedical Sensors and Transducers	3	5	Blended	3	0	BM321
BM358	Biomedical Sensors and Transducers Lab	1	0	Blended	0	3	BM352
CE212	Digital systems	3	6	F-to-F	3	0	CS116
CE2120	Digital systems Lab	1	0	Blended	0	3	CE212
BM551	Medical Instrumentation I	3	5	Blended	3	0	ECE241
BM371	Numerical Methods for Engineers	3	5	Blended	3	0	MATH203, MATH205, CS116
BM391	Field Training*	0	6	F-to-F	0	0	Dept. Approval
BM499	International Internship	12	30	F-to-F	0	0	Dept. Approval
BM552	Medical Instrumentation II	3	5	Blended	3	0	BM551
BM557	Medical Instrumentation Lab	1	0	Blended	0	3	BM551
ENE315	Introduction to Electric Machines and Drives	3	5	F-to-F	3	0	ECE241
BM5811	Health care management and Engineering Economy	3	4	Online	3	0	IE211
BM5822	Medical Ethics & Regulatory affairs	2	3	Online	3	0	-
BM5633	Artificial Organs	2	5	F-to-F	2	0	BM242
BM5922	Selected Topics in Biomedical	3	5	Blended	3	0	Dept.

	Engineering						Approval.
BM598	Graduation Project I	1	2	Blended	0	0	Dept. Approval
BM599	Graduation Project II	2	6	Blended	0	0	BM598
	Total	**114**	**200**		**95**	**42**	

3.2. Program Requirements (Electives[b]): (12 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites/ Co-requisites
					Lect	Lab	
BM584	Biomedical Engineering Design	3	5		0	0	-
CE342	Microprocessor and Embedded Systems	3	5		3	0	CE212
CE3420	Microprocessor and Embedded Systems Lab	1	0		0	3	CE342
BM334	Principle of Tissue Engineering	3	5		3	0	BM331
BM351	Optics for Medical Applications	3	5		3	0	PHYS103
BM401	Medical Physics	3	5		3	0	PHYS104
BM432	Biophysics	3	5		3	0	PHYS104; BIO111
BM436	Biomaterials-Tissue Interaction	3	5		3	0	BM331
BM439	Advanced Biomaterials in the Design of Medical Devices	3	5		3	0	BM331
BM445	Cardiovascular Mechanics	3	5		3	0	BM341
BM447	Tissue Mechanics	3	5		3	0	BM341
BM453	Magnetic Resonance Imaging	3	5		3	0	BM322
BM454	Fundamentals of X-ray Modalities	3	5		3	0	BM322
BM455	Introduction to Ultrasound Technique	3	5		3	0	BM322
BM456	Photo medicine	3	5		3	0	BM322
BM458	Laser Applications in Medicine and Biology	3	5		3	0	BM551
BM459	Biotechnology and Bioprocess Engineering	3	5		3	0	BM227
BM461	Introduction to Nanomaterials	3	5		3	0	BM331
BM465	Micro/Nano Fabrication Techniques	3	5		3	0	BM352
BM471	Biomedical Modeling and Simulation	3	5		3	0	CE331; BM371
BM472	Computer-Aided Design & Prototyping	3	5		3	0	BM371; CE331
BM513	Hygiene and Sterilization	3	5		3	0	BIO111
BM515	Molecular Biotechnology and Genetics	3	5		3	0	BIO111
BM526	Quantitative and Functional Imaging	3	5		3	0	BM322
BM527	Laser-Tissue Interaction	3	5		3	0	PHYS104
BM528	Introduction to Ionizing Radiation	3	5		3	0	PHYS104
BM536	Drug Delivery	3	5		3	0	BM331

BM537	Materials Biocompatibility	3	5		3	0	BM331
BM538	Nanotechnology & Nanomedicine	3	5		3	0	BM331
BM539	Transport Phenomena in Cells and Organs	3	5		3	0	BM227; BM242
BM541	Bio robotics	3	5		3	0	BM341
BM542	Human Anthropometric and Physical Measurements	3	5		2	1	BM341
BM543	Surgery for Engineers	3	5		3	0	BM551
BM547	Sport Biomechanics & Rehabilitation	3	5		3	0	BM3421
BM524	Fundamentals of Computer Tomography	3	5		3	0	BM322
BM555	System Safety & Safety Technology	3	5		3	0	BM551
BM576	Bio media	3	5		3	0	CE331
BM559	Pacemaker Technologies	3	5		3	0	BM551
BM561	Neuroengineering	3	5		3	0	BM211
BM562	BioMEMS	3	5		3	0	BM242, BM352
BM565	BioMEMS Design	3	5		3	0	BM562
BM571	Pattern Recognition of Bio-Medical Applications	3	5		3	0	BM321
BM583	Tenders & Technical Specifications	3	5		3	0	MATH203
BM592	Special Topics I	1	3		1	0	Dept. App.
BM593	Special Topics II	2	4		2	0	Dept. App.
BM594	Special Topics III	3	5		3	0	Dept. App.
	Total	**12**	**20**		**12**	**0**	

[b]BM499 International Internship is a prerequisite for all elective courses

VII. Study Plan[c] Guide for the Bachelor's Degree in Biomedical Engineering

First Year				
First Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
GERL101	German I	3	-	-
ENGL101	English III	1	ENGL099	-
MATH101	Calculus I	3	MATH99	-
PHYS103	Physics I	3	-	-
CS116	Computing Fundamental Technical	3	-	-
CS1160	Computing Fundamental Lab	1	-	CS116
BIO111	Human Biology	3	-	-
BM105	Engineering Drawing for BM	1	-	
	Total	**18**		

First Year				
Second Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
GERL102	German II	3	GER101	-
ENGL102	English IV	1	ENGL101	-
MATH102	Calculus II	3	MATH101	-
PHYS104	Physics II	3	PHYS103	-
PHYS106	Physics II Lab	1	-	PHYS104
ARB 100	Arabic	3	ARB099	-
CHEM103	General Chemistry	3	-	-
CHEM106	General Chemistry Lab	1	-	CHEM103
IE121	Engineering Workshop	1	-	-
	Total	**19**		

[c] The following study plan guide assumes having passed all placement tests

Second Year				
First Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
GERL201	German III	3	GER102	-
ENGL201	English V	2	ENGL102	-
BM2021	Introduction to Biomedical Engineering	1	-	ENGL102
ENE211	Electrical Circuit I	3	PHYS104	-
ENE213	Electrical Circuit Lab	1	-	ENE211
MATH205	Differential Equations	3	MATH102	-
MATH203	Applied Mathematics for Engineers	3	MATH102	-
BM211	Anatomy and Physiology	3	BIO111	-
BM213	Anatomy and Physiology lab	1	BM211	BM213
	Total	**20**		

Second Year				
Second Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
GERL202	German IV	3	GER201	-
ENGL202	English VI	2	ENGL201	-
ECE241	Electronics I	3	ENE211	-
ECE2410	Electronics I Lab	1	-	ECE241
BM242	Biofluid Mechanics and Transport Phenomena	3	MATH203	-
IE211	Applied Statistics and probability for Engineers	3	MATH102	-
BM227	Bioorganic Chemistry for BM	3	CHEM103, BIO111	-
BM229	Bioorganic Chemistry for BM	1	-	BM227
CE331	Signals and systems	3	ENE211, MATH205	-
	Total	**22**		

Third Year				
First Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
GERL301	German V	3	GERL202	-
BM331	Biomaterials	3	BM211, BM227	-
BM333	Biomaterials Lab	1	-	BM331
BM341	Biomechanics and Rehabilitation I	3	PHYS103, MATH203	-
CE211	Digital Systems	3	CS116	-
CE2110	Digital Systems Lab	1	-	CE211
BM321	Medical signal processing	3	CE331	-
BM323	Medical signal processing Lab	1	-	BM321
	Total	**18**		

Third Year				
Second Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
GERL302	German VI	3	GER301	-
BM3421	Biomechanics and Rehabilitation II	2	BM341	-
BM344	Biomechanics and Rehabilitation II Lab	1	-	BM3421
BM3255	Physiological Modeling and control systems	3	MATH205, PHYS104	-
BM3288	Physiological Modeling and control systems Lab	1	-	BM3255
ECE321	Communication Systems I	3	CE331, ECE241	-
BM352	Biomedical Sensors and Transducers	3	BM321	-
BM358	Biomedical Sensors and Transducers Lab	1	-	BM352
BM391	Field Training	0	Dept. Approval	-
BM371	Numerical Methods for Engineers	3	MATH203, MATH205, CS116	-
	Total	**20**		

Fourth Year				
First Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
	Program Elective I	3	-	-
	Program Elective II	3	-	-
	Program Elective III	3	-	-
	Program Elective IV	3	-	-
	Total	**12**		

Fourth Year				
Second Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
BM499	International Internship[d]	12	Dep. App	-
	Total	**12**		

German year prerequisites are:

1. A minimum GPA of 61.0%
2. Successful completion of 90 credit hours excluding all German language courses
3. Passing GERL302 German VI and B1 German language test (all 4 language skills) conducted by Goethe Institute or another approved provider
4. ENGL201 English V, and Arabic 99
5. Passing four out of the five following courses:

- BM331 Biomaterials
- BM341 Biomechanics and Rehabilitation I
- BM352 Biomedical Sensors and Transducers
- BM551 Medical Instrumentation I

[d] Courses attended and/or passed during International Internship are not transferable

Fifth Year				
First Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
BM551	Medical Instrumentations I	3	ECE241	-
NE101	National Education	3	-	-
BM598	Graduation Project I	1	Dept. Approval	-
BM5633	Artificial Organs	2	BM242	-
BM326	Medical Image Processing Lab	1	-	BM322
BM322	Medical Imaging Systems	3	CE331	-
	University Elective	3	-	-
BM5811	Healthcare Management and Engineering Economy	3	IE211	-
	Total	**19**		

Fifth Year				
Second Semester				
Course ID	**Course Name**	**Cr Hr**	**Prerequisites**	**Co-requisite**
BM599	Graduation Project II	2	BM598	-
BM552	Medical Instrumentation II	3	BM551	-
BM557	Medical Instrumentations Lab	1	-	BM551
ENE315	Introduction to Electric Machines and Drives	3	ECE241	-
BM5822	Medical Ethics and Regulatory Affairs	2	-	-
	University Elective	3	-	-
MILS101	Military Sciences	3	-	-
BM5922	Selected Topics in Biomedical Engineering	3	Dept. App	-
	Total	**20**		

VIII. Compulsory Courses Offered by Biomedical Engineering Department

BM105 Engineering Drawing for BM **1 Cr Hr (0,3)** **2 ECTS**

Introduction to engineering drawing software which are used in biomedical engineering applications. Geometric construction, Orthographic and Isometric projections; Sketching, sectioning, dimensioning and layering; emphasis on 2D sketches, 3D devices models, PCB schematics, technical drawing for structural metal work, design and production drawing, assembly/disassembly drawings of machine components, prosthetics/orthotics drawings, healthcare facilities layout.

Prerequisites: -

BIO111 Human Biology **3 Cr Hr (3,0)** **5 ECTS**

Human Biology course examines how the human body functions, and looks in detail at cellular events, from the developing embryo to the adult. Topics covered will include cell biology, human reproduction and embryology, physiology and biochemistry, the origins of human variation and inheritance in humans. In addition, students will be introduced to human dysfunction, treatments and preventions.

Prerequisites: -

BM211 Anatomy and Physiology **3 Cr Hr (3,0)** **5 ECTS**

This course explores the systems comprising the human body by emphasizing physiological mechanisms and a thorough understanding of organism anatomy. In addition, the physiological and biochemical concepts which control activities of different organs will be covered. An emphasis is placed on the interrelatedness of such systems as the skeletal, muscular, endocrine, digestive, urinary, respiratory, nervous, reproductive, and circulatory. This course has a substantial laboratory component, including mouse and rat dissection, study of the physiology of muscles, nerves, neurons, blood, respiration, hormones and excretions.

Prerequisites: BIO111

BM213 Anatomy and Physiology Lab **1 Cr Hr (0,3)** **0 ECTS**

Topics covered include the anatomical position and its importance, anterior and posterior surface landmarks , compare between the dissecting and compound light microscope , skeletal system ,physiology of the muscular system ,physiology of the nervous system , acquire ECG signal then correlate it with heart sounds, blood pressure measurement , urine analysis , blood analysis and special senses. Moreover, the student will be able to know the most common faults then search on the possible solutions to fix problems as a biomedical engineer for the devices that will covered during this lab.

Co-requisites: BM211

BM227 Bioorganic chemistry for BM **3 Cr Hr (3,0)** **5 ECTS**

Organic: Bonding models for CH; simple CC and multiple CC bonds; Electron structure of conjugated double bonds and aromatic π-systems; the most important classes of organic compounds; Overview of various reaction types and initial mechanistic reaction observations. Biochemistry: Amino acids and peptides; Proteins: structure and function; Enzymes; enzyme kinetics of carbohydrates; Lipids; biological membranes; Nucleic acids.

Prerequisites: BIO111, CHEM103

BM229 Bioorganic chemistry for BM Lab **1 Cr Hr (0,3)** **0 ECTS**

A substantial Laboratory for Bioorganic Chemistry where the student learns about the concepts covered in the theoretical course through practical experiments.

Co-requisites: BM227

BM2021 Introduction to biomedical Engineering **1 Cr Hr (1,0)** **4 ECTS**

Engineering profession and its applications in biomedicine, introductory lectures on the definition of biomedical engineering, its history, ethics and regulations with a scientific overview of the different topics : biomechanics, bioinstrumentation, medical imaging and physiological modeling, biomedical sensors and biomedical signal processing and bio micro and nanotechnology, Simultaneously the students will be instructed on principles of technical writing and communication skills and will be asked to apply their knowledge on a group project about which they will be required to write a report and give an oral presentation.

Prerequisites: ENGL 102

BM321 Medical Signal Processing **3 Cr Hr (3,0)** **5 ECTS**

Design of Digital Filters for physiological one- and two-dimensional signals: FIR, IIR Recursive and Non-Recursive; Adaptive filters; Medical signals and medical image display, enhancement, processing and analysis as well as their applications in medical instruments and imaging systems. Topics covered include image filtering and enhancement, display and visualization, image segmentation and image registration. Examples will be presented to give the students exposure to real-world applications in medicine. An overview of useful open-source software tools for medical signals and images processing, analysis and visualization will be demonstrated. In addition, software packages will be introduced for data analysis on ECG, EEG, EMG, ERG, MRI, fmri, X-Ray, and PET signals and images.

Prerequisites: CE331

BM323 Medical Signal Processing Lab **1 Cr Hr (0,3)** **0 ECTS**

Software experiments illustrating the basic principles and techniques of digital signal processing in order to process and analyse different physiological signals. Topics covered include sampling theorem, oversampling and aliasing phenomena, designing IIR and FIR filters for band pass, band stop, low pass and high pass filters, block convolution, signal smoothing, filtering of long duration signals, analysis of physiological signals that have valuable information in useless form, spectral analysis, and amplitude modulation.

C0-requisites: BM321

BM322 Medical Imaging Systems **3 Cr Hr (3,0)** **5 ECTS**

This course introduces the engineering and physical principles of imaging and its instrumental methods in medicine; Medical imaging systems to be presented including conventional X-ray; computed tomography (CT); magnetic resonance (MRI); nuclear medicine (PET and SPECT); and ultrasound. Light-microscopy, electron-microscopy and mass spectrometric imaging will be encompassed as well. Each of these modalities will be introduced from basic engineering principles to the process of image formation.

Prerequisites: CE331

BM326 Medical Imaging Systems Lab **1 Cr Hr (0,3)** **0 ECTS**

Software experiments illustrating the concepts in image processing and analysis. Topics covered include basics of medical image processing: Grey-Level operations, image subtraction, averaging, manipulate histograms for image enhancement; including histogram equalization, and image filtering (in spatial domain). Moreover, it includes analysis of image quality (MTF, image noise, S/N-behavior), image segmentation, gradient operators, morphological filter, image enhancement, restoration; and reconstruction.

Co-requisites: BM322

BM331 Biomaterials **3 Cr Hr (3,0)** **5 ECTS**

A lecture and laboratory course that introduces a series of materials; including metals; ceramics; glass; polymers; and composites; These materials are compared with the natural materials; with consideration given to issues of mechanical properties; biocompatibility; degradation of materials by biological systems; and biological response to artificial materials; The interaction and response of body cells, proteins, and

immune system to the biomaterials. Particular attention is given to materials for the total hip prosthesis; dental restoration; and implantable medical devices. Topics include fundamentals of materials science and engineering integrated into biology for the better regeneration of tissue.

Prerequisites: BM211, BM227

BM333 Biomaterials Lab **1 Cr Hr (0,3)** **0 ECTS**

The aim is to Understanding the fundamental concepts of the multidisciplinary science of biomaterials in addition to Learning the main mechanical properties of different type of materials(metals, polymers, ceramics, xeno-bone, skin…etc) that affect material design.

Moreover, Study mechanical properties for materials which should be replace in our body, in order to mimic the part that will be replaced, so that studying the mechanical properties for Biological materials such a (bovine bones) take in consideration in this lab.

Co-requisites: BM331

BM341 Biomechanics and Rehabilitation I **3 Cr Hr (3,0)** **5 ECTS**

Basic concepts of statics and dynamics with application to biological systems and the human body. Human skeletal position, direction, and common movement terminology, major joints motions, muscle groups, tendons and ligaments. Statics (Vector representations, forces and force systems, moments, equilibrium of rigid bodies, analysis of trusses and frames, centroids, moments of inertia, and friction). Linear and angular kinematics (rectilinear and curvilinear motion, position, velocity and acceleration. Absolute and relative motion). Linear and angular kinetics (Equation of motion, inertia force, work, kinetic and potential energy, power, impulse, momentum, conservation of energy and momentum, impact). Gait analysis (Normal and Pathological), Rehabilitation engineering: Seating and wheelchairs; aids to daily living; exercise and performance techniques in sports.

Prerequisites: MATH203, PHYS103

BM3421 Biomechanics and Rehabilitation II **2 Cr Hr (2,0)** **5 ECTS**

The concepts of mechanics of materials and their application to biomaterials (Stress and Strain, Stiffness, Mohr's Circle, Equations of Equilibrium and Compatibility, Beam Theory, Shear Stress and strain, torsion of bars and members, energy methods). Tissue Biomechanics (Hard Tissue: Bones, Bone Cells and Microstructure, Physical Properties of Bone, Bone Development (Wolff's law), Bone Failure (Fracture and Osteoporosis), (Soft Tissue: Muscle tissue, cartilage, ligaments, brain tissue, and skin tissue. Viscoelasticity). Rehabilitation and Injury mechanics, prevention, and healing. Applications of biomechanics in rehabilitation through the design of assistive technologies, Functional Stimulation.

Prerequisites: BM341

BM344 Biomechanics and Rehabilitation Lab **1 Cr Hr (0,3)** **0 ECTS**

The aim is to the study of the movement of living things using the science of mechanics, also it is concerned with the description of motion and how forces create motion. Moreover, understanding how living things move and how kinesiology professionals might improve movement or make movement safer. In general, topics covered Anthropometry and Goniometry, Muscles Force, Gait Analysis and some Anatomical parts like Lungs Functions and Audiometry.

Co-requisites: BM3421

BM3255 Physiological Modeling and Control Systems **3 Cr Hr (3,0)** **6 ECTS**

Elements and control of physiological systems/processes, generalized properties and parameters of physiological systems, design and analysis of subsystems, basic concepts of modeling, Lumped / distributed/ compartmental models, particular and complementary solution, analytical and numerical solutions, Respiratory/ Cardiovascular/Muscular / gas exchange/ transport Modeling, transient response, time and frequency responses and analysis of physiological control systems , stability of physiological control systems, open and closed-loop systems, negative feedback, Forward feedback, impulse and step

response of physiological control systems and transfer function, state-space design and control Modeling of biological electrical, Fluid (pneumatic and hydraulic), and mechanical systems. Components of control systems, Transfer functions, block diagrams, and signal flow graph. Time and frequency domain analysis and Modeling, test signals, transient response, steady state error and stability. Root locus, bode plots, PID control, phase lead, phase lag. Case studies: Distillation Process, Reactor Process, Mixing Process. Software application such as Matlab and Simulink.

Prerequisites: MATH205, PHYS104

BM3288 Physiological Modeling and Control Systems Lab **1 Cr Hr (0,3)** **0 ECTS**

Modeling of various systems using Matlab/Simulink software (or equivalent software), modeling of pharmacokinetic systems; Lumped parameter modeling; control systems modeling; statistical modeling.

Laboratory to introduce the concepts learned in the course through practical experiments using Software application such as Matlab and Simulink.

Co-requisites: BM3255

BM352 Biomedical Sensors and Transducers **3 Cr Hr (3,0)** **5 ECTS**

Theory and principles of biosensor design and application in medicine for chemical and biological measurements; Analysis and selection of physical; electrical; mechanical; thermal; and chemical transduction mechanisms which form the basis of the biosensor design; Introduction to Precision; Error in Measurement; Calibration; Analysis of Experimental Data; Principles and fundamental properties of transducers (dynamics; linearity; hysteresis; and frequency range); Transducer interfacing and signal conditioning; material biocompatibility; and packing, Selected examples: micro fluidics; bioelectronics; pressure sensors; temperature sensors and electrochemical sensors.

Prerequisites: BM321

BM358 Biomedical Sensors and Transducers **1 Cr Hr (0,3)** **0 ECTS**

The aim of this lab is to gain insight into working of such sensors which can be used in day-to-day life. moreover, the student will take measurements for many sensors using the Arduino Uno and the LabVIEW to study the characteristic and the relation between the input and output. Topics covered include temperature measurement using Arduino UNO then using a LabVIEW, Light dependent resistor using the Arduino, sound level sensor, magnetic field sensor, PH sensor, light sensor, thermocouple, and gas pressure sensor. Moreover, the students have the ability to be familiar with LabVIEW and the Arduino while take the measurement of each sensor.

Co-requisites: BM352

BM551 Medical Instrumentation I **3 Cr Hr (3,0)** **5 ECTS**

This course introduces measurements techniques in general and from biological systems; Topics include: Basic concepts of medical instrumentation; basic sensors and measurements; Biopotential amplifiers and signal conditioning; biopotential electrodes and instrumentation; ECG, EMG, EEG, Blood pressure, cardiac output measurements, pulse oximeter and bedside monitors.

Prerequisites: ECE 241

BM552 Medical Instrumentation II **3 Cr Hr (3,0)** **5 ECTS**

This course provides further study of the scientific bases and design strategies for medical instrumentation systems Topics include: Concepts and design strategies for advanced medical instrumentation systems; Clinical laboratory equipment: spectrophotometry; hematology and electrophoresis; Therapeutic and diagnostics devices: dialysis machine; electric stimulators; defibrillators; ventilators; anesthesia machine, and infant incubators; drug delivery systems, assistive devices, Electro surgery instruments and lithotripsy.

Prerequisites: BM551

BM557 Medical Instrumentation Lab **1 Cr Hr (0,3)** **0 ECTS**

Topics covered include building instrumentation amplifiers to compare it with the single chip, optocoupler working principle and its importance in biomedical field, operation, designing, and implementation of ECG circuit, and building simple PPG circuit then compare the signal with the one obtained from pulse oximetry. Moreover, the student will be able to work on two training Kit (i.e., the blood pressure and infusion injection pump training kit) in order to troubleshoot the possible faults.

Co-requisites: BM551

BM371 Numerical Methods for Engineers **3 Cr Hr (3,0)** **5 ECTS**

Fundamentals of error analysis, numerical solutions of linear and nonlinear equations, numerical solution of system of equations, curve fitting, numerical integration and differentiation, numerical solution of ordinary differential equations. Application of numerical methods using relevant software packages.

Prerequisites: MATH203, MATH205, CS116

BM5811 Health Care Management and Engineering Economy **3 Cr Hr (3,0)** **4 ECTS**

Data and dataflow in hospitals; general ledger formulation; instrumentation specifications and detailing; cost accounting; evaluation techniques; capital budgeting and value analysis; depreciation and valuation, materials management; inventory control; management of healthcare information systems; Planning; project management; system selection; analysis; evaluation and implementation. The regulations and rules for medical instruments uses and quality assurance in health care systems.

Prerequisites: -

BM582 Medical Ethics and Regulatory Affairs **2 Cr Hr (3,0)** **3 ECTS**

Introduces the wide spectrum of ethical; regulatory; and legal issues facing health care practitioners and health- related research workers; Helps students become aware of the ethical and legal issues involved in their work; Helps students understand how legal and ethical decisions should be made in health-related matters; as well as what sources of help and guidance are available.

Prerequisites: -

BM242 Biofluid mechanics and transport phenomena **3 Cr Hr (3,0)** **5 ECTS**

Fundamental equations including continuum equations and Navier Stokes equations, The course will also cover the behavior of both Newtonian and Non-newtonian physiological fluids.

Concepts and biomedical applications in fluid mechanics and mass transport, The effect of transport processes on biochemical interactions, Protein diffusion and solute transport across capillary endothelium, Biomedical transport across the glomerulus, blood flow in organs and organism level, Blood and Tissue Oxygenation, Drug Transport in the human body and pharmacokinetic analysis, Analytical and numerical solutions of transport problems, Extracorporeal devices: renal dialysis and oxygenators; Bioartificial organs: Bioartificial Pancreas, and artificial Blood.

Prerequisites: MATH203

BM5633 Artificial Organs **2 Cr Hr (2,0)** **5 ECTS**

Introduction to electrically and pneumatically driven extracorporeal and totally implantable ventricular assist devices or the Total Artificial Heart; Analysis and design of replacements for the heart, kidneys, and lungs, artificial ear and artificial eye. Specification and realization of structures for artificial organ systems; Understand the individual and synergistic function of the major natural ("internal") organs; Understand the major organ replacement systems currently available; and the major problems associated with replacing failed organs in Cardiovascular system, Renal system , Pulmonary system, Hepatic system Endocrine system, Neural prostheses (Muscular-skeletal prostheses). An introduction to the designing and evaluation of prosthetics (artificial limbs), and orthotics (braces and splints). Biocompatibility of materials used in Orthopedic and dental applications

Prerequisites: BM242

BM391 Field Training* **0 Cr Hr (0,0)** **6 ECTS**

Eight consecutive weeks of training where students must complete 160 hours of field training in approved industries in Jordan. This training course is a fundamental course for all students. It gives the students a first impression of the professional environment he/she is preparing for during his/her studies, giving the opportunity to link theory and practice, respectively knowledge and experience.

Prerequisites: Dep. App

BM5922 Selected Topics in Biomedical engineering **3 Cr Hr (3,0)** **5 ECTS**

Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

Prerequisites: Dep. App

BM499 International Internship **12 Cr Hr (0,0)** **30 ECTS**

Field training is a period of six month to be spent in the industry in Germany, under supervision of the academic faculty in Jordan and in Germany. Periodic reports and a final report need to be submitted for evaluation and an oral examination is required. The training must cover any topic or multiple areas of the respective field of study. The training must be approved by the Office of Industry Links (OIL) at GJU and the respective Exchange Coordinator.

Prerequisites: Dep. App

BM598 Graduation Project I **1 Cr Hr (0,0)** **2 ECTS**

This is a no-lecture project course that will allow student to apply knowledge gained throughout their course of undergraduate study on real life problem or opportunity. It is typically a teamwork project with up to three students. Instructor with students select a project topic and get the project completed through guiding them in searching relevant literature, collecting and analyzing data, preparing and presenting results, and writing reports.

Prerequisites: Dep. App

BM599 Graduation Project II **2 Cr Hr (0,0)** **6 ECTS**

This is a no-lecture project course that will allow student to apply knowledge gained throughout their course of undergraduate study on real life problem or opportunity. It is typically a teamwork project with up to three students. Instructor with students select a project topic and get the project completed through guiding them in searching relevant literature, collecting and analyzing data, preparing and presenting results, and writing reports.

Prerequisites: Dep. App

IX. Elective Course Offered by Biomedical Engineering Department

BM562 BioMEMS **3 Cr Hr (3,0)** **5 ECTS**

Introduction to what BioMEMS are and what advantages they bring versus current methods; Microfluidic principles to be considered in the design of BioMEMS; Micro and nanosystem used in advanced analytical techniques for microfluidic devices; implantable chips; non-invasive biomedical sensors; DNA chips and microelectronic array system; Applications as microsensors and microactuators; Lab-on-a-chip devices; Fabrication techniques; including silicon and "soft" techniques; The course will also discuss some of the most popular polymer materials used.

Prerequisites: BM352, BM242

BM334 Principle of Tissue Engineering **3 Cr Hr (3,0)** **5 ECTS**

The selection; processing; testing and performance of materials used in biomedical application with special emphasis upon tissues engineering; Topics include material selection and processing; mechanism and kinetics of materials degradation; cell-materials interaction and interface; effects of construct architectures on tissue growth; and transport through engineered tissues; Examples of engineering tissues for replacing cartilage; bone; tendons; ligaments; skin and liver will be presented.

Prerequisites: BM331

BM351 Optics for Medical Applications **3 Cr Hr (3,0)** **5 ECTS**

Introductory overview of optical phenomena and the optical properties of biological tissue; Fundamentals of optical systems design; integration and analysis used in biomedical optics; Design components: light sources; lenses; mirrors; dispersion elements optical fiber; detectors; Systems integration: radiometry and interferometer; Optical system analysis: resolution; modulation transfer function; deconvolution; tissue optics and noise; Optical imaging fundamentals: reflection; refraction; interference; diffraction; polarization; light scattering and fluorescence; and their application in biomedical imaging and microscopy.

Prerequisites: PHYS103

BM401 Medical Physics **3 Cr Hr (3,0)** **5 ECTS**

This course aims to give students an understanding of relevant physical principles for biological systems; Topics include diffusion and transport; fluids; entropic forces; motor proteins; biological membranes and its electrical properties, nerve impulses; introduce them to experimental and theoretical techniques of biophysics and to communicate the excitement of cutting-edge biophysics research. Introduction to medical physics: production and measurement of x-rays and charged particles for nuclear medicine, interaction of radiation with biological materials, radiation dosimetry, radiation safety, physics of medical imaging, magnetic resonance imaging.

Prerequisites: PHYS104

BM432 Biophysics **3 Cr Hr (3,0)** **5 ECTS**

This course aims to give students an understanding of relevant physical principles for biological systems; Topics include diffusion; fluids; entropic forces; motor proteins; enzymes; nerve impulses; networks and evolution; introduce them to experimental and theoretical techniques of biophysics and to communicate the excitement of cutting-edge biophysics research.

Prerequisites: PHYS 104, BIO111

BM436 Biomaterials-Tissue Interactions **3 Cr Hr (3,0)** **5 ECTS**

Examines the principle of materials science and cell biology underlying the design of medical device; artificial organs and scaffolds for tissue engineering; Molecular and cellular interaction with biomaterials are analyzed in terms of cellular processes such as matrix synthesize; degradation and contraction;

Principles of wound healing and tissue remodeling are used to study biological responses to implanted materials and devices; Examining criteria for restoring physiological function of tissue and organs and investigate strategies to design implants based on control biomaterial-tissue interactions.

Prerequisites: BM331

BM439 Advanced Biomaterials in the Design of Medical Devices 3 Cr Hr (3,0) 5 ECTS

Addresses the unique role of biomaterials in medical device design and the use of emerging biomaterials technology in medical devices; The need to understand design requirements of medical devices based on safety and efficacy will be addressed; e.g. Expected device failure due to synergistic interactions from chronic loading; aqueous environments and biologic interactions; Testing methodologies to assess accelerated effects of loading in physiologic-like environments; Evaluate biomaterials and their properties as related to design and reliability of medical devices.

Prerequisites: BM331

BM445 Cardiovascular Mechanics 3 Cr Hr (3,0) 5 ECTS

Basic understanding of the biomechanics of organs (heart; containers) and the Organ systems (heart circulation). Basic of the Biofluid mechanics. Physics of the heart and of the circulation. Phases of the heart cycle; Time variable Elastance Theory; Basic understanding to the pump function of the heart and the wall movement. The dynamics of the heart and blood vessels; Pulsatile blood flow; microcirculation; and muscle mechanics; Modeling of boundary value problems in cardiovascular engineering; Tissue Engineering in cardiovascular application: Artificial Heart and Blood.

Prerequisites: BM341

BM447 Tissue Mechanics 3 Cr Hr (3,0) 5 ECTS

Advanced techniques for the characterization of the structure and function of hard and soft tissues and their relationship to physiologic processes; Solid mechanics of prominent musculoskeletal and cardiovascular tissues; Their normal and pathological behaviors (stiffness; strength; relaxation; creep; adaptive remodeling; etc) in response to physiologic loading will be examined and quantified; Application includes: tissue injury; wound healing; the effect of pathological conditions upon tissue properties and design of medical device.

Prerequisites: BM341

BM453 Magnetic Resonance Imaging 3 Cr Hr (3,0) 5 ECTS

This course will first introduce the basic physics of MRI; including magnetic moments and resonance; nuclear spin interactions with applied magnetic fields; and magnetic relaxation; The second portion of the course will discuss basic concepts of image formation; including radiofrequency pulse excitation; magnetic field gradients; imaging equation; Fourier Transform; and two-dimensional spatial encoding; The final portion of the course will introduce practical imaging methods and applications; such as image artifacts; fast imaging methods; signal-to-noise; contrast-to-noise; resolution; MR imaging of heart and blood vessels; and MR imaging of the neural system.

Prerequisites: BM322

BM454 Fundamentals of X-ray Modalities 3 Cr Hr (3,0) 5 ECTS

Physics and fundamentals of x-rays; conventional x-ray modality; Computerized Tomography CT modality; Principles and mathematics of 3D reconstruction from projections in medicine; Application of x-ray's modalities in human body scanning.

Prerequisites: BM322

BM455 Introduction to Ultrasound Technique 3 Cr Hr (3,0) 5 ECTS

Physics and fundamentals of Ultrasound; Propagation of ultrasound in heterogeneous media such as tissue; Ultrasound Imaging principles and basics of tissue characterization; Simple tissue models based on

ultrasound wave absorption and scattering; Ultrasound transducer models; advantages and disadvantages of various transducer configurations; details of A- and B- mode scanners; The principles of acoustic output measurements and instrumentation requirements; Electrical and biological effects of ultrasound diagnostics algorithms.

Prerequisites: BM322

BM456 Photomedicine **3 Cr Hr (3,0)** **5 ECTS**

Studies the use of optical and engineering-based systems (laser-based) for diagnosis; treating diseases; manipulation of cells and cell function; Physical; optical; and electro-optical principles are explored regarding molecular; cellular; organ; and organism applications; Topics are : Optical instrumentation ; Light properties; Optical coherence tomography; Diffuse reflectance; Photochemistry; Photodynamic therapy; Laser scissors; Laser tweezers; Multiphoton microscopy; Lasers in gynaecology; Cancer; dermatology; veterinary medicine; dentistry; and other clinical application.

Prerequisites: BM322

BM458 Laser Applications in Medicine and Biology **3 Cr Hr (3,0)** **5 ECTS**

Basic physics of lasers and laser beams; special laser types; interaction of laser radiation and biological tissue; technical details of medical laser systems; selected topics of laser applications; laser safety; laser applications in biological and medical laboratories; fluorescence techniques; Energy levels of atoms and molecules; interaction of light and matter; laser resonators and laser beams; interaction of laser radiation and tissue; Nd:YAG lasers; CO 2 lasers; details of laser-tissue interaction; optical fibers; excimer lasers; semiconductor lasers; photorefractive eye surgery: PRK and LASIK ; confocal microscopy; microstructuring with lasers; photodynamic therapy; fluorescence and light detection.

Prerequisites: BM551

BM459 Biotechnology and Bioprocess Engineering **3 Cr Hr (3,0)** **5 ECTS**

Introduction to the principles of bioprocess. Topics include: introduction to cellular and protein structure and function, modeling of enzyme kinetics, DNA transcription, metabolic pathways, cell and microbial growth and product formation, bioprocess operation, scale-up, and design.

Prerequisites: BM227

BM461 Introduction to Nanomaterials **3 Cr Hr (3,0)** **5 ECTS**

Nanotechnology involves behavior and control of materials and processes at the atomic and molecular levels. This interdisciplinary course introduces the theoretical basis; synthetic processes and experimental techniques for nanomaterials. Introduction to nanostructures; microstructures; macrostructures and functional components of hard and soft tissue as applied to implantable materials; devices and pharmaceutical modalities.

Prerequisites: BM331

BM465 Micro/Nano Fabrication Techniques **3 Cr Hr (3,0)** **5 ECTS**

Overview of semiconductors materials. Semiconductors devices application actuators control system and sensors; Instruction and hands-on semiconductor process in clean-room environment; including two sided wet and dry lithography for microelectronics; micro sensors and MEMS; Micro fabrication

Principles and elements; epitaxial growth; oxidation; thin film deposition; Lithography; etching; doping and LIGA micromachining and process integration.

Prerequisites: BM352

BM471 Biomedical Modeling and Simulation **3 Cr Hr (3,0)** **5 ECTS**

An introduction to the modeling of physiological systems; some insights into the nature of physiological complexity in terms of function, behavior, and measurements; The concepts and nature of models and the modeling process; The basic ingredients of model formulation; identification; validation; and simulation;

Examination of approaches to modeling and representations of physiological dynamics; Modeling systems at different levels (comparison and contrast of different cases: static v; dynamic; deterministic v; stochastic; time-invariant v; time-varying; etc); Techniques for estimating the unknown parameters; Software tools; The course includes a modeling project to be done by the students.

Prerequisites: BM371, CE331

BM472 Computer-Aided Design & Prototyping **3 Cr Hr (3,0)** **5 ECTS**

Introduction to advanced computer-aided design (CAD) for product design, modeling, analysis and prototyping. Individual use and team-based environment to design and prototype a functional and marketable product. Projects include use of the advanced design tools to produce a working prototype that is manufacturable. Mechanical desktop. Computerized Numerical control of CNC machine.

Prerequisites: BM371, CE331

BM513 Hygiene and Sterilization **3 Cr Hr (3,0)** **5 ECTS**

It provides you full knowledge of the lifestyle practices that result in optimal health. Principles of disease transmission; Infection control policies, patient procedures, patient assessment and fundamental instrumentation for the hygienist; Foundation of knowledge and strategies of preventive hygiene and sterilization. Also, comprehensive presentation of sterilization procedures as they are now used in the pharmaceutical and medical devices industries. The course explores the practical application of basic scientific knowledge to the destruction of microbials in the manufacture of sterile products and the validation of the sterilization procedures used.

Prerequisites: BIO111

BM515 Molecular Biotechnology and Genetics **3 Cr Hr (3,0)** **5 ECTS**

The purpose of this course is to introduce students to basic molecular biological concepts and techniques used in the fields of biotechnology and genetic engineering. Current experimentation and progress in these fields as well as ethical considerations of this research will be discussed.

Prerequisites: BIO111

BM526 Quantitative and Functional Imaging **3 Cr Hr (3,0)** **5 ECTS**

This course emphasizes the technical aspects of making quantitative measurements of structure and function using different imaging methods; including special imaging methods as well as approaches to image analysis algorithms; and the use of modeling or data analytic techniques for assessing function.

Prerequisites: BM322

BM527 Laser-Tissue Interaction **3 Cr Hr (3,0)** **5 ECTS**

Optical behavior of random media in interaction with laser irradiation. Approximate transport equation methods to predict the absorption and scattering parameters of laser light inside tissue; measuring absorption spectra of tissue/tissue phantoms; making tissue phantoms; determination of optical properties of different tissues; techniques of temperature distribution measurements; Port- wine stain treatment; cancer treatment by photo chemotherapy; cardiovascular applications; Computer simulations of light propagation in tissue.

Prerequisites: PHYS104

BM528 Introduction to Ionizing Radiation **3 Cr Hr (3,0)** **5 ECTS**

Covering the basic principles of radiation and the interaction of radiation with matter; with particular attention given to radiation detection and measurement; Discusses natural and man-made radiation sources; energy deposition and dose calculations; various physical; chemical; and biological processes and effects of radiation with examples of their uses; and principles of radiation protection; Throughout the course emphasis is placed on the underlying physics and the technical issues that impact image quality.

Prerequisites: PHYS104

BM536 Drug Delivery **3 Cr Hr (3,0)** **5 ECTS**

Engineering principle and biological considerations in designing drug delivery systems for medicals uses; The concept of biocompatibility and its implication in formulation controlled release devises are illustrated; Emphasis on the use of biodegradation materials to design drug delivery systems for site- specific applications.

Prerequisites: BM331

BM537 Materials Biocompatibility **3 Cr Hr (3,0)** **5 ECTS**

This course will encourage student learning in the field of biocompatibility, with emphasis on understanding biological responses to the broad range of medical devices and materials available today. Biocompatibility encompasses the host responses to medical devices as well as the material responses to physiological conditions. The problems encountered when exposing medical devices to the human body include deposition of proteins, cells and tissue growth leading to failure (thrombus, lipid absorption etc), toxic responses (acute, primary, immune, genotoxic etc), abnormal cell/tissue responses (carcinogenesis etc), and device degradation leading to failure (environmental stress cracking, wear etc).

Prerequisites: BM331

BM541 Biorobotics **3 Cr Hr (3,0)** **5 ECTS**

Topics include biomimetic design (why nature and humans design differently); sensors (touch; stereo and position); actuators (muscles; smart materials); and intelligent (neural and computer controlled) systems; the application of robotics in medicine, enhancing human movement, and following neurological injuries.

Prerequisites: BM341

BM542 Human Anthropometric and Physical Measurements **3 Cr Hr (3,0)** **5 ECTS**

Engineering aspects of the human Body Parts Measure. Find patterns and symmetry in human body. Applied these aspects to Biomechanics Science and Biomechanics design. Used international standard Measurement table of the human Body. Correlating the Human Anthropometric and the occupational ergonomics.

Prerequisites: BM341

BM543 Surgery for Engineers **3 Cr Hr (3,0)** **5 ECTS**

Fundamental skills and principles of surgery devices. Operating rooms design and sterilization; Computer assisted surgery technologies; including surgical navigation; image guidance and robotic surgery.

Prerequisites: BM551

BM547 Sport Biomechanics and Rehabilitation **3 Cr Hr (3,0)** **5 ECTS**

Introduces the fundamental principles that underpin the understanding of the biomechanics of both sports injury and performance, and how contemporary biomechanical science can be used to answer two goals: reducing injury risk and improving sports performance. It includes a close look at sports injury, including the properties of biological materials, mechanisms of injury occurrence, risk reduction, and the estimation of forces in biological structures. Biomechanical enhancement of sports performance including analytical techniques, statistical and mathematical modelling of sports movements, and the use of feedback to enhance sports performance.

Prerequisites: BM3421

BM538 Nanotechnology and Nanomedicine **3 Cr Hr (3,0)** **5 ECTS**

An introduction to basic concepts of nanotechnology and nanomedicine, define and describe nanostructures and nanomaterials. Nanoscale Fabrication and Characterization. Characterization technologies. Nanoscale and Molecular Electronics, Nanofluidics. The application and challenges in the use of nanotechnology in medicine, including the regulatory issues. The use of nanomaterials for drug delivery and the development of lab on a chip technology.

Prerequisites: BM331

BM524 Fundamentals of Computer Tomography **3 Cr Hr (3,0)** **5 ECTS**

Introduction to the development and process of Computed Tomography, projection data acquisition and reconstructions in science and medicine, focusing on x-ray data and types of Scanning; electron microscopy, nuclear medicine, ultrasound. Physical Problems Associated with Data Collection in CT, Computer Simulation of Data Collection in CT, Data Collection and Reconstruction of the Phantom, Basic Concepts of Reconstruction Algorithms their accuracy under ideal and realistic circumstances, Fourier and linogram reconstruction methods, Backprojection, Filtered Backprojection for Parallel and divergent Beams, Other Transform Methods for Parallel Beams, Algebraic Reconstruction Techniques, Quadratic Optimization Methods, Truly Three-Dimensional Reconstruction (Ex. Snark09), Three-Dimensional Display of Organs.

Prerequisites: BM322

BM555 System Safety and Safety Technology **3 Cr Hr (3,0)** **5 ECTS**

Physiological effects of electricity Inductive methods for analyzing systems to recognize; evaluate; and control hazards; Techniques include preliminary hazard analysis; failure mode and effects analysis; protection and equipment design; Safety analyzer and lest of safety devices.

Prerequisites: BM551

BM576 Biomedia **3 Cr Hr (3,0)** **5 ECTS**

The objective of this project oriented course is to give students basic knowledge about interaction between human and its environment; The focus is on how to understand human beings from computing; communication; and interaction points of view; Among the topics discussed are biometric identities including facial expression; body gesture; biosignals like EKG; EEG; EMG etc; The use of Information Theory to estimate the amount of information can be collected from the face; fingerprint; bio signals etc.

Prerequisites: CE331

BM539 Transport Phenomena in Cells and Organs **3 Cr Hr (3,0)** **5 ECTS**

Applications of the principles of mass and momentum transport to the analysis of selected processes of biomedical and biotechnological interest. Emphasis on the development and critical analysis of models of the particular transport process. Topics include: reaction-diffusion processes, transport in natural and artificial membranes, dynamics of blood flow, pharmacokinetics, receptor-mediated processes and macromolecular transport, normal and neoplastic tissue.

Prerequisites: BM227, BM242

BM559 Pacemaker Technology **3 Cr Hr (3,0)** **5 ECTS**

Introduction to electrically and pneumatically driven extracorporeal and totally implantable ventricular assist devices. Theoretical foundations of electrophysiology of the heart. Understanding of the electrophysiological operation and technology of pacemakers and implantable defibrillators and their indications. Structure and function of pacemakers and pacemaker leads. Teaching of practical skills in programming the pacemakers.

Prerequisites: BM551

BM561 Neuroengineering **3 Cr Hr (3,0)** **5 ECTS**

Introduction to the theory of neural signaling; Fundamentals of neuroscience and the human neural system; Biology of the Neuron and the Action Potential; Neural recordings and their acquisition (equipment; circuits; skin/electrode interface; multielectrode arrays (meas); Neural Signal Characteristics & Processing (Filtering; smoothing artificat suppression); Neural spike train statistics and information content; Current research publications and review papers as well as state-of-the art research and techniques will be discussed; Modeling of neural signaling will be done using computer programming.

Prerequisites: BM211

BM565 BioMEMS Design **3 Cr Hr (3,0)** **5 ECTS**

Use of MEMS in biotechnology; instrumentation; robotics; manufacturing and other applications; Synthesize and design high performance MEMS that satisfy the requirements and specifications imposed; Integrated approaches applied to design and optimize MEMS including: integrate microelectromechanical motion devices; ics; and micro sensors; Recent advances in biomedical applications of MSMS; Course will require a design using CAD tool for a biomedical MEMS-based micro integrated system.

Prerequisites: BM562

BM571 Pattern Recognition for Bio-Medical Applications **3 Cr Hr (3,0)** **5 ECTS**

This course covers fundamental topics in machine learning and pattern recognition. The course will provide an introduction to supervised learning, unsupervised learning, classical learning theory, and reinforcement learning. The approach followed in this course is first to make student familiar with general approaches such as Bayes Classification, Nearest Neighbor Rule, Neural Networks, and Support Vector Machines. Then, after introducing several types of classifiers, students will utilize the learned classifiers for solving Bio-Medical problems such as automatic medical diagnosis. Also, students will learn how to read and summarize research papers related to the content of this course.

Prerequisites: BM321

BM583 Tenders & Technical Specifications **3 Cr Hr (3,0)** **5 ECTS**

Students will able to write Tenders and Technical Specification for medical device (the correct level of detail; Information find quickly and efficiently); Bid writing (giving tight deadline).

Prerequisites: MATH203

BM592 Special Topics I **3 Cr Hr (1,0)** **3 ECTS**

Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

Prerequisites: Dep. App

BM593 Special Topics II **3 Cr Hr (2,0)** **4 ECTS**

Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

Prerequisites: Dep. App

BM594 Special Topics III **3 Cr Hr (3,0)** **5 ECTS**

Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

Prerequisites: Dep. App

BM584 Biomedical Engineering design **3 Cr Hr (3,0)** **5 ECTS**

Detailed description of the engineering design definition, process, fundamental idea generation, decision, and comparison tools, It includes problem definition, concept generation, design requirements, design specifications, evaluation, design validation, regulations, liability, and safety, The implementation of engineering design principles in solving biomedical problems using the student's background in engineering and biomedicine with an emphasis on biomedical instrumentation circuit design to solve presented problems.

Prerequisites: -

X. Course Offered by Other Departments

ECE321 Communication Systems I **3 Cr Hr (3,0)** **5 ECTS**

Introduction to the signal representation in time and frequency domain, basic analog communication techniques like modulation theory, system design for analog modulator and demodulator, random process and noise analysis.

Prerequisites: CE331

ENE315 Introduction to Electric Machines and Drives **3 Cr Hr (3,0)** **5 ECTS**

AC power analysis; polyphase circuits; transformers; magnetic circuits; switch mode power electronics; electromechanical energy conversion; DC motors; DC motor drives and feedback control; AC machines; AC motor drives; stepper motor drives; loses and efficiency.

Prerequisites: ENE211

MATH101 Calculus I **3 Cr Hr (3,0)** **5 ECTS**

This course introduces the student to the calculus of single-valued functions. Topics include: limits, continuity, rates of change, rules for differentiating, differentials and local linear approximations, maxima and minima problems, L'Hôpital's rule, related rates, logarithmic and implicit differentiation, inverse trigonometric and hyperbolic functions, Rolle's theorem, the mean-value theorem, and applications of derivatives and integrals.

Prerequisites: Pre-MATH

MATH102 Calculus II **3 Cr Hr (3,0)** **5 ECTS**

This is a course in multivariate calculus as a continuation of Calculus I. The course focuses on power series, polar coordinates and polar functions, sequences and infinite series, vectors, functions of several variables and their limits, partial differentiation and their applications. The course views multiple integrals: double and triple, line integrals, surface integrals, Green's theorem, Gauss's divergence theorem, and Stoke's theorem.

Prerequisites: MATH101

IE211 Probability and Statistics **3 Cr Hr (3,0)** **5 ECTS**

Descriptive statistics and probability models with emphasis on engineering experimentation. Discrete and continuous random variables and probability distribution. Joint Probability Distribution. Sampling. Statistical estimation and confidence intervals. Test of Hypotheses. Introduction to Linear regression and Correlation. Statistical Quality Control methods. Design of Experiment including factorial and optimal designs.

Prerequisites: MATH102

MATH203 Applied Mathematics for Engineers **3 Cr Hr (3,0)** **5 ECTS**

This course begins with an overview of vector analysis, linear algebra concentrating on using matrices to solve systems of equations, and the diagonalization of matrices, and complex numbers. It then moves into a study of differential equations, shedding light on the solutions of differential equations (first order, second and higher orders) with applications. The course will discuss Laplace transforms and Fourier series and Fourier Transforms with applications in solving initial value problems.

Prerequisites: MATH102

MATH205: Differential Equations **3 Cr Hr (3,0)** **5 ECTS**

Ordinary differential equations; Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transform, and Fourier transform. Eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in applied mathematics. Applications to illustrate typical problems and

methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.

Prerequisites: MATH102

IE121 Engineering Workshops **1 Cr Hr (0,3)** **2 ECTS**

General safety, materials and their classifications, measuring devices and their accuracy, basic household plumbing and electricity, fits and tolerances, theoretical background for the practical exercises including fitting, forging, carpentry, casting, welding, mechanical saws, shearers, drills, lathes, milling machines, shapers and grinders.

Prerequisites: -

CS116 Computing Fundamentals **3 Cr Hr (3,0)** **6 ECTS**

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation. Based on programming language such as C.

Prerequisites: -

CS1160 Computing Fundamentals Lab **1 Cr Hr (0,3)** **0 ECTS**

3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered: Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation. Based on programming language such as C.

Co-requisites: CS116

PHYS103 Physics I **3 Cr Hr (3,0)** **5 ECTS**

Physics and measurement. Motion in one dimension. Vectors. Motion in two dimensions. Force and motion. Kinetic energy and work. Potential energy and conservation of energy. Linear momentum and collisions. Rotation. Rolling and angular momentum.

Prerequisites: -

PHYS104 Physics II **3 Cr Hr (3,0)** **5 ECTS**

Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of Magnetic Field. Faraday's Law.

Prerequisites: PHYS103

PHYS106 Physics Lab **3 Cr Hr (0,3)** **2 ECTS**

Credit Hours: 1, Lecture Hours: 0, Lab Hours: 48.

Co-requisites: PHYS104

CHEM103 General Chemistry **3 Cr Hr (3,0)** **5 ECTS**

Stoichiometry of formulas and equations. Gases and the kinetic-molecular theory. Quantum theory and atomic structure. The components of matter. The major classes of chemical reactions (precipitation, acid-base, oxidation-reduction, and reversible reactions). Thermodynamics: energy flow and chemical change. Quantum theory and atomic structure. Electron configurations and chemical periodicity. Kinetics: rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria.

Prerequisites: -

CHEM106 General Chemistry Lab **1 Cr Hr (0,3)** **0 ECTS**

Stoichiometry of formulas and equations. Gases and the kinetic-molecular theory. Quantum theory and atomic structure. The components of matter. The major classes of chemical reactions (precipitation, acid-base, oxidation-reduction, and reversible reactions). Thermodynamics: energy flow and chemical change. Quantum theory and atomic structure. Electron configurations and chemical periodicity. Kinetics: rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria.

Co-requisites: CHEM103

ENE211: Electrical Circuits I **3 Cr Hr (3,0)** **5 ECTS**

The course Introduces the students to the basic concept of circuit and devices. And to the concepts of design to all kind of electrical circuits, such as DC and AC electric circuits. It Reinforce in the student a systematic approach to problem solving. The ability to involve in a team work. The concept and link between the theory and practical of electric circuits. Reinforce the communication skills, written and oral.

Prerequisites: PHY104

ENE213: Electrical Circuits Lab **1 Cr Hr (0,3)** **2 ECTS**

Resistive circuits, Potentiometers, Superposition, Thevenin's theorem and maximum power transfer, RLC current and voltage characteristics, Frequency response of RL, RC and RLC circuits, Series and parallel resonant circuits, Amplifiers.

Co-requisites: ENE211

ECE241 Electronics I **3 Cr Hr (3,0)** **6 ECTS**

Introduction to Semiconductors, Diode; operation; diode circuits for biomedical applications: Zener diode; optical diode, Bipolar Junction Transistor (BJT) Switches; BJT circuits for biomedical applications, Junction Field Effect Transistor (JFET) Switches and Amplifiers operation; JFET circuits for biomedical applications. Operational Amplifiers (Op-Amp); Op-Amp circuits for biomedical applications: instrumentation amplifiers; isolation amplifiers and current-to-voltage, Active filters (1st and higher orders) for biomedical applications. Converters.

Prerequisites: ENE211

ECE2410 Electronics I Lab **1 Cr Hr (0,3)** **0 ECTS**

Introducing the concepts learned in the course through real experiments with medical applications.

Co-requisites: ECE241

CE211 Digital Systems **3 Cr Hr (3,0)** **6 ECTS**

The theoretical and practical basics of digital logic and digital systems: Number Systems and conversions. Digital Arithmetic, Logic Gates, Boolean Algebra and Simplification Techniques, SOP and POS forms, Arithmetic circuits (Hardware); combinational circuits; half and full adder and subtractors; comparator; multiplier, multiplexers and de-multiplexers; encoders and de-encoders, Priority Encoder, Parity Checker/Generator Flip-Flops; RS; J; T; D, Counters and Registers; asynchronous, synchronous, modulus, and up/down counters; shift register/counter, Sequence detectors; Memory; RAM and ROM elements, Programmable Logic Devices and of-the-shelf microcontroller in medical applications. Microelectronic devices for biomedical application.

Prerequisites: CS116

CE2110 Digital Systems lab **1 Cr Hr (0,3)** **0 ECTS**

The Lab aim is the application of the theory in practical realizations to enhance hands-on experience on topics that are theoretically covered in the course including: basic logic gate experiments, combinational logic circuits experiments, and sequential logic circuits experiments.

C0-requisites: CE211

CE331: Signals and Systems **3 Cr Hr (3,0)** **5 ECTS**

Concepts and mathematical tools in continuous and discrete-time signal processing and linear systems analysis with examples from digital signal processing, communications, and control. Discrete-time signal models. Discrete-time impulse and step response. Frequency domain representations: Fourier series and transforms. Connection between continuous and discrete time frequency representations. Discrete Fourier Transforms (DFT). Discrete-time and hybrid linear systems. Stability and causality. Z transforms and their connection to Laplace transforms. Frequency response of discrete-time systems.

Prerequisites: ENE211, MATH203

CE 341 Microprocessor and Embedded Systems **3 Cr Hr (3,0)** **5 ECTS**

Introduction to Microprocessor based Embedded System, Microcontroller Basic Architecture, Instruction Set and Addressing Mode, Hardware and Software Development Tools, Interrupts and Exceptions, Digital I/O Interfacing, Timer Functions, Analog I/O Interfacing (ADC and DAC), Serial and Parallel Communications, Microcontroller Circuit for Biomedical Application.

Prerequisites: BM551

CE 3410 Microprocessor and Embedded Systems Lab **1 Cr Hr (0,3)** **0 ECTS**

Programming and Design of different medical applications of microcontrollers, I/O interface with serial and parallel connection including seven segment display, display screen, graphics screen, comparison with medical devices applications like blood pressure devices, medical digital thermometer, alphanumeric keyboard, Interfacing to several devices such as LED, speaker, ECG sensors, timer, temperature sensor, A/D converter, Final comprehensive lab project.

Co-requisites: CE341

XI. Courses offered by Other Schools

ARB099: Arabic 99 **0 Cr Hr (3,0)** **0 ECTS**

This course aims to develop student's ability to read, comprehend, literary analyze, grammatically analyze, linguistically analyze, poetically analyze, and rhetorically analyze texts properly. The course also includes a selection of Arabic literature in poetry and prose representing different literary ages, in addition to several common forms of writing such as scientific article, news article, and others.

Prerequisites: -

ARB100: Arabic **3 Cr Hr (3,0)** **3 ECTS**

This course aims to improve the student's competence in the various linguistic skills in terms of reading, comprehension, and taste. This is achieved through the study of selected texts with many implications that raise issues in spelling, grammar, composition, meaning, and inference, and the use of an old and modern thesaurus.

Prerequisites: **ARB099**

ENGL099: English II **0 Cr Hr (3,0)** **0 ECTS**

Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role-play activities for speaking, reading comprehension and writing short descriptive paragraphs.

Prerequisites: -

ENGL101: English III **1 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.

Prerequisites: **ENGL099**

ENGL102: English IV **1 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

Prerequisites: **ENGL101**

ENGL 201: English V **2 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments.

There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.

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Prerequisites: **ENGL102**

ENGL 202: English VI **2 Cr Hr (3,0)** **3 ECTS**

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

Prerequisites: **ENGL 201**

ENGL 202: English VI **2 Cr Hr (3,0)** **3 ECTS**

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

Prerequisites: **ENGL 201**

GERL101B1: German I B1 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Comprehend very familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the Level A1.1 (beginners without pre-knowledge).
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and partially in past tense, set private and semi-official appointments, describe people and things and express frequency and quantity in a very basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and are willing to support the non-native speaker.

Prerequisites: Intensive pre-course (only for 1st semester of an academic year)

GERL102B1: German II B1 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Understand and use familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A1.2 (basic users).

- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

Prerequisites: **GERL101B1**

GERL201B1: German III B1 track **3 Cr Hr (6,0)** **4 ECTS**

By the end of this module, the student will be able to:

- Understand and use familiar, frequently used expressions and simple sentences and structures related to areas of a wider immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers within simple and familiar tasks requiring a simple and direct exchange of information on familiar and routine matters.

Prerequisites: **GERL102B1**

GERL202B1: German IV B1 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.2 (basic users) and, partially, at the level B1.1 (independent user).
- Talk about personal experiences with languages, express feelings of happiness, joy and discomfort, describe own media consumption habits, describe travel experiences, convince others, describe and report in official situations, describe statistics, write formal invitations and short emails, make suggestions and talk about future events and situations, describe dreams hopes and ambitions and briefly give reasons or explanations for opinions and plans.
- Communicate with native speakers about essential points and ideas in familiar contexts.
- Understand the characteristics of the official B1 exam according to the CEFR and use strategies to overcome obstacles while solving said exam.

Prerequisites: **GERL201B1**

GERL301B1: German V B1 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B1.1 and B1.2 (independent user).
- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions, statistics, and briefly give reasons and explanations for opinions and plans.
- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal

letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.

- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use a variety of strategies to overcome obstacles while solving said exam and all its components.

Prerequisites: **GERL202B1**

GERL302REG: German VI Regular **3 Cr Hr (6,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

Prerequisites: **GERL301B1**

GERL302INT: German VI Intensive **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

Prerequisites: **GERL301B1**

GERL102B2: German II B2 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Understand and use familiar, everyday expressions and simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A1.2 and, partially, A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

Prerequisites: **GERL101B1**

GERL201B2: German III B2 track **3 Cr Hr (6,0)** **4 ECTS**

By the end of this module, the student will be able to:

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.1 and A2.2 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, describe simple statistics, express frequency and quantity in a basic way both orally and in writing, express feelings of happiness, joy and discomfort and write personal emails and letters, understand and produce comments, blogs and reports.
- Communicate with native speakers in simple and familiar tasks requiring a simple and direct exchange of essential information on familiar and routine matters.

Prerequisites: **GERL102B2**

GERL202B2: German IV B2 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B1.1 and B1.2 (independent user).
- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.
- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal

letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.
- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and all its components.

Prerequisites: **GERL201B2**

GERL301B2: German V B2 track **3 Cr Hr (9,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Largely understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B2.1 (independent user).
- Interact with an initial degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Largely understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a relatively high controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Largely follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand the main characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

Prerequisites: **GERL202B2**

GERL302B2: German VI B2 track **3 Cr Hr (6,0)** **6 ECTS**

By the end of this module, the student will be able to:

- Understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B2.2 (independent user).
- Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a highly controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.

- Understand all characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.
- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

Prerequisites: **GERL301B2**

BE302: Business Entrepreneurship **3 Cr Hr (3,0)** **3 ECTS**

The course focuses on critical skills necessary to develop appropriate financing strategies for new venture creation and growth. Students will use case studies and team projects in course studies. Three primary topics are covered: first, an overview of the entrepreneurial finance process and involved players; second, performing business valuations; and third, securities law with emphasis on developing term sheets and private placement memorandums. Student teams will complete a valuation and mock securities offering for an existing small to mid-size business. Financial valuations and terms sheets developed by student teams will be presented to a panel of venture capital professionals for evaluation and critique.

Prerequisites: **English101**

DES101: Arts Appreciation **3 Cr Hr (3,0)** **3 ECTS**

An introductory course designed for non-art students to give them the basic knowledge of arts and simple approaches to the understanding of the history, development, elements, criticism, esthetics and materials of different art forms (visual, aural and performing arts). A comparative approach between the different arts is given to enhance the students' global understanding of arts and to give them the ability to look at art works and form their own opinions. The course is combined with examples of audio and visual arts.

Prerequisites: **ARB099, ENGL101**

IC101: Intercultural Communication **3 Cr Hr (3,0)** **3 ECTS**

This course is designed to provide prospective students (whose majors have an international flavor) with tools that offer powerful possibilities for improving the communication process. We will examine the process of sending and receiving messages between people whose cultural background could lead them to interpret verbal and nonverbal signs differently. We will learn about the diversity of these cultural differences and at the same time learn how we might overcome them. Our efforts to recognize and surmount cultural differences will hopefully open up business opportunities throughout the world and maximize the contribution of all the employees in a diverse workforce.

Prerequisites: **English101**

MILS100: Military Science **3 Cr Hr (3,0)** **3 ECTS**

History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.

Prerequisites:

NE101: National Education **3 Cr Hr (3,0)** **3 ECTS**

In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active and responsible citizenship becomes more crucial. It is often argued that democracy requires "democrats" to flourish, and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.

Prerequisites:

SE301: Social Entrepreneurship and Enterprises **3 Cr Hr (3,0)** **3 ECTS**

This course will serve as an introduction to the field of social entrepreneurship and social enterprises. Through lectures, field visits, analyses of relevant literature, case studies and exercises, this course will explore social entrepreneurship's potentials, opportunities and limitations. The topics will cover Defining Social Entrepreneurship. Contextualizing Social Entrepreneurship (need, motives, forms, criteria). Role of Leadership, Creativity and Innovation. Locating SE on the profit/non-profit continuum. SE in the larger fields of development, social change, community activism. Social Enterprises (Missions, Markets, Finances). Ethical business and corporate social responsibility.

Prerequisites: **English101**

SFTS101: Soft Skills **3 Cr Hr (3,0)** **3 ECTS**

This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence and technical reports. Additionally, the student will compose and deliver oral presentations. Assignments will include the use of inductive and deductive approaches to conveying a variety of messages. The course emphasis the use of software tools to prepare presentations, stress management, confidence, and sensitivity to others. It also stresses on resume writing and conducting interviews.

Prerequisites: **English101**