DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY
COURSE SYLLABUS

Course Details					
Code			**Academic Year**		**Semester**
MWT310			3		Summer
Title	**T**	**A**	**L**	**ECTS**	
Biomaterials	3	-	2	6	

Language	German					
Level	**Undergraduate**	**X**	**Graduate**		**Postgraduate**	
Department / Program	Materials Science and Technology					
Forms of Teaching and Learning	Face to face					
Course Type	**Compulsory**		**Elective**	X		
Objectives	The aim of the lecture is to introduce students to the field of biomaterials, and to attain a fundamental knowledge about the - Main chemical and biological concepts, - Bulk and surface properties of materials - Biocompatibility - Biological/biochemical fundamentals of the interaction of cells or tissues with materials - Selected materials in implantology as well as special surface modifications - Biomimetic-inspired materials and materials for tissue engineering					
Content	- Introduction to biomaterial science and engineering - The Nature of Materials - Cells and Biomolecules - Metals - Polymers - Ceramics - Composites - Materials Processing - Testing Biomaterials - Degradation of Biomaterials - Applications of biomaterials in tissue engineering and drug delivery - Medical Device Considerations					
Prerequisites	None					
Coordinator	None					
Lecturer(s)	Asst. Prof. Dr. Duygu Ekinci					
Assistant(s)	M.Sc. Eyüp Metin					
Work Placement	None					

Recommended or Required Reading	
Books / Lecture Notes	- Epple, Matthias. **Biomaterialien und Biomineralisation: Eine Einführung für Naturwissenschaftler, Mediziner und Ingenieure.** Springer-Verlag, 2003. - Ratner B.D., Hoffman A.S., Schoen F.J., Lemons J.E. **Biomaterials Science: An Introduction to Materials in Medicine**. Elsevier Academic Press, 2020. - Dahman Y. **Biomaterials Science and Technology: Fundamentals and Developments.** CRC Press, 2019.

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	- Chen Q., Thouas G. **Biomaterials – A Basic Introduction**. CRC Press, 2015.
Other Sources	-

Additional Course Material	
Documents	Google-Classroom page of the Course
Assignments	Google-Classroom page of the Course
Exams	

Course Composition		
Mathematics und Basic Sciences		%
Engineering		%
Engineering Design	30	%
Social Sciences		%
Educational Sciences		%
Natural Sciences	30	%
Health Sciences	20	%
Expert Knowledge	20	%

Assessment

Activity	Count	Percentage (%)
Midterm Exam	1	20
Quiz		
Assignments	2	20
Attendance		
Recitations	2	20
Projects		
Final Exam	1	40
	Total	**100**

ECTS Points and Work Load

Activity	Count	Duration	Work Load (Hours)
Lectures	15	3	45
Self-Study	15	4	60
Assignments	2	10	20
Presentation / Seminar Preparation	0	0	0
Midterm Exam	1	2	2
Recitations	2	10	20
Laboratory	15	2	30
Projects	0	0	0

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Final Exam	1	2	2
		Total Work Load	**179**
		ECTS Points (Total Work Load / Hours)	**6**

Learning Outcomes	
1	Understand common use biomaterials as metals, ceramics and polymers and its chemical structure, properties and morphology.
2	Describe general structure and function of cells, extracellular matrix and tissue.
3	Understand and account for methods for categorization of biomaterials.
4	Explain methods to modify surfaces of biomaterials and choose material for desired biological response.
5	Describe interactions between biomaterials, proteins and cells.
6	Understand the interaction between biomaterial and tissue for short term and long term implantations, distinguish between reactions in blood and in tissue.
7	Apply and account for methods to characterize interactions between materials and tissue.

Weekly Content	
1	Introduction to biomaterial science and engineering: Definitions and Historical perspective. The Nature of Materials: Bulk Properties of Materials, Surface Properties of Materials, Mechanical Properties of Materials, An introduction to Four Categories of Materials. Cells and Biomolecules: Cell biochemistry and Biosynthesis, Cell metabolism, Cell structure, Transport through cell membrane, Cell proliferation, Cell Differentiation and Stem Cells
2	Metals – I: Development of Metallic Biomaterials, Stainless steel, Cobalt-Based Alloys, Titanium Alloys
3	Metals – II: Metallic biomaterials – Applications: Dental metarials, NiTi Shape Memory Alloys, Magnesium Alloys, Toxicity and Corrosion
4	Polymers – I: Basics concepts, Structure of polymers, Synthesis of polymers, Chemical Design principles of Medical Polymers
5	Polymers – II: Bioinert polymers: Polyolefins, Silicones, Fluorinated polymers, Polyurethanes, Biodegradable polymers, Polyesters, polyethers, polyamides, biological polymers
6	Ceramics: Classification of bioceramics, Inert Bioceramics, Bioactive and bioresorbable ceramics, Calcium phosphates and Hydroxyapatite, Bioactive glasses, Bioactive glass-ceramics, Bone bonding mechanisms
7	Composites: Definition and classification of composites, General Structure-Property Relationship, Natural composites, Dental composites.
8	Materials Processing: Surface modification of biomaterials, nonfouling surfaces, nonthrombogenic treatments and strategies, surface immobilized biomolecules, surface patterning, textured and porous biomaterials.
9	Testing Biomaterials: In vitro assessment of cell and tissue compatibility, in vivo assessment of tissue compatibility, evaluation of blood-materials interactions.
10	Degradation of Biomaterials and the biological environment, calcification of biomaterials.
11	Applications of biomaterials in tissue engineering and drug delivery - I: Cardiovscular medical devices, extracorporeal artificial organs and therapeutic devices, orthopedic applications, dental applications, ophthalmologic applications,
12	Applications of biomaterials in tissue engineering and drug delivery – II: bioelectronics neural implants, burn dressings and skin substitutes, adhesives, biomaterials for immunoengineering, tumor-microenvironment interactions, drug delivery systems
13	Applications of biomaterials in tissue engineering and drug delivery III: Tissue engineering Scaffolds, Bone Tissue Engineering, Cardiovascular Tissue Engineering, Soft Tissue Engineering
14	Medical Device Considerations – I: Total product lifecycle for biomaterial-based medical devices, safety and risk considerations in medical device development, sterilization and disinfection of biomaterials for medical devices, verification and validation, commercial considerations in medical device development.

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15	Medical Device Considerations – II: regulatory constraints for medical products using biomaterials, role of standards for testing and performance requirements of biomaterials, medical device failure, legal concepts for biomaterial engineers, moral and ethical issues in the development of biomaterials and medical products.

Contribution of Learning Outcomes to Program Objectives (1-5)

	P1	P2	P3	P4	P5	P6	P7
1	5	5	5	3	3	4	3
2	5	5	5	3	3	4	3
3	5	5	5	3	3	4	3
4	5	5	5	3	3	4	3
5	5	5	5	3	3	4	3
6	5	5	5	3	3	4	3
7	5	5	5	3	3	4	3

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
https://obs.tau.edu.tr/oibs/bologna/progLearnOutcomes.aspx?lang=en&curSunit=207	
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