المؤسسة العامة للتدريب التقني والمهني
Technical and Vocational Training Corporation
Directorate General of Curricula

Training Plans for

Bachelor of Technical Colleges

Technical Electronic Engineering

Applied Medical Equipment Engineering

1446 - 2024

Index

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Program Description

This program of Applied Medical Equipment is designed so as to meet the training needs of the local labor market, following professional International standards set for Electronic Engineering Technology. Training in this program includes general skills in English, mathematics and vocational ethics, methods of human communication, interaction skills, project management, Quality management and leadership. It also includes training on Intermediate skills in computer and electrical engineering and basic skills in Mechanical as well as specialized skills in the field of electronics, such as: Analog and Digital Pulses, Signals and Systems, Computer Aided Design, Sensors and measurement systems ,Embedded Systems , Optoelectronics , Digital Systems Design , Electromechanical Systems , Process Control , Digital Control Systems , Robotics , Artificial Intelligence. In this training program the trainees spend (1504) training hours in college in addition to (490) hours of training in the labor market.

The graduates of this program will be given a bachelor degree in the specialization of "Applied Medical Equipment". Graduates of this program must demonstrate: Thermodynamics

- The ability to analyze, design, and implement control systems, instrumentation systems, communications systems and electronics system.
- Repair the mechanical faults for the medical equipment
- The a ability to maintain and calibrate the medical equipment
- Repair the electronic& electrical faults for biomedical equipment
- Knowledge on troubleshooting
- Installation and operation of medical equipment.

In addition, students complete the program, which provides the knowledge students need in leadership, and interpersonal and communication skills.

In addition, students can gain real-world experience through participation in the Co-op / training

توزيع الخطة التدريبية على الفصول التدريبية لمرحلة البكالوريوس بالنظام النصفي ١٤٤٦هـ

The Curriculum Framework Distributed on Semesters 2024G

6th Semester	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي السادس
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	ENGL 301	English Language (1)	0	3	3	0	1	4	.	لغة انجليزية ١	٣٠١ انجل	١	
	2	MATH 301	Mathematics (1)	0	3	3	0	0	3	.	رياضيات ١	٣٠١ رياض	٢	
	3	PHYS 301	Physics	0	3	2	2	0	4	.	فيزياء	٣٠١ فيزي	٣	
	4	KCHE 331	Chemical Processes	0	3	3	0	0	3	.	العمليات الكيميائية	٣٣١ نكيم	٤	
	5	ICMT 402	Computer Programming	0	3	2	2	0	4	.	برمجة الحاسب الآلي	٤٠٢ حاسب	٥	
	6	EBMT 342	Analog & Digital Electronics	0	3	2	2	0	4	.	دوائر تماثلية و رقمية	٣٤٢ اجطب	٦	
	Total Number of Units				18	15	6	1	22	المجموع				

7th Semester	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي السابع
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	ENGL302	English Language (2)	ENGL 301	3	3	0	1	4	٣٠١ انجل	لغة انجليزية ٢	٣٠٢ انجل	١	
	2	MATH 302	Mathematics (2)	MATH 301	3	3	0	0	3	٣٠١ رياض	رياضيات ٢	٣٠٢ رياض	٢	
	3	STAT 303	Statistics and Probability	0	3	3	0	0	3	.	الإحصاء والاحتمالات	احصا ٣٠٣	٣	
	4	EBMT 352	Diagnostic and Therapeutic Equipment (1)	PHYS 301	3	2	2	0	4	٣٠١ فيزي	الأجهزة التشخيصيه والعلاجيه (١)	٣٥٢ اجطب	٤	
	5	EBMT 332	Computer Aided Design in Biomedical Technologies	ICMT 402	3	2	2	0	4	٤٠٢ حاسب	تصميم بواسطة الحاسب في التقنيات الطبية	٣٣٢ اجطب	٥	
	6	EBMT 361	Biomechanics & Biomaterials	PHYS 301	3	3	0	0	3	٣٠١ فيزي	الميكانيكا الحيوية والمواد الحيوية	٣٦١ اجطب	٦	
	Total Number of Units				18	16	4	1	21	المجموع				

Semester	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي الثامن
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	EBMT 424	Control Systems for Biomedical Equipment	MATH 302	3	2	2	0	4	٣٠٢ رياض	انظمه التحكم للاجهزه الطبية	٤٢٤ اجطب	١	
	2	EBMT ***	Elective Course (1)	0	3	3	0	0	3	٠	مقرر اختياري (١)	***اجطب	٢	
	3	EBMT 423	Embedded Systems	ICMT 402	3	2	2	0	4	٤٠٢ حاسب	الأنظمة المدمجة	٤٢٣ اجطب	٣	
	4	EBMT 460	Biomedical Analog and Digital Signal Processing	MATH 301	3	2	2	0	4	٣٠١ رياض	معالجة الإشارات الطبية التناظرية والرقمية	٤٦٠ اجطب	٤	
	5	EBMT 453	Diagnostic and Therapeutic Equipment (2)	EBMT 352	3	2	2	0	4	٣٥٢ اجطب	الأجهزة التشخيصيه والعلاجيه (٢)	٤٥٣ اجطب	٥	
	6	EBMT 425	Medical Imaging Systems	PHYS 301	3	2	2	0	4	٣٠١ فيزي	انظمة التصوير الطبي	٤٢٥ اجطب	٦	
	Total Number of Units				**18**	**13**	**10**	**0**	**23**	**المجموع**				

CTH: Contact Hours T: Tutorial Practical :P L: Lecture CRH: Credit Hours

س.أ : ساعات اتصال أسبوعي تم : تمارين، ورش، /عم : عملي مح : محاضرة، و.م : وحدات معتمدة،

9th Semester	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي التاسع
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	EBMT ***	Elective Course (2)	0	3	3	0	0	3	٠	مقرر اختياري (٢)	***اجطب	١	
	2	EBMT 454	Laboratory and Optical Equipment	KCHE 331	3	2	2	0	4	٣٣١ نكيم	أجهزة البصريات والمختبرات	٤٥٤ اجطب	٢	
	3	EBMT 466	Medical Information Systems	ICMT 402	3	3	0	0	3	٤٠٢ حاسب	نظم المعلومات الطبية	٤٦٦ اجطب	٣	
	4	EBMT 472	Biomedical Image Processing	EBMT 453 EBMT 425	3	2	2	0	4	٤٥٣اجطب ٤٢٥اجطب	معالجة الصور الطبية	٤٧٢ اجطب	٤	
	5	EBMT 422	Rehabilitation Engineering & Technologies	EBMT 453 EBMT 361	3	3	0	0	3	٤٥٣ اجطب ٣٦١ اجطب	تقنيات هندسة إعادة التأهيل	٤٢٢ اجطب	٥	
	6	EBMT 491	Graduation Project	EBMT 424 EBMT 453	2	1	2	0	3	٤٢٤ اجطب ٤٥٣ اجطب	مشروع التخرج	٤٩١ اجطب	٦	

	Total Number of Units	17	14	6	0	20	المجموع

10th Semester	.No	Course Code	Course Name	Prereq	No. of Units			المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي العاشر
					CRH	و.م						
	١	EBMT 499	Co-operative Training		٤				التدريب التعاوني	٤٩٩ اجطب	١	
	Total Number of Units				4				المجموع			

Total Number of Semesters Units	CRH	L	P	T	CTH	المجموع الكلي لوحدات البرنامج
	و.م	مح	عم	تم	س.أ	
	75	58	26	2	86	

Total Contact Hours × 16	Co-operative Training	المجموع الكلي لوحدات التدريب	التدريب التعاوني	ساعات الإتصال الكلية × ١٦
1376	280	1656	٢٨٠	١٣٧٦

Elective Courses

Elective Courses -1	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	المقررات الإختيارية -١
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	EBMT 473	Telemedicine	0	3	3	0	0	3	.	الطب عن بعد	٤٧٣ اجطب	١	
	2	EBMT 429	Nano-technology & Applications	0	3	3	0	0	3	.	تقنيات النانو و تطبيقاتها	٤٢٩ اجطب	٢	
	CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours									س.أ : ساعات اتصال أسبوعي تم : تمارين، ورش، /عم : عملي مح : محاضرة، و.م : وحدات معتمدة،				

Elective Courses -2	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	المقررات الإختيارية -٢
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	EBMT 488	Quality Control of Biomedical Equipment	0	3	3	0	0	3	.	مراقبة جودة الأجهزة الطبية	٤٨٨ اجطب	١	
	2	EBMT 428	Numerical Methods in Biomedical Engineering	0	3	3	0	0	3	.	الطرق الرقمية في الهندسة الطبية	٤٢٨ اجطب	٢	
	CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours									س.أ : ساعات اتصال أسبوعي تم : تمارين، ورش، /عم : عملي مح : محاضرة، و.م : وحدات معتمدة،				

Brief Description

Course Name	Physics	Course Code	PHYS 301	Credit Hours	3
Description	The objective of this is course to provide an understanding of basics of physics, its relation with the biomedical phenomena, applications of the physics principles into biological systems. It includes units and dimensions of different physiological parameters, mechanic and fluid mechanics, electrostatics, optics, sound and ultrasound. It contains also isotopes, nature and properties of ionizing radiation, dose calculation, and electromagnetic radiation in medical instruments.				

Course Name	Chemical Processes	Course Code	KCHE 331	Credit Hours	3
Description	The course aims to acquire trainee basics kills to do principles technical chemical calculations. The course submits detailed explanation of the units of measurement systems and dimensions used in industrial processes. In addition, it gives the trainee the ability to deal with processes variables and how to calculate the chemical composition of the mixtures and solutions. In addition, it provides a full explanation of the laws of material and energy balance and its applications on industrial units whether single or multiple. The course also helps the trainee to understand and accommodate other specialized courses.				

Course Name	Analog and digital electronics	Course Code	EBMT 342	Credit Hours	3
Description	Operational amplifier applications: differential amplifiers. Common mode rejection ratio, instrumentation amplifiers, comparators, active rectifiers, peak detectors, logarithmic amplifiers, photodetectors, integrators, differentiators and active filters (LPF, HPF, BPF, NOTCH Filters and switched Capacitor Filters. Requirements of bio potential amplifiers, Noises, transient protection, common mode and other interference reduction circuits. Isolation amplifiers. Examples: ECG and EMG amplifiers' design. Wave Generators, Schmitt Trigger. The 555 Timer, Oscillators, PLL, Analog Switches, Multiplexers, and De multiplexers. Weighted-Resistor D/A Converter, R-2R Ladder Network D/A Converter, D/A Conversion Errors, D/A ICs. Counting-type A/D Converters, Successive Approximation A/D Converters, Parallel/Flash A/D Converters.				

Course Name	Diagnostic and Therapeutic Equipment (1)	Course Code	EBMT 352	Credit Hours	3
Description	This course is designed to give the student a basic knowledge of the medical equipment in general. The student has to know the principle and fundamentals of diagnostic and therapeutic of some medical equipment's including the study of function and installation of instruments such as artificial respiration system, anesthesia, sterilization unit, suction devices, heart lung machine, infant incubators, hospitals beds, artificial kidney dialyze machines, some electro-mechanical equipment (Infusion pumps, syringe pumps). This course provides also an introduction to the bio-potential and the basic of electrophysiology and its relation with the origin and the interpretation of some biomedical signal as: ECG, EEG, EMG and EOG.				

Course Name	Computer Aided Design in Biomedical Technology	Course Code	EBMT 332	Credit Hours	3
Description	This course gives the trainees an introduction of Programmable Logic Devices (PLD) technology and the design of digital systems using PLDs. The design methodology, systematically introduced & used in the course. Students also learn some basic algorithms of electronic circuit design like Proteus with its two components: ISIS and ARES and how to use LabVIEW to design and test biomedical electronic circuit.				

Course Name	Biomechanics & Biomaterials	Course Code	EBMT 361	Credit Hours	3
Description	This course provides an understanding of the basics of mechanics, its relation with biomechanics, fields where biomechanics applies, establish the ability to use the basics of mechanics acquired and apply it to biomechanics systems in different areas. Stress-strain relationships and principal stress/strain components are investigated via Mohr's circle. It also covers the basics of fluid mechanics, and methods of pressure calculation and measurement on viscous and non-viscous basic fluid especially on blood flow in circulatory system as well as application on cardiovascular biomechanics and calculation of hemodynamic vascular parameters in relation with biomedical equipment. It includes also the concept of mechanical properties of biomaterials such as composite minerals, polymers, viscoelastic. It focuses also on synthetic replacement, prosthetics, orthotics and methods of linking the orthopedic organs with tissue and bone inside the body.				

Course Name	Embedded Systems	Course Code	EBMT 423	Credit Hours	3
Description	Introduction to embedded systems, embedded microcontrollers, digital signal processor (DSP), and field-programmable gate array (FPGA). Software aspects of embedded systems, real time programming languages, operating systems. Embedded ROM, RAMs and interfacing peripherals, USB, RS232 and parallel interfacing. ECG analysis. Display by embedded system as an example of blood pressure determination.				

Course Name	Control System for Biomedical Equipment	Course Code	EBMT 424	Credit Hours	3
Description	This course is designed to give the student a basic knowledge of the control system in general. The student has to know how to analyze any electric circuit using the different methods of analysis. Also this course is designed to give the student a basic knowledge of designing the Feedback Systems				

Course Name	Biomedical Analog and Digital Signal Processing	Course Code	EBMT 460	Credit Hours	3
Description	The objectives of this course are to introduce students to the basic concepts of signals, system modeling, and system classification; to develop students' understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete systems. This course is designed, also, to give the student a basic knowledge of the fundamental ideas of biomedical signals in general. The student has to know how to using the different methods of filters, spectral and time frequency analysis on biomedical digital signal processing. In addition, this course is designed to give the student some Biomedical signal processing applications.				

Course Name	Diagnostic and Therapeutic Equipment (2)	Course Code	EBMT 453	Credit Hours	3
Description	This course provides an introduction to the bio-potential and the basic of electrophysiology and its relation with the origin and the interpretation of some biomedical signals. Main electrophysiological unit like ECG, EEG, EMG and EOG are studied. The course deals with some invasive and non-invasive methods for cardiac output measurements. The course focuses, also, on studying several biomedical electronics instrument including: defibrillators, peacemakers and electrosurgical unities. The course deals also with management and electrical safety and standards of the biomedical electronics instruments and hospital environment.				

Course Name	Medical Imaging Systems	Course Code	EBMT 425	Credit Hours	3
Description	This course is designed to give student a basic knowledge of some medical imaging systems including ionizing imaging system (radiography, CT scan, gamma camera, and non-ionizing imaging system (echography system, MRI systems).				

Course Name	Laboratory and Optical Equipment	Course Code	EBMT 454	Credit Hours	3
Description	This course provides an understanding of working principle, maintenance and calibration of laboratory instruments as pH meter, conduction meter, automated units, chromatography, electrophoresis, hematology and automated chemical analyzers instruments. The course focuses also on studying optical instruments starting by understanding the optical principles, operation of some laboratory and medical instruments. It covers light microscopy, emission and absorption spectrometry, flame spectrophotometer, flame photometers, endoscope instruments. Medical lasers: Argon ion, Carbon dioxide, Yag, excimer.. etc systems. Laser-surgery techniques Photo application (LASIC, ophthalmology IVF etc…). Semiconductor lasers. It includes also acoustic instruments covering concepts of acoustic physics, noise problems and medical equipment used in the objective hearing tests.				

Course Name	Medical Information Systems	Course Code	EBMT 466	Credit Hours	3
Description	This course is designed to give the student a basic knowledge on information system in general. The student has to know how to represent and uses of data. this course is designed to give the student a basic knowledge of medical information system. Case study will present in this course. This course develop, also, an understanding of basic functions of management. Understand the basic concepts and key issues involved in managing engineering organizations. Introduction to Healthcare System Management. Medical equipment acquisition and evaluation. Safety procedures implementation management. Ethics in biomedical engineering organizations.				

Course Name	Biomedical Image Processing	Course Code	EBMT 472	Credit Hours	3
Description	This course is designed to give the student a basic knowledge of the Biomedical Digital Image processing. The student has to know the principal of imaging. Also this course is designed to give the student an application of digital image processing in Biomedical Images.				

Course Name	Graduation Project	Course Code	EBMT 491	Credit Hours	2
Description	In this course groups of at least two students shall start their graduation project. The course includes a literature survey, action plan, design of complete project taking into account, realistic constraints, computer simulation (if applicable), implementation and testing of remaining part of their design. Oral presentation, poster presentation and complete detailed report are required at the end of the project.				

Course Name	Rehabilitation engineering and technologies	Course Code	EBMT 424& EBMT 453	Credit Hours	3
Description	Introduction to rehabilitation engineering. Pathophysiology components of Disability: Physical impairment; Speech impairment, Disabilities and symptoms. Rehabilitation engineering technology: Assistive devices, Transportation Wheel chairs to enhance mobility. Disability assessment. Application of rehabilitation engineering: Prosthetics, Orthotics, Artificial limbs and brain computer interface (BCI).				

Course Name	Telemedicine	Course Code	EBMT 473	Credit Hours	4
Description	Telemedicine: Introduction, motivation, and overview; clinical applications; data dimensionality, acquisition, and conversion; transmission methods (wired, wireless); networking; compression; measurement of quality and accuracy; reception and display considerations; data archiving and retrieval; store-and-forward vs. interactive; privacy and security issues; commercial hardware and software; standards (including DICOM); economic issues; user-interface considerations; picture archiving and communication systems (PACS).				

Course Name	Nano-technology and Applications	Course Code	EBMT 429	Credit Hours	4
Description	Atomic and molecular nanotechnology. Nano systems and molecular forces and fields. Thermodynamics and statistical mechanics and small system mechanics. Quantum phenomena and metaptosis. Molecular structural forces. Nano particule types; carbon nanotubes, quantum dots, polymer nano particules, gold nano particules, dedrimers. Nanomaterials and nanostructures. Application of nanoparticles in targeted drug delivery and thermal or light transfer in circuits. Therapeutic applications, light focus in nano shells, nanoparticles activation with X-rays and magnetic fields, magnetic hyperthermia with nanoparticles. Applications in Medical Imaging. Nano-sensors, Nano robots and nano machines. Nano electronics applications in Medicine.				

Course Name	Quality Control of Biomedical Equipment	Course Code	EBMT 488	Credit Hours	4
Description	The course provides an understanding principle of quality control (QC) methods used for electronic medical equipment (ECG, EEG, EMG, electro surgical unit …) concerning, calibration safety and international standards of QC and quality assurance. This course focus also on the quality control of heavy medical equipment (X-ray, CT scan, nuclear medicine imaging, catheterize system, hemodialysis system …) it includes: Protocols and standards of quality control (NEMA Protocol, radiation protection standards…)				

Course Name	Numerical methods in biomedical engineering	Course Code	EBMT 428	Credit Hours	4
Description	Modeling Biosystems: Constructing bio models and solving models by computers. Concepts of numerical analysis. Linear biological systems, iterative solutions, Jacobi method. Nonlinear biological systems, successive substitution, linear interpolation and Newton-Raphson method. Finite difference method and finite element method in biomechanics. Runge-Kutta method, drug absorption example. Partial differential equations: cell migration, drug diffusion. Least square modeling and curve fitting. Applications: Diabetes and insulin regulation. Renal clearance example.				

Department	**Electronics Engineering**		**Major**	**Biomedical Equipment**						
Course Name	**Analog and Digital Electronics**		**Course Code**	**EBMT 342**						
Prerequisites			**Credit Hours CRH**	**3**		CTH	4			
				L	**2**	P	**2**	T	**0**	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description:

Op-amp applications: differential amplifiers. Common mode rejection ratio, instrumentation amplifiers, comparators, active rectifiers, peak detectors, logarithmic amplifiers, photodetectors, integrators, differentiators and active filters (LPF, HPF, BPF, NOTCH Filters and switched Capacitor Filters. Requirements of biopotential amplifiers, Noises, transient protection, common mode and other interference reduction circuits. Isolation amplifiers. Examples: ECG and EMG amplifiers' design. Wave Generators, Schmitt Trigger. The 555 Timer, Oscillators. PLL, Analog Switches, Multiplexers, and Demultiplexers. Weighted-Resistor D/A Converter, R-2R Ladder Network D/A Converter, D/A Conversion Errors, D/A ICs. Counting-type A/D Converters, Successive Approximation A/D Converters, Parallel/Flash A/D Converters.

Topics :

- Amplifiers and Filters
- Bio-potential amplifiers
- Oscillator circuits
- Digital and analog converters
- Multiplexers

References :

1. Operational Amplifier Circuits: Theory and Applications, ISBN: 0030019486 Authors: Eldredge Johnson Kennedy
2. Introduction to Biomedical Equipment Technology by Joseph J. Carr (Author), John M. Brown (Author)

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Inverting and non-inverting amplifiers. Differential amplifier.	**2**
2	Comparators, rectifiers, peak detectors, logarithmic amplifiers	**2**
3	Common mode rejection ratio. Instrumentation amplifiers	**2**
4	Integrators, differentiators and active filters, LPF, HPF, BPF, NOTCH Filtersa nd switched Capacitor Filters	**4**
5	Requirements of biomedical amplifiers, Noises, transient protection, common mode and other interference reduction circuits.	**4**
6	Isolation amplifiers.	**3**

7	ECG and EMG amplifiers' design	**3**
8	The feedback concepts, positive and negative feedback in amplifiers. Wave Generators, Schmitt Trigger. The 555 Timer, Oscillators. PLL, and applications of oscillators in biomedical instrumentation.	**3**
9	Analog Switches, Multiplexers, and Demultiplexers.	**3**
10	Weighted-Resistor D/A Converter, R-2R Ladder Network D/A Converter, D/A Conversion Errors, D/A ICs	**3**
11	Counting-type A/D Converters, Successive Approximation A/D Converters, Parallel/Flash A/D Converters.	**3**
	Total	**32**
Textbook:	Design with Operational Amplifiers and Analog Integrated Circuits by Franco, Sergio, ISBN: 0071121730	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1st Experiment:** Op-Amp as simple comparator	**3**
2	**2nd Experiment:** Op-Amp as an inverting amplifier	**3**
3	**3rd Experiment:** Non-Inverting Op-Amp	**3**
4	**4rd Experiment:** Frequency Response of Low & High Pass active Filter	**4**
5	**6th Experiment:** Integrators and differentiator circuits	**4**
6	**7th Experiment:** Differential amplifier and CMRR	**3**
7	**8th Experiment:** Instrumentation Amplifier (IA)	**3**
8	**9th Experiment:** Second order active filters	**3**
9	**10th Experiment:** Oscillators	**3**
10	**11th Experiment:** DAC and ADCs	**3**
Total		**32**
Textbook:	**Practical Manual**	

Department	Electronics Engineering	Major	Biomedical Equipment
Course Name	Diagnostic and Therapeutic Equipment (1)	Course Code	EBMT 352
Prerequisites	PHYS 301	Credit Hours CRH	3 CTH 4
			L 2 P 2 T 0

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This course is designed to give the student a basic knowledge of the medical equipment in general. The student has to know the principle and fundamentals of diagnostic and therapeutic of some medical equipment's as biomechanical equipment including the study of function and installation of mechanical instruments such as artificial respiration system, anesthesia, sterilization unit, suction devices, heart lung machine, infant incubators, hospitals beds, artificial kidney dialyze machines, some electro-mechanical equipment (Infusion pumps, syringe pumps), dental machine.

Topics :

- Medical equipment distribution
- Artificial respiration system
- Spirometer
- Anesthesia system
- Sterilization unit
- Suction device. Aspirator
- Heart lung machine
- Infant incubators
- Hospital beds
- Artificial kidney dialyze machines
- Electro-mechanical equipment
- Dental Machine

Experiments: If applicable, it will support the course topics.

References :

1. Medical Instruments and Devices: Principles and Practices. Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson. Ed. CRC Press. Oct. 2017 - ISBN: ISBN 9781138748521
2. Introduction to Biomedical Equipment Technology, Fourth Edition; Joseph J. Carr, John M. Brown. 2001 by Prentice-Hall, Inc.3 ISBN-13: 978-0130104922 | Edition: 4
3. Medical Instrumentation; Application and Design, John G. Webster, Publisher John Wiley,Year 2009,Edition 4th edition, ISBN-13: 978-0471676003 | Edition: 4
4. Biomedical Equipment Use, Maintenance and management , Joseph Carr. ISBN-13: 978-0132575775
5. Handbook of Electro medicine , Johannes Patzold-HienzKresse, Siemens,John Wiley& Sons. ISBN: 0-07-02134-5
6. Electrotherapy Explained: Principles and Practice, val Robertson ISBN-13: 978-0750688437 | Edition: 4
7. Gait Analysis: An Introduction, Michael Whittle ISBN-13: 978-0702042652 | Edition: 5 6.

8. Understanding Disability: From Theory to Practice, Michael Oliver ISBN-13: 978-0230220287 Edition: 2

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• Medical equipment distribution • Distribution of medical equipment by function • Distribution of medical equipment by specialty	**3**
2	▪ Artificial respiration system ▪ Spirometer	**5**
3	• Anesthesia system • Sterilization unit	**5**
4	▪ Suction device ▪ Aspirator	**2**
5	▪ Heart lung machine	**5**
6	▪ Infant incubators ▪ Hospital beds	**3**
7	▪ Artificial kidney dialyze machines	**3**
8	▪ Electro-mechanical equipment ▪ Infusion pumps ▪ Syringe pumps	**3**
9	• Dental Machine	**3**
Total		**32**
Textbook:	1. Medical Instrumentation; Application and Design, John G. Webster, Publisher John Wiley,Year 2009,Edition 4th edition, ISBN-13: 978-0471676003 | Edition: 4 2. Biomedical Equipment and Devices, Second Edition. Moore. 2013 – ISBN: 9781439859599	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1st Experiment:** Respirator	**3**
2	**2nd Experiment:** Spirometer	**3**
3	**3rd Experiment:** Anesthesia system	**3**
4	**4th Experiment:** Sterilization unit	**5**
5	**5th Experiment:** Suction device	**5**
6	**6th Experiment:** Infant incubator	**5**
7	**7th Experiment:** Dialyse machine	**4**

8	**8th Experiment:** Infusion pump	**4**
Total		**32**

Department	**Electronics Engineering**	**Major**	**Biomedical Equipment**						
Course Name	**Computer Aided Design in Biomedical Technologies**	**Course Code**	**EBMT 332**						
Prerequisites	ICMT 402	**Credit Hours CRH**	**3**	CTH	4				
			L	**2**	P	**2**	T	**0**	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course gives the trainees an introduction of Programmable Logic Devices (PLD) technology and the design of digital systems using PLDs. The design methodology, systematically introduced & used in the course. Students also learn some basic algorithms of electronic ciruit design like Proteus with its two components: ISIS and ARES and how to use Labview to design and test biomedical electronic circuit.

Topics :

- Combinational Logic
- Introduction to MSI and PLD Components
- Read Only memory (ROM)
- Programmable Logic Array (PLA)
- Programmable Array logic (PAL)
- Algorithmic State Machine (ASM)
- Design Examples using PLDs
- Control Implementation
- Proteus Software
- Labview

Experiments: If applicable, it will support the course topics.

References :

- Digital McLogic Design, Bryan J. Mealy & James T. Mealy © Bryan J. Mealy 2012.
- M. Morris Mano, Digital Design, Prentice Hall, 1997.
- P.K. Lala, Digital System Design Using Programmable Logic Design, Prentice Hall.
- John Carter, Digital Designing with programmable Logic Devices, Prentice.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Combinational Logic:** Introduction to Logic Gates, Logic Variables, Uses of Simple Logic, Logic Gates, Representing Logic Functions, Boolean Algebra.	**3**
2	**Introduction to MSI and PLD Components:** Introduction to asics and programming logic asic fabricationtechnologies, filed programmable logic, mask programmable gate arrays, standard cell and custom asics, system level asicdesign issues	**3**

3	**Read Only memory (ROM):** Introduction, Classic mask-programmed ROM, Programmable read-only memory, Erasable programmable read-only memory, Electrically erasable programmable read-only memory. Electrically alterable read-only memory, Flash memory, Dynamic random access memory (DRAM).	4
4	**Programmable Logic Array (PLA):** Enabling Concept, Before Programming, After Programming, Alternate Representation for High Fan-in Structures.	3
5	**Programmable Array Logic (PAL) :**Programmable logic definition, dvantages Programmable logic, programming technologies. Programmable Logic Array Example, PLA Design Example**.**	3
6	**Algorithmic State Machine (ASM):** Algorithmic state machine theory, guide velopment, UML theory, project plan. Software design, software acceptance testing.	2
7	**Design Examples using PLDs:** Introduction, Constructing a Combinatorial Design-Basic Gates, Understanding the Logic Diagram, Building the Design File. Generating a JEDEC File, Simulating the Gates, Constructing a Registered Design-Basic Flip-Flops.	2
8	**Control Implementation:** Global System Description, ICCG Component, Detection Component, Processor Component.	4
9	**Software design :** Design of medical electronic circuit by Proteus software: ISIS and ARES.	4
10	**Labview and biomedical electronic design**	4
Total		32
Textbook:	• Digital McLogic Design, Bryan J. Mealy & James T. Mealy © Bryan J. Mealy 2012. • M. Morris Mano, Digital Design, Prentice Hall, 1997. • P.K. Lala, Digital System Design Using Programmable Logic Design, Prentice Hall. • John Carter, Digital Designing with programmable Logic Devices, Prentice.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1 st Experiment:** Implementation of logic equation and showing the output through LED by using EPROM.	4
2	**2nd Experiment:** Implementation of a Logic Comparator by Using EPROM.	4
3	**3rd Experiment:** Implementation of a Logic Full Adder by using EPROM.	4
4	**4th Experiment:** Implementation of a Logic to add and multiply 2-bit numbers by using EPROM.	2
5	**5th Experiment:** Implementation of a 2-bit Sequential Counter by using EPROM.	2
6	**6th Experiment:** Implementation of a schematic diagram of the controlled counter by using EPROM	2

7	**7th Experiment:** Implementation of logic equation and showing the output through LED by using GAL Devices.	**2**
8	**8th Experiment:** Implementation of logic equation and showing the output through LED by using GAL Devices.	**2**
9	**9th Experiment:** Implementation of 3-bit Sequential Counter by using GAL Devices.	**2**
10	**10th Experiment:** Implementation of 3-bit Sequential using GAL Devices.	**2**
11	**11th Experiment:** Implementation of 2-bit Sequential Counter by using (EPROM and D – type flip – flop).	**2**
12	**12th Experiment:** Design of biomedical electronic circuit by Proteus Software	**2**
13	**13th Experiment:** Design of bioleical device by Labview	**2**
Total		**32**
Textbook:	**Practical Manual**	

Department	Electronics Engineering	Major	Biomedical Equipment
Course Name	**Biomechanics & Biomaterial**	Course Code	**EBMT 361**
Prerequisites	PHYS 301	Credit Hours CRH	3 CTH 3
			L 3 P 0 T 0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course provides an understanding of the basics of mechanics, its relation with biomechanics, fields where biomechanics applies, establish the ability to use the basics of mechanics acquired and apply it to biomechanics systems in different areas. Stress-strain relationships and principal stress/strain components are investigated via Mohr's circle. It also covers the basics of fluid mechanics, and methods of pressure calculation and measurement on viscous and non-viscous basic fluid especially on blood flow in circulatory system as well as application on cardiovascular biomechanics and calculation of hemodynamic vascular parameters in relation with biomedical equipment. It includes also the concept of mechanical properties of biomaterials such as composite minerals, polymers, viscoelastic. It focuses also on synthetic replacement, prosthetics, orthotics and methods of linking the orthopedic organs with tissue and bone inside the body.

Topics :

- Basics of mechanics and biomedical applies
- Stress-Strain. Mohr’s circle.
- Fluid mechanics and ideal fluid
- Real fluid
- Hemodynamics and biorheology
- Biomaterial and mechanical proprieties
- Prosthesis and synthetic replacement

Experiments: If applicable, it will support the course topics.

References :

- Site web: www.biomech.com/
- Elementary Biophysics. P.K. Srivastava. Narosa publishing house. (2011) ISBN:978-81-7319-913-4
- Fundamentals of Biomechanics, Ozkaya and M Nordin 2nd Edition, Springer, New York, 1999. ISBN-13: 978-1461411499 | Edition: 3rd ed. 2012
- Mechanical Properties of Materials. Pelleg. Ed. Springer. 2013
- Biomechanical systems technology: A 4-Volume Set. Cornelius T Leondes. Ed. world Scientific – 2009.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• Basics of mechanics and biomedical applies • Moment of force • Solids balance • Support leg modeling • Biomedical applications	**7**
2	▪ Stress-Strain. Mohr's circle. ▪ Hooke law ▪ Solid deformation ▪ Mohr's circle ▪ Biomedical applications	**7**
3	• Fluid mechanics and ideal fluid • Fundamental principles of hydrostatics • Equation of continuity • Bernoulli theorem • Biomedical applications	**7**
4	▪ Real fluid ▪ Viscosity and real fluid ▪ Flow of real fluid ▪ Poiseuille law ▪ Viscosity measurements	**7**
5	▪ Hemodynamics and biorheology ▪ Blood and vessels ▪ Cardiac biomechanics ▪ Cardiac output ▪ Pressure measurements	**8**
6	• Biomaterial and mechanical proprieties • Composite minerals, polymers, viscoelastic material • Mechanical proprieties. Young module	**6**
7	• Prosthetics and synthetic replacement • Prosthetics composite minerals, polymers, viscoelastic • Orthotics	**6**
Total		**48**
Textbook:	1. Fundamental of biomechanics. Huston. Ed. CRC Press. 2013 ISBN: 9781466510371 **2.** Biomedical Applications of Magnetic Particles. Jeffrey N. Anker. 2014 ISBN: 9781439839683 **3.** Mechanics of Real Fluids. M. RAHMAN. Ed. WIT Press. 2011	

Department	Electronics Engineering		**Major**	Biomedical Equipment				
Course Name	**Control Systems for Biomedical Equipment**		**Course Code**	**EBMT 424**				
Prerequisites	MATH 302		**Credit Hours** / **CRH**	**3**	CTH	4		
				L	**2**	P	**2**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed to give the student a basic knowledge of the control system in general.

The student has to know how to analyze any electric circuit using the different methods of analysis. In addition, this course is designed to give the student a basic knowledge of designing the Feedback Systems.

Course topics:

- Introduction to Control Systems, Review of Frequency Domain
- Systems Analysis (Laplace Transform, Transfer Function
- Modeling Dynamic Systems (e.g., electrical systems, Biomechanical Systems)
- State-Space Analysis (Matrix Algebra ،State-Space Representation ،Case Study: Pharmacokinetics
- Review of Time Domain Systems Analysis (Poles and Zeros
- Second-Order Systems ،Physiological Systems Modeling
- Analysis of Feedback Systems ،Feedback Control
- Performance of Feedback Systems: Steady-State Errors
- Physiological Control System Modeling
- Stability and Design of Feedback Systems (Routh-Hurwitz Criterion، Root Locus Techniques, Compensators
- Stability and Design of Feedback Systems via Compensation and Frequency Response Techniques (Nyquist Criterion)
- Design of Feedback Systems via State-Space Techniques (Controllability), Design of Biomedical Systems

Experiments: If applicable, it will support the course topics.

References :

Detailed of Theoretical Contents		
	Contents	**Hours**
1	Introduction to Control Systems, Review of Frequency Domain	**7**
2	Modeling Dynamic Systems (e.g., electrical systems, Biomechanical Systems	**6**
3	Review of Time Domain Systems Analysis (Poles and Zeros Second-Order Systems, Physiological Systems Modeling	**4**
4	Analysis of Feedback Systems, Feedback Control Performance of Feedback Systems: Steady-State Errors Physiological	**5**
5	Stability and Design of Feedback Systems (Routh-Hurwitz Criterion, Root Locus Techniques, Compensators)	**5**
6	Response Techniques (Nyquist Criterion) Design of Feedback Systems via State-Space Techniques (Controllability), Design of Biomedical Systems	**5**
	Total	**32**
Textbook:	1. Norman S. Nise, Control Systems Engineering (John Wiley & Sons, Inc.). ISBN-13: 978-0470646120 | Edition: 6th Edition International Student Version.	

Detailed of practical Contents		
	Contents	**Hours**
1	Introduction to Matlab	**1**
2	Open loop and close loop transfer function	**2**
3	Laplace Transform	**3**
4	Poles and zeros	**2**
5	First order system	**3**
6	Second order system	**2**
7	PI and PD controllers with motor system	**2**
8	PID controller with motor system	**2**
9	Frequency response (Bode plot)	**2**
10	Root Locus	**3**
11	Routh – Hurwitz	**3**
12	Final assessment	**3**
13	Control sytem with Labview	**4**
	Total	**32**
Textbook:	**Lab manual**	

Department	**Electronics Engineering**	**Major**	**Biomedical Equipment**
Course Name	**Biomedical Analog and Digital Signal Processing**	**Course Code**	**EBMT 460**
Prerequisites	MATH 301	**Credit Hours** **CRH**	**3** CTH 4 L **2** P **2** T **0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The objectives of this course are to introduce students to the basic concepts of signals, system modeling, and system classification; to develop students' understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete systems. This course is designed, also, to give the student a basic knowledge of the fundamental ideas of biomedical signals in general. The student has to know how to using the different methods of filters, spectral and time frequency analysis on biomedical digital signal processing. In addition, this course is designed to give the student some Biomedical signal processing applications.

Topics :

- Standard Signals and Systems
- Convolution
-
- Fourier Series and Fourier Transform
- Laplace Transform
- z-Transform
- Frequency response and filter design
- Discrete Signals and Systems
- Discrete Fourier Transforms
- FIR & IIR Filter Design
- DSP Algorithm Implementation and Biomedical applications

Experiments: If applicable, it will support the course topics.

References :

- Openheim and Wilsky, Signals and Systems, Prentice Hall, 1992
- Frederick and Carlson, Linear Systems, Prentice Hall
- Discrete-Time Signal Processing. Oppenheim A., Schafer R., and Buck J. Publisher Prentice Hall. Year 1999,Edition 3rd edition. ISBN-13: 978-0131988422 | Edition: 3
- Biomedical Signal Processing and Signal Modeling. Bruce, E.N. John Wiley and Sons, Inc., 2000. ISBN: 978-0-471-34540-4
- Biomedical Digital Signal Processing. Tompkins W. J., , Prentice Hall, 1993. ISBN: 9781439870334،
- Digital Signal Processing. Proakis J. and Manolakis, 2007, 4th edition, Pearson Education, ISBN-13: 978-0131873742 | Edition: 4

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Standard Signals and Systems:** • Signal and System Basics, Signals , Basic Functions, Systems, LTI Systems	**3**
2	**Convolution** • Definition, Properties, the convolution integral for continuous-time LTI systems, convolution sum for discrete-time LTI systems	**3**
3	**Fourier Series and Fourier Transform** • **Fourier Series** Sinusoidal Analyze, Fourier series, Existence of the Fourier series, Properties of the Fourier series, Fourier series Coefficients, Computation of the Fourier Coefficients, The Response of Linear Systems to Periodic Inputs • **Fourier Transform** Fourier transform equations, Existence of the Fourier Transform, Properties of the Fourier Transform , Applications of Fourier Transform	**5**
4	**Laplace Transform** • The Laplace Transform Definition, relation with Fourier Transform, Properties of the Laplace Transform, Laplace Transforms of Periodic Functions, The Dirac Delta Function and Impulse Response, Applications of Fourier Transform	**3**
5	**z-Transform** • Definition of z-Transforms, z-Transforms properties, Stability convergence of z-Transfoms, LTI System applications	**3**
6	**Frequency response and filter design** • Ideal filters, Real filters, Butterworth Chebyschev and Elliptic Filters, Bandpass Filters,	**4**
7	**Fourier Analysis of Discrete-Time Signals and Systems** Discrete Time Fourier Transform (DTFT), Sufficient condition for the DTFT of Periodic Signals, DTFT and LTI systems: Frequency response	**4**
8	**FIR and IIR Filter Design**	**3**
9	**DSP Algorithm Implementation** **Application of DSP in Biomedical Signals**	**4**
Total		**32**

Textbook:	• Digital McLogic Design, Bryan J. Mealy & James T. Mealy © Bryan J. Mealy 2012. • M. Morris Mano, Digital Design, Prentice Hall, 1997. • P.K. Lala, Digital System Design Using Programmable Logic Design, Prentice Hall. • John Carter, Digital Designing with programmable Logic Devices, Prentice.

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1 st Experiment:** Analog Filter Design	**7**
2	**2nd Experiment:** Discrete Time Fourier Transform (DTFT) of medical signals	**9**
3	**3rd Experiment:** FIR and IIR Filter Design	**5**
4	**4th Experiment:** DSP Algorithm Implementation (Matlab, Labview)	**11**
Total		**32**
Textbook:	**Practical Manual**	

Department	Electronics Engineering	Major	Biomedical technology
Course Name	Embedded Systems	Course Code	EBMT 423
Prerequisites	ICMT 402	Credit Hours CRH	3 CTH 4
		L 2 P 2 T	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course Description :

Embedded systems are involved in almost every facet and modern life. Cell phones, pagers, PDAs answering machines, microwaves ovens, televisions, video games consoles, GPS devices, networks routers…
Late model cars may contain as many as 65 embedded microprocessors, controlling such tasks as antilock braking, engine control, audio system control**.**

In this course the fundamentals of embedded systems hardware and firmware design will be explored. Issues such us embedded processor selection, hardware- firmware partitioning, logic circuit design, circuit layout, circuit debugging, developing tools, firmware architecture, firmware design and firmware debugging..

Topics :

- Converter classification and electronic switches.
- General-purpose processors: Software
- Standard single-purpose processors: Peripherals
- Custom single-purpose processors: Hardware
- Memories
- Interfacing

Experiments: If applicable, it will support the course topics

References :

- Ali Mazidi, Janice Gillispie Mazidi., "The 8051 Microcontroller and Embedded systems", Person Education, 2nd Edition, 2004.
- Dorf R.C., Bishop R.H. Modern control systems, Addison Wesley, 1995.

	Detailed of Theoretical Contents	
No.	**Contents**	**Hours**
1	**Introduction to the Course and Embedded Systems** Embedded systems overview, Design challenge – optimizing design metrics, Embedded processor technology, IC technology, Design technology,	3
2	**General-purpose processors: Software.**Basic architecture, Operation, Programmer's view, Microcontrollers, Selecting a microprocessor	5
3	**Standard single-purpose processors: Peripherals** Timers, counters, and watchdog timers, UART (Universal Asynchronous Receiver/Transmitter), Pulse width modulator, LCD controller, Keypad controller, Stepper motor controller.	5
4	**Custom single-purpose processors: Hardware** Combinational logic design, Sequential logic design, Custom single-purpose processor design	5
5	**Memories**: Read-only memory – ROM, Read-write memory – RAM, Composing memories.	6

6	**Interfacing**: Timing diagrams, Hardware protocol basics, Interfacing with a generalpurpose processor, Arbitration, Multi-level bus architectures.	**6**
7	Final Assessment.	**2**
	Total	**32**
Textbook	• Marwedel, Peter, Embedded System Design : Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, Springer International Publishing 2018 • Elecia White, Making Embedded Systems: Design Patterns for Great Software, O'Reilly, 2011 • Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley , 2001	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1.	Assembly Microprocessor Programming	**4**
2.	AVR/ARM programming	**6**
3.	DSP algorithms programming	**6**
4.	Custom single-purpose processor design	**6**
5.	Memory programming and Testing	**4**
6.	Interfacing of LCD display to Microcontroller	**4**
7.	Final Assessment.	**2**
	Total	**32**
Textbook	Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley, 2001.	

Textbooks	Marwedel, Peter, Embedded System Design : Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, Springer International Publishing 2018 Elecia White, Making Embedded Systems: Design Patterns for Great Software, O'Reilly, 2011 Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley , 2001
	Frank Vahid, Tony Givargis, Embedded System Design: a unified hardware/software introduction, Wiley, 2001.

Department	Electronics Engineering	Major	Biomedical Equipment
Course Name	Diagnostic and Therapeutic Equipment (2)	Course Code	EBMT 453
Prerequisites	EBMT 352	Credit Hours CRH	3 CTH 4
			L 2 P 2 T 0

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This course provides an introduction to the bio-potential and the basic of electrophysiology and its relation with the origin and the interpretation of some biomedical signals. Main electrophysiological unit like ECG, EEG, EMG, ICG and EOG are studied. The course deals with some invasive and non-invasive methods for cardiac output measurements. The course focuses, also, on studying several biomedical electronics instrument including: defibrillators, peacemakers and electrosurgical unities. The course deals also with management and electrical safety and standards of the biomedical electronics instruments and hospital environment.

Topics :

- Electrophysiology and biomedical signals
- Electrocardiography (ECG)
- Electroencephalography (EEG)
- Electromyography (EMG)
- Impedance cardiography (ICG)
- Electrooculograph system (EOG)
- Cardiac output measurement
- Defibrillators
- Pace maker
- Electro-surgical unit
- Management and medical electrical safety

Experiments: If applicable, it will support the course topics.

References :

- Medical Instruments and Devices: Principles and Practices. Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson. Ed. CRC Press. Oct. 2017 - ISBN: ISBN 9781138748521
- Handbook of biomedical instrumentation, third edition. R.S. Khandpur. Ed. McGraw Hill Education. 2014 – ISBN:٩٧٨٩٣٣٩٢٠٥٤٣٠
- Biomedical diagnostic science and technology. Naim Akmal. 2013 – ISBN: 9780203909140

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• Electrophysiology and biomedical signals • Electrical dipole • Nernst potential • Rest and action potential • Electrophysiological signals	**4**
2	▪ Electrocardiography ▪ ECG signal ▪ ECG leads ▪ ECG electronic circuit	**4**
3	• Electroencephalography • EEG signal • EEG electrodes • EEG electronic circuit	**3**
4	▪ Electromyography ▪ EMG signals ▪ Electrodes ▪ EMG electronic circuit	**3**
5	▪ Impedance cardiography ▪ Cardiac bioimpedance method ▪ Bioimpedance signal and medical applications ▪ Bioimpedance electronic circuit	**3**
6	▪ Electrooculography ▪ Electrooculography principle ▪ EOG signal and medical applications ▪ EOG electronic circuit	**3**
7	▪ Cardiac output measurement ▪ Cardiac output and cardiac index ▪ Cardiac output monitoring: invasive methods ▪ Cardiac output monitoring: non-invasive methods	**3**
8	▪ Defibrillators ▪ Definitions ▪ Defibrillation and defibrillator ▪ Defibrillator electronic circuit	**2**
9	▪ Pace maker ▪ Stimulation principle ▪ The pace maker ▪ Block diagram and electronic circuit	**2**
10	• Electro-surgical unit • Physical principle • Monopolar technique • Bipolar technique • Precaution, security and medical applications • Device operating and electronic circuit	**2**
11	• Management and medical electrical safety • Hospital managment • Medical electrical safety	**3**
Total		**32**

Textbook:	1. Biomedical instrumentation and measurement. Betterword books (2001). ISBN : 9780675209434 2. Basic Electronic Troubleshooting for Biomedical Technicians (2010). ISBN : 978-1934302514 3. Principles of Medical Electronics and Biomedical Instrumentation (Biomedical engineering) C. Raja Rao, S.K. Guha. 2000 - ISBN: 978-8173712579 **4.** Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, Second Edition Robert B. Northrop March 29, 2017 by CRC Press ISBN 9781138073050

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1st Experiment:** ECG electronic circuit and device	**4**
2	**2nd Experiment:** EEG electronic circuit and device	**4**
3	**3rd Experiment:** EMG electronic circuit and device	**4**
4	**4th Experiment:** ICG electronic circuit and device	**5**
5	**5th Experiment:** EOG electronic circuit and device	**5**
6	**6th Experiment:** Defibrillator	**5**
7	**7th Experiment:** Electrosurgical unit	**5**
Total		**32**
Textbook:	**Practical Manual**	

Department	Electronics Engineering	Major	Biomedical Equipment						
Course Name	Medical Imaging Systems	Course Code	EBMT 425						
Prerequisites	PHYS 301	Credit Hours CRH	3	CTH	4				
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed to give student a basic knowledge of some medical imaging systems including ionizing imaging system (radiography, CT scan, gamma camera, SPECT and PET systems), non-ionizing imaging system (echography system, MRI systems, Doppler techniques) and multi modalities systems (CT/PET, MRI/PET/CT)

Course topics:

- X-ray
- X-ray principles
- Hardware of x ray machine
- Computed tomography (CT**)**
- Principles of CT. Operation of CT
- Gamma ray emission
- Principle and hardware of gamma ray system
- SPECT System
- PET System
- Ultrasound
- Ultrasound production &applications
- Magnetic resonance imaging (MRI)
- Magnetic resonance principles
- Clinical MRI imaging systems and hardware
- Principles of Multi modalities imaging system
- PET/Scan System
- CT/PET/MRI System
- Safety precautions

Experiments: If applicable, it will support the course topics.

References :

- Handbook of X-Ray Data Publisher: Springer 2007 ISBN: 3540286187 | edition 2007
- Basic X-ray Machine Operator Study Guide Gary Tomaszewski ASIN: B000NJJ36A
- Nuclear Medicine Instrumentation. Jennifer Prekeges. Ed. Jones & Bartlett Publishers. 2011 – ISBN: 9780763766382.
- Nuclear Medicine and PET/CT - E-Book: Technology and Techniques. Kristen M. Waterstram-Rich,David Gilmore. Elsevier. 2017 – ISBN: 9780323356220
- Ultrasound in Medical Diagnosis White, D. N. ISBN13 9780718610012
- Physical Principles of Ultrasound Nyborg WL ISBN 91-38-04082-4

- Medical Instrumentation Application and Design John Webster ISBN-13: 978-0471676003
- An Introduction to the Physics and Function of Magnetic Resonance
- Imaging, .Weishaupt D., Koechli V.D., Marincek B. ISBN: 9783540300670 ،

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• X-ray principles • Hardware of x ray machine • Safety precautions	**5**
2	• Computed tomography CT • Principles of CT • Operation of CT	**5**
3	• Gamma ray emission • Principle and hardware of gamma ray system • SPECT System • PET System	**7**
4	• Ultrasound • Ultrasound production &applications • Echo doppler techniques	**5**
5	• Magnetic resonance imaging (MRI) • magnetic resonance principles • clinical MRI imaging systems and hardware	**5**
6	• Muti modalities systems • PET/SCAN • PET/SCAN/MRI	**5**
Total		**32**
Textbook:	1. Ultrasound Physics and Technology. Vivien Gibbs, David Cole, Antonio Sassano. Ed. Elsevier. 2009 – ISBN: 9780702030413 2. Medical Instrumentation Application and Design John Webster ISBN-13: 978-0471676003 3. Ultrasound in Medical Diagnosis White, D. N. ISBN13 9780718610012	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1st Experiment:** X ray system	**6**
2	**2nd Experiment:** CT Scan system	**6**
3	**3rd Experiment:** Doppler techniques	**7**
4	**4th Experiment:** Echography imaging system	**5**
5	**4th Experiment:** Gamma camera system	**5**
6	**5th Experiment:** MRI System	**3**
Total		**32**

Textbook:	**Practical Manual**

Department	**Electronics Engineering**	**Major**	**Biomedical Equipment**						
Course Name	**Laboratory and Optical Equipment**	**Course Code**	**EBMT 454**						
Prerequisites	**KCHE 331**	**Credit Hours** **CRH**	**3**	CTH	4				
			L	**2**	P	**2**	T	**0**	

CRH**: Credit Hours** L**: Lecture** P**: Practical** T**: Tutorial** CTH**: Contact Hours**

Course description :

This course provides an understanding of working principle, maintenance and calibration of laboratory instruments as pH meter, conductimeter, automated units, chromatography, electrophoresis, hematology and automated chemical analyzer instruments. The course focuses also on studying optical instruments starting by understanding the optical principles operation of some laboratory and medical instruments. It covers light microscopy, emission and absorption spectrometry, flame spectrophotometer, flame photometers, endoscope instruments. Medical lasers: Argon ion, Carbon dioxide, Yag, excimer.. etc systems. Laser-surgery techniques (Photo ablation, LASIK, ophthalmology IVF). Semiconductor lasers. It includes also acoustic instruments covering concepts of acoustic physics, noise problems and medical equipment used in the objective hearing tests.

Topics :

- pH meter
- Conductimeter
- Automated analyzer instrument
- Chromatograph
- Electrophoresis unit
- Light microscope
- Spectrometer and Spectrophotometer
- Endoscope instrument
- Medical lasers, semiconductor lasers
- Laser-surgery techniques
- Acoustic physics and Audiometry

Experiments: If applicable, it will support the course topics.

References :

- Handbook of biomedical instrumentation, third edition. R.S. Khandpur. Ed. McGraw Hill Education. 2014 – ISBN:٩٧٨٩٣٣٩٢٠٥٤٣٠
- Medical Instruments and Devices: Principles and Practices. Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson. Ed. CRC Press. Oct. 2017 - ISBN: ISBN 9781138748521
- Handbook of Biomedical Optics 1st Edition. David A. Boas et al. Ed. CRC Press. 2011 ISBN: 978-1420090369

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• pH meter • pH concept • pH electrodes • Equipment and measurement techniques	**2**
2	▪ Conductimeter ▪ Concept of conductivity ▪ Conductivity electrodes ▪ Equipment and measurement techniques	**3**
3	• Automated analyzer instrument • Hematology analyzer • Chemical analyzer	**3**
4	▪ Chromatograph ▪ Electrophoresis unit	**5**
5	▪ Light microscope ▪ Synoptic of the light microscope ▪ Operating mode ▪ Microscope check	**5**
6	▪ Spectrometer ▪ Spectrophotometer ▪ Endoscopy and dbroscopy	**5**
7	▪ Medical lasers ▪ Different kinds of laser ▪ Laser-surgery techniques	**5**
8	• Acoustic physics • Audiometry • Audiogram analisis	**4**
Total		**32**

Textbook:	1. Lasers and Optical Instrumentation. S. Nagabhushana. Ed. I. K. International Publishing House Pvt Ltd. 2010 – ISBN: 9789380578231 2. Audiometers: Equipment for extended high-frequency audiometry. British Standards Institution, Global Engineering Documents (Firm). Ed. BSI. 3. Basic Audiometry Learning Manual. Par Mark DeRuiter,Virginia Ramachandran. Ed. Plural Publishing. 2017 – ISBN : 9781597568654 4. Practical Instrumental Analysis: Methods, Quality Assurance and Laboratory Management. Sergio Petrozzi. Ed. Wiley VCH. 2013 - ISBN: 978-3527329519

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1st Experiment:** PH meter	**4**
2	**2nd Experiment:** Conductimeter	**4**
3	**3rd Experiment:** Electrophoresis	**4**
4	**4rd Experiment:** Light microscope	**4**
5	**5th Experiment:** Spectrophotometer	**5**
6	**6th Experiment:** Endoscopy and fibroscopy	**5**
7	**7th Experiment** : Geometric optical and medical laser	**3**
8	**8th Experiment :** Audiometry	**3**
Total		**32**
Textbook:	**Practical Manual**	

Department	Electronics Engineering		**Major**	Biomedical Equipment					
Course Name	**Medical Information Systems**		**Course Code**	**EBMT 466**					
Prerequisites	**ICMT402**		**Credit Hours** **CRH**	**3**		CTH	3		
				L	**3**	P	**0**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed to give the student a basic knowledge on information system in general. The student has to know how to represent and uses of data. this course is designed to give the student a basic knowledge of medical information system. Case study will present in this course. This course develop, also, an understanding of basic functions of management. Understand the basic concepts and key issues involved in managing engineering organizations. Introduction to Healthcare System Management. Medical equipment acquisition and evaluation. Safety procedures implementation management. Ethics in biomedical engineering organizations.

Course topics:

- Introduction to biomedical informatics: Basic medical practices, terminology, work flow systems, laws, regulations, and the significant underlying safety, efficiency.
- Basics of Professional and Commercial Information Technologies
- Representations and uses of Data : Human and Cultural aspects of health, illness, science, and human performance, Conclusions, integration, interpretation, synthesis, &hypothesis
- Case study
- Basic functions of management
- Healthcare System Management
- Medical equipment acquisition and evaluation

Detailed of Theoretical Contents		
	Contents	**Hours**
1	Introduction to biomedical informatics ، Basic medical practices, terminology, work flow systems, laws, regulations, and the	**9**
2	Basics of Professional and Commercial Information Technologies	**7**
3	Human and Cultural aspects of health, illness, science, and human performance,	**7**
4	Case study	**7**
5	Basic functions of management	**5**
6	Healthcare System Management	**4**
7	Medical equipment acquisition and evaluation	**5**
8	Ethics in biomedical engineering organizations.	**4**
	Total	**48**

Textbook:	1. Biomedical Informatics: Computer Applications in Health Care and Biomedicine, Edward H. Shortliffe, James J. Cimino ISBN-13: 978-0387289861 | Edition: 3rd, March 23, 2012

Department	Electronics Engineering		**Major**	Biomedical Equipment					
Course Name	**Biomedical Image processing**		**Course Code**	**EBMT 472**					
Prerequisites	EBMT453 EBMT425		**Credit Hours** **CRH**	**3**	CTH	4			
				L	**2**	P	**2**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed to give the student a basic knowledge of the Biomedical Digital Image processing. The student has to know the principal of imaging. Also this course is designed to give the student an Application of digital image processing in Biomedical Images.

Course topics:

- Digital Image Fundamental & Transforms
- Image Enhancement Technique
- Image Restoration
- Image Compression
- Image Segmentation & Representation
- Image Algorithm Implementation
- Application of digital image processing in Biomedical Images

Experiments: If applicable, it will support the course topics.

Detailed of Theoretical Contents		
	Contents	**Hours**
1	Digital Image Fundamental & Transforms	**9**
2	Image Restoration	**8**

3	Image Segmentation & Representation	5
4	Application of digital image processing in Biomedical Images	10
	Total	32
Textbook:	1. Digital Image Processing. Gonzales R and Woods R., Publisher Prentice Hall Year 2008,3rd edition. ISBN-10: 0131453610.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	**1st Experiment:** Introduction to medcal image processing	5
2	**2st Experiment:** Reading medical inhancement	5
3	**3nd Experiment:** Medical Image restoration	4
4	**4rd Experiment:** Medical image compression	4
5	**5th Experiment:** Medical image segmentation	4
6	**6th Experiment:** Medical image representation	3
7	**7h Experiment:** Medical image implementation	4
8	**8th Experiment:** Numerical **q**uality control of medical image	3
Total		32
Textbook:	**Practical Manual**	

Department	Electronics Engineering		**Major**	Biomedical Equipment					
Course Name	**Rehabilitation Engineering and Technologies**		**Course Code**	**EBMT 422**					
Prerequisites	**EBMT 453, EBMT 461**		**Credit Hours CRH**	**3**	CTH	3			
				L	**3**	P	**0**	T	**0**

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description:

Introduction to rehabilitation engineering. Patho-physiology components of Disability: Physical impairment; Speech impairment, Disabilities and symptoms. Rehabilitation engineering technology: Assistive devices, Transportation Wheel chairs to Enhance mobility. Disability assessment. Application of rehabilitation engineering: Prosthetics, Orthotics, Artificial limbs and brain computer interface (BCI).

Topics :

- Introduction to rehabilitation engineering
- Patho-physiology components
- Disabilities and symptoms
- Rehabilitation engineering technology
- Application of rehabilitation engineering:

References :

1. An introduction to Rehabilitation Engineering, Rory A. Cooper CRC press 2006.
2. Wheel chairs: A Guide to selection and Configuration, Rory A. Cooper, Demos Medical Publishers, New York
3. J.D. Bronzino, The biomedical Engineering handbook, CRS press and IEEE press (1995).

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to rehabilitation engineering: Definition - History	**4**
2	Patho-physiology components	**5**
3	Disabilities: Disability Categories - Physical impairment - Speech impairment	**5**
4	Disabilities and symptoms	**5**

5	Rehabilitation engineering technology: Assistive devices – Transportation - Wheel chair	**9**
6	Physiological, biomedical measurement techniques: Sensors and Disability assessment - Visual, hearing aids and medical stimulators	**6**
7	Application of rehabilitation engineering: Physiological – Medical - Social	**5**
8	Prosthetics & Orthotics: Artificial limbs – Bionics - Brain computer interface (BCI).	**9**
	Total	**48**

Textbook:

1 An introduction to Rehabilitation Engineering, Rory A. Cooper CRC press 2006.
2 Wheel chairs: A Guide to selection and Configuration, Rory A. Cooper, Demos Medical Publishers, New York
3 J.D. Bronzino, The biomedical Engineering handbook, CRS press and IEEE press (1995).

Department	**Electronics Engineering**	**Major**	**Biomedical Equipment**						
Course Name	**Telemedicine**	**Course Code**	**EBMT 473**						
Prerequisites		**Credit Hours CRH**	**3**	CTH	3				
			L	**3**	P	**0**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

Telemedicine: Introduction, motivation, and overview; clinical applications; data dimensionality, acquisition, and conversion; transmission methods (wired, wireless); networking; compression; measurement of quality and accuracy; reception and display considerations; data archiving and retrieval; store-and-forward vs. interactive; privacy and security issues; commercial hardware and software; standards (including DICOM); economic issues; user-interface considerations; picture archiving and communication systems (PACS).

Topics :

- Telemedicine: Introduction and overview
- Clinical applications
- Data dimensionality, acquisition and conversion
- Transmission, reception and display methods
- Networking and security
- Commercial hardware and software
- DICOM
- PACS

Experiments: If applicable, it will support the course topics.

References :

- PACS and Imaging Informatics: Basic Principles and Applications. H. K. Huang. Ed. Wiley Online Library. 2010 – ISBN: 9780470373729 - Online ISBN: 9780470560525

- Digital Imaging and Communications in Medicine (DICOM). Oleg S. Pianykh. Ed. Springer. 2008 – ISBN: 9783540745709

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• Telemedicine: Introduction and overview • Introduction • Motivation • Overview	**6**
2	▪ Clinical applications ▪ Medical equipment maintenance ▪ Surgical techniques ▪ Medical imaging ▪ Health care	**8**
3	• Data dimensionality, acquisition and conversion • Data dimensionality • Acquisition and conversion	**7**
4	▪ Transmission, reception and display methods ▪ Transmission ▪ Reception ▪ Display method	**9**
5	▪ Commercial hardware and software ▪ Telemedicine hardware techniques ▪ Telemedicine software techniques ▪ Applications	**7**
6	• DICOM and PACS • Digital Imaging and Communications in Medicine (DICOM) • Picture Archiving and Communication System (PACS)	**11**
Total		**48**

Textbook:	**1.** Global Telemedicine and eHealth Updates: Knowledge Resources. Malina Jordanova and Frank Lievens. Ed. International Society for Telemedicine & eHealth. 2012 - ISSN 1998-5509. **2.** Lessons learned from 25 years with telemedicine in Northern Norway. Gunnar Hartvigsenand Steinar Pedersen. Ed. University Hospital of North Norway. 2015 – ISBN: 978-82-8242-053-2.

Department	**Electronics Engineering**	**Major**	**Biomedical Equipment**
Course Name	**Nano-technology & Applications**	**Course Code**	**EBMT 429**
Prerequisites		**Credit Hours CRH**	**3** CTH 3

L	3	P	0	T	0

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description:

Atomic and molecular nanotechnology. Nanosystems and molecular forces and fields. Thermodynamics and statistical mechanics and small system mechanics. Quantum phenomena and metaptosis. Molecular structural forces. Nanoparticle types; carbon nanotubes, quantum dots, polymer nanoparticles, gold nanoparticles, dedrimers. Nanomaterials and nanostructures. Application of nanoparticles in targeted drug delivery and thermal or light transfer in circuits. Nano-sensors, Nanorobots and nanomachines. Nanoelectronics applications in Medicine

Topics :

- Structure, function and properties at the nanoscale
- Bionanomaterials and nanoparticle types
- Application of nanomaterials in medicine
- Nano-sensors, nanorobots and nanomachines

References : Malsch, N.H., "Biomedical Nanotechnology", CRC Press (2005).

M. Ferrari, A. P. Lee and J. Xie, Biological and Biomedical Nanotechnology, Springer, 2006

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to nanotechnology and small dimensions	**4**
2	Nanoscale properties (Electrical, Optical, Chemical, Forces)	**4**
3	Nanoscale visualization techniques: Electron microscopy, scanning probe microscopy and diffraction techniques.	**3**
4	Bionanomaterials: Biological building blocks	**3**

	Bionanostructures: (nanofibers, nanotubes, nanocellulose).	
5	Nanoparticle types; carbon nanotubes, quantum dots, polymer nanoparticles, gold nanoparticles, dedrimers. Nanomaterials and nanostructures.	**3**
6	Biological nanomachines: Ribosomes, Photosynthesis systems	**3**
7	Biological nanomachines: Bionanomotors	**3**
8	Engineered nanomaterials: carbon and metal, quantum dots, liquid crystals nanomaterials and applications	**3**
9	Microfabrication methods (photolithography, principles, thermodynamics, interactions)	**3**
10	Nanotechnology by self assembly: (Protein and DNA)	**3**
11	Microfluidics and nanofludics	**3**
12	Nano drug delivery	**3**
13	Medical microdevices, lab on chips. MEMS, Nano-sensors, Nanorobots and nanomachines. Nanoelectronics applications in Medicine	**7**
14	Nano technology safety	**3**
	Total	**48**

Textbook:	1. Malsch, N.H., "Biomedical Nanotechnology", CRC Press (2005). 2. M. Ferrari, A. P. Lee and J. Xie, Biological and Biomedical Nanotechnology, Springer, 2006

Department	**Electronics Engineering**	**Major**	**Biomedical Equipment**
Course Name	**Quality Control of Biomedical Equipment**	**Course Code**	**EBMT 488**
Prerequisites		**Credit Hours CRH**	**3** CTH 3 L **3** P **0** T **0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The course provides an understanding principle of quality control (QC) methods used for electronic medical equipment (ECG, EEG, EMG, electro surgical unit …) concerning, calibration safety and international standards of QC and quality assurance. This course focus also on the quality control of heavy medical equipment (X-ray, CT scan, nuclear medicine imaging, catheterize system, hemodialysis system …) it includes: Protocols and standards of quality control (NEMA Protocol, radiation protection standards…)

Topics :

- Quality control and quality assurance
- International standards of medical electrical safety
- Quality control of electrophysiological units
- Quality control of electro surgical unit
- Quality control of hemodialysis system
- Radiation protection in medical department
- Quality control of X ray and CT Scan department
- Quality control in nuclear medicine imaging

Experiments: If applicable, it will support the course topics.

References :

- Medical Device Quality Assurance and Regulatory Compliance. Richard C. Fries. Ed. Amazon Book. 1998 - ISBN: 978-0824701772
- Medical Equipment Quality Assurance. J. Tobey Clark, Michael Lane and Leah Rafuse. Ed. Fluke Biomedical. 2009 Fluke Biomedical. 1/2009 3276553 C-EN-N Rev A.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	• Quality control and quality assurance • Quality control • Quality assurance	**8**
2	▪ International standards of medical electrical safety ▪ IEC 62353 & IEC 60601 ▪ Classes and types of medical electrical equipment ▪ Electrical Measurement Tests	**6**
3	• Quality control of electrophysiological units • Safety and calibration of ECG • Safety and calibration of EMG • Safety and calibration of EEG • Safety and calibration of bioimpedance system	**6**
4	▪ Quality control of electro surgical unit ▪ Quality control of hemodialysis system	**7**
5	▪ Radiation protection in medical department ▪ Quantities used in radiation protection ▪ International Standards of radiation protection ▪ Radiation protection in medical imaging department	**7**
6	• Quality control of X ray and CT Scan department • QC of radioscopy and radiography devices • QC of CT Scan	**7**
7	• Quality control in nuclear medicine imaging • QC of Gamma camera • QC of Multi Modalities imaging system	**7**
Total		**48**

Textbook:	1. Radiation Protection in Nuclear Medicine. Sören Mattsson, Christoph Hoeschen. Ed. Springer, Berlin, Heidelberg. 2013- ISBN: 978-3-642-31166-6 2. Quality control of gamma camera using phantoms. Amardeep Singh Sran. Powerpoint: https://fr.scribd.com/presentation/13351720/Quality-Control-of-Gamma-Camera-Using-Phantom

	3. Quality Management in the Imaging Sciences. Jeffrey Papp. Ed. Elsevier (E-book). 2015 – ISBN: 9781597568654.

Department	Electronics Engineering	Major	Biomedical Equipment						
Course Name	**Numerical Methods in Biomedical Engineering**	Course Code	**EBMT 428**						
Prerequisites		Credit Hours CRH	3	CTH	3				
			L	3	P	0	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description:

Modeling Biosystems: Constructing biomodels and solving models by computers. Concepts of numerical analysis. Linear biological systems, iterative solutions, Jacobi method. Nonlinear biological systems, successive substitution, linear interpolation and Newton-Raphson method. Finite difference method and finite element method in biomechanics. Runge-Kutta method, drug absorption example. . Partial differential equations: cell migration, drug diffusion. Applications: Diabetes and insulin regulation. Renal clearance example.

Topics :

- Modeling Biosystems
- Linear and nonlinear Biological systems
- Dynamic Behavior representation of Biosystems
- Modeling Tools and applications

References : Numerical methods in biomedical engineering. Stanley M. Dunn, Alkis Constantinides, and Parabhas V. Moghe 2006. Academic Press.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	Introduction to biosystem modeling, rate form, balance equations, conservation laws. Examples of solving biomodels by computer.	**4**
2	Linear Models of Biological systems. Force balance in biomechanics, image processing, metabolic engineering and cellular biotechnology, Gauss and Gauss-Jordan method. Iterative, and Jacobi method of solving linear systems. Matlab examples.	**6**
3	Non-linear Models, molecular bioengineering, cellular and tissue engineering, bioheat, flow transport dynamics. Successive substitution, linear interpolation, and Newton-Raphson methods of solving nonlinear systems. Matlab examples.	**9**
4	Finite difference method and finite element method in biomechanics.	**9**
5	Dynamic Systems examples: Pharmacokinetics, Pharmodynamics, cell differentiation, nonlinear ODE, Runge-Kutta methods, Enzyme catalysis example, Linear ODE example of drug absorption. Advanced examples: Metabolic engineering, membrane dynamics and cell potentials.	**6**

6	PDE types in Biomedical Engineering, Diffusion across biological membranes. Dynamics of membrane (cochlea example), cell migration on prosthetic materials, Matlab example.	**7**
7	Modeling Biosystems: Applications, PhysioNet, PhysioBank, and Physio Toolkit. Diabetes and insulin regulation. Renal clearance example. Coaractation of the aorta and Simulink examples.	**7**
	Total	**48**
Textbook:	Numerical methods in biomedical engineering. Stanley M. Dunn, Alkis Constantinides, and Parabhas V. Moghe 2006. Academic Press.	

Appendix: Laboratory Equipment, Workshops and Laboratories

No.	Laboratory name / workshop	Capacity of training	Number of trainers	Training courses benefiting from the laboratory / workshop / lab
1.	Biomedical Electro-Mechanical Laboratory	20	1	BMT 455: Diagnostic and Therapeutic Medical Equipment (1)
2.	Biomedical Electronics Equipment Laboratory	20	1	BMT 457: Diagnostic and Therapeutic Medical Equipment (2)
3.	Optical and physico-chemical equipment Laboratory	20	1	BMT 459: Laboratory and optical medical equipment
4.	Biomedical Signal and image Processing & design Laboratory	20	2	BMT 456: Biomedical analog and digital signal processing CMT 325: Computer programming BMT 485: Computer aided design in Biomedical Equipment BMT 461: Biomedical image processing
5.	Control system laboratory	20	1	BMT 375: Control sytem for biomedical equipment
6.	Medical imaging system laboratory	20	1	BMT 458: Medical imaging system

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Biomedical Electro-Mechanical Laboratory		
No.	**Product's Name**	**Quantity**
1.	**Respiratory system (ventilator) and accessories** **Accessories for ventilator :** • human bio system model for Medical Ventilator • Oxygen Cylinder for Medical Ventilator • Facial/Nasal Masks for Medical Ventilator • inhale/exhale tubefor Medical Ventilator • bacterial/filterfor Medical Ventilator	**1** **1** **1** **1** **1** **16**
2.	**Spirometer system and accessorie** **Accessories for spirometer:** • bacterial/filter, for Spirometer • disposable mouth piece for Spirometer	**1** **16** **32**
3.	**Anesthesia system and accessories** human bio system model (demonstration) for Anesthesia System	**1** **1**
4.	**Sterilization system (Autoclave) and accessories**	**1**

5.	**Suction device (Aspirator) and accessories** **Accessories for aspirator:** • human bio system model (demonstration) for Aspirator • Disposable Bag Valve Mask Resuscitators for Aspirator • Oxygen Flow meters for Aspirator • Suction Regulator • Disposable hydrophobic bacterial/filters for Aspirator • Disposable suction tubing for Aspirator • Reusable / disposable collection bottles for Aspirator	**1** **1** **4** **4** **4** **4** **4** **4**
6.	**Infant Incubator System and accessories** human bio system model (demonstration) for Infant Incubator	**1** **1**
7.	**Dialyse Machine and accessories** human bio system model (demonstration) for Dialysis Machine	**1** **1**
8.	**Infusion pump and accessories** human bio system model (demonstration) for Infusion Pump	**1** **1**

Biomedical Electronics Equipment Laboratory		
No.	**Product's Name**	**Quantity**

1.	**Electro-cardiograph system (ECG) and accessories** **Accessories for each ECG system:** • Cable with ten wires ECG leads • Disposable electrodes • Four crocodile electrodes • Six chest electrodes • Gel for ECG electrods • Alcohol preparation pads • Paper cartridge for signal ECG recording • Software for ECG acquisition in computer	**2** **1** **100** **1 set** **1 set** **2** **1 set** **5** **1**
2.	**Electro-myograph system (EMG) and accessories** **Accessories for EMG system:** • EMG electrodes • Dumbbell of 5 Kg • Alcohol preparation pads • Software for EMG acquisition signal in computer	**1** **1 set** **1** **1 set** **1**
3.	**Electro-Encephalograph system (EEG) and accessories** **Accessories for EEG system** • EEG electrods • Alcohol preparation pads • Software for EEG acquisition signal in computer	**1** **1set**

4.	**Bioimpedance cardiograph system (ICG) and accessories** **Accessories for ICG system:** • ICG disposable electrodes • Alcohol preparation pads • Gel for ICG electrodes • Software for ICG acquisition signal in computer	**1** **1 set** **1 set** **2** **1**

5.	**Electro-Oculograph system (EOG) and accessories**	**1**
6.	**Defibrillator System and accessories** • Fibrilator electrodes • Cable for ECG detection	**1** **1 set**
7.	**ECG simulator**	**10**
8.	**Electrosurgical unit and accessories** **Accessories for Electrosurgical unit:** • Monpolar electrodes • Bipolar electrodes	**2** **1set**
9.	**Biomedical equipment measuring system KL- 720 and accessories** **Accessories for KL-720** • Digital oscilloscope with ANC card • Laptop with software acquisition • Wires and accessories.	**2** **1 set for each system**
10.	**Digital Oscilloscope with the following specifications:** • Frequency : 100 Mhz • Interface A/N card • Probes for the signal detection • 2 Inputs signal	**10**
11.	**Function Generator with the following specifications** • Sinusoidal signal • Triangular signal • Square signal • Multi Electric Sockets	**10**
12.	**Power supply with the following specifications:** • Two variable voltage outputs: 0 – 30 V • Variable current: 0 -5 A	**10**

13.	**Laboratory magnifier lamp**	**2**
14.	**Computer 64 bit and accessories**	**10**
15.	**Digital multimeter**	**10**
16.	**Electronic suitcase with different accessories**	**2**
17.	**Soldering iron and accessories**	**10**
18.	**Drawer for electronic component storage**	**10**
19.	**Matlab Software**	**1**
20.	**Proteus Software**	**1**
21.	**Electronic Components and connectors** • Test plate A4 • IC TLO82 • IC TLO 84 • IC AD620 • IC 741 C • Resistors 0.6 watt : 1 Ω, 10 Ω, 47 Ω, 100 Ω, 510 Ω, 1K , 1.5 K, 5.6 K, 10 K, 15 K, 2.2 K, 33 K, 100 K, 22 K • Potentiometer: 1k, 10 K, 100 k, 500 k • Capacitors: 1 uF, 10 uF, 100 uF, 1000 uF, 4.7 uF, 2.2 uF, 3.3 nF, 6.6 nF. • Diodes : 1N4001 • BNC - BNC wires • BNC Bananes wire • Crocodile wires • Probes for oscilloscopes • USB – USB wires • Bananes – Bananes wires • Connector wire for test plate	**10** **25** **25** **25** **50** **20 each** **20 each** **20 each** **20 each** **20** **10** **20** **10** **10** **10** **20** **500**

Optical and physico-chemical equipment Laboratory		
No.	**Product's Name**	**Quantity**
1.	**PH meter Unit and accessories** **Accessories for PH meter:** • PH electrodes • Buffer solutions for the PH meter calibration • PH test paper	**10** **1 set for each**
2.	**Conductimeter Unit and accessories**	**10**
3.	**Electrophoresis system and accessories**	**5**
4.	**Spectrophotometer unit and accessories**	**2**
5.	**Medical laser unit and accessories**	**2**
6.	**Endoscopy system (rigid and flexible) and accessories** **Accessories for Endoscop** • human bio system model (demonstration) for Endoscope (upper & lower) • biopsy forceps, Graspers, Baskets, Injectors, Dilators, Knives	**1** **1 set**
7.	**Fibroscopy system and accessories** human bio system model (demonstration) for fibroscope system	**1** **1**
8.	**Pulse Oximeter and accessories**	**2**
9.	**Hemocytometer andaccessories**	**2**
10	**Blood Gas Analyzer and accessories**	**2**
11.	**Audiometer and accessories**	**10**
12.	**Optical Bench and accessories** **Accessories for optical Bench** • Different convergent and divergent lenses	**2**

	• Lens support • Photoelectric cells didactic • Laser HgHe	**2 sets**

Medical Imaging System Laboratory		
No.	**Product's Name**	**Quantity**
1.	**Educative X ray machine:** X-Ray Basic set covering the fundamental principles and areas of applications of X-Ray, e.g. Radiation detection, counting, dosemetry, Fluoroscopy, photography experiments and X-Ray. With upgrade sets applications, accessories and complete students experiment sheets.	**1**
2.	**Educative CT- Scan system** With Phantom sets applications, to measure image quality, resolutions, accessories and complete students experiment sheets.	**1**
3.	**MRI Educative Simulator** **Earth's field MRI probe** ▪ Tunable RF coil from 1800 Hz to 3000 Hz ▪ Three gradients for 3D MRI ▪ Fourth gradient coil (4.75 mT m-1 A-1) for diffusion measurements ▪ Polarising coil generates up to 18.8 mT prepolarising field @ 6 A ▪ Weight 9 kg **Complete students experiment sheets.**	**1**
4.	**Ultrasound Educative system**	**1**

	Ultrasound imaging + ultrasonic echoscope + probe+ test block transparent + ultrasonic test phantom + ultrasonic fetal phantom + gel and complete students experiment sheets.	
5.	**Doppler System and accessories** Ultrasonic Flow Doppler experiences	**1**
6.	**Echography A and B system** Ultrasonic echography A and B-Model and complete students experiment sheets.	**1**

Control System Laboratory		
No.	**Product's Name**	**Quantity**
1.	**Universal Control Unit, Continuous and Discontinuous include:** ▪ P Controller ▪ Reference Variable Generator ▪ I controller - D Controller ▪ Simulated Control System ▪ dead time element ▪ summation point 5 points ▪ summation point 2 points ▪ power amplifier	**1**
2.	**Motor and Generator Units for Speed control System:** ▪ Motor generator ▪ Power amplifier ▪ +-15 power supply ▪ Gain and offset adjust ▪ Reference variable generator ▪ Interface with winfact software. All fit on the frame and control in computer.	**1**
3.	**Temperature Control System and Accessories Light and Bright Control System include:** ▪ Two position controller ▪ Reference variable Generator ▪ Power amplifier ▪ +- 15 Power supply ▪ Temperature control system light control system. ▪ Interface with winfact software. All fit on the frame and control in computer.	**1**
4.	**Fluid level Control System and Accessories Flow Control System Include:** ▪ Liquid Controlled system ▪ Reference variable generator ▪ Immersion tube ▪ Differential Pressure Transducer ▪ PID Controller ▪ Interface Proffi cassy with winfact ▪ All must be fit it on the Frame and Control in computer.	**1**

5.	**PID Control Training with PC Sim Software.** ▪ Enhanced 7-character Display ▪ On/Off Controller ▪ Accutune III ▪ Universal Analog inputs ▪ 0.1% Accracy ▪ Fast scan rate (166 ms) ▪ 5X Analog Outputs ▪ 2 X Analog inputs ▪ 4 X Digital inputs ▪ Modbus communications ▪ Interface PC and Pocket PC configuration ▪ NEMA 4X , IP65 Front Face Protection ▪ Jumper Free Configuration ▪ Set point Programming (1 program 20 segments) ▪ Single-loop Multi-language prompt.	**1**
6.	**Fuzzy Control Unity, P-Fuzzy and PI-Fuzzy controllers, Includes:** ▪ Reference Variable Generator ▪ Set of machines 10 W ▪ Temperature control system ▪ Power Amplifier ▪ Listing Control System ▪ Profit-CASSY-Starter 2 USB ▪ Software: WINFACT7 LD License (English)	**1**

Biomedical Signal Processing Laboratory		
No.	**Product's Name**	**Quantity**
1.	Computer 64 bit and accessories	10
2.	Matlab Software	10
3.	Proteus Software	1
4.	Labview system (hard and soft) for medical DSP	1
5.	C++ Software	1
6.	A/D card with software	10
7.	Medical signal data base	1
8.	Medical image data base	1

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