BME504 –MATHEMATICAL AND COMPUTATIONAL METHODS IN BIOMECHANICS OF HUMAN SKELETAL SYSTEMS	**BIOMEDICAL ENGINEEERING**

Semester	**Credit Structure**				
	Lecture	***Practice***	***Laboratory***	***National Credits***	***ECTS***
1	4	-	-	3	10

Level of Course	**MSc. program**	**Language**	English
Type of Course	ELECTIVE	**Mode of Delivery**	Face to Face
Prerequisites	**BACKGROUND lN ENGINEERING AND MATHEMATICS**		

Catalog Description	Biomechanics of the human skeleton and the problem of alloarthroplasty, introduction to the anatomy of the skeletal system, total replacement of human joints, mathematical models of biomechanics, background of biomechanics, mathematical models of particular parts of the human skeleton and joints and their replacements based on boundary value problem analyses, mathematical analyses and numerical solutions of fundamental biomechanical problems, biomechanical analyses of particular parts of the human skeleton, joints, and their replacements, biomechanical models based on contact problems and biomechanical analyses of some human joints, their total replacements, and some other parts of the human skeleton.
Course Objectives	**1.** Introducing the concept of biomechanics of the human skeleton. **2.** Introducing the concept of anatomy of the skeletal system. **3.** Introducing the concept of the total replacement of human joints. **4.** Introducing the concept of the mathematical models of biomechanics, **5.** Introducing the concept of the mathematical models of particular parts of the human skeleton and joints and their replacements based on boundary value problem analyses. **6.** Introducing the concept of the mathematical analyses and numerical solutions of fundamental biomechanical problems. **7.** Introducing the concept of the biomechanical analyses of particular parts of the human skeleton, joints, and their replacements, biomechanical models based on contact problems and biomechanical analyses of some human joints, their total replacements, and some other parts of the human skeleton.
Course Outcomes	**1.** Understanding the concept of the biomechanics of the human skeleton. **2.** Understanding the anatomy of the skeletal system. **3.** Understanding the concept of the total replacement of human joints. **4.** Building mathematical models of biomechanics. **5.** Building the mathematical models of particular parts of the human skeleton and joints and their replacements based on boundary value problem analyses. **6.** Understanding the mathematical analyses and numerical solutions of fundamental biomechanical problems. **7.** Understanding the concept of the biomechanical analyses of particular parts of the human skeleton, joints, and their replacements, biomechanical models based on contact problems and biomechanical analyses of some human joints, their total replacements, and some other parts of the human skeleton.

Course Category by Content (%)		
	Mathematics and Basic Sciences	0
	Engineering	100
	Engineering Design	0
	General Education	0

Textbook and /or References	1. Jirí Nedoma, Jirí Stehlík, Ivan Hlavácek, Josef Danek, Tatjana Dostálová, and Petra Pre ˇ Cková, ".Mathematical And Computational Methods In Biomechanics Of Human Skeletal Systems", John Wiley & Sons, Inc 2. Y.C. Fung, "Biomechanics. Mechanical Properties of Living Tissues", Springer-Verlag, 1993, New York, 2nd edition. 3. Duane Knudson, "Fundamentals of Biomechanics", 2nd edition, Springer, 2007. 4. Ozkaya and Nordin, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation". 5. G.A. Holzapfel, R.W. Ogden (eds.): "Mechanics of Biological Tissue", Springer-Verlag, 2006, Heidelberg. 6. J.D. Humphrey, S.L. Delange, "An Introduction to Biomechanics, Solids and Fluids, Analysis and Design", Springer-Verlag, 2004, New York.

Assessment Criteria		**Quantity**	**Percentage**
	Attendance		10
	Quiz		
	Homework	1	15

	Project		1	15
	Term Paper			
	Laboratory Work			
	Other			
	Midterm Exams		1	20
	Final Exam		1	40

Student Workload	***Activities***	***Quantity***	***Duration (hour)***	***Total Workload***
	Course duration in class (including Exam weeks)	15	4	60
	Labs and Tutorials			
	Homework	4	2	8
	Project/Presentation/Report	1	102	102
	E-learning activities			
	Quizzes			
	Midterm Examination Study	1	6	6
	Final Examination Study	1	12	12
	Self Study	16	7	112
	Total Workload (hours)			300
	Total Workload / 30 (hours)			10
	ECTS Credit of the Course			10

Course Plan

Week	***Topics***
1	Biomechanics of the human skeleton and the problem of alloarthroplasty.
2	Introduction to the anatomy of the skeletal system.
3	Total replacement of human joints.
4	Background of biomechanics.
5	Mathematical models of particular parts of the human skeleton and joints and their replacements based on boundary value problem analyses.
6	Mathematical models of particular parts of the human skeleton and joints and their replacements based on boundary value problem analyses.
7	Mathematical analyses and numerical solutions of fundamental biomechanical problems.
8	Mid Term
9	Mathematical analyses and numerical solutions of fundamental biomechanical problems.
10	Biomechanical analyses of particular parts of the human skeleton, joints, and their replacements.
11	Biomechanical analyses of particular parts of the human skeleton, joints, and their replacements.
12	Biomechanical models based on contact problems and biomechanical analyses of some human joints, their total replacements, and some other parts of the human skeleton.
13	Biomechanical models based on contact problems and biomechanical analyses of some human joints, their total replacements, and some other parts of the human skeleton.
14	Biomechanical models based on contact problems and biomechanical analyses of some human joints, their total replacements, and some other parts of the human skeleton.
15	Final Exam

Relationship between the Course and Program Learning Outcomes

Program Outcomes		**C**
i.	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied knowledge in these areas in complex engineering problems.	4
ii.	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.	4
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.	4
iv.	Ability to devise, select, and use modern techniques and tools needed for analyzing and solving complex problems encountered in engineering practice; ability to employ information technologies effectively.	4
v.	Ability to design and conduct experiments, gather data, analyze and interpret results forinvestigating complex engineering problems or discipline specific research questions.	4
vi.	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability towork individually.	4
vii.	Ability to communicate effectively in Turkish, both orally and in writing; knowledge of a minimum of one foreign language; ability to write effective reports and comprehend written reports, prepare design and production reports, make effective presentations, and give and receive clear and intelligible instructions.	4
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.	5

ix.	Consciousness to behave according to ethical principles and professional and ethical responsibility; knowledge on standards used in engineering practice.	4
x.	Knowledge about business life practices such as project management, risk management,and change management; awareness in entrepreneurship, innovation; knowledge aboutsustainable development.	4
xi.	Knowledge about the global and social effects of engineering practices on health,environment, and safety, and contemporary issues of the century reflected into the fieldof engineering; awareness of the legal consequences of engineering solutions.	4
C (Contribution of the course): 1: None 2: Weak, 3: Medium, 4: Strong, 5: Very Strong		

Prepared by: Assoc. Prof. Dr. Fa'eq Radwan **Date** : 03.07.2016