YEDITEPE UNIVERSITY
FACULTY OF ENGINEERING

UNDERGRADUATE PROGRAM OF BIOMEDICAL ENGINEERING

INFORMATION PACKAGE (2016)

GOALS

The goal of this program is to train expert engineers equipped with theoretical and practical knowledge and skills who deliver biomedical engineering services demanded in various areas of biomedical engineering especially at hospitals.

OBJECTIVES

Our main objective is the training of graduate engineers that contribute to the development of new biomedical devices for better diagnosis, treatment and follow-up of diseases, that follow the innovationsin the health sector with the spirit of research, that ensure the flow of informationby acting as a bridge between medicine and engineering fields and that make contribution to the new generation of biomedical engineers come after him.

PROGRAM OUTCOMES

Program outcomes of the undergraduate biomedical engineering program are as listed below:

1) Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.

2) Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.

3) Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.

4) Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.

5) Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.

6) Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.

7) Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.

8) Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.

9) Awareness of professional and ethical responsibility.

10) Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.

TEACHING and LEARNING METHODS

Teaching - learning methods and strategies are selected so asto improve the student skills such asself-study, lifelong learning, observation, non-teaching, presentation, critical thinking, teamwork and benefiting from informationefficiently. Education and teaching methods used in the program are as shown in the table below.

Education and teaching method	**Main Teaching Facilities**	**Tools Used**
Course	Listening and interpretation	Standard classroom technologies, multimedia tools, projector, computer, overhead projector
Course with Discussion	Listening and interpretation, observation, critical thinking, question development	Standard classroom technologies, multimedia tools, projector, computer, overhead projector
Brainstorming	Listening and interpretation, observation, critical thinking, question development, teamwork	Standard classroom technologies, multimedia tools, projector, computer, overhead projector
Presentation	Listening and interpretation, observation	Real or virtual environment allowing observations
Simulation	Listening and interpretation, observation, IT skills	Real or virtual environment allowing observations
Seminar	Research, life-long learning, writing, reading, IT, listening and interpretation, management skills	Standard classroom technologies, multimedia tools, projector, computer, overhead projector
Group Work	Research, life-long learning, writing, reading, IT, critical thinking, question development, management skills, teamwork	Internet databases, library databases, e-mail, online chat, Web-based discussion forums
Experiment	Observation / condition processing, IT, managerial skills, teamwork	Dedicated hardware
Homework	Research, life-long learning, writing, reading, IT	Internet databases, library databases, e-mail,
Invited Speaker	Listening and interpretation, Observation / condition processing	Standard classroom technologies, multimedia tools, projector, computer, overhead projector
Student Club Activities / Projects	Observation / condition processing, critical thinking, question development, teamwork, research - life-long learning, writing, reading, management skills, pre-planned special skills.	

COURSE STRUCTURE and ECTS CREDITS

The course structure offered by the program and the ECTS credits of these courses are as seen in the table below.

1st Semester			ECTS
BME	102	Introduction to Biomedical Engineering	2
AFE	131	Academic English I	4
CHEM	101	General Chemistry	6
ES	161	Engineering Drawing	5
MAH	131	Calculus I	6
PHYS	101	Physics I	6
		Semester ECTS Total	**29**

2nd Semester			ECTS
AFE	132	Academic English II	4
ES	112	Algorithms & Computer Programming	6
MATH	132	Calculus II	6
MATH	221	Linear Algebra	6
PHYS	102	Physics II	6
HUM	103	Humanities	3
		Semester ECTS Total	**31**

3rd Semester			ECTS
BME	211	Biological and Medical Physics	11
BME	213	Biology in Biomedical Engineering	6
CHBE	203	Organic Chemistry	5
MATH	241	Differential Equations	6
TKL	201	Turkish Language I	2
		Semester ECTS Total	**30**

4th Semester			ECTS
BME	214	Electrical Circuits in Biomedical Eng.	5
BME	222	Electromagnetic Fields and Waves in BME	6
BME	252	Biomechanics	6
BME	262	Biomaterials	6
FE	XX1	Free Elective I	5
TKL	202	Turkish Language II	2
		Semester ECTS Total	**30**

5th Semester			ECTS
BME	301	Biomedical Electronics I	6
BME	313	Human Physiology	5
BME	351	Modelling and Control of Biomedical Sys.	6
ES	224	Signals and Systems	5
ES	272	Numerical Analysis	6
HTR	301	History of Turkish Revolution I	2
		Semester ECTS Total	**30**

6th Semester			ECTS
BME	302	Biomedical Electronics II	8
BME	314	Biomedical Instrumentation	8
BME	324	Biomedical Sensors and Transducers	7
BME	XX1	Restricted Elective I	5
HTR	302	History of Turkish Revolution II	2
		Semester ECTS Total	**30**

7th Semester			ECTS
BME	421	Medical Imaging	9
BME	441	Microprocessors & Microcontrollers in BME	8
BME	XX2	Restricted Elective II	5
BME	XX3	Restricted Elective III	5
ES	301	Engineering Management	4
BME	400	Summer Practice	1
		Semester ECTS Total	**32**

8th Semester			ECTS
BME	492	Engineering Project	8
BME	XX4	Restricted Elective IV	5
BME	XX5	Restricted Elective V	5
BME	XX6	Restricted Elective VI	5
FE	XX2	Free Elective II	5
		Semester ECTS Total	**28**

COURSE - PROGRAM LEARNING OUTCOMES

The relation between the courses offered by the program and the program learning outcomes are as listed in the following table.

Course	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
Introduction to Biomedical Engineering				x		x	x	x	x	x
Biological and Medical Physics	x	x	x	x	x	x				
Electrical Circuits in Biomedical Engineering	x	x	x	x	x			x	x	x
Electromagnetic Fields and Waves in BME	x	x	x	x						
Biomechanics	x	x	x	x	x	x	x	x	x	x
Biomaterials	x	x		x		x	x	x	x	
Biomedical Electronics I	x	x	x	x	x	x		x		
Human Physiology	x	x	x	x	x	x				
Modelling and Control of Biomedical Sys.	x	x	x	x	x	x	x	x	x	x
Biomedical Electronics II	x	x	x	x	x	x		x		
Biomedical Instrumentation	x	x	x	x	x	x	x	x	x	
Biomedical Sensors and Transducers	x	x	x	x	x	x		x		
Medical Imaging	x	x		x	x	x	x	x	x	
Microprocessors and Microcontrollers in BME	x	x	x	x	x	x		x		
Summer Practice										
Engineering Project	x	x	x	x	x	x	x	x	x	x
Restricted Elective Biological Transport Systems	x	x	x	x	x	x	x	x	x	x
Restricted Elective Magnetic Resonance Spectroscopic Imaging	x	x		x		x	x	x	x	
Restricted Elective Orthopedic Cements for Hard Tissue Repair	x	x		x		x	x	x	x	
Restricted Elective Biometry For Analytical Reasoning and Modelling	x	x		x	x	x	x	x	x	
Restricted Elective Artificial Intelligence in Medicine	x	x	x	x	x	x	x	x	x	
Restricted Elective Magnetic Resonance Imaging	x	x		x		x	x	x	x	
Restricted Elective Medical Robotics	x	x	x	x	x	x	x	x	x	x

COURSE CATEGORIES

Courses offered by the program are as categorized below:

Support Courses	ECTS
Biology in Biomedical Engineering	6
Calculus I	6
Calculus II	6
Differential Equations	6
Academic English I	4
Academic English II	4
General Chemistry	6
Linear Algebra	6
Organic Chemistry	5
Physics I	6
Physics II	6
ECTS Total	**61**

Basic Vocational Courses	ECTS
Algorithms & Computer Programming	6
Engineering Drawing	5
Numerical Analysis	6
Signals and Systems	5
ECTS Total	**22**

Social-Economics-Administration Courses	ECTS
Engineering Management	4
History of Turkish Revolution I	2
History of Turkish Revolution II	2
Humanities	3
Turkish Language I	2
Turkish Language II	2
Free Elective I (course confirmed by the department)	5
Free Elective II (course confirmed by the department)	5
ECTS Total	**25**

Expertise / Field Courses	ECTS
Biological and Medical Physics	11
Biomaterials	6
Biomechanics	6
Biomedical Electronics I	6
Biomedical Electronics II	8
Biomedical Instrumentation	8
Biomedical Sensors and Transducers	7
Electrical Circuits in Biomedical Engineering	5
Electromagnetic Fields and Waves in BME	6
Engineering Project	8
Human Physiology	5
Introduction to Biomedical Engineering	2
Microprocessors and Microcontrollers in BME	8
Modelling and Control of Biomedical Sys.	6
Medical Imaging	9
Summer Practice	1
ECTS Total	**102**

Restricted Electives	ECTS
Artificial Intelligence in Medicine	5
Biological Transport Systems	5
Biometry For Analytical Reasoning &Modelling	5
Magnetic Resonance Imaging	5
Magnetic Resonance Spectroscopic Imaging	5
Medical Robotics	5
Orthopedic Cements for Hard Tissue Repair	5
ECTS Total (any six)	**30**

LEVEL OF QUALIFICATION

This program is a first cycle (undergraduate) programme of 240 ECTS credits in the area of Biomedical Engineering.Students who complete the program successfully and acquire the program competencies receive an undergraduate degree in the area of Biomedical Engineering.

ADMISSIN REQUIREMENTS

In line with the academic and legal procedures of the university, the students who apply for admission into the program should follow the process governed by ÖSYM and succeed in the university entrance examination. Students who have started an equivalent programme in Turkey or abroad may apply for transfer to the program. Application of the student is evaluated before the semester starts considering the credentials of the student and the degree for which s/he is applying. Detailed information regarding admission to the university is available in the university catalogue.

Students, who come to the university from abroad through exchange programmes whose conditions have been drawn by an agreement and approved by the university,may take the courses offered in the programme. To take a course, the student should demonstrate that s/he has completed its prerequisite courses or their equivalents. All courses in the programme curriculum are conducted in English.

OCCUPATIONAL PROFILES

Our graduates are employed in a variety of sectors including minister of health and private companies in healthcare. Meanwhile, many of our graduates continue their education at the graduate level and receive Masters and Doctorate degrees in the area of Biomedical Engineering and related fields.

GRADUATION REQUIREMENTS

In order to graduate from the programme, a student is required complete a total of 48 courses including 41 compulsory, 1 free elective and 6restricted elective courses to receive a total of 146 credits and 240 ECTS and obtain a CGPA of at least 2.00/4.00. Among the courses in the curriculum, “BME492 Engineering Project” allows the student to apply the knowledge they have acquired during the program to a real-life engineering project. Moreover, each student is required to work as an intern for an institution that has been approved by the department for a total of 20 working days. This compulsory internship is with the course “BME400 Summer Practice”.

PROGRAM Director and ECTS COORDINATOR

PROGRAM Director:

Assist. Prof. Dr. Gökhan ERTAŞ

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Faculty of Engineering and Architecture
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ECTS COORDINATOR:

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POLLS APPLIED TO STUDENTS

The polls applied to students are presented below.

T.C. YEDİTEPE ÜNİVERSİTESİ
Mühendislik ve Mimarlık Fakültesi

Ders Çıktı Değerlendirme Anketi

Please use the following scale to rate how the outcomes are served by this course:
(Note to the instructor: If an outcome is not served by this course, please ask your students to rate it as **"NA"** before filling out the rest of the evaluation).
NA: Not Applicable (does not serve)
1. Very little 2. Little 3. Moderately 4. Well 5. Very well

Lütfen aşağıdaki puanlama sistemini kullanarak bu dersin çıktılara nasıl hizmet verdiğini değerlendiriniz:
(Öğretim üyesine not: Öğrencilerinizin anketin geri kalanını değerlendirmeden önce dersinizin hizmet vermediği çıktıları **"ID"** şeklinde işaretlemelerini sağlayınız).
İD: İlgili değil (hizmet vermiyor)
1. Çok az 2. Az 3. Orta 4. İyi 5. Çok iyi

DERS KODU

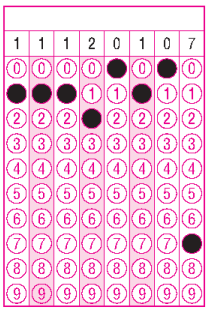
Kod		No			Şube		Dönem		Yıl	
CSE	0	0	0	0	0	0	Güz	0	0	0
BME	1	1	1	1	1	1	Bahar	1	1	1
EE	2	2	2	2	2	2			2	2
GBE	3	3	3	3	3	3			3	3
FDE	4	4	4	4	4	4			4	4
CE	5	5	5	5	5	5			5	5
CHBE	6	6	6	6	6	6			6	6
ME	7	7	7	7	7	7			7	7
SYE	8	8	8	8	8	8			8	8
		9	9	9	9	9			9	9

		NA / ID	ÇOK AZ	AZ	ORTA	İYİ	ÇOK İYİ
i	**Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.** (Matematik, fen bilimleri ve kendi dalları ile ilgili mühendislik konularında yeterli bilgi birikimi; bu alanlardaki kuramsal ve uygulamalı bilgileri mühendislik problemlerini modelleme ve çözme için uygulayabilme becerisi.)	○	1	2	3	4	5
ii	**Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.** (Karmaşık mühendislik problemlerini saptama, tanımlama, formüle etme ve çözme becerisi; bu amaçla uygun analiz ve modelleme yöntemlerini seçme ve uygulama becerisi.)	○	1	2	3	4	5
iii	**Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose. (Realistic constraints and conditions may include factors such as economic and environmental issues, sustainability, manufacturability, ethics, health, safety issues, and social and political issues, according to the nature of the design.)** (Karmaşık bir sistemi, süreci, cihazı veya ürünü gerçekçi kısıtlar ve koşullar altında,belirli gereksinimleri karşılayacak şekilde tasarlama becerisi; bu amaçla modern tasarım yöntemlerini uygulama becerisi. (Gerçekçi kısıtlar ve koşullar tasarımın niteliğine göre, ekonomi, çevre sorunları, sürdürülebilirlik, üretilebilirlik, etik, sağlık, güvenlik, sosyal ve politik sorunlar gibi öğeleri içerirler).	○	1	2	3	4	5
iv	**Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.** (Mühendislik uygulamaları için gerekli olan modern teknik ve araçları geliştirme, seçme ve kullanma becerisi; bilişim teknolojilerini etkin bir şekilde kullanma becerisi.)	○	1	2	3	4	5
v	**Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.** (Mühendislik problemlerinin incelenmesi için deney tasarlama, deney yapma, veri toplama, sonuçları analiz etme ve yorumlama becerisi.)	○	1	2	3	4	5
vi	**Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.** (Disiplin içi ve çok disiplinli takımlarda etkin biçimde çalışabilme becerisi; bireysel çalışma becerisi.)	○	1	2	3	4	5
vii	**Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.** (Sözlü ve yazılı etkin iletişim kurma becerisi; en az bir yabancı dil bilgisi.)	○	1	2	3	4	5
viii	**Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.** (Yaşam boyu öğrenmenin gerekliliği bilinci; bilgiye erişebilme, bilim ve teknolojideki gelişmeleri izleme ve kendini sürekli yenileme becerisi.)	○	1	2	3	4	5
ix	**Awareness of professional and ethical responsibility.** (Mesleki ve etik sorumluluk bilinci.)	○	1	2	3	4	5
x	**Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.** (Proje yönetimi ile risk yönetimi ve değişiklik yönetimi gibi iş hayatındaki uygulamalar hakkında bilgi; girişimcilik, yenilikçilik ve sürdürebilir kalkınma hakkında farkındalık.)	○	1	2	3	4	5
xi	**Knowledge about contemporary issues and the global and societal effects of engineering practices on health, environment, and safety; awareness of the legal consequences of engineering solutions.** (Mühendislik uygulamalarının evrensel ve toplumsal boyutlarda sağlık, çevre ve güvenlik üzerindeki etkileri ile çağın sorunları hakkında bilgi; mühendislik çözümlerinin hukuksal sonuçları konusunda farkındalık.)	○	1	2	3	4	5

20.5x28.5

YEDİTEPE UNIVERSITY - FACULTY OF ENGINEERING AND ARCHITECTURE
INSTRUCTOR EVALUATION FORM
YEDİTEPE ÜNİVERSİTESİ - MÜHENDİSLİK VE MİMARLIK FAKÜLTESİ
ÖĞRETİM ÜYESİ DEĞERLENDİRME FORMU

The purpose of this form is to enable you to evaluate the course instructor's performance. Feedback from students is very important for improving the level of education in our Faculty. Hence, please answer the questions objectively.
Bu formun amacı dersi veren öğretim üyesinin performansını değerlendirmenizi sağlamaktır. Fakültemizdeki eğitimin kalitesini arttırmak için öğrencilerden gelen geri dönüşümler çok önemlidir. Bu nedenle, lütfen bütün soruları tarafsızca cevaplayınız.



ABOUT THE STUDENT
ÖĞRENCİ HAKKINDA

1. Letter grade I expect from this course Bu dersten beklediğim harf notu	○ F	○ DD/DC	○ CC/CB	○ BB/BA	○ AA
2. The proficiency of my English to follow the course Dersi takip edebilmek için İngilizcemin yeterliliği	○ Very Poor	○ Poor	○ Fair	○ Good	○ Very Good
3. My course attendance Derse devamım	○ <49%	○ 50-69%	○ 70-79%	○ 80-89%	○ 90-100%
4. Amount of homework assignments and projects I've turned in Yapıp teslim ettiğim ödev ve proje miktarı	○ <49%	○ 50-69%	○ 70-79%	○ 80-89%	○ 90-100%
5. Benefits I've gained by doing the homework assignments and projects Ödev ve proje yapmış olmaktan kazanımlarım	○ Very Poor	○ Poor	○ Fair	○ Good	○ Very Good
6. Total number of hours I spent on this course per week (including lectures and labs) Bu derse harcadığım haftalık toplam saat (ders ve laboratuvar saatleri dahil)	○ 1-4 hrs	○ 5-6 hrs	○ 7-8 hrs	○ 9-10 hrs	○ >10 hrs

ABOUT THE INSTRUCTOR ÖĞRETİM ÜYESİ HAKKINDA	**Very Poor**	**Poor**	**Fair**	**Good**	**Very Good**
7. Fairness of the grading policy Not vermedeki adaleti	○	○	○	○	○
8. Quality of the assigned homework Verilen ödevlerin öğreticiliği	○	○	○	○	○
9. Availability of the supplementary course materials (class-notes, handouts, solutions, etc.) Derse destek materyallerinin varlığı (ders notu, derste verilenler, çözümler, vs.)	○	○	○	○	○
10. Ability to generate interest and interaction in class Derse ilgi çekme ve katılım sağlama yeteneği	○	○	○	○	○
11. Ability to use the English language İngilizce diline hakimiyeti	○	○	○	○	○
12. Efficient use of teaching aids (PC, projector, whiteboard, etc.) Eğitime yardımcı araçları verimli kullanımı (PC, projeksiyon cihazı, tahta, vs.)	○	○	○	○	○
13. Informative quality of the "syllabus" handed out at the beginning of the semester Dönemin başında dağıtılan "ders planı"nın bilgilendirme niteliği	○	○	○	○	○
14. Clarity of the lectures Dersin anlaşılabilirliği	○	○	○	○	○
15. Preparedness for the lectures and organization Derse hazırlıklı gelişi ve organizasyonu	○	○	○	○	○
16. Mastery of the course material Dersin konularına hakimiyeti	○	○	○	○	○
17. Clarity of handwriting El yazısının okunabilirliği	○	○	○	○	○
18. Clarity of descriptions, examples and illustrations presented in the lectures Derste verilen tanımlar, örnekler ve şekillerin anlaşılabilirliği	○	○	○	○	○
19. Availability during office hours Ofis saatlerinde ulaşılabilirliği	○	○	○	○	○
20. Efficient and effective use of the lecture time Ders saatini verimli ve etkili kullanımı	○	○	○	○	○
21. Prompt grading and posting solutions Notları ve çözümleri kısa sürede ilan etmesi	○	○	○	○	○
22. Would you choose another course from this instructor? Bu öğretim üyesinden başka ders seçer miydiniz?	○	○	○	○	○

If you have additional comments, please use this section
Ekleyeceğiniz yorumlarınız varsa, lütfen bu kısmı kullanınız

BİKDM BİLGİ İŞLEM VE KOMÜNİKASYON (0216) 346 24 34 / (0216) 346 24 65 / (0216) 348 83 99

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
INTRODUCTION TO BIOMEDICAL ENGINEERING	BME 102	1	2+2+0	3	2

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Prof.Dr. Ali Ümit KESKIN
Assistants	-
Goals	Introduce the general concept of Biomedical engineering.
Content	Introduction to Engineering and Technology; History and development of Biomedical Engineering in accordance with the development of Science and Technology; Basic working areas for Biomedical Engineers; Presentation to students about the relevant seminars and exhibitions.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Adequate knowledge in local and international status of Biomedical Engineering.	9, 10	1,2,3,12	A,C
2) Ability to occupational prospecting in Biomedical Engineering for students.	4,6,7,8	1,2,3,12	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Engineering and Technology.	Textbook

2	History of Biomedical Engineering.	Textbook
3	Development of Biomedical Engineering in accordance with the development of Science and Technology.	Textbook
4	Working areas for Biomedical Engineers.	Textbook
5	Clinical Engineering.	Textbook
6	Biomedical Engineering and interrelated areas.	Textbook
7	Recent research in Biomedical Engineering.	Textbook
8	MIDTERM I	-
9	Industrial presentations in Biomedical Engineering.	Textbook
10	Industrial presentations in Biomedical Engineering.	Textbook
11	Industrial presentations in Biomedical Engineering.	Textbook
12	Industrial presentations in Biomedical Engineering.	Textbook
13	Industrial presentations in Biomedical Engineering.	Textbook
14	Industrial presentations in Biomedical Engineering.	Textbook

RECOMMENDED SOURCES	
Textbook	John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino. Introduction to Biomedical Engineering.
Additional Resources	-

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	75
Assignment	10	25
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		60
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL		40

GRADE		
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			**X**		
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					**X**
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					**X**
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				**X**	
9	Awareness of professional and ethical responsibility.				**X**	
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	48
Hours for off-the-classroom study (Pre-study, practice)	14	0	0
Mid-terms	1	5	5

Homework	2	1	2
Final examination	1	5	5
Total Work Load			60
Total Work Load / 25 (h)			2.40
ECTS Credit of the Course			2

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOLOGICAL AND MEDICAL PHYSICS	BME 211	3	2+2+0	3	11

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Assist.Prof.Dr.Andaç HAMAMCI
Assistants	-
Goals	The aim of this course is to provide student with knowledge of biological and medical physics.
Content	Introduction to biological and medical physics; biomechanics; biomaterials; bioelectronics; biological effects of electromagnetic fields; electrical security systems in medical applications; bio-optics; bio-acoustics; basic functional construction of the living tissue; water as a life medium; bioenergetics; radiation physics; beams and their application in medicine; biophysics of the respiratory system; biophysics of the vascular system; cardiac pacemakers; blood pressure.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
3) Explains the fundamentals of biological and medical physics	1, 3	1,2,3	A,C
4) Inspires the applications of medical physics to biomechanics, biomaterials and bioelectronics.	1,2,3,4,5	1,2,3	A,C
5) Explains the radiation physics as applied to medicine.	1,5,6	1,2,3	A,C
6) Explains the biophysics in human body	1,2,4,5	1,2,3	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	ELECTROMAGNETIC WAVES	Textbook
2	ELECTROMAGNETIC WAVES	Textbook
3	LASERS: LIGHT AND MATTER	Textbook
4	LASERS: INTERACTION MECHANISMS	Textbook
5	X-RAYS	Additional Resources
6	PRODUCTION OF X-RAYS	Additional Resources
7	INTERACTION OF PHOTONS WITH MATTER	Additional Resources
8	MIDTERM I	
9	ATTENUATION	Additional Resources
10	BIOLOGICAL EFFECTS OF RADIATION	Additional Resources
11	NUCLEAR MEDICINE IN IMAGING	Additional Resources
12	NUCLEAR MEDICINE IN THERAPY	Additional Resources
13	NUCLEAR RADIATION	Additional Resources
14	ABSORBED DOSE CALCULATION	Additional Resources

RECOMMENDED SOURCES	
Textbook	LASER-TISSUE INTERACTIONS, FUNDAMENTALS AND APPLICATIONS, 3RD EDITION MARKOLF H. NIEMZ, SPRINGER.
Additional Resources	INTERMEDIATE PHYSICS FOR MEDICINE AND BIOLOGY, 4TH EDITION RUSSEL K. HOBBIE, BRADLEY J. ROTH, SPRINGER,2007.

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT

IN-TERM STUDIES	NUMBER	PERCENTAGE
Mid-terms	1	75
Assignment	4	25
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		60
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		40
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.				**X**	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					**X**
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			**X**		
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.		**X**			
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					**X**
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	4	56
Hours for off-the-classroom study (Pre-study, practice)	14	7	98
Mid-terms	1	20	20
Homework	6	10	60
Final examination	1	30	30
Total Work Load			264
Total Work Load / 25 (h)			10.56
ECTS Credit of the Course			11

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOLOGY in BIOMEDICAL ENGINEERING	BME 213	3	3+0+0	3	6

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Assist.Prof.Dr. F. Şermin UTKU
Assistants	-
Goals	To ensure that students gain knowledge about basic biology of cells and improve practical experience with experimental approaches
Content	Introduction to biology from the biomedical engineering perspective, carbon cycle and polymer principles, cellular elements, cell membrane structure, metabolism and modelling approaches, cellular respiration, the cell cycle, meiosis and sexual life cycles, the molecular basis of ınheritance, from gene to protein, regulation of gene expression, protein and gene drug delivery, genomics, proteomics, metabolics, information technologies, dna arrays, virtual laboratory applications, simulational software in computative biology.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Understands the basic concepts of cell structure and functions.	1	1,2	A,C
2) Observes and interpret different cell types and internal structures using a light microscope.	1,3	1,2,3	A,B,C
3) Correctly uses life sciences laboratory equipment and interpret the results.	1,3	1,2,3	A,B,C
4) Explains and evaluates the isolation and analysis of DNA using molecular biology techniques.	1,3	1,2,3	A,B,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Simulation-Laboratory

Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Biology from the Biomedical Engineering Perspective	Textbook, Course notes, Videos
2	Carbon Cycle and Polymer Principles	Textbook, Course notes, Videos
3	Cellular Elements	Textbook, Course notes, Videos
4	Cell Membrane Structure, Metabolism and Modeling Approaches	Textbook, Course notes, Videos
5	Cellular Respiration	Textbook, Course notes, Videos
6	The Cell Cycle	Textbook, Course notes, Videos
7	MIDTERM	Textbook, Course notes, Videos
8	Meiosis and Sexual Life Cycles	Textbook, Course notes, Videos
9	The Molecular Basis of Inheritance	Textbook, Course notes, Videos
10	From Gene to Protein	Textbook, Course notes, Videos
11	Regulation of Gene Expression	Textbook, Course notes, Videos
12	Protein and Gene Drug Delivery	Textbook, Course notes, Videos
13	Genomics, proteomics, metabolics, information technologies	Textbook, Course notes, Videos
14	DNA Arrays	Textbook, Course notes, Videos
15	Virtual Laboratory Applications	Textbook, Course notes, Videos

16	Simulational software in Computative Biology	Textbook, Course notes, Videos

RECOMMENDED SOURCES	
Textbook	"Biology", Mader &Windelspecht, 11th International Edition With CONNECT.
Additional Resources	CampbellBiology, CampbellandReese, 10th edition, PEARSON

MATERIAL SHARING	
Documents	Course Notes, Textbook
Assignments	Homework and simulation reports
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	70
Assignment	4	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.			**X**		
3	Ability to design a complex system, process, device or product under realistic					

	constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					**X**
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				**X**	
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					
9	Awareness of professional and ethical responsibility.				**X**	
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	5	70
Mid-terms	1	2	2
Homework	6	4	24
Final examination	1	14	14
Total Work Load			152
Total Work Load / 25 (h)			6.08
ECTS Credit of the Course			6

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
ELECTRICAL CIRCUITS IN BME	BME 214	4	2+0+2	3	5

Prerequisites	PHYS102

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Assoc.Prof.Dr. Ali Ümit KESKIN
Assistants	-
Goals	Introduce the general concept of circuit theory in Biomedical Engineering.
Content	Circuit elements, resistive circuits, Ohm's law. Kirchhoff's current and voltage laws. Circuit analysis techniques, node-voltage, mesh-current methods. Thevenin and Norton equivalents. Source transformation. Inductors and capacitors, series and parallel connections. Laplace analysis.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
7) Adequate knowledge in circuit elements and their composite behaviour.	2,3,5,10	1,2,3,9	A,B,C
8) Ability to perform circuit analysis using the circuit laws and rules.	1,4	1,2,3,9	A,B,C
9) Development of practical skills in design and application of circuits in Biomedical Engineering.	1,2,3,4,8,9	1,2,3	A,B,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT

Week	Topics	Study Materials
1	Circuit definitions: current, voltage.	Textbook
2	Circuit definitions: Power and energy.	Textbook
3	Circuit theorems.	Textbook
4	DC circuits, active and passive elements.	Textbook
5	DC circuits, active and passive elements.	Textbook
6	Thevenin and Norton transformations.	Textbook
7	MIDTERM I	-
8	Maximum power transfer.	Textbook
9	First order circuits.	Textbook
10	Second order circuits.	Textbook
11	Sinusoidal steady state, phasors, phasor network equations.	Textbook
12	Laplace transform methods in circuit analysis.	Textbook
13	State equations for higher order dynamic circuits, their solutions in time and s-domain.	Textbook
14	Stability, circuit equations in w- and s-domain.	Textbook

RECOMMENDED SOURCES	
Textbook	R.C. Dorf and J. A. Svoboda, Introduction to Electric Circuits, John Wiley and Sons, New York, 1996.
Additional Resources	C.K. Alexander,M.N.O.Sadiku, Fundamentals of Electric Circuits, McGraw-Hill Higher Education, 2007 J. D. Irvin, Basic Engineering Circuit Analysis, MacMillan,1987 W.H.Hayt, J.E. Kemmerly, Engineering Circuit Analysis, McGraw-Hill Book Company,N.Y.,1986

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	75

Assignment	10	25
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		60
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		40
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.				**X**	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				**X**	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					**X**
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.				**X**	
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				**X**	
9	Awareness of professional and ethical responsibility.				**X**	
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.				**X**	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)

Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Mid-terms	1	14	14
Homework	6	4	24
Final examination	1	14	14
Total Work Load			122
Total Work Load / 25 (h)			4.88
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
ELECTROMAGNETIC FIELDS AND WAVES IN BME	BME 222	4	3+0+0	3	6

Prerequisites	PHYS 102, MATH 132

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Assist.Prof.Dr. Andaç HAMAMCI
Assistants	-
Goals	The aim of this course is to introduce the students the fundamentals of electrical and magnetic fields, electromagnetic waves and magnetic properties of materials.
Content	Electrostatics, Electric Field, Gauss' Law, Conductors, Dielectrics, Magnetostatics, Magnetic Forces, The Biot-Savart Law, Ampere's Law, Magnetic Properties of Materials, Maxwell's Equations, Faraday's Law, Displacement Current, Electromagnetic Waves, Time- Harmonic Fields, Plane Waves in Lossless Media, Waves in Lossy Media.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
10) Adequate knowledge in electrical and magnetic fields.	1	1,2,3	A,C
11) Ability to use laws describing the fields and waves.	1, 2	1,2,3	A,C
12) Ability to explain propagation of electromagnetic waves.	1, 2	1,2,3	A,C
13) Familiarity with the electromagnetics application in medical devices	1,2,3,4	1,2,3	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction to Electromagnetic Theory and its necessity for engineering. Basic Vector Algebra and Vector Calculus.	Electromagnetic Theory
2	Electrostatics: Coulomb's Law and Electric Field Intensity.	Electromagnetic Theory
3	Gauss's Law and Applications, Electric Flux Density.	Electromagnetic Theory
4	Conductors and Dielectrics in Static Electric Fields. Capacitance and Capacitors.	Static Electric Fields
5	Steady Currents: Current Density and Ohm's Law.	Steady Currents
6	Electromotive Force and Kirchhoff's Voltage Law. Equation of Continuity and Kirchhoff's Current Law	Kirchhoff's Voltage and Current Laws
7	MIDTERM I	-
8	Power Dissipation and Joule's Law. Resistance Calculations.	Joule's Law
9	Magnetostatics: Fundamental Postulates of Magnetostatics.	Magnetostatics
10	The Biot – Savart Law and Applications.Magnetic Field Intensity.	Magnetostatics
11	Magnetic Circuits. Inductances and Inductors	Magnetic Circuits
12	Time – Varying Fields and Maxwell's Equations	Maxwell's Equations
13	The Uniform Plane Waves	Plane Waves
14	Biomedical Applications	-

RECOMMENDED SOURCES	
Textbook	David K. Cheng, "Field and Wave Electromagnetics," Addison – Wesley Publishing Company, 2nd Edition.
Additional Resources	William H. Hayt Jr., John A. Buck, "Engineering Electromagnetics," McGraw – Hill International, 7th Edition. Schaum's Outline of Electromagnetics, Third Edition.

MATERIAL SHARING	
Documents	E. Kreyszig, "Advanced Engineering Mathematics" Wiley, 10th Edition. George B. Arfken, Hans J. Weber, Frank E. Harris, "Mathematical Methods for Physicists, Seventh Edition: A Comprehensive Guide," Acedemic Press, 7th Edition
Assignments	-
Exams	-

ASSESSMENT

IN-TERM STUDIES	NUMBER	PERCENTAGE
Mid-terms	1	50
Assignment	10	50
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.				**X**	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					**X**
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.				**X**	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	1	14	14
Homework	10	3	30
Final examination	1	14	14
Total Work Load			146
Total Work Load / 25 (h)			5.84
ECTS Credit of the Course			6

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMECHANICS	BME 252	4	3+0+0	3	6

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Assist.Prof.Dr. Alper YAMAN
Assistants	-
Goals	The aim of this course is to introduce students the engineering mechanics as applied to human muscle-skeletal system.
Content	Application techniques of engineering mechanics to human muscle-skeletal systems. Mechanical properties of tissues. Structural properties and mechanical analysis of bones, muscles and joints. Dynamics of mechanical systems. Investigation of orthopedic materials through mechanical procedures, stress and strain applications of implantation materials. Description of basic research areas related to biomechanics and problems.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
14) Adequate knowledge in mechanics of human muscle-skeletal system.	1,2,3,4,5	1,2,3	A,C
15) Adequate knowledge in structural properties and mechanical analysis of bones, muscles and joints.	1,2,3	1,2,3	A,C
16) Ability to distinguish orthopedic materials.	4	1,2,3	A,C
17) Awareness of basic research areas related to biomechanics and problems.	5,6,7,8,9,10	1,2,3	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Anatomy and "medical speak"	Textbook
2	The nature of vector quantities, combining and resolving two-dimensional vectors.	Textbook
3	Basic terms involved in kinematics (e.g. velocity, acceleration, etc.)	Textbook
4	Kinematic relationships between linear and angular motion	Textbook
5	Concepts of kinematics to analyze human motion	Textbook
6	Midterm I	
7	Basic terms involved in the kinetics of linear motion (e.g. force, inertia, momentum, etc.)	Textbook
8	Important characteristics of forces (e.g. magnitude, direction, point of application, components)	Textbook
9	Newton's laws of motion and relation to biomechanical analysis	Textbook
10	The significance of the impulse-momentum, work-energy and conservation of momentum relationships to sports activities	Textbook
11	Basic terms involved in the kinetics of angular motion (e.g. angular momentum, moment of inertia, torque)	Textbook
12	Kinetic relationship	Textbook
13	Midterm II	
14	Mechanics of biomaterials; stress, shear, bending, torsion, toughness, fatigue, viscoelasticity, wear, corrosion.	Textbook

RECOMMENDED SOURCES	
Textbook	Susan Hall. Basic Biomechanics. 5th Ed. St. Louis: WCB McGraw-Hill, 2002.
Additional Resources	Manohar Panjabi and Augustus White. Biomechanics in The Musculoskeletal System, Churchill Livingstone, 2001.

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	67
Assignment	1	33
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X	
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					X	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				X		
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					X	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.				X		
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				X		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.				X		
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X		
9	Awareness of professional and ethical responsibility.					X	
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.				X		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	2	14	28
Homework	4	5	20
Final examination	1	14	14
Total Work Load			146
Total Work Load / 25 (h)			5.84
ECTS Credit of the Course			6

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMATERIALS	BME 262	4	2+2+0	3	6

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. F. Şermin UTKU
Assistants	-
Goals	The aim of this course is to introduce students the fundamentals of material sciences as applied to medicine.
Content	Material science and relation with medicine. Properties of crystal and non-crystal materials. Natural biological materials. Artificial biologic materials. Applications of material science in orthopedic surgery. Mechanics, corrosive and surface properties, tissue reactions of polymers, ceramics, bioglass, medical-grade titanium synthetics and other materials. Cardiology and material science.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
18) Adequate knowledge incrystal and non-crystal materials.	1,2,4	1,2,3	A,C
19) Ability to distinguish natural and artificial biological materials.	1,2,4,8,9	1,2,3	A,C
20) Adequate knowledge in material science as applied to medicine.	1,2,4,8,9	1,2,3	A,C
21) Ability to present a specific subject to an audience.	1,2,4,6,7,8	1,2,3	C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Biomaterials	Textbook
2	Introduction to Hard Tissues	Textbook
3	Hard Tissue Replacements, introduction to mechanics of materials	Textbook
4	Hard Tissue Replacements, mechanical testing of materials	Textbook
5	Compressive, Tensile, Torsional and FlexuralTesting of Materials Introduction to the Cardiovascular System	Textbook
6	Cardiovascular Replacements	Textbook
7	MIDTERM	
8	Soft Tissue Replacements	Textbook
9	Soft Tissue Replacements, HCF and LCF Fatigue Testing	Textbook
10	Metallic Materials, Corrosion of Materials	Textbook
11	Polymeric Materials, Viscoelasticity	Textbook
12	Ceramic Materials, Degradation of Ceramic Materials	Textbook
13	Composite Materials, Medical Standards and Ethics, Student Presentations	Textbook
14	Student Presentations	

RECOMMENDED SOURCES	
Textbook	Biomaterials, An introduction, JB Park, available at Yeditepe Library. Materials Science, Malzeme Bilimi, Kaşif Onaran, 12th ed., 2012
Additional Resources	Biomaterials Science, Eds. Ratner, Hoffman, Schoen, Lemons Biomaterials, Wong, Bronzino, eds. E-book.

MATERIAL SHARING	
Documents	Powerpoint presentations
Assignments	Sample Problems
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	60

Assignment	1	40
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.			X		
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.				X	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					X
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					X
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					X
9	Awareness of professional and ethical responsibility.					X
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course	14	4	56

hours)			
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Mid-terms	1	14	14
Homework	1	10	10
Final examination	1	14	14
Total Work Load			160
Total Work Load / 25 (h)			6.40
ECTS Credit of the Course			6

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMEDICAL ELECTRONICS I	BME 301	5	3+0+2	4	6

Prerequisites	BME214

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Andaç HAMAMCI
Assistants	-
Goals	The aim of this course is to introduce students the fundamentals of electronics as applied to biomedical instruments.
Content	Fundamental solid-state principles, doping, PN Junction, bias. Diode models and applications, load-line analysis, AND/OR gates, rectifiers and voltage multipliers, clippers clampers and Zener voltage regulators. Bipolar junction transistors (BJT), PNP and NPN types, characteristics, common-emitter, common- base and common-collector configurations, basic biasing circuits and applications. JFET and MOSFET transistors and applications. Noise and circuit analysis and design of circuits with JFET, bipolar Transistor and MOSFET Combination. BJT,FET,MOS networks used at the input of EEG, ECG, EMG instruments in the medical field applications.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
22) Adequate knowledge in diodes, their models and applications.	1,2,5	1,2,3	A,B,C
23) Adequate knowledge in the working principles of transistors.	1,2,5	1,2,3	A,B,C
24) Ability to analyze and implement transistor networks.	1,2,3,4,5	1,2,3	A,B,C
25) Ability to use computer software to design diodes and transistors.	2,4,5	1,2,3,9	A,B,C
26) Ability to devise, select, use diodes and transistors in biomedical instruments.	3,4,6,8	1,2,3,12	A,B,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study

Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Fundamental solid-state principles. Doping. PN Junction.	Textbook
2	PN Junction, Diode models. Loadline Analysis.	Textbook
3	AND/OR Gates. Rectifiers. Voltage Multipliers. Clippers. Clampers.	Textbook
4	Zener Voltage Regulators. Bipolar Junction Transistor (BJT)	Textbook
5	BJT Characteristics. PNP and PNP Types. Common-emitter, Common-base and Common-collector Configurations.	Textbook
6	Basic Biasing Circuits and Applications.	Textbook
7	MIDTERM I	
8	JFET Characteristics and Applications.	Textbook
9	MOSFET Characteristics and Applications.	Textbook
10	Computer Aided Design of Diodes, BJTs and MOSFETs.	Textbook
11	Design of Circuits with BJTs, JFETs and MOSFETs.	Textbook
12	MIDTERM II	
13	BJT, JFET and MOSFET Networks.	Textbook
14	Low Noise Amplifier Circuits in EEG, ECG and EMG instruments.	Textbook

RECOMMENDED SOURCES	
Textbook	Robert L. BOYLESTAD and Louis NASHELSKY. 1999. Electronic Devices and Circuit Theory. 6th Edition. Prentice Hall.
Additional Resources	Sedra S. ADEL and Kenneth C. SMITH. 2004 Microelectronic Circuits. 5th Edition. Oxford University Press.

MATERIAL SHARING	
Documents	Lecture Surveys.
Assignments	-
Exams	-

ASSESSMENT

IN-TERM STUDIES	NUMBER	PERCENTAGE
Mid-terms	2	62
Assignment	1	38
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.				**X**	
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.				**X**	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.			**X**		
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.				**X**	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					**X**
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.		**X**			
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.		**X**			
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	5	60
Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Mid-terms	2	14	28
Homework	2	10	20
Final examination	1	14	14
Total Work Load			150
Total Work Load / 25 (h)			6
ECTS Credit of the Course			6

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMEDICAL ELECTRONICS II	BME 302	6	3+0+2	4	8

Prerequisites	BME301

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	-
Goals	The aim of this course is to introduce students the advancedelectronics as applied to biomedical instruments.
Content	Power amplifiers of A, B, C class, high and low frequency responses of amplifiers (BJT,FET and MOSFET), operational amplifiers, instrumentation amplifiers, active filters with operational amplifiers and it's frequency responses, designs which can be used at the output of EEG, EMG, ECG. Oscillators and voltage regulators. Logic circuits and digital circuit design applied in the instruments such as EEG, EMG, ECG, patient stimulator and pacemakers in the medical field applications.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
27) Adequate knowledge in analysis of circuits with operational amplifiers. Ability to devise, select and use operational amplifiers in biomedical instruments.	1,2,3,4,5	1,2,3	A,B,C
28) Adequate knowledge in working principles of power amplifiers.	1,2,3,4,5	1,2,3	A,B,C
29) Adequate knowledge inhigh and low frequency responses of transistors and their use in signal amplifiers.	1,2,3,4,5	1,2,3	A,B,C
30) Adequate knowledge in working principles of oscillators. Ability to use and design voltage regulators.	1,2,3,4,5	1,2,3	A,B,C

31) Adequate knowledge in logic circuits and their design using diodes, transistors and integrated circuits.	1,2,3,4,5	1,2,3	A,B,C
32) Familiarity with the implementation of advanced electronics to biomedical instruments.	6, 8	1,2,3	A

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Basics of Operational Amplifiers	Circuit analysis and Kirchhoff's current and voltage laws
2	Basics of Operational Amplifiers	Circuit analysis and Kirchhoff's current and voltage laws
3	Signal Filtering	Signals and Systems
4	Active Filtering with Operational Amplifiers	Signals and Systems
5	MIDTERM I	
6	Frequency responses of amplifiers with BJT	Transistors in signal amplification
7	Frequency responses of amplifiers with FET	Transistors in signal amplification
8	Power Amplifiers	Large signal amplifiers
9	MIDTERM II	
10	Oscillators	Oscillation
11	Voltage Regulators	Power supplies
12	Logic Circuits and Digital Circuit Design	Logic Circuits
13	Applications in Biomedical Engineering	-
14	Applications in Biomedical Engineering	-

RECOMMENDED SOURCES	
Textbook	Robert L. BOYLESTAD and Louis NASHELSKY. 1999. Electronic Devices and Circuit Theory. 6th Edition. Prentice Hall.

Additional Resources	-

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	80
Assignment	6	20
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**	
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					**X**	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				**X**		
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			**X**			
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					**X**	
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.			**X**			

7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					**X**
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	5	60
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Mid-terms	2	14	28
Homework	5	4	20
Final examination	1	14	14
Total Work Load			206
Total Work Load / 25 (h)			8.24
ECTS Credit of the Course			8

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
HUMAN PHYSIOLOGY	BME 313	5	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. F. Şermin UTKU
Assistants	-
Goals	The aim of this course is to introduce students the concepts of human physiology and mechanisms of physiological control.
Content	Homeostasis, body fluid compartments and transport mechanisms, muscular physiology, cardiovascular physiology, respiratory physiology, neurological system and mechanisms of physiological control.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
33) Awareness of the concepts of body fluid compartments and transport mechanisms.	1, 3, 6	1,2,3	A
34) Ability to distinguish the characteristics ofmuscular physiology, cardiovascular physiology, respiratory physiology.	1, 2, 5, 6	1,2,3	A
35) Adequate knowledge in different physiological systems in human.	1, 2, 3, 4, 6	1,2,3	A
36) Adequate knowledge in neurological system and mechanisms of physiological control.	3, 6	1,2,3	A

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion
Assessment Methods:	A: Testing

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Physiology and Homeostasis, Body Fluids and Transport of Substances	Textbook
2	Membrane Potentials and Action Potentials	Textbook
3	The Muscular System Regulation of Cardiac Function	Textbook
4	Cardiac Cycle and Cardiac Output, Principles of Hemodynamics and Regulation of Blood Pressure	Textbook
5	Heart Valves and Heart Sounds	Textbook
6	Components and Functions of Bloods Renal Physiology Gastrointestinal Physiology	Textbook
7	Pulmonary Ventilation and Circulation Diffusion and Transport Of Blood Gases Regulation of Respiration	Textbook
8	MIDTERM	
9	Neurophysiology	Textbook
10	Organization of The Nervous System	Textbook
11	Sensory Receptors and Pathways	Textbook
12	Motor Functions and Pathways	Textbook
13	Cerebral Functions and Intellectual Functions of The Brain	Textbook
14	States of Brain Activity and Brain Waves, Endocrinology	Textbook

RECOMMENDED SOURCES	
Textbook	Lauralee Sherwood. Human Physiology: From Cells to Systems.2008.
Additional Resources	

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT

IN-TERM STUDIES	NUMBER	PERCENTAGE
Mid-terms	1	100
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		50
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		50
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.				x	
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.			x		
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				x	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			x		
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.		x			
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					x
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload

			(Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	1	18	18
Final examination	1	20	20
Total Work Load			122
Total Work Load / 25 (h)			4.88
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMEDICAL INSTRUMENTATION	BME 314	6	3+0+2	4	8

Prerequisites	BME301

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	-
Goals	The aim of this course is to introduce students the concepts of medical instrumentation for physiological measurements.
Content	Basic concepts of medical instrumentation. Principles of electrodes and transducers. Biopotential electrodes. Biopotential amplifiers. Electrocardiography. Basic principles related to physiological pressure measurements and phonocardiography. Measurement techniques of blood flow and volume of blood flow. Other cardiovascular measurements.Therapeutic and prosthetic devices, defibrillators, pacemakers, heart-lung pumps. Instrumentation for measuring brain functions, EEG and EMG Measurements. Human respiratory system and its measurements, respiratory therapy equipment. Intensive and coronary-care units. Operating rooms and electro-surgery systems.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
37) Adequate knowledge in basic concepts of medical instrumentation.	1,2,3,6	1,2,3	A,B,C
38) Adequate knowledge in the working principles of electrodes, transducers and biopotantial amplifiers.	1,2,3,4,5,6	1,2,3	A,B,C
39) Ability to use, design and develop instrument for physiological measurements from human body.	3,4,5,6,9	1,2,3	A,B,C,E
40) Adequate knowledge in biomedical instruments at intensive and coronary-care units and operating rooms.	4,6,7,8,9	1,2,3	A,B,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project, E: Presentation

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction and motivation.	Textbook
2	The origin of biopotentials: ECG, EMG, EEG, MEG, etc.	Textbook
3	Biopotential electrodes and amplifiers.	Textbook
4	Measurement of blood flow and pressure.	Textbook
5	Cardiovascular system, hemodynamics.	Textbook
6	MIDTERM I	
7	Respiratory system, measurements of the respiratory system.	Textbook
8	Measurement of blood pressure.	Textbook
9	MIDTERM II	Textbook
10	Processing of biological signals.	Textbook
11	Clinical laboratory systems.	Textbook
12	Biocontrol.	Textbook
13	Electrical safety.	
14	Student Presentations.	Textbook

RECOMMENDED SOURCES

Textbook	Introduction to Biomedical Equipment Tech., Carr and Brown, Prentice Hall.
Additional Resources	

MATERIAL SHARING

Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	62
Assignment	1	23
Presentation	1	15
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.			**X**			
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.	**X**					
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					**X**	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					**X**	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.			**X**			
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					**X**	
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.	**X**					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.			**X**			
9	Awareness of professional and ethical responsibility.				**X**		
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship,						

	innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	6	64
Hours for off-the-classroom study (Pre-study, practice)	14	6	64
Mid-terms	2	14	28
Homework	4	5	20
Presentation	1	7	7
Final examination	1	14	14
Total Work Load			197
Total Work Load / 25 (h)			7.88
ECTS Credit of the Course			8

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMEDICAL SENSORS AND TRANSDUCERS	BME 324	6	3+0+0	3	7

Prerequisites	BME301

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	-
Goals	The aim of this course is to introduce students the concepts of medical instrumentation for physiological measurements.
Content	The properties of transducers, dynamic linearity, hysteresis and frequency range. The basis of biosensor design, analysis and selection of physical, optical, electrical, mechanical, thermal transduction mechanisms. Biological elements, immobilization of biological components. Medical, biological and chemical sensors and transducers based on electrochemistry, optics, and solid- state devices.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
41) Awareness of the concepts of transducer, sensor and actuator. Adequate knowledge in instrument model.	1	1,2,3	A, C
42) Ability to distinguish the characteristics of sensors and transducers.	1,2,3,8	1,2,3	A, C
43) Adequate knowledge in measurement principles, error and accuracy.	1,2,3	1,2,3	A, C
44) Adequate knowledge in the theory and the practical biomedical use of displacement sensors, temperature sensors and electromagnetic radiation sensors.	1,2,3,4,5,6	1,2,3	A, C
45) Adequate knowledge in modelling and working of	1,2,3,4,5,6	1,2,3	A, C

biological and chemical sensors.			
46) Adequate knowledge in biosensor design.	1,2,3,4,5,6,8	1,2,3	A, C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT

Week	Topics	Study Materials
1	Transducers, sensors and actuators.	Instrumentation and measurement.
2	Instrument Model.	Instrumentation and measurement.
3	Classification of sensors and transducers.	Sensor technologies.
4	Characteristics of sensors and transducers.	Sensor technologies.
5	Principles of measurement. Error. Accuracy.	Instrument types and performance characteristics.
6	Displacement sensors: Resistive and capacitive.	Measurement sensors and instruments.
7	Displacement sensors: Resistive and capacitive. Wheatstone Bridge.	Measurement sensors and instruments.
8	MIDTERM	
9	Displacement sensors: Inductive and piezoelectric.	Measurement sensors and instruments.
10	Displacement sensors: Inductive and piezoelectric.	Measurement sensors and instruments.
11	Temperature sensors: Thermistors and thermocouples.	Temperature measurement.
12	Electromagnetic radiation sensors: Thermal and photon detectors.	Electromagnetic radiation measurement.
13	Biological and chemical sensors.	Sensor technologies.
14	The basis of biosensor design. Analysis and selection of transduction mechanisms. Linearization of sensor characteristics	Biosensors.

RECOMMENDED SOURCES

Textbook	Aston R. 1990. Principles of Biomedical Instrumentation and Measurement. Merril Publishing Company.
Additional Resources	Webster JG. 2010. Medical Instrumentation. John Wiley.

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	64
Assignment	5	36
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		45
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		55
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					**X**
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				**X**	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			**X**		
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					**X**
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.			**X**		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					

8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					**X**
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Mid-terms	2	14	28
Homework	5	5	25
Final examination	1	14	14
Total Work Load			165
Total Work Load / 25 (h)			6.60
ECTS Credit of the Course			7

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
MODELING AND CONTROL OF BIOMEDICAL SYSTEMS	BME 351	5	2+2+0	3	6

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Alper YAMAN
Assistants	-
Goals	The aim of this course is to introduce students the concepts of human physiology and mechanisms of physiological control.
Content	Mathematical modelling and simulation of physiological systems. Laplace transform and state-space representation. Time and frequency domain analysis. Stability of linear systems. PID control applications. Parametric identification and optimal control of physiological systems. Application of control techniques to Cheyne-Stokes breathing, glucose regulation, cardiovascular and human muscle-reflex systems.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
47) Awareness of the concepts of modelling and simulation.	1,2	1,2,3	A
48) Awareness of control techniques and ability to apply them to breathing, glucose regulation, cardiovascular and human muscle-reflex systems.	1,2,3	1,2,3	A
49) Ability to model and simulate physiological systems.	1,2,8,9,10	1,2,3	A, D
50) Adequate knowledge in parametric identification and optimal control of physiological systems.	1,2,3,4,5,6,7	1,2,3	A, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Mathematical modelling and simulation of physiological systems.	Textbook, Additional Sources
2	Laplace transform and state-space representation.	Textbook, Additional Sources
3	Block Diagrams Signal Flow Graphs	Textbook, Additional Sources
4	System Simulation, System Sensitivity, system Response Performance Indices	Textbook, Additional Sources
5	S-Plane Roots, Stability Root Locus, Design, Sensitivity	Textbook, Additional Sources
6	Frequency Response, Nyquist Stability Criterion, Gain & Phase Margins, Design Using Frequency Response	Textbook, Additional Sources
7	MIDTERM	
8	Compensation, Control Design	Textbook, Additional Sources
9	Deadbeat Response, Prefilters, & Pole Zero Cancelation	Textbook, Additional Sources
10	PID control applications.	Textbook, Additional Sources
11	Parametric identification and optimal control of physiological systems.	Textbook, Additional Sources
12	Application of control techniques to Cheyne-Stokes breathing	Textbook, Additional Sources
13	Glucose regulation	Textbook, Additional Sources
14	Cardiovascular and human muscle-reflex systems	Textbook, Additional Sources

RECOMMENDED SOURCES	
Textbook	*Physiological Control Systems – Analysis, Simulation and Estimation*, Michael Khoo, Wiley/IEEE Press, 1999.
Additional Resources	*Mühendislik Sistemlerinin Modellenmesi ve Dinamiği*, Yücel ERCAN, Literatür Yayınları. *Modern Control Systems*, 9th edition, Richard C. Dorf and Robert H. Bishop, Prentice-Hall. *Endogenous and Exogenous Regulation and Control of Physiological Systems*, Robert B. Northrop, Chapman and Hall/CRC, Boca Raton, FL, 2000.

MATERIAL SHARING	
Documents	-

Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	67
Project	1	33
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X	
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					X	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				X		
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					X	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.				X		
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				X		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.				X		
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X		
9	Awareness of professional and ethical responsibility.					X	

10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.				X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	4	56
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	2	9	18
Project	1	6	6
Final examination	1	14	20
Total Work Load			142
Total Work Load / 25 (h)			5.68
ECTS Credit of the Course			6

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOLOGICAL TRANSPORT SYSTEMS	BME 372	6	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restricted Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. Feride Şermin UTKU
Assistants	-
Goals	The aim of this course is to gain students the fundamentals of interaction of liposomes with cells and controlled drug delivery systems.
Content	Introduction to biomaterials as carriers of novel Drug Delivery Systems. Composition of Liposomes. Mechanisms of interaction of liposomes with cells. Controlled Polymeric Drug Delivery Systems. Transdermal Drug Delivery Systems. Design of Peptide Protein Gene Drug Delivery Systems. Infusion pumps and implantable drug delivery systems.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
51) Adequate knowledge in biomaterials as carriers of novel Drug Delivery Systems.	1,2,3,4	1,2,3	A
52) Adequate knowledge in Liposomes and mechanisms of interaction of liposomes with cells.	1,2,3,4,5	1,2,3	A
53) Ability to use theoretical and applied information to understand the applications of drug delivery systems.	5,6,7,8,9,10	1,2,3,12	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to New Drug Delivery Systems benefits, mechanism and materials	Textbook, Course notes, Videos
2	Classification of New Drug Delivery Systems	Textbook, Course notes, Videos
3	Ocular Drug Delivery systems	Textbook, Course notes, Videos
4	Transdermal Drug Delivery Systems	Textbook, Course notes, Videos
5	Iontophoresis Applications	Textbook, Course notes, Videos
6	Micro-needle Technology, Microchip application	Textbook, Course notes, Videos
7	MIDTERM I	Textbook, Course notes, Videos
8	Oral Administration Novel systems: Osmotic Pump etc Implants: Gliadel Wafer, Duros etc.	Textbook, Course notes, Videos
9	Vaginal Administration Route: Intrauterine devices	Textbook, Course notes, Videos
10	Nano Technology	Textbook, Course notes, Videos
11	Liposomes, Stealth Liposomes,	Textbook, Course notes, Videos
12	Infusion Pumps	Textbook, Course notes, Videos
13	Biotechnological Products Overview	Textbook, Course notes, Videos
14	Protein and Gene Drug Delivery	Textbook, Course notes, Videos

RECOMMENDED SOURCES	
Textbook	Ansel, H.C., Pharmaceutical dosage forms and drug delivery systems. Lea and Febiger, Philadelphia
Additional Resources	Remington: The Science and Practice of Pharmacy, Mack Publishing Co: Easton, PA, 1995.

MATERIAL SHARING	
Documents	Course Notes, Textbook
Assignments	
Exams	Presentation

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	30
Assignment	1	70
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		60
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		40
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.			**X**		
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.	**X**				
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.			**X**		
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					**X**
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.	**X**				
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				**X**	
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.			**X**		
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					**X**
9	Awareness of professional and ethical responsibility.		**X**			
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.				**X**	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	1	14	14
Homework	1	14	14
Final examination	1	14	14
Total Work Load			126
Total Work Load / 25 (h)			5.04
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
SUMMER PRACTICE	BME400	7	0+2+0	0	1

Prerequisites	AFE 132

Language of Instruction	Turkish. report to be written in English.
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory summer practice
Course Coordinator	
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	
Goals	The aim of summer practice is to let students observe and experience the engineering world outside the university, get a glimpse of the practical aspects of engineering, observe how the knowledge at school and the engineering practice outside are related and decide what they would like to do after they graduate and, perhaps, decide about their elective courses according to that.
Content	Compulsory summer internship for a minimum of 20 business days. Internships cannot coincide with academic semesters. Students are required to undertake an internship prior to or in the middle of their fourth year of education, if time permits, and to register to this course in the semester following the completion of their internship. Their written report is evaluated and graded within this course.

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Ability to convey in writing what they observed, did and experienced during their summer practice.	8, 9	From previous courses	D
2) A practical experience with a chance to observe what mechanical engineering involves in a practical environment, how such environments are organized and run.	7, 11, 12	8	D

Teaching Methods:	8: Summer practice.
Assessment Methods:	D: Report.

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Report writing	
2	Report writing	
3	Report writing	
4	.	
	.	
	.	
	.	
14	Report writing	

RECOMMENDED SOURCES	
Textbook	
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Report	1	100
Total		**100**
CONTRIBUTION OF FINAL EXAM TO OVERALL GRADE		---
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		100
Total		**100**

COURSE CATEGORY	Summer Practice

	COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution						
		NA	1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline.	**X**						
2	Ability to use theoretical and applied information in these areas to model and solve engineering problems.	**X**						
3	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.	**X**						
4	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	**X**						
5	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.	**X**						
6	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.	**X**						
7	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams.			**X**				
8	Ability to work individually.				**X**			
9	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.			**X**				
10	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.	**X**						
11	Awareness of professional and ethical responsibility.			**X**				
12	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.			**X**				
13	Knowledge about contemporary issues and the global and societal effects of engineering practices on health, environment, and safety; awareness of the legal consequences of engineering solutions.	**X**						
14	Ability to work professionally in both thermal and mechanical systems areas, including design and realization.	**X**						
15	Ability to verify and validate numerical solutions to engineering problems.	**X**						

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (14 weeks)	14	2	28
Total Work Load			28
Total Work Load / 25 (h)			1.1
ECTS Credit of the Course			1

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
MAGNETIC RESONANCE SPECTROSCOPIC IMAGING	BME 412	7	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restrictive Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. Alper YAMAN
Assistants	-
Goals	The aim of this course is to introduce students the magnetic resonance spectroscopic imaging technique that is widely used in the clinical settings for the diagnosis and follow-up of several diseases.
Content	Basic theory, underlying biochemistry and physiology, basic and advanced techniques for acquiring and processing MR spectroscopic data and biomedical applications. 1H, 13C and 31P NMR spectroscopy, nuclear spin states, nuclear magnetic moment, resonance, chemical environment and chemical shift, shielding, spin-spin splitting, spin-spin coupling, coupling constants, A2 AB AX spin systems, typical 31P, 13C and 1H spectra of chemical compounds, T1 and T2 relaxation, MR spectroscopic imaging, clinical MRS pulse sequences, MR spectroscopic data reconstruction, underlying biochemistry and cellular physiology, clinical MR spectroscopic applications.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
54) MR spectroscopic imaging principles	1,2,4	1,2,3	A,C
55) MR spectroscopic imaging data acquisition	1,2,4	1,2,3	A,C
56) MR spectroscopic imaging data processing and quantification	1,2,4	1,2,3	A,C
57) Solving homework questions	1,2,4,6	1,2,3	C
58) Ethical responsibilities of biomedical engineers in healthcare	9	1,2,3	A
59) Importance of MR spectroscopic imaging in healthcare	9	1,2,3	A,C

60) Project selection and presentation	4,6,7,8,9	1,2,3	A, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Presentation

COURSE CONTENT

Week	Topics	Study Materials
1	Instrumentation	Textbook & Power point slides
2	Nuclear spin states, nuclear magnetic moment, magnetization, resonance absorption	Textbook & Power point slides
3	1H NMR Spectroscopy	Textbook & Power point slides
4	Spin-spin splitting, spin-spin coupling, coupling constants, A2 AB AX spin systems	Textbook & Power point slides
5	Chemical compounds and 1H spectra	Textbook & Power point slides
	Chemical compounds and 1H spectra (II)	Textbook & Power point slides
6	T1 and T2 relaxation	Textbook & Power point slides
7	1H MR spectroscopic imaging	Textbook & Power point slides
8	Multi-nuclear MR spectroscopy: 13C and 31P NMR Spectroscopy	Textbook & Power point slides
9	MIDTERM	Textbook & Power point slides
10	MR spectroscopic data acquisition and clinical MRS pulse sequences (PRESS, STEAM, ISIS)	Textbook & Power point slides
11	MR spectroscopic data reconstruction and quantification	Textbook & Power point slides
12	Clinical MR spectroscopic applications (pediatric, brain, prostate, muscle, cardiac, soft tissue applications)	Textbook & Power point slides
13	Project Presentations	
14	Project Presentations	

RECOMMENDED SOURCES

Textbook	Clinical MR Spectroscopy: First Principles Nouha Salibi and Mark A. Brown, 1st Ed, 1997
Additional Resources	Introduction to Spectroscopy, Pavia, Lampman and Kriz, 3rd Ed, 2001

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	40
Attendance	-	15
Project	1	15
Assignment	4	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.				X	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	X				
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			X		
5	Ability to design and conduct experiments, gather data, analyze and interpret results forinvestigating engineering problems.	X				
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.			X		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					X

8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X	
9	Awareness of professional and ethical responsibility.			X		
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.	X				

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Mid-terms	1	15	15
Homework	4	4	16
Final examination	1	15	15
Project	1	15	15
Total Work Load			131
Total Work Load / 25 (h)			5.24
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
ORTHOPEDIC CEMENT FOR HARD TISSUE REPAIR	BME 414	7	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restrictive Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. F. Şermşn UTKU
Assistants	-
Goals	The aim of this course is to provide student with knowledge of cements for hard tissue repair.
Content	Description of hard tissues, brief review of hard tissue-cell interactions, description of the mineralogical structure of bones and teeth, bone defect filling applications, inorganic cements for hard tissue repair, organic cements for bone repair and fixation, chemistry of injectable cements, ISO standards relevant to orthopedic cement manufacture, sterilization of cements, cytotoxicity of cements.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
61) Ability to distinguish natural and artificial biological materials.	1,2,4,8,9	1,2,3	A,C
62) Adequate knowledge of hard tissues	1,2,4,8,9	1,2,3	A,C
63) Adequate knowledge in material science as applied to medicine.	1,2,4,8,9	1,2,3	A,C
64) Adequate knowledge in cement material advancements	1,2,4,8,9	1,2,3	A,C
65) Ability to present a current advancement in the field of cements materials	1,2,4,6,7,8	1,2,3	C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Review of Biomaterials and Mechanics of Materials	Textbook
2	Review of Hard Tissues and Hard-tissue - Cell Interactions	Textbook
3	Tissue Reaction to Biomaterials and Ceramic Biomaterials	Textbook
4	Introduction to Solid Materials and Crystals,	Textbook
5	X-Ray Crystallography	Textbook
6	the Mineralogy of Bones and Teeth	Textbook
7	MIDTERM	
8	Osteogenic, Osteoconductive and Osteoinductive Materials	Textbook
9	Inorganic Cements	Textbook
10	Organic Cements	Textbook
11	Injectable Cements	Textbook
12	Sterilization and Cytotoxicity of Ceramic Materials	Textbook
13	ISO Standards for Ceramic Material Manufacture Student Presentations	Textbook
14	Student Presentations	

RECOMMENDED SOURCES	
Textbook	Biomaterials, Wong, Bronzino, eds. E-book Materials Science and Bioceramics, 11th International Symposium on Ceramics in Medicine
Additional Resources	Laboratory experiments in X-Ray Crystallography by Azaroff and Donahue Selected Research Papers

MATERIAL SHARING	
Documents	Powerpoint Presentations
Assignments	Sample Problems
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**

Mid-terms	1	60
Assignment	1	40
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.			X		
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.				X	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					X
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					X
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					X
9	Awareness of professional and ethical responsibility.					X
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload

			(Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	1	14	14
Homework	1	12	12
Final examination	1	14	14
Total Work Load			122
Total Work Load / 25 (h)			4.88
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
MEDICAL IMAGING	BME 421	7	2+0+2	3	9

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Andaç HAMAMCI
Assistants	-
Goals	This course will provide insight into the medical imaging modalities that are routinely used to diagnose several diseases including cancer using advanced data acquisition, reconstruction and visualization methods.
Content	The main contents of the course will be the data acquisition principles and reconstruction methods of X-ray radiography, mammography, fluoroscopy, computed tomography (CT), ultrasound, magnetic resonance imaging (MRI), nuclear planar imaging, single photon emission computed tomography (SPECT) and positron emission tomography (PET). The parameters that would control the image quality, spatial resolution, contrast resolution, and radiation dose (in relevant modalities) will be discussed for all of these medical imaging modalities.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
66) Medical imaging modalities (data acquisition, reconstruction, image quality, spatial resolution, contrast resolution, noise characteristics)	1,2,4	1,2,3	A,C
67) Solving homework questions	1,2,4,5,6	1,2,3	C
68) MATLAB programming for medical imaging applications at the laboratory	1,2,4,5,6	1,2,3,9	C
69) Ethical responsibilities of biomedical engineers in healthcare	9	1,2,3	A
70) Importance of medical imaging in healthcare and clinical applications	9	1,2,3	A,C

71) Project selection and presentation	4,6,7,8	1,2,3	A, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction to Medical Imaging	Textbook & Power point slides
2	Radiation and the Atom	Textbook & Power point slides
3	Interaction of Radiation with Matter	Textbook & Power point slides
4	X-Ray Imaging	Textbook & Power point slides
5	Mammography	Textbook & Power point slides
6	Fluoroscopy	Textbook & Power point slides
7	Computed Tomography (CT)	Textbook & Power point slides
8	Ultrasound	Textbook & Power point slides
9	Radioactivity, Radionuclide Production and Radiopharmaceuticals	Textbook & Power point slides
10	Radiation Detection and Measurement	Textbook & Power point slides
11	Nuclear Imaging – The Scintillation Camera, Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET)	Textbook & Power point slides
12	Magnetic Resonance Imaging	Textbook & Power point slides
13	Project Presentations	-
14	Project Presentations	-

RECOMMENDED SOURCES

Textbook	The Essential Physics of Medical Imaging, Bushberg, Seibert, Leidholdt and Boone, 2nd Ed, 2002
Additional Resources	-

MATERIAL SHARING

Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	40
Laboratory Attendance	-	5
Classroom Attendance	-	10
Project	1	15
Assignment	8	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X	
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.				X		
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	X					
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			X			
5	Ability to design and conduct experiments, gather data, analyze and interpret results forinvestigating engineering problems.			X			
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams;			X			

	ability to work individually.					
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					X
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X	
9	Awareness of professional and ethical responsibility.			X		
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.	X				

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	2	28
Hours for off-the-classroom study (Pre-study, practice)	14	5	70
Mid-terms	1	15	15
Homework	8	8	64
Laboratory	10	1	10
Final examination	1	15	15
Project	1	15	15
Total Work Load			217
Total Work Load / 25 (h)			8.68
ECTS Credit of the Course			9

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
BIOMETRY FOR ANALYTICAL REASONING AND MODELING	BME 423	8	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restrictive Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	-
Goals	Biostatistics is an important component of writing a complete research article and delivering the significance of results to an audience. This course will provide insight into the various statistical tests and discuss the most appropriate test choices for a set of problems including the multiple comparisons, correlations and the survival analysis. The main question we will seek an answer for in this course will be, '*How are the biostatistical methods utilized in biosciences to define the impact of new methodologies and what is the most appropriate statistical test to prove this significance?'*
Content	Numerical data sampling in biomedical applications, measures of central tendency and dispersion in biomedical data, interval, nominal and ordinal quantification and estimation, Gaussian models in biomedical engineering, hypothesis testing, unpaired and paired t-test, analysis of variance, repeated measures analysis of variance, linear regression models, product-moment correlation analysis, Bland-Altman test, Spearman rank correlation models, Chi-square analysis of contingency tables, McNemar's analysis, Cochrane Q, Mann-Whitney rank sum test, Kruskal Wallis statistic, Wilcoxon signed rank test, Friedman statistical analysis for small biomedical data, Survival analysis, Log-rank test, and Gehan's modeling of survival data.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
72) Learning about different biostatistical analysis methods	1,2,4	1,2,3	A,C
73) Solving homework questions	1,2,4,5,6	1,2,3	C
74) Ethical responsibilities of	9	1,2,3	A

biomedical engineers in healthcare			
75) Importance of biostatistics in healthcare	9	1,2,3	A,C
76) Project selection and presentation	4,5,6,7,8	1,2,3	A, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework D: Presentation

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction, Sampling, Experimentation, Measurement	Textbook & Power point slides
2	Descriptive Statistics	Textbook & Power point slides
3	Analysis of Variance	Textbook & Power point slides
4	t-test	Textbook & Power point slides
5	Multiple Comparisons	Textbook & Power point slides
6	Rates and Proportions	Textbook & Power point slides
7	Power and Sample Size	Textbook & Power point slides
8	Regression and Correlation	Textbook & Power point slides
9	Repeated Measures(paired t-test)	Textbook & Power point slides
10	Repeated measures (Repeated measures ANOVA)	Textbook & Power point slides
11	Nonparametric Methods	Textbook & Power point slides
12	Survival Analysis	Textbook & Power point slides
13	Project Presentations	-
14	Project Presentations	-

RECOMMENDED SOURCES	
Textbook	Primer of Biostatistics (6th ed.) By Stanton A. Glantz (McGraw-Hill)-2005

Additional Resources	-

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	40
Attendance	-	15
Project	1	15
Assignment	10	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.				X	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	X				
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			X		

5	Ability to design and conduct experiments, gather data, analyze and interpret results forinvestigating engineering problems.				X	
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.			X		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					X
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X	
9	Awareness of professional and ethical responsibility.			X		
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.	X				

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	1	14
Mid-terms	1	15	15
Homework	10	3.5	35
Final examination	1	15	15
Project	1	15	15
Total Work Load			136
Total Work Load / 25 (h)			5.44
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
MICROPROCESSOR AND MICROCONTROLLER IN BME	BME 441	7	3+0+2	4	8

Prerequisites	BME302 BIOMEDICAL ELECTRONICS II

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	-
Goals	The aim of this course is to introduce students the microprocessors and the microcontrollers; microcontroller programming in biomedical instruments.
Content	Memories. Input-Output elements. Interrupts and Priorities. Arithmetic Logic Unit. Registers. Timing considerations. Synchronous and multitasking applications. Microprocessor, microcontroller and system design and programming in biomedical instruments.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
77) Adequate knowledge in the components and architectures of microprocessors and microcontrollers.	1,2,3	1,2,3	A,B,C
78) Adequate knowledge in the concept of programming, programming languages and steps in program development.	1,2,3,4	1,2,3	A,B,C
79) Ability to devise, design and use hardware and software of biomedical instruments.	5,6,8	1,2,3,9	A,B,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Microprocessors and Microcontrollers: Components and architectures.	Textbook
2	Fundamentals of microcontroller programming.	Textbook
3	Program development steps and flowcharts.	Textbook
4	PIC as a microcontroller.	Textbook
5	PIC Pin Layout and Circuit Connections.	Textbook
6	MIDTERM I	
7	PicBasic as a programming language: Variables, data types, operations,statements and expressions.	Textbook
8	Configuring and controlling I/O Ports.	Textbook
9	Conditionals and Loops. Timings.	Textbook
10	MIDTERM II	
11	Using Liquid Crystal Displays.	Textbook
12	Reading and Writing memory.	Textbook
13	Analogue-Digital Conversion. Interrupts.	Textbook
14	Applications in Biomedical Engineering.	

RECOMMENDED SOURCES	
Textbook	Harpit SANDHU. 2009. Making PIC Microcontroller Instruments and Controllers. McGraw-Hill.
Additional Resources	Chuck HELLEBUYCK. 2003. Programming PIC Microcontrollers with PicBasic. Elsevier Science.

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	67

Assignment	1	33
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					**X**
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				**X**	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			**X**		
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					**X**
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.			**X**		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					**X**
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)

Course Duration (Including the exam week: 14x Total course hours)	14	4	56
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Mid-terms	2	14	28
Homework	3	14	42
Final examination	1	14	14
Total Work Load			196
Total Work Load / 25 (h)			7.84
ECTS Credit of the Course			8

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
ARTIFICIAL INTELLIGENCE IN MEDICINE	BME 442	8	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restricted Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. Gökhan ERTAŞ
Assistants	-
Goals	The aim of this course is to gain students the fundamentals of artificial intelligence and its implementation in the field of medicine.
Content	Introduction to artificial intelligence (AI). AI-based clinical decision making. AI in medical diagnosis, therapy selection and monitoring. Reasoning with clinical knowledge. Machine learning systems. Clinical Decision Support Systems. Medical Applications of AI.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
80) Adequate knowledge in artificial intelligence and artificial intelligence based clinical decision making.	1,2,3,4,5	1,2,3	A,C
81) Adequate knowledge in machine learning systems and clinical decision support systems.	2,3,4,5,6,8	1,2,3	A,C
82) Ability to use theoretical and applied information to understand the applications of artificial in medicine.	4,6,7,8,9	1,2,3	A, E

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project, E: Presentation

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction to artificial intelligence (AI)	Textbook
2	Introduction to artificial intelligence (AI)	Textbook
3	AI-based clinical decision making	Textbook
4	AI-based clinical decision making	Textbook
5	MIDTERM I	
6	AI in medical diagnosis, therapy selection and monitoring	Textbook
7	AI in medical diagnosis, therapy selection and monitoring	Textbook
8	Reasoning with clinical knowledge	Textbook
9	MIDTERM II	
10	Machine learning systems	Textbook
11	Clinical Decision Support Systems	Textbook
12	Medical Applications of AI	Textbook
13	Medical Applications of AI	Textbook
14	Student Presentations	

RECOMMENDED SOURCES	
Textbook	Donna L. Hudson, Maurice E. Cohen. NEURAL NETWORKS AND ARTIFICIAL INTELLIGENCE FOR BIOMEDICAL ENGINEERING. Wiley-IEEE Press. 1999.
Additional Resources	-

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	62
Assignment	1	23

Presentation	1	15
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.			**X**		
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.		**X**			
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.		**X**			
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					**X**
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.		**X**			
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				**X**	
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.		**X**			
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				**X**	
9	Awareness of professional and ethical responsibility.			**X**		
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)

Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	2	14	28
Homework	1	2	2
Presentation	1	7	7
Final examination	1	14	14
Total Work Load			135
Total Work Load / 25 (h)			5.40
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
MAGNETIC RESONANCE IMAGING	BME 444	8	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restrictive Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. Alper YAMAN
Assistants	-
Goals	Magnetic resonance imaging (MRI) provides non-invasive information about the body's anatomy, structure, and even metabolism through its detection of signals coming from water, lipid, macromolecules, and micromolecules. It has been widely used in the clinical settings for cancer localization and characterization in various parts of the body, as well as detection of structural anomalies. The main question we will seek an answer for in this course will be, '*How is the MR imaging technology utilized in the clinical environments for the visualization of the human anatomy, the localization and assessment of several diseases, and even the understanding of the cancer dynamics?'*
Content	This course will provide insight into what the magnetic resonance (MR) phenomenon is, as well as how the magnetic resonance images are created through the in depth understanding of MR hardware system parts, MR signal formation, localization, image reconstruction, 2D and 3D MR imaging, fast MRI, and MR clinical application to the understanding of several disease characteristics.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
83) MR imaging principles, MR physics	1,2,4	1,2,3	A,C
84) MR imaging data acquisition (MR magnet, gradients, RF coils) and reconstruction	1,2,4	1,2,3	A,C
85) Relaxation and image contrast	1,2,4	1,2,3	A,C
86) 2D imaging, 3D imaging, Fast imaging	1,2,4	1,2,3	A,C

87) Solving MR signal equations for different data acquisition schemes (Spin echo, gradient echo, inversion recovery, saturation recovery, excitation recovery)	1,2,4	1,2,3	A,C
88) Solving homework questions	1,2,4,6	1,2,3	C
89) Ethical responsibilities of biomedical engineers in healthcare	9	1,2,3	A
90) Importance of MR imaging in healthcare and clinical applications	9	1,2,3	A,C
91) Project selection and presentation	4,6,7,8,9	1,2,3	A, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework D: Presentation

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction	Textbook (p. 1-15, 205-209)
2	Mathematical Preliminaries	Textbook (p.15-33)
3	MR Hardware	Textbook (p.43-55)
4	MR Physics	Textbook (p.55-66), PowerPoint slides
5	MR Signal	Textbook (p. 67-82)
6	2D Imaging	Textbook (p. 82-103)
7	Signal Excitation, Off Resonance	Textbook (p. 107-127, 133-145)
8	T1 and T2 Relaxation	Textbook (p. 145-150), PowerPoint slides
9	Image Contrast	Textbook (p. 150-158), PowerPoint slides
10	Noise	Textbook (p. 158-169)
11	3D Imaging	Textbook (p. 177-187)
12	Fast Imaging	Textbook (p. 187-195)
13	MR Clinical Applications	PowerPoint slides
14	Project Presentations	

RECOMMENDED SOURCES	
Textbook	'Principles of Magnetic Resonance Imaging' by Dwight G. Nishimura. Stanford University.
Additional Resources	http://www.cis.rit.edu/htbooks/nmr/bnmr.htm http://www.cis.rit.edu/htbooks/mri/ Magnetic Resonance Imaging: Physical Principles and Sequence Design by E. Mark Haacke et al. Good MRI reference in general. Principles of Magnetic Resonance Imaging: A Signal Processing Perspective by Zhi-Pei Liang, Paul C. Lauterbur A very good book on MRI basics and signal processing.

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	40
Attendance	-	15
Project	1	15
Assignment	4	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM						
No	Program Learning Outcomes	Contribution				
		1	2	3	4	5

1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.				X	
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	X				
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.			X		
5	Ability to design and conduct experiments, gather data, analyze and interpret results forinvestigating engineering problems.	X				
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.			X		
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					X
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X	
9	Awareness of professional and ethical responsibility.			X		
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.	X				

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Mid-terms	1	15	15
Homework	4	4	16
Final examination	1	15	15
Project	1	15	15
Total Work Load			131
Total Work Load / 25 (h)			5.24
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
MEDICAL ROBOTICS	BME 462	8	3+0+0	3	5

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Restricted Elective
Course Coordinator	-
Instructors	Assist.Prof.Dr. Alper YAMAN
Assistants	-
Goals	The aim of this course is to gain students the fundamentals of robotics hardware, robot kinematics and the implementation of robotics in the field of medicine.
Content	Design of robotics hardware, sensor and actuator. Robot kinematics and dynamics. Trajectory planning. Haptics and telemanipulation. Human-robot interaction. Robot assisted rehabilitation therapy. Micro-scale surgical robotics. Robot assisted image guided medical intervention. Current topics in medical robotics.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
92) Adequate knowledge in robotics hardware, robot kinematics and dynamics.	1,2,3,4	1,2,3	A
93) Adequate knowledge in human-robot interaction	1,2,3,4	1,2,3	A
94) Ability to use theoretical and applied information to understand the working principles of robots in medicine.	1,2,5	1,2,3	A
95) Familiarity with the current topics in medical robotics.	4,6,7,8,9,10	1,2,3	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Current topics in medical robotics.	Textbook
2	Design of robotics hardware, sensor and actuator.	Textbook
3	Robot kinematics	Textbook
4	Robot Jacobian, velocity, force analysis	Textbook
5	Robot dynamics	Textbook
6	Computer aided robotic simulation	Textbook
7	MIDTERM I	
8	Trajectory planning.	Textbook
9	Haptics and telemanipulation.	Textbook
10	Human-robot interaction.	Textbook
11	Robot assisted rehabilitation therapy.	Textbook
12	Micro-scale surgical robotics.	Textbook
13	Robot assisted image guided medical intervention.	Textbook
14	MIDTERM II	

RECOMMENDED SOURCES	
Textbook	INTRODUCTION TO ROBOTICS: MECHANICS AND CONTROL, 3rd Edition, by John J. Craig, Prentice-Hall (Pearson), 2005, ISBN: 0-13-123629-6.
Additional Resources	MEDICAL ROBOTICS, Vanja Bozovic, InTech 2008.

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	67

Assignment	1	33
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					X
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				X	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.				X	
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.			X		
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				X	
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.				X	
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.				X	
9	Awareness of professional and ethical responsibility.					X
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.				X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course	14	3	42

hours)			
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Mid-terms	2	14	28
Homework	1	7	7
Final examination	1	14	14
Total Work Load			133
Total Work Load / 25 (h)			5.32
ECTS Credit of the Course			5

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*T+P+L Hour*	*Credits*	*ECTS*
ENGINEERING PROJECT	BME 492	8	1+0+4	3	8

Prerequisites	-

Language of Instruction	English
Course Level	Bachelor's Degree (First Cycle Programmes)
Course Type	Compulsory
Course Coordinator	-
Instructors	Prof.Dr. Ali Ümit KESKİN
Assistants	-
Goals	The aim of this course is to gain students the conceptual thinking, problem solving ability and reporting in the field of biomedical engineering.
Content	Detailed analysis, design and realization of a biomedicalengineering problem, presentation of the results in the form of project report, seminar and demonstration.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
96) Adequate knowledge in analysis, design and realization of any biomedical engineering problem.	1,2,3,4,5,6	1,2,3,9	A, D
97) Ability to perform individual projects in biomedical engineering	1,2,3,4,5,6,10	1,2,3,9	A, D
98) Adequate knowledge in writing an engineering report.	7,8,9	1,2,3	A, D
99) Adequate knowledge in presentation techniques. Ability to prepare a presentation.	8,9	1,2,3	A, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT

Week	Topics	Study Materials
1	Identification of Biomedical Engineering problem.	Online documents
2	Identification of Biomedical Engineering problem.	Online documents
3	Understanding the problem and detailed analysis	Online documents
4	Understanding the problem and detailed analysis	Online documents
5	Thinking the solution. Design of a hardware/software	Online documents
6	Design of a hardware/software	Online documents
7	Implementation of the hardware/software	Online documents
8	Implementation of the hardware/software	Online documents
9	Implementation of the hardware/software	Online documents
10	Testing and verification	Online documents
11	Testing and verification. Report Writing	Online documents
12	Report Writing	Online documents
13	Report Writing. Composing the presentation	Online documents
14	Presentation and demonstration	

RECOMMENDED SOURCES	
Textbook	-
Additional Resources	-

MATERIAL SHARING	
Documents	"BME492 Report Template" and "BME492 Report Style" documents on BME server: bme.yeditepe.edu.tr
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	0	0
Assignment	0	0
Total		**100**

CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		100
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		0
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					**X**
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.					**X**
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.				**X**	
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					**X**
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.					**X**
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.				**X**	
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					**X**
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					**X**
9	Awareness of professional and ethical responsibility.					**X**
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 16x Total course hours)	14	5	60
Hours for off-the-classroom study (Pre-study, practice)	14	8	112

Report Writing	1	20	20
Final examination (Presentations and Demonstration)	1	10	10
Total Work Load			202
Total Work Load / 25 (h)			8.08
ECTS Credit of the Course			8