

## GRADUATE SCHOOL OF SCIENCES

The Graduate School of Sciences at Anadolu University was first established in 1982, but when this school became a part of the newly established Osmangazi University, the graduate school was re-founded in 1993. The main purpose of the graduate school is to offer MSc and PhD education at international standards and encourage students to carry out advanced research.

Director : Prof. Dr. Hasan Ferdi GERÇEL  
Deputy Director : Prof. Dr. Mustafa TOMBUL  
Deputy Director : Asst. Prof. Dr. Recep Sulhi ÖZKÜTÜK  
Secretary of Institute : Demet BAYRAKTAR

### STAFF

**Research Assistants:** Fesih KESKİN

## DEPARTMENT OF ADVANCED TECHNOLOGIES

Head : Prof. Dr. Servet TURAN

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM IN DOCUMENTING CULTURAL HERITAGE

Advanced Technologies Research Unit was founded in 2004 in order to plan, coordinate and to put in application the interdisciplinary research projects which will be performed according to the scientific and technological priorities of the 21st century.

Mission of the Advanced Technologies Research Unit:

- Determining the science and technology platform of Anadolu University
- Performing interdisciplinary projects
- Improving University-Industry collaboration
- Tending to be a technology center

Mission of the Advanced Technologies Research Unit:

Providing Anadolu University to have an important position at the field of science and technology both in Turkey and in the world, and to be a center of excellence at certain fields.

Advanced Technologies Research Unit has three sub-units:

- Nanotechnology
- Biotechnology
- Documenting Cultural Heritage

### PROGRAM

I. SEMESTER				II. SEMESTER			
BEL 501	Terrestrial Photogrammetry and Laser Scanning	2+2	7,5	KOR 506	Technics of Documentation	3+0	7,5
UCS 533	Fundamentals of Mapping and Geographical Information Systems	3+0	7,5	UCS 519	Automated Mapping and Facility Management Systems	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0		<i>Elective Courses (2)</i>	-	15,0
			30,0				30,0

### III. SEMESTER

BEL 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

### ELECTIVE COURSES

ARK 546	Construction Elements in Archaic Age	3+0	7,5	BEL 505	Construction History Researches	3+0	7,5
ARK 547	Architecture and Urbanization in Archaic Age	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

### PROGRAM IN BIOTECHNOLOGY

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### PROGRAM

#### I. SEMESTER

İTB 501	Biotechnology	3+0	7,5
İTB 503	Biotechnology Laboratory Techniques I	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

#### II. SEMESTER

İTB 504	Biotechnology Laboratory Techniques II	3+0	7,5
İTB 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

#### III. SEMESTER

İTB 790	Thesis	0+1	30,0
			<hr/> 30,0

### ELECTIVE COURSES

BIY 513	Advanced Cell Physiology	3+0	7,5	BİY 621	Advanced Molecular Genetics	3+0	7,5
BIY 530	Plant Tissue Culture	3+0	7,5	ÇEV 530	Anaerobic Biotechnology for the Treatment of Wastes	3+0	7,5
BIY 531	Immunology	3+0	7,5	ÇEV 616	Advanced Disinfection Techniques	3+0	7,5
BIY 539	Microbial Enzymes and Biotechnology	3+0	7,5	FKG 510	Pharmacobiotechnology	3+0	7,5
BIY 545	Advanced Biochemistry	3+0	7,5	FKG 601	Advanced Pharmacognosy I	3+0	10,0
BIY 548	Modern Biotechnology	3+0	7,5	FKL 501	Experimental Pharmacology	3+0	7,5
BIY 551	Stem Cell Biology	3+0	7,5	FKL 512	Receptors, Signal Transduction and Drug Action	3+0	7,5
BIY 614	Basic Bioinformatics	3+0	7,5	FKL 602	Molecular Pharmacology	3+0	10,0
				FTK 501	Advanced Toxicology	3+0	7,5

İTB 505	Biomaterials	3+0	7,5	KİM 609	Advanced Polymer Chemistry	3+0	7,5
İTB 506	Drug Design and Application	3+0	7,5	KMH 516	Physical Operations in Food Technologies	3+0	7,5
İTB 507	Biometer	3+0	7,5	KMH 518	New and Renewable Energy Sources	3+0	7,5
İTB 508	Applications of High Performance Liquid Chromatography in Biotechnology	3+0	7,5	MAT 517	Applied Mathematics	3+0	7,5
İTB 509	Biotechnological Production of Medicine Raw Materials	3+0	7,5	MİM 505	Ecological Planning and Design	3+0	7,5
İTB 511	DNA Vaccines and Viral Vector	3+0	7,5	ÜİT 701	Research in Area of Specialization	3+0	4,5
İTB 513	Antisense Technology and its Applications	3+0	7,5	ÜİT 702	Research in Area of Specialization	3+0	4,5

## PROGRAM IN NANOTECHNOLOGY

Advanced Technologies Research Unit was founded in 2004 in order to plan, coordinate and to put in application the interdisciplinary research projects which will be performed according to the scientific and technological priorities of the 21st century.

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- Improving University-Industry collaboration
- Tending to be a technology center

Mission of the Advanced Technologies Research Unit:

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Advanced Technologies Research Unit has three sub-units:

- Nanotechnology
- Biotechnology
- Documenting Cultural Heritage

## PROGRAM

### I. SEMESTER

İTN 501	Atom and Molecular Structure	3+0	7,5
İTN 502	Nanotechnology	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

### II. SEMESTER

İTN 503	Applications of Nanotechnology	3+0	7,5
İTN 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

### III. SEMESTER

İTN 790	Thesis	0+1	30,0
			<u>30,0</u>

### ELECTIVE COURSES

ENT 501	Industrial Design I	3+0	7,5
FİZ 501	Mathematical Physics	3+0	7,5
FİZ 508	Quantum Mechanics	3+0	7,5
FİZ 514	Electromagnetic Wave Theory	3+0	7,5
FİZ 624	Selected Topics in Semiconductors	3+0	7,5
İTN 505	Nanocharacterisation I	3+0	7,5
İTN 506	Nanocharacterisation II	3+0	7,5
İTN 507	Nanomaterials	3+0	7,5
İTN 508	Synthesis of Nanomaterials	3+0	7,5
İTN 509	Nano-Biotechnology	3+0	7,5
İTN 510	Structure Property Relationship in Nanomaterials	3+0	7,5

İTN 511	Properties of Nanomaterials	3+0	7,5
İTN 512	Nanodevices and Design	3+0	7,5
İTN 513	Nanotechnology Applications in Textiles	3+0	7,5
İTN 514	Nanomagnetism and Applications	3+0	7,5
KİM 513	Chemical Thermodynamics	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5
KİM 531	Modern Analysis Methods I	3+0	7,5
KİM 532	Modern Analysis Methods II	3+0	7,5
KİM 536	Chromatographic Techniques	3+0	7,5
KİM 609	Advanced Polymer Chemistry	3+0	7,5
MAT 517	Applied Mathematics	3+0	7,5

MLZ 551	Mechanical Behavior of Materials	3+0	7,5	SRM 609	Scanning Electron Microscopy and Chemical Analysis Techniques	3+0	7,5
SRM 503	Dielectric Materials and Devices	3+0	7,5	SRM 612	Crystal Anisotropy	3+0	7,5
SRM 506	Structure-Property Relationships in Ceramics	3+0	7,5	SRM 614	Colloid Chemistry and Rheological Behaviour	3+0	7,5
SRM 521	X-Ray Diffraction Techniques in Materials Characterization	3+0	7,5	ÜİT 701	Research in Area of Specialization	3+0	4,5
SRM 528	Advanced Composite Materials	3+0	7,5	ÜİT 702	Research in Area of Specialization	3+0	4,5
SRM 602	Transmission Electron Microscopy and Interphase Boundaries	3+0	7,5				
SRM 608	Ferroelectrics Materials and Devices	3+0	7,5				

## DEPARTMENT OF AIR TRAFFIC CONTROL

Head : Prof. Dr. Aydan CAVCAR

### DOCTORATE DEGREE (PH.D)

#### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
HTK 890	Thesis	0+1	30,0	HTK 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
ELECTIVE COURSES				HTK 613	Universal Design in Air Traffic Control	3+0	7,5
HTK 601	Air Traffic Management and Aircraft Performance II	3+0	7,5	HTK 615	Critical Questioning in Air Traffic Control	3+0	7,5
HTK 603	Models and Simulation in Air Traffic Management II	3+0	7,5	SHA 601	Airline Management	3+0	7,5
HTK 604	Aviation Safety Management Application	3+0	7,5	SHA 602	Aircraft Dynamics	3+0	7,5
HTK 605	New Concepts and Visions in Air Traffic	3+0	7,5	SHA 608	Optimization Methods in Flight Mechanics	3+0	7,5
HTK 606	Advanced Aircraft Controls and Navigation II	3+0	7,5	SHA 614	Airport Design	3+0	7,5
HTK 607	Measuring of Quality and Customer Satisfaction in Air Traffic Control Services	3+0	7,5	SHA 626	Genetic Algorithms and Applications of Control Systems	3+0	7,5
HTK 609	Air Traffic Management and Environment	3+0	7,5	SHA 628	Airspace Management	3+0	7,5
HTK 611	Artificial Intelligence Applications in Air Traffic Control	3+0	7,5	SHA 632	Free Flight Concept and Analysis	3+0	7,5
				UHT 901	Research in Area of Specialization	5+0	7,5
				UHT 902	Research in Area of Specialization	5+0	7,5

### MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

I. SEMESTER				II. SEMESTER			
HTK 501	Air Traffic Management and Aircraft Performance I	3+0	7,5	HTK 502	Models and Simulation in Air Traffic Management I	3+0	7,5

<i>Elective Courses (3)</i>	-	22,5	HTK 592	Seminar	3+0	7,5
		<u>30,0</u>	SHA 538	Flight Procedures And Airspace Design	3+0	7,5
				<i>Elective Courses (1)</i>	-	7,5
						<u>30,0</u>

### III. SEMESTER

HTK 790	Thesis	0+1	30,0
			<u>30,0</u>

### ELECTIVE COURSES

HTK 504	Air Traffic Flow Management and Airspace Capacity Analysis	3+0	7,5	HTK 511	Air Traffic System and Evulation Criterion	3+0	7,5
HTK 505	Multi-Criteria Decision-Making	3+0	7,5	HTK 512	Performance Based Navigation and Design Methods	3+0	7,5
HTK 506	Statistical Analysis for Air Traffic System	3+0	7,5	HTK 513	Quantitative and Qalitative Research Methods in Air Traffic Control	3+0	7,5
HTK 507	Research Methods for Air Traffic System	3+0	7,5	HTK 515	Human-Computer Interactin in Air Traffic Control	3+0	7,5
HTK 508	Human Factors in Air Traffic Control	3+0	7,5	HTK 517	Scientific Research Projects in Air Traffic Control	3+0	7,5
HTK 509	Real Time Simulation and Data Analysis in Air Traffic Control	3+0	7,5	UHT 701	Research in Area of Specialization	3+0	4,5
HTK 510	Advanced Aircraft Controls and Navigation I	3+0	7,5	UHT 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF AIRFRAME AND POWERPLANT MAINTENANCE

Head : Prof. Dr. Mehmet Şerif KAVSAOĞLU

### DOCTORATE DEGREE (PH.D)

#### PROGRAM

#### I. SEMESTER

<i>Elective Courses (4)</i>	-	30,0
		<u>30,0</u>

#### II. SEMESTER

<i>Elective Courses (3)</i>	-	22,5
		<u>22,5</u>

#### III. SEMESTER

UGM 890	Thesis	0+1	30,0
			<u>30,0</u>

#### IV. SEMESTER

UGM 890	Thesis	0+1	30,0
			<u>30,0</u>

### ELECTIVE COURSES

MLZ 652	Fatigue and Creep Behaviour of Aircraft Materials	3+0	7,5	SHA 619	Cogeneration -Combined Heat Power Systems	3+0	7,5
SHA 601	Airline Management	3+0	7,5	SHA 620	Aircraft Performance and Operational Analysis II	3+0	7,5
SHA 602	Aircraft Dynamics	3+0	7,5	SHA 621	Advanced Gas Thermodynamics	3+0	7,5
SHA 604	Engineering Economic Analysis	3+0	7,5	SHA 625	Fatigue of Thermal Barrier Coating Systems	3+0	7,5
SHA 608	Optimization Methods in Flight Mechanics	3+0	7,5	SHA 629	Non-Destructive Inspection Methods for Aircraft Maintenance	3+0	7,5
SHA 615	Advanced Mechanical Vibrations	3+0	7,5	SHA 631	Aerothermodynamic Optimization of Aircraft Propulsion Systems	3+0	7,5

UGM 601	Environmental Impact of Commercial Aircraft	3+0	7,5	UGM 610	Thermoeconomic and Thermoenvironmental Optimization in Aviation	3+0	7,5
UGM 603	Advanced Heat Transfer Calculations in Aviation	3+0	7,5	UUG 901	Research in Area of Specialization	5+0	7,5
UGM 605	Advanced Exergy Analysis in Aviation	3+0	7,5	UUG 902	Research in Area of Specialization	5+0	7,5

## MASTER OF SCIENCE (MS) DEGREE

### PROGRAM

#### I. SEMESTER

SHA 511	Aircraft Performance And Operation Analysis I	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			30,0

#### II. SEMESTER

MAT 517	Applied Mathematics	3+0	7,5
SHA 539	Advanced Aerodynamics	3+0	7,5
UGM 592	Seminar	3+0	7,5
	<i>Elective Courses (1)</i>	-	7,5
			30,0

#### III. SEMESTER

UGM 790	Thesis	0+1	30,0
			30,0

#### ELECTIVE COURSES

MLZ 552	Materials Selection For Aircraft Structure	3+0	7,5
MLZ 553	Mechanical Behavior of Composite Materials	3+0	7,5
MLZ 554	Structure and Properties of Aircraft Materials	3+0	7,5
SHA 513	Oil Analysis Program in Aircraft Maintenance	3+0	7,5
SHA 515	The Effects of Construction Techniques Aircraft on Performances of Light	3+0	7,5
SHA 531	Industrial Aerodynamics	3+0	7,5
SHA 535	Helicopter Theory and Flight Principles	3+0	7,5
SHA 537	Exergy Analysis	3+0	7,5
SHA 541	Current Issues in Gas Turbine Engines	3+0	7,5

SHA 543	Parametric Cycle Analysis of Aircraft Propulsion System	3+0	7,5
SHA 547	Flight Tests and Instrumentation	3+0	7,5
SHA 548	Experimental Aerodynamics Analysis for Incompressible Flow	3+0	7,5
SHA 549	Gas Turbine Combustion	3+0	7,5
SHA 550	Preliminary Design of Unmanned Air Vehicle and Its Propulsion System	3+0	7,5
SHA 551	Airline Operations and Scheduling	3+0	7,5
SHA 552	Experimental Methods and Data Processing Techniques for Turbomachinery	3+0	7,5
SHA 553	Air-conditioning Systems for Aircraft	3+0	7,5
TER 501	Advanced Thermodynamics	3+0	7,5
UGM 510	Failure Analysis of Aircraft Structures	3+0	7,5
UUG 701	Research in Area of Specialization	3+0	4,5
UUG 702	Research in Area of Specialization	3+0	4,5

# DEPARTMENT OF ARCHITECTURE

Head : Prof. Dr. Nuray ÖZASLAN

## (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

### PRESERVATION OF ARCHITECTURE

#### PROGRAM

##### I. SEMESTER

KOR 501	Preservation Studio I	2+4	10,0
KOR 503	Conservation History and Theories	3+0	7,5
	<i>Elective Courses (2)</i>	-	12,5
			<u>30,0</u>

##### II. SEMESTER

KOR 502	Preservation Studio II	2+4	10,0
	<i>Elective Courses (3)</i>	-	20,0
			<u>30,0</u>

##### III. SEMESTER

MİM 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### ELECTIVE COURSES

KOR 504	Architectural History and Concepts	3+0	7,5
KOR 505	Special Topics in Preservation	2+0	5,0
KOR 506	Technics of Documentation	3+0	7,5
KOR 507	Cultural Heritage Management	3+0	7,5
KOR 508	Preservation Management	2+0	5,0
KOR 517	History of Modern Turkish Architecture	3+0	7,5
KOR 518	History of Anatolian Architecture	3+0	7,5
MİM 501	Analysis in Architecture	3+0	7,5
MİM 502	Criticism in Architecture	3+0	7,5
MİM 503	Housing Problems and Policies	3+0	7,5
MİM 504	Qualitative Values of Housing Areas	3+0	7,5
MİM 505	Ecological Planning and Design	3+0	7,5
MİM 509	Legal Aspects of Urban Planning	3+0	7,5
MİM 512	Administrative and Legal Aspects of Planning	3+0	7,5
MİM 513	Computer Programming and Introduction to Architectural Practices	3+0	7,5
MİM 514	User Interface Design	3+0	7,5
MİM 516	Building Shell Design in Energy Efficient Buildings	3+0	7,5
MİM 517	Architectural Precast	3+0	7,5
MİM 518	Structure in Architecture	3+0	7,5

MİM 519	Housing Architecture	3+0	7,5
MİM 520	Architectural Steel	3+0	7,5
MİM 521	Environmental Design	3+0	7,5
MİM 523	Contemporary Interpretation of Traditional Turkish Houses	3+0	7,5
MİM 525	Culture, House and Identity	3+0	7,5
MİM 526	Computer Aided Architectural Analyses Techniques	3+0	7,5
MİM 528	Using of Space around House and House Environment	3+0	7,5
MİM 529	Urban Space and Handicapped People	3+0	7,5
MİM 530	National and International Aspects of Urban Conservation and Renewal	3+0	7,5
MİM 532	Urban Regeneration	3+0	7,5
MİM 534	Designing of Housing Areas	3+0	7,5
MİM 535	Urban Design Theory	3+0	7,5
MİM 536	Rationalism in Architecture	3+0	7,5
MİM 543	Building Material Experiments	3+0	7,5
MİM 545	Architecture Sociological Readings	3+0	7,5
MİM 547	Architecture Communication	3+0	7,5

## PROGRAM IN BUILDING CONSTRUCTION

### PROGRAM

I. SEMESTER			II. SEMESTER		
MİM 511	Building Material Failures	3+0 7,5	<i>Elective Courses (4)</i>		- 30,0
MİM 515	Solar Energy in Architecture	3+0 7,5			
MİM 541	Architectural Design Studio I	2+4 7,5			30,0
	<i>Elective Courses (1)</i>	- 7,5			
		30,0			
III. SEMESTER					
MİM 599	Term Project	3+0 15,0			
	<i>Elective Courses (2)</i>	- 15,0			
		30,0			

### ELECTIVE COURSES

KOR 504	Architectural History and Concepts	3+0 7,5	MİM 519	Housing Architecture	3+0 7,5
KOR 505	Special Topics in Preservation	2+0 5,0	MİM 520	Architectural Steel	3+0 7,5
KOR 506	Technics of Documentation	3+0 7,5	MİM 521	Environmental Design	3+0 7,5
KOR 507	Cultural Heritage Management	3+0 7,5	MİM 523	Contemporary Interpretation of Traditional Turkish Houses	3+0 7,5
KOR 508	Preservation Management	2+0 5,0	MİM 525	Culture, House and Identity	3+0 7,5
KOR 517	History of Modern Turkish Architecture	3+0 7,5	MİM 526	Computer Aided Architectural Analyses Techniques	3+0 7,5
KOR 518	History of Anatolian Architecture	3+0 7,5	MİM 528	Using of Space around House and House Environment	3+0 7,5
MİM 501	Analysis in Architecture	3+0 7,5	MİM 529	Urban Space and Handicapped People	3+0 7,5
MİM 502	Criticism in Architecture	3+0 7,5	MİM 530	National and International Aspects of Urban Conservation and Renewal	3+0 7,5
MİM 503	Housing Problems and Policies	3+0 7,5	MİM 532	Urban Regeneration	3+0 7,5
MİM 504	Qualitative Values of Housing Areas	3+0 7,5	MİM 534	Designing of Housing Areas	3+0 7,5
MİM 505	Ecological Planning and Design	3+0 7,5	MİM 535	Urban Design Theory	3+0 7,5
MİM 509	Legal Aspects of Urban Planning	3+0 7,5	MİM 536	Rationalism in Architecture	3+0 7,5
MİM 512	Administrative and Legal Aspects of Planning	3+0 7,5	MİM 543	Building Material Experiments	3+0 7,5
MİM 513	Computer Programming and Introduction to Architectural Practices	3+0 7,5	MİM 545	Architecture Sociological Readings	3+0 7,5
MİM 514	User Interface Design	3+0 7,5	MİM 547	Architecture Communication	3+0 7,5
MİM 516	Building Shell Design in Energy Efficient Buildings	3+0 7,5			
MİM 517	Architectural Precast	3+0 7,5			
MİM 518	Structure in Architecture	3+0 7,5			

## PROGRAM IN BUILDING DESIGN

### PROGRAM

I. SEMESTER			II. SEMESTER		
MİM 531	Architectural Design Methods	3+0 7,5	MİM 542	Architectural Design Studio II	2+4 7,5
MİM 533	Methodologies in Architectural Design Research	3+0 7,5	<i>Elective Courses (3)</i>		- 22,5
MİM 541	Architectural Design Studio I	2+4 7,5			30,0
	<i>Elective Courses (1)</i>	- 7,5			
		30,0			



### III. SEMESTER

MİM 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

#### ELECTIVE COURSES

KOR 504	Architectural History and Concepts	3+0	7,5	MİM 518	Structure in Architecture	3+0	7,5
KOR 505	Special Topics in Preservation	2+0	5,0	MİM 519	Housing Architecture	3+0	7,5
KOR 506	Technics of Documentation	3+0	7,5	MİM 520	Architectural Steel	3+0	7,5
KOR 507	Cultural Heritage Management	3+0	7,5	MİM 521	Environmental Design	3+0	7,5
KOR 508	Preservation Management	2+0	5,0	MİM 523	Contemporary Interpretation of Traditional Turkish Houses	3+0	7,5
KOR 517	History of Modern Turkish Architecture	3+0	7,5	MİM 525	Culture, House and Identity	3+0	7,5
KOR 518	History of Anatolian Architecture	3+0	7,5	MİM 526	Computer Aided Architectural Analyses Techniques	3+0	7,5
MİM 501	Analysis in Architecture	3+0	7,5	MİM 528	Using of Space around House and House Environment	3+0	7,5
MİM 502	Criticism in Architecture	3+0	7,5	MİM 529	Urban Space and Handicapped People	3+0	7,5
MİM 503	Housing Problems and Policies	3+0	7,5	MİM 530	National and International Aspects of Urban Conservation and Renewal	3+0	7,5
MİM 504	Qualitative Values of Housing Areas	3+0	7,5	MİM 532	Urban Regeneration	3+0	7,5
MİM 505	Ecological Planning and Design	3+0	7,5	MİM 534	Designing of Housing Areas	3+0	7,5
MİM 509	Legal Aspects of Urban Planning	3+0	7,5	MİM 535	Urban Design Theory	3+0	7,5
MİM 512	Administrative and Legal Aspects of Planning	3+0	7,5	MİM 536	Rationalism in Architecture	3+0	7,5
MİM 513	Computer Programming and Introduction to Architectural Practices	3+0	7,5	MİM 543	Building Material Experiments	3+0	7,5
MİM 514	User Interface Design	3+0	7,5	MİM 545	Architecture Sociological Readings	3+0	7,5
MİM 516	Building Shell Design in Energy Efficient Buildings	3+0	7,5	MİM 547	Architecture Communication	3+0	7,5
MİM 517	Architectural Precast	3+0	7,5				

### DOCTORATE DEGREE (PH.D)

For candidates who want to continue his/her academic career in architecture field and especially in architectural design discipline.

#### PROGRAM

##### I. SEMESTER

<i>Elective Courses (4)</i>	-	30,0
		<hr/> 30,0

##### II. SEMESTER

<i>Elective Courses (3)</i>	-	22,5
		<hr/> 22,5

##### III. SEMESTER

MİM 890	Thesis	0+1	30,0
			<hr/> 30,0

##### IV. SEMESTER

MİM 890	Thesis	0+1	30,0
			<hr/> 30,0

#### ELECTIVE COURSES

MİM 601	Architectural Studio Research I	3+0	7,5	MİM 606	Urban Space Design Quality	3+0	7,5
MİM 602	Architectural Studio Research II	3+0	7,5	MİM 607	The Tools and Quality Measurement Methods for Design	3+0	7,5
MİM 603	Architectural Research Methods	3+0	7,5	MİM 613	Civic Space and Buildings	3+0	7,5
MİM 604	Architecture: Art, Science and Technology	3+0	7,5	MİM 614	Health Impact Assessment of Space	3+0	7,5
MİM 605	Sustainable Architecture	3+0	7,5	MİM 615	Spatial Relationships and Architecture	3+0	7,5
				MİM 616	Boundaries of the House and Modernity	3+0	7,5

MİM 617	Architecture and the Morphological Study	3+0	7,5	PSİ 606	Psychology in Architecture Design	3+0	7,5
MİM 618	History and Criticism of Contemporary Architecture	3+0	7,5	UMİ 901	Research in Area of Specialization	5+0	7,5
MİM 620	Universal Design	3+0	7,5	UMİ 902	Research in Area of Specialization	5+0	7,5

## MASTER OF SCIENCE (MS) DEGREE

Architecture can be described as the design of the built or man-made environment. This environment is in nature social, cultural, political, economic as well as physical. Design is a process of creative intervention ,the purpose of which is to improve the built environment. This calls for : a) an interest in the human condition in so far as it is effected by and affects the built environment ; b) the development of intellectual and creative qualities, critical abilities, the capacity to make value judgements and the motivation to learn ; c) the acquisition of knowledge in the arts and sciences( as it shapes the built environment ) and the development of analytical, creative, technical, managerial , organisational and communication skills.

The Department of Architecture, Anadolu University- Eskişehir was founded in 1984 within the organisational structure of the faculty of engineering and architecture . By 1993 , Anadolu University was divided into two distinct universities, as a result of this the department of architecture was reorganized and has commenced education in 1994 with a brand new sprit and incentive. In October,1999 the department of architecture has finally moved into newly purpose built buildings at the İki Eylül Campus of the Anadolu University.

Today , the department enjoys of some 6000 M2 indoor spaces including 3 lecture rooms, 6 design studios ; 2 computers labs (Mac and IBM ) ; print room ; construction lab ; model-making studio ; dark-room ; departmental library ; exhibition halls and staff-rooms / administration block . The Graduate department has 12 full-time members of teaching staff including 2 Professors, 3 Associate, Professors, 7 Assistant Professors. Each member of staff has his / her own well equipped and furnished office.

There is a departmental design office where the staff can practice architecture and students can take up part-time work. Numerous projects have been completed through the design office so far, and several member of staff took part in designing and construction phases Today, the department has a potential for offerring services to both public and the industry due to the expertise staff and the facilities available .

## PRESERVATION OF ARCHITECTURE

### PROGRAM

I. SEMESTER				II. SEMESTER			
KOR 501	Preservation Studio I	2+4	10,0	KOR 502	Preservation Studio II	2+4	10,0
KOR 503	Conservation History and Theories	3+0	7,5	MİM 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	12,5		<i>Elective Courses (2)</i>	-	12,5
			<u>30,0</u>				<u>30,0</u>
III. SEMESTER							
MİM 790	Thesis	0+1	30,0				
			<u>30,0</u>				

### ELECTIVE COURSES

KOR 504	Architectural History and Concepts	3+0	7,5	KOR 518	History of Anatolian Architecture	3+0	7,5
KOR 505	Special Topics in Preservation	2+0	5,0	MİM 501	Analysis in Architecture	3+0	7,5
KOR 506	Technics of Documentation	3+0	7,5	MİM 502	Criticism in Architecture	3+0	7,5
KOR 507	Cultural Heritage Management	3+0	7,5	MİM 503	Housing Problems and Policies	3+0	7,5
KOR 508	Preservation Management	2+0	5,0	MİM 504	Qualitative Values of Housing Areas	3+0	7,5
KOR 517	History of Modern Turkish Architecture	3+0	7,5	MİM 505	Ecological Planning and Design	3+0	7,5
				MİM 509	Legal Aspects of Urban Planning	3+0	7,5

MİM 512	Administrative and Legal Aspects of Planning	3+0	7,5	MİM 528	Using of Space around House and House Environment	3+0	7,5
MİM 513	Computer Programming and Introduction to Architectural Practices	3+0	7,5	MİM 529	Urban Space and Handicapped People	3+0	7,5
MİM 514	User Interface Design	3+0	7,5	MİM 530	National and International Aspects of Urban Conservation and Renewal	3+0	7,5
MİM 516	Building Shell Design in Energy Efficient Buildings	3+0	7,5	MİM 532	Urban Regeneration	3+0	7,5
MİM 517	Architectural Precast	3+0	7,5	MİM 534	Designing of Housing Areas	3+0	7,5
MİM 518	Structure in Architecture	3+0	7,5	MİM 535	Urban Design Theory	3+0	7,5
MİM 519	Housing Architecture	3+0	7,5	MİM 536	Rationalism in Architecture	3+0	7,5
MİM 520	Architectural Steel	3+0	7,5	MİM 543	Building Material Experiments	3+0	7,5
MİM 521	Environmental Design	3+0	7,5	MİM 545	Architecture Sociological Readings	3+0	7,5
MİM 523	Contemporary Interpretation of Traditional Turkish Houses	3+0	7,5	MİM 547	Architecture Communication	3+0	7,5
MİM 525	Culture, House and Identity	3+0	7,5	UMİ 701	Research in Area of Specialization	3+0	4,5
MİM 526	Computer Aided Architectural Analyses Techniques	3+0	7,5	UMİ 702	Research in Area of Specialization	3+0	4,5

## PROGRAM IN BUILDING CONSTRUCTION

### PROGRAM

#### I. SEMESTER

MİM 511	Building Material Failures	3+0	7,5
MİM 515	Solar Energy in Architecture	3+0	7,5
MİM 541	Architectural Design Studio I	2+4	7,5
	<i>Elective Courses (1)</i>	-	7,5
			<u>30,0</u>

#### II. SEMESTER

MİM 592	Seminar	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			<u>30,0</u>

#### III. SEMESTER

MİM 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

KOR 504	Architectural History and Concepts	3+0	7,5	MİM 516	Building Shell Design in Energy Efficient Buildings	3+0	7,5
KOR 505	Special Topics in Preservation	2+0	5,0	MİM 517	Architectural Precast	3+0	7,5
KOR 506	Technics of Documentation	3+0	7,5	MİM 518	Structure in Architecture	3+0	7,5
KOR 507	Cultural Heritage Management	3+0	7,5	MİM 519	Housing Architecture	3+0	7,5
KOR 508	Preservation Management	2+0	5,0	MİM 520	Architectural Steel	3+0	7,5
KOR 517	History of Modern Turkish Architecture	3+0	7,5	MİM 521	Environmental Design	3+0	7,5
KOR 518	History of Anatolian Architecture	3+0	7,5	MİM 523	Contemporary Interpretation of Traditional Turkish Houses	3+0	7,5
MİM 501	Analysis in Architecture	3+0	7,5	MİM 525	Culture, House and Identity	3+0	7,5
MİM 502	Criticism in Architecture	3+0	7,5	MİM 526	Computer Aided Architectural Analyses Techniques	3+0	7,5
MİM 503	Housing Problems and Policies	3+0	7,5	MİM 528	Using of Space around House and House Environment	3+0	7,5
MİM 504	Qualitative Values of Housing Areas	3+0	7,5	MİM 529	Urban Space and Handicapped People	3+0	7,5
MİM 505	Ecological Planning and Design	3+0	7,5	MİM 530	National and International Aspects of Urban Conservation and Renewal	3+0	7,5
MİM 509	Legal Aspects of Urban Planning	3+0	7,5	MİM 532	Urban Regeneration	3+0	7,5
MİM 512	Administrative and Legal Aspects of Planning	3+0	7,5	MİM 534	Designing of Housing Areas	3+0	7,5
MİM 513	Computer Programming and Introduction to Architectural Practices	3+0	7,5	MİM 535	Urban Design Theory	3+0	7,5
MİM 514	User Interface Design	3+0	7,5	MİM 536	Rationalism in Architecture	3+0	7,5

MİM 543	Building Material Experiments	3+0	7,5	UMİ 701	Research in Area of Specialization	3+0	4,5
MİM 545	Architecture Sociological Readings	3+0	7,5	UMİ 702	Research in Area of Specialization	3+0	4,5
MİM 547	Architecture Communication	3+0	7,5				

## PROGRAM IN BUILDING DESIGN

### PROGRAM

#### I. SEMESTER

MİM 531	Architectural Design Methods	3+0	7,5
MİM 533	Methodologies in Architectural Design Research	3+0	7,5
MİM 541	Architectural Design Studio I	2+4	7,5
	<i>Elective Courses (1)</i>	-	7,5
			<u>30,0</u>

#### II. SEMESTER

MİM 542	Architectural Design Studio II	2+4	7,5
MİM 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### III. SEMESTER

MİM 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

KOR 504	Architectural History and Concepts	3+0	7,5	MİM 520	Architectural Steel	3+0	7,5
KOR 505	Special Topics in Preservation	2+0	5,0	MİM 521	Environmental Design	3+0	7,5
KOR 506	Technics of Documentation	3+0	7,5	MİM 523	Contemporary Interpretation of Traditional Turkish Houses	3+0	7,5
KOR 507	Cultural Heritage Management	3+0	7,5	MİM 525	Culture, House and Identity	3+0	7,5
KOR 508	Preservation Management	2+0	5,0	MİM 526	Computer Aided Architectural Analyses Techniques	3+0	7,5
KOR 517	History of Modern Turkish Architecture	3+0	7,5	MİM 528	Using of Space around House and House Environment	3+0	7,5
KOR 518	History of Anatolian Architecture	3+0	7,5	MİM 529	Urban Space and Handicapped People	3+0	7,5
MİM 501	Analysis in Architecture	3+0	7,5	MİM 530	National and International Aspects of Urban Conservation and Renewal	3+0	7,5
MİM 502	Criticism in Architecture	3+0	7,5	MİM 532	Urban Regeneration	3+0	7,5
MİM 503	Housing Problems and Policies	3+0	7,5	MİM 534	Designing of Housing Areas	3+0	7,5
MİM 504	Qualitative Values of Housing Areas	3+0	7,5	MİM 535	Urban Design Theory	3+0	7,5
MİM 505	Ecological Planning and Design	3+0	7,5	MİM 536	Rationalism in Architecture	3+0	7,5
MİM 509	Legal Aspects of Urban Planning	3+0	7,5	MİM 543	Building Material Experiments	3+0	7,5
MİM 512	Administrative and Legal Aspects of Planning	3+0	7,5	MİM 545	Architecture Sociological Readings	3+0	7,5
MİM 513	Computer Programming and Introduction to Architectural Practices	3+0	7,5	MİM 547	Architecture Communication	3+0	7,5
MİM 514	User Interface Design	3+0	7,5	UMİ 701	Research in Area of Specialization	3+0	4,5
MİM 516	Building Shell Design in Energy Efficient Buildings	3+0	7,5	UMİ 702	Research in Area of Specialization	3+0	4,5
MİM 517	Architectural Precast	3+0	7,5				
MİM 518	Structure in Architecture	3+0	7,5				
MİM 519	Housing Architecture	3+0	7,5				

## DEPARTMENT OF AVIONICS

Head : Asst. Prof. Dr. Gülay ÜNAL



## DOCTORATE DEGREE (PH.D)

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
HEE 890	Thesis	0+1	30,0	HEE 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
<b>ELECTIVE COURSES</b>							
SHA 601	Airline Management	3+0	7,5	SHA 620	Aircraft Performance and Operational Analysis II	3+0	7,5
SHA 602	Aircraft Dynamics	3+0	7,5	SHA 626	Genetic Algorithms and Applications of Control Systems	3+0	7,5
SHA 604	Engineering Economic Analysis	3+0	7,5	UHE 901	Research in Area of Specialization	5+0	7,5
SHA 608	Optimization Methods in Flight Mechanics	3+0	7,5	UHE 902	Research in Area of Specialization	5+0	7,5
SHA 614	Airport Design	3+0	7,5				
SHA 618	Fault Tolerant Flight Control System Design	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

### PROGRAM

I. SEMESTER				II. SEMESTER			
HEE 501	Satellite Based Navigation Systems	3+0	7,5	HEE 592	Seminar	3+0	7,5
SHA 511	Aircraft Performance And Operation Analysis I	3+0	7,5	MAT 517	Applied Mathematics	3+0	7,5
<i>Elective Courses (2)</i>		-	15,0	<i>Elective Courses (2)</i>		-	15,0
			<u>30,0</u>				<u>30,0</u>
III. SEMESTER							
HEE 790	Thesis	0+1	30,0				
			<u>30,0</u>				
<b>ELECTIVE COURSES</b>							
SHA 524	Modern Control Systems	3+0	7,5	SHA 547	Flight Tests and Instrumentation	3+0	7,5
SHA 525	CNS-ATM Systems	3+0	7,5	SHA 554	Aviation Lighting Technics	3+0	7,5
SHA 536	Flight Control System Design	3+0	7,5	UHE 701	Research in Area of Specialization	3+0	4,5
SHA 545	Fuzzy Logic Applications in Aviation	3+0	7,5	UHE 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF BIOLOGY

Head : Prof. Dr. Hülya SİVAS

## DOCTORATE DEGREE (PH.D)

The Department was established in 1982 as a Biology Department under Faculty of Sciences and Literatures. In 1993, the department was reestablished with the same name under Faculty of Sciences after the segregation of Osmangazi University from Anadolu University. The department is located at the Yunusemre Campus and occupies a covered area of 4000 m<sup>2</sup>. Currently, 5 Professors, 2 Associate Professors, 11 Assistant Professors and 10 Assistants are working in the department. The decisions related with the department are made by the department council which is composed of all faculty members of the department. The department is governed by one chairman and two deputy chairmen. One of the deputy chairmen takes care of technical activities of the department while the other deputy chairman assists chairman in academic activities in the department.

The principal education philosophy of the Department has been to provide a sound professional training which has been consistent with the current scientific and technological state of the art background supported by practice through laboratory applications in biology discipline. The department is in collaboration with several international universities, research laboratories and the centers. The laboratories of the department are equipped with all the modern research equipment and facilities needed to do scientific research with both traditional and high technology methods.

Teaching is by lectures, laboratory and field classes. Regular attendance at all types of class is essential to enable students not only to learn about biology but also to develop their own skills in experimentation, thinking and communicating as well as their thoughts in writing and in discussion.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
BİY 890	Thesis	0+1	30,0	BİY 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>

### ELECTIVE COURSES

BİY 601	Microbial Laboratory Techniques	3+0	7,5	BİY 627	Ecophysiology	3+0	7,5
BİY 602	Water Microbiology	3+0	7,5	BİY 628	Genetic Regulation of Development	3+0	7,5
BİY 603	Environmental Pollution and Plants	3+0	7,5	BİY 629	Molecular Taxonomy	3+0	7,5
BİY 604	Recombinant DNA Technology	3+0	7,5	BİY 630	Modern Methods in Plant Taxonomy	3+0	7,5
BİY 605	Animal Tissue Culture	3+0	7,5	BİY 631	Ecological Economics	3+0	7,5
BİY 606	Yeast Science	3+0	7,5	BİY 632	Biochemistry of Cancerogens and Mutanges	3+0	7,5
BİY 607	Oceanology	3+0	7,5	BİY 633	Economic Botany	3+0	7,5
BİY 608	Advanced Endocrinology	3+0	7,5	BİY 634	Evolution of Microbial Pathogens	3+0	7,5
BİY 609	Parasite Plants	3+0	7,5	BİY 635	Characteristic Behaviour of Animal Groups	3+0	7,5
BİY 611	Genomics	3+0	7,5	BİY 636	Biochemistry of Free Radicals	3+0	7,5
BİY 612	Microbial Physiology	3+0	7,5	BİY 637	Aquatic Entomology	3+0	7,5
BİY 613	Modern Mycology	3+0	7,5	BİY 638	Archaeobacteria	3+0	7,5
BİY 614	Basic Bioinformatics	3+0	7,5	BİY 640	Basic Virology	3+0	7,5
BİY 616	Biogeography	3+0	7,5	BİY 641	Soil Science	3+0	7,5
BİY 617	Celluar Signal TransductionPathways	3+0	7,5	BİY 642	Protein and Nucleic Acid Analysis Techniques	3+0	7,5
BİY 618	Fhlyogenetic Systematics	3+0	7,5	BİY 644	Intracellular Traffic	3+0	7,5
BİY 620	Forest Vegetation of Turkey	3+0	7,5	BİY 645	Biochemistry of Nucleic Acids	3+0	7,5
BİY 621	Advanced Molecular Genetics	3+0	7,5	BİY 646	Eutrophication in Lakes	3+0	7,5
BİY 622	Soil Biology	3+0	7,5	BİY 647	Human Biochemistry	3+0	7,5
BİY 624	Use of Bioindicators in Environment	3+0	7,5	BİY 648	Applied Mycology and Biotechnology	3+0	7,5
BİY 625	Special Microscopic Techniques	3+0	7,5				
BİY 626	Enviromental Microbiology	3+0	7,5				

BİY 649	Plant Genetic Resources	3+0	7,5	BİY 665	Advanced Biochemistry and Biochemical Techniques I	3+0	7,5
BİY 651	Vegetation Research Methods	3+0	7,5	BİY 666	Advanced Biochemistry and Biochemical Techniques II	3+0	7,5
BİY 652	Microbial Genomics	3+0	7,5	BİY 667	Actinomycetes in Biotechnology	3+0	7,5
BİY 653	Advanced Molecular Biology	3+0	7,5	BİY 668	Advanced Protein Biochemistry	3+0	7,5
BİY 654	Ecological Genetics	3+0	7,5	BİY 669	Biology of Lichenicolous Fungi	3+0	7,5
BİY 655	Natural Antimicrobial Agents and Food	3+0	7,5	BİY 671	Statistical Analyses in Biology	3+0	7,5
BİY 656	Chemotaxonomy	3+0	7,5	BİY 672	Advanced Biochemistry and Bioenergetics	3+0	7,5
BİY 657	Food, Human Health and Probiotics	3+0	7,5	BİY 673	Molecular Industrial Biotechnology	3+0	7,5
BİY 658	Cell Regulation	3+0	7,5	BİY 674	Molecular Microbial Ecology Techniques	3+0	7,5
BİY 659	Cancer Genetics	3+0	7,5	UBJ 901	Research in Area of Specialization	5+0	7,5
BİY 660	Medical Genetics	3+0	7,5	UBJ 902	Research in Area of Specialization	5+0	7,5
BİY 661	The Molecular Basis of Cell Differentiation	3+0	7,5				
BİY 662	Basis of Molecular Evolution	3+0	7,5				
BİY 663	Araneology	3+0	7,5				
BİY 664	Ecological Restoration	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

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## PROGRAM IN BIOLOGY

### PROGRAM

#### I. SEMESTER

BİY 505	Bacteriology	3+0	7,5
BİY 549	Modern Methods for Microbial Identification and Typing	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

#### II. SEMESTER

BİY 584	Advanced Microbial Physiology	3+0	7,5
BİY 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

#### III. SEMESTER

BİY 790	Thesis	0+1	30,0
			<hr/> 30,0



**ELECTIVE COURSES**

BİY 501	Herbarium Techniques	3+0	7,5
BİY 506	Enzymatic Regulation	3+0	7,5
BİY 507	Biology of Lichens	3+0	7,5
BİY 509	Special Histology	3+0	7,5
BİY 512	Principles of Zoological Nomenclature	3+0	7,5
BİY 513	Advanced Cell Physiology	3+0	7,5
BİY 514	The Harmful Insects	3+0	7,5
BİY 515	Forest Ecology	3+0	7,5
BİY 516	Bioenergetics	3+0	7,5
BİY 517	Water Pollution and Biological Effect	3+0	7,5
BİY 518	Signal Transduction in The Cell	3+0	7,5
BİY 519	Limnology	3+0	7,5
BİY 520	Bacterial Plant Diseases	3+0	7,5
BİY 521	Biophotography	3+0	7,5
BİY 522	Investigation Methods of Ecosystems	3+0	7,5
BİY 524	Fishery Biology and Population Dynamics	3+0	7,5
BİY 526	Cytogenetics	3+0	7,5
BİY 527	Plant Microbiology	3+0	7,5
BİY 528	DNA Repair Mechanisms	3+0	7,5
BİY 529	Landscape Ecology	3+0	7,5
BİY 530	Plant Tissue Culture	3+0	7,5
BİY 531	Immunology	3+0	7,5
BİY 535	Mineral Feeding Physiology in Plants	3+0	7,5
BİY 537	Stress Physiology in Plants	3+0	7,5
BİY 539	Microbial Enzymes and Biotechnology	3+0	7,5
BİY 543	Plant Molecular Biology	3+0	7,5
BİY 546	Methods of Genetic Toxicology	3+0	7,5
BİY 547	Forest and Park Trees	3+0	7,5
BİY 551	Stem Cell Biology	3+0	7,5

BİY 552	Plant Science	3+0	7,5
BİY 553	The Ecology of Bird Communities	3+0	7,5
BİY 555	Birds of Turkey	3+0	7,5
BİY 556	Transmission Electron Microscopy and its Applications I	3+0	7,5
BİY 557	Transmission Electron Microscopy And its Applications II	3+0	7,5
BİY 560	Instrumental Analyses in Biochemistry	3+0	7,5
BİY 561	Animal Cell Culture	3+0	7,5
BİY 562	Molecular Biotechnology	3+0	7,5
BİY 563	Halophilic Microorganisms and Their Potential in Biotechnology	3+0	7,5
BİY 565	Extremophiles	3+0	7,5
BİY 567	In-Vitro Techniques	3+0	7,5
BİY 571	Taxonomy	3+0	7,5
BİY 572	Molecular Biology Methods	3+0	7,5
BİY 574	Foodborn Pathogen Microorganisms	3+0	7,5
BİY 575	Microorganisms and Biotechnology	3+0	7,5
BİY 577	Enzyme Technology	3+0	7,5
BİY 578	Arachnology	3+0	7,5
BİY 579	Plant Bacteriology	3+0	7,5
BİY 581	Permaculture	3+0	7,5
BİY 582	Cyanobacteria and Biotechnological Applications	3+0	7,5
BİY 585	Advanced Biochemistry and Metabolism	3+0	7,5
BİY 586	Systematics of Lichens	3+0	7,5
BİY 705	Insect Behavior	3+0	7,5
UBJ 701	Research in Area of Specialization	3+0	4,5
UBJ 702	Research in Area of Specialization	3+0	4,5

**PROGRAM IN BOTANY****PROGRAM****I. SEMESTER**

BİY 510	Flora of Turkey	3+0	7,5
BİY 550	Molecular Techniques in Systematics	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

**II. SEMESTER**

BİY 502	Methods of Plant Identification	3+0	7,5
BİY 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

**III. SEMESTER**

BİY 790	Thesis	0+1	30,0
			<hr/> 30,0

**ELECTIVE COURSES**

BİY 501	Herbarium Techniques	3+0	7,5
BİY 506	Enzymatic Regulation	3+0	7,5
BİY 507	Biology of Lichens	3+0	7,5
BİY 509	Special Histology	3+0	7,5

BİY 512	Principles of Zoological Nomenclature	3+0	7,5
BİY 513	Advanced Cell Physiology	3+0	7,5
BİY 514	The Harmful Insects	3+0	7,5
BİY 515	Forest Ecology	3+0	7,5

BİY 516	Bioenergetics	3+0	7,5	BİY 557	Transmission Electron Microscopy And its Applications II	3+0	7,5
BİY 517	Water Pollution and Biological Effect	3+0	7,5	BİY 560	Instrumental Analyses in Biochemistry	3+0	7,5
BİY 518	Signal Transduction in The Cell	3+0	7,5	BİY 561	Animal Cell Culture	3+0	7,5
BİY 519	Limnology	3+0	7,5	BİY 562	Molecular Biotechnology	3+0	7,5
BİY 520	Bacterial Plant Diseases	3+0	7,5	BİY 563	Halophilic Microorganisms and Their Potential in Biotechnology	3+0	7,5
BİY 521	Biophotography	3+0	7,5	BİY 565	Extremophiles	3+0	7,5
BİY 522	Investigation Methods of Ecosystems	3+0	7,5	BİY 567	In-Vitro Techniques	3+0	7,5
BİY 524	Fishery Biology and Population Dynamics	3+0	7,5	BİY 571	Taxonomy	3+0	7,5
BİY 526	Cytogenetics	3+0	7,5	BİY 572	Molecular Biology Methods	3+0	7,5
BİY 527	Plant Microbiology	3+0	7,5	BİY 574	Foodborn Pathogen Microorganisms	3+0	7,5
BİY 528	DNA Repair Mechanisms	3+0	7,5	BİY 575	Microorganisms and Biotechnology	3+0	7,5
BİY 529	Landscape Ecology	3+0	7,5	BİY 577	Enzyme Technology	3+0	7,5
BİY 530	Plant Tissue Culture	3+0	7,5	BİY 578	Arachnology	3+0	7,5
BİY 531	Immunology	3+0	7,5	BİY 579	Plant Bacteriology	3+0	7,5
BİY 535	Mineral Feeding Physiology in Plants	3+0	7,5	BİY 581	Permaculture	3+0	7,5
BİY 537	Stress Physiology in Plants	3+0	7,5	BİY 582	Cyanobacteria and Biotechnological Applications	3+0	7,5
BİY 539	Microbial Enzymes and Biotechnology	3+0	7,5	BİY 585	Advanced Biochemistry and Metabolism	3+0	7,5
BİY 543	Plant Molecular Biology	3+0	7,5	BİY 586	Systematics of Lichens	3+0	7,5
BİY 546	Methods of Genetic Taxicology	3+0	7,5	BİY 705	Insect Behavior	3+0	7,5
BİY 547	Forest and Park Trees	3+0	7,5	UBJ 701	Research in Area of Specialization	3+0	4,5
BİY 551	Stem Cell Biology	3+0	7,5	UBJ 702	Research in Area of Specialization	3+0	4,5
BİY 552	Plant Science	3+0	7,5				
BİY 553	The Ecology of Bird Communities	3+0	7,5				
BİY 555	Birds of Turkey	3+0	7,5				
BİY 556	Transmission Electron Microscopy and its Applications I	3+0	7,5				

## PROGRAM IN ECOLOGY

### PROGRAM

#### I. SEMESTER

BİY 583	Methods of Ecological Analysis	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			30,0

#### II. SEMESTER

BİY 502	Methods of Plant Identification	3+0	7,5
BİY 538	Vegetation Ecology	3+0	7,5
BİY 592	Seminar	3+0	7,5
	<i>Elective Courses (1)</i>	-	7,5
			30,0

#### III. SEMESTER

BİY 790	Thesis	0+1	30,0
			30,0

#### ELECTIVE COURSES

BİY 501	Herbarium Techniques	3+0	7,5	BİY 515	Forest Ecology	3+0	7,5
BİY 506	Enzymatic Regulation	3+0	7,5	BİY 516	Bioenergetics	3+0	7,5
BİY 507	Biology of Lichens	3+0	7,5	BİY 517	Water Pollution and Biological Effect	3+0	7,5
BİY 509	Special Histology	3+0	7,5	BİY 518	Signal Transduction in The Cell	3+0	7,5
BİY 512	Principles of Zoological Nomenclature	3+0	7,5	BİY 519	Limnology	3+0	7,5
BİY 513	Advanced Cell Physiology	3+0	7,5	BİY 520	Bacterial Plant Diseases	3+0	7,5
BİY 514	The Harmful Insects	3+0	7,5	BİY 521	Biophotography	3+0	7,5
				BİY 522	Investigation Methods of Ecosystems	3+0	7,5

BİY 524	Fishery Biology and Population Dynamics	3+0	7,5	BİY 561	Animal Cell Culture	3+0	7,5
BİY 526	Cytogenetics	3+0	7,5	BİY 562	Molecular Biotechnology	3+0	7,5
BİY 527	Plant Microbiology	3+0	7,5	BİY 563	Halophilic Microorganisms and Their Potential in Biotechnology	3+0	7,5
BİY 528	DNA Repair Mechanisms	3+0	7,5	BİY 565	Extremophiles	3+0	7,5
BİY 529	Landscape Ecology	3+0	7,5	BİY 567	In-Vitro Techniques	3+0	7,5
BİY 530	Plant Tissue Culture	3+0	7,5	BİY 571	Taxonomy	3+0	7,5
BİY 531	Immunology	3+0	7,5	BİY 572	Molecular Biology Methods	3+0	7,5
BİY 535	Mineral Feeding Physiology in Plants	3+0	7,5	BİY 574	Foodborn Pathogen Microorganisms	3+0	7,5
BİY 537	Stress Physiology in Plants	3+0	7,5	BİY 575	Microorganisms and Biotechnology	3+0	7,5
BİY 539	Microbial Enzymes and Biotechnology	3+0	7,5	BİY 577	Enzyme Technology	3+0	7,5
BİY 543	Plant Molecular Biology	3+0	7,5	BİY 578	Arachnology	3+0	7,5
BİY 546	Methods of Genetic Taxicology	3+0	7,5	BİY 579	Plant Bacteriology	3+0	7,5
BİY 547	Forest and Park Trees	3+0	7,5	BİY 581	Permaculture	3+0	7,5
BİY 551	Stem Cell Biology	3+0	7,5	BİY 582	Cyanobacteria and Biotechnological Applications	3+0	7,5
BİY 552	Plant Science	3+0	7,5	BİY 585	Advanced Biochemistry and Metabolism	3+0	7,5
BİY 553	The Ecology of Bird Communities	3+0	7,5	BİY 586	Systematics of Lichens	3+0	7,5
BİY 555	Birds of Turkey	3+0	7,5	BİY 705	Insect Behavior	3+0	7,5
BİY 556	Transmission Electron Microscopy and its Applications I	3+0	7,5	UBJ 701	Research in Area of Specialization	3+0	4,5
BİY 557	Transmission Electron Microscopy And its Applications II	3+0	7,5	UBJ 702	Research in Area of Specialization	3+0	4,5
BİY 560	Instrumental Analyses in Biochemistry	3+0	7,5				

## PROGRAM IN FUNDAMENTAL AND INDUSTRIAL MICROBIOLOGY

### PROGRAM

#### I. SEMESTER

BİY 505	Bacteriology	3+0	7,5
BİY 549	Modern Methods for Microbial Identification and Typing	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### II. SEMESTER

BİY 584	Advanced Microbial Physiology	3+0	7,5
BİY 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### III. SEMESTER

BİY 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

BİY 501	Herbarium Techniques	3+0	7,5
BİY 506	Enzymatic Regulation	3+0	7,5
BİY 507	Biology of Lichens	3+0	7,5
BİY 509	Special Histology	3+0	7,5
BİY 512	Principles of Zoological Nomenclature	3+0	7,5
BİY 513	Advanced Cell Physiology	3+0	7,5
BİY 514	The Harmful Insects	3+0	7,5
BİY 515	Forest Ecology	3+0	7,5
BİY 516	Bioenergetics	3+0	7,5
BİY 517	Water Pollution and Biological Effect	3+0	7,5

BİY 518	Signal Transduction in The Cell	3+0	7,5
BİY 519	Limnology	3+0	7,5
BİY 520	Bacterial Plant Diseases	3+0	7,5
BİY 521	Biophotography	3+0	7,5
BİY 522	Investigation Methods of Ecosystems	3+0	7,5
BİY 524	Fishery Biology and Population Dynamics	3+0	7,5
BİY 526	Cytogenetics	3+0	7,5
BİY 527	Plant Microbiology	3+0	7,5
BİY 528	DNA Repair Mechanisms	3+0	7,5
BİY 529	Landscape Ecology	3+0	7,5
BİY 530	Plant Tissue Culture	3+0	7,5

BİY 531	Immunology	3+0	7,5	BİY 563	Halophilic Microorganisms and Their Potential in Biotechnology	3+0	7,5
BİY 535	Mineral Feeding Physiology in Plants	3+0	7,5	BİY 565	Extremophiles	3+0	7,5
BİY 537	Stress Physiology in Plants	3+0	7,5	BİY 567	In-Vitro Techniques	3+0	7,5
BİY 539	Microbial Enzymes and Biotechnology	3+0	7,5	BİY 571	Taxonomy	3+0	7,5
BİY 543	Plant Molecular Biology	3+0	7,5	BİY 572	Molecular Biology Methods	3+0	7,5
BİY 546	Methods of Genetic Taxicology	3+0	7,5	BİY 574	Foodborn Pathogen Microorganisms	3+0	7,5
BİY 547	Forest and Park Trees	3+0	7,5	BİY 575	Microorganisms and Biotechnology	3+0	7,5
BİY 551	Stem Cell Biology	3+0	7,5	BİY 577	Enzyme Technology	3+0	7,5
BİY 552	Plant Science	3+0	7,5	BİY 578	Arachnology	3+0	7,5
BİY 553	The Ecology of Bird Communities	3+0	7,5	BİY 579	Plant Bacteriology	3+0	7,5
BİY 555	Birds of Turkey	3+0	7,5	BİY 581	Permaculture	3+0	7,5
BİY 556	Transmission Electron Microscopy and its Applications I	3+0	7,5	BİY 582	Cyanobacteria and Biotechnological Applications	3+0	7,5
BİY 557	Transmission Electron Microscopy And its Applications II	3+0	7,5	BİY 585	Advanced Biochemistry and Metabolism	3+0	7,5
BİY 560	Instrumental Analyses in Biochemistry	3+0	7,5	BİY 586	Systematics of Lichens	3+0	7,5
BİY 561	Animal Cell Culture	3+0	7,5	BİY 705	Insect Behavior	3+0	7,5
BİY 562	Molecular Biotechnology	3+0	7,5	UBJ 701	Research in Area of Specialization	3+0	4,5
				UBJ 702	Research in Area of Specialization	3+0	4,5

## PROGRAM IN MOLECULAR BIOLOGY

### PROGRAM

#### I. SEMESTER

BİY 573	Scientific Research in Biology	3+0	7,5
BİY 591	Advanced Molecular Biology and Genetics	4+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### II. SEMESTER

BİY 511	Gene Regulation	3+0	7,5
BİY 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### III. SEMESTER

BİY 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

BİY 501	Herbarium Techniques	3+0	7,5	BİY 522	Investigation Methods of Ecosystems	3+0	7,5
BİY 506	Enzymatic Regulation	3+0	7,5	BİY 524	Fishery Biology and Population Dynamics	3+0	7,5
BİY 507	Biology of Lichens	3+0	7,5	BİY 526	Cytogenetics	3+0	7,5
BİY 509	Special Histology	3+0	7,5	BİY 527	Plant Microbiology	3+0	7,5
BİY 512	Principles of Zoological Nomenclature	3+0	7,5	BİY 528	DNA Repair Mechanisms	3+0	7,5
BİY 513	Advanced Cell Physiology	3+0	7,5	BİY 529	Landscape Ecology	3+0	7,5
BİY 514	The Harmful Insects	3+0	7,5	BİY 530	Plant Tissue Culture	3+0	7,5
BİY 515	Forest Ecology	3+0	7,5	BİY 531	Immunology	3+0	7,5
BİY 516	Bioenergetics	3+0	7,5	BİY 535	Mineral Feeding Physiology in Plants	3+0	7,5
BİY 517	Water Pollution and Biological Effect	3+0	7,5	BİY 537	Stress Physiology in Plants	3+0	7,5
BİY 518	Signal Transduction in The Cell	3+0	7,5	BİY 539	Microbial Enzymes and Biotechnology	3+0	7,5
BİY 519	Limnology	3+0	7,5	BİY 543	Plant Molecular Biology	3+0	7,5
BİY 520	Bacterial Plant Diseases	3+0	7,5	BİY 546	Methods of Genetic Taxicology	3+0	7,5
BİY 521	Biophotography	3+0	7,5	BİY 547	Forest and Park Trees	3+0	7,5

BİY 551	Stem Cell Biology	3+0	7,5	BİY 572	Molecular Biology Methods	3+0	7,5
BİY 552	Plant Science	3+0	7,5	BİY 574	Foodborn Pathogen Microorganisms	3+0	7,5
BİY 553	The Ecology of Bird Communities	3+0	7,5	BİY 575	Microorganisms and Biotechnology	3+0	7,5
BİY 555	Birds of Turkey	3+0	7,5	BİY 577	Enzyme Technology	3+0	7,5
BİY 556	Transmission Electron Microscopy and its Applications I	3+0	7,5	BİY 578	Arachnology	3+0	7,5
BİY 557	Transmission Electron Microscopy And its Applications II	3+0	7,5	BİY 579	Plant Bacteriology	3+0	7,5
BİY 560	Instrumental Analyses in Biochemistry	3+0	7,5	BİY 581	Permaculture	3+0	7,5
BİY 561	Animal Cell Culture	3+0	7,5	BİY 582	Cyanobacteria and Biotechnological Applications	3+0	7,5
BİY 562	Molecular Biotechnology	3+0	7,5	BİY 585	Advanced Biochemistry and Metabolism	3+0	7,5
BİY 563	Halophilic Microorganisms and Their Potential in Biotechnology	3+0	7,5	BİY 586	Systematics of Lichens	3+0	7,5
BİY 565	Extremophiles	3+0	7,5	BİY 705	Insect Behavior	3+0	7,5
BİY 567	In-Vitro Techniques	3+0	7,5	UBJ 701	Research in Area of Specialization	3+0	4,5
BİY 571	Taxonomy	3+0	7,5	UBJ 702	Research in Area of Specialization	3+0	4,5

## PROGRAM IN ZOOLOGY

### PROGRAM

#### I. SEMESTER

BİY 523	Zootaxonomy	3+0	7,5
BİY 573	Scientific Research in Biology	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### II. SEMESTER

BİY 525	The Collection Methods of Invertebrate Animals	3+0	7,5
BİY 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### III. SEMESTER

BİY 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

BİY 501	Herbarium Techniques	3+0	7,5
BİY 506	Enzymatic Regulation	3+0	7,5
BİY 507	Biology of Lichens	3+0	7,5
BİY 509	Special Histology	3+0	7,5
BİY 512	Principles of Zoological Nomenclature	3+0	7,5
BİY 513	Advanced Cell Physiology	3+0	7,5
BİY 514	The Harmful Insects	3+0	7,5
BİY 515	Forest Ecology	3+0	7,5
BİY 516	Bioenergetics	3+0	7,5
BİY 517	Water Pollution and Biological Effect	3+0	7,5
BİY 518	Signal Transduction in The Cell	3+0	7,5
BİY 519	Limnology	3+0	7,5
BİY 520	Bacterial Plant Diseases	3+0	7,5
BİY 521	Biophotography	3+0	7,5
BİY 522	Investigation Methods of Ecosystems	3+0	7,5
BİY 524	Fishery Biology and Population Dynamics	3+0	7,5
BİY 526	Cytogenetics	3+0	7,5

BİY 527	Plant Microbiology	3+0	7,5
BİY 528	DNA Repair Mechanisms	3+0	7,5
BİY 529	Landscape Ecology	3+0	7,5
BİY 530	Plant Tissue Culture	3+0	7,5
BİY 531	Immunology	3+0	7,5
BİY 535	Mineral Feeding Physiology in Plants	3+0	7,5
BİY 537	Stress Physiology in Plants	3+0	7,5
BİY 539	Microbial Enzymes and Biotechnology	3+0	7,5
BİY 543	Plant Molecular Biology	3+0	7,5
BİY 546	Methods of Genetic Taxicology	3+0	7,5
BİY 547	Forest and Park Trees	3+0	7,5
BİY 551	Stem Cell Biology	3+0	7,5
BİY 552	Plant Science	3+0	7,5
BİY 553	The Ecology of Bird Communities	3+0	7,5
BİY 555	Birds of Turkey	3+0	7,5
BİY 556	Transmission Electron Microscopy and its Applications I	3+0	7,5
BİY 557	Transmission Electron Microscopy And its Applications II	3+0	7,5

BiY 560	Instrumental Analyses in Biochemistry	3+0	7,5	BiY 579	Plant Bacteriology	3+0	7,5
BiY 561	Animal Cell Culture	3+0	7,5	BiY 581	Permaculture	3+0	7,5
BiY 562	Molecular Biotechnology	3+0	7,5	BiY 582	Cyanobacteria and Biotechnological Applications	3+0	7,5
BiY 563	Halophilic Microorganisms and Their Potential in Biotechnology	3+0	7,5	BiY 585	Advanced Biochemistry and Metabolism	3+0	7,5
BiY 565	Extremophiles	3+0	7,5	BiY 586	Systematics of Lichens	3+0	7,5
BiY 567	In-Vitro Techniques	3+0	7,5	BiY 705	Insect Behavior	3+0	7,5
BiY 571	Taxonomy	3+0	7,5	UBJ 701	Research in Area of Specialization	3+0	4,5
BiY 572	Molecular Biology Methods	3+0	7,5	UBJ 702	Research in Area of Specialization	3+0	4,5
BiY 574	Foodborn Pathogen Microorganisms	3+0	7,5				
BiY 575	Microorganisms and Biotechnology	3+0	7,5				
BiY 577	Enzyme Technology	3+0	7,5				
BiY 578	Arachnology	3+0	7,5				

## DEPARTMENT OF CERAMIC ENGINEERING

Head : Prof. Dr. Servet TURAN

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

##### I. SEMESTER

MLZ 501	The Structure-Property Relationships in Materials	3+0	7,5
SRM 501	Ceramic Forming Techniques	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

##### II. SEMESTER

MAT 517	Applied Mathematics	3+0	7,5
MLZ 502	Thermodynamic Applications in Material Science	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

##### III. SEMESTER

SRM 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

##### ELECTIVE COURSES

CAM 513	Metallic Glasses	3+0	7,5
CAM 514	Chemical Durability of Glasses	3+0	7,5
CAM 515	Engineering Glasses	3+0	7,5
ENM 501	Design and Analysis of Experiments	3+0	7,5
MLZ 504	Fracture Mechanics of Materials	3+0	7,5
MLZ 509	Advanced Composite Materials	3+0	7,5
MLZ 510	Thin Film Production and Vacuum Technologies	3+0	7,5
MLZ 511	Dielectric Materials and Devices	3+0	7,5
MLZ 512	Applications of Crystallography	3+0	7,5
MLZ 513	Raw Materials and Mineral Processing	3+0	7,5
MLZ 514	The use of Glass Materials in Industry	3+0	7,5
MLZ 515	Refractory Technology	3+0	7,5

MLZ 516	Coating Techniques	3+0	7,5
MLZ 517	X-Ray Diffraction Techniques in Materials Characterisation	3+0	7,5
SRM 502	Rheological Behavior of Ceramics	3+0	7,5
SRM 510	High Temperature Properties of Ceramic Materials	3+0	7,5
SRM 513	Making of Heavy-Clay Products	3+0	7,5
SRM 517	Ceramic Body and Glaze	3+0	7,5
SRM 520	Ceramic Tiles and Sanitary ware Production	3+0	7,5
SRM 526	Ceramic-Metallic Thin Films and Coatings	3+0	7,5

## DOCTORATE DEGREE (PH.D)

Materials Science and Engineering is an interdisciplinary field of science that studies ceramic, metallic, polymeric and composite materials and is strongly interrelated with the basic sciences of physics, chemistry and biology as well as chemical and mechanical engineering. The courses offered in the Materials Science and Engineering program especially emphasize the microstructure-property-performance relationships as well as factors that affect the materials behaviour in service. Materials are critical to all fields of engineering since design is often constrained by their limited availability. Furthermore, innovations in materials may lead to new design criteria and result in emergence of new products. Thus, most programs within the Faculty of Engineering involve one or two courses on Materials Science and Engineering. In spite of the fact that the metals and their alloys still constitute the most widely used family of engineering materials, improvements and developments in ceramic, polymer and composite materials are being achieved at an increasing rate.

The department was established in 1993 as Ceramic Engineering Department then in 2002 the curriculum was extended and its name was changed to Department of Materials Science & Engineering. The department is located at the Iki Eylül Campus and occupies a covered area of 5000 m<sup>2</sup>. 3 Professors, 4 Associate Professors, 4 Assistant Professors and 13 Assistants are currently working in the department. The decisions related with the department are made by the department academic board which is composed of all faculty members of the department. The department is governed by one head of department and two deputy head of department. One of the head of department takes care of technical activities of the department while the other deputy head of department assists the head of department in academic activities in the department.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
SRM 890	Thesis	0+1	30,0	SRM 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
<b>ELECTIVE COURSES</b>				MLZ 612	Ferroelectric Materials and Devices	3+0	7,5
CAM 601	Ionic Diffusion in Oxide Based Glasses	3+0	7,5	MLZ 613	Crystal Anisotropy	3+0	7,5
CAM 602	Glass Science and Technological Improvements	3+0	7,5	MLZ 614	Spintronic and Applications	3+0	7,5
MLZ 601	Scanning Electron Microscopy and Chemical Analysis Techniques	3+0	7,5	MLZ 615	Material and Energy Balance in Production	3+0	7,5
MLZ 602	Transmission Electron Microscope and Chemical Analysis Techniques	3+0	7,5	MLZ 616	Colloid Chemistry and Rheological Behaviour	3+0	7,5
MLZ 603	Special X-Ray Techniques and Their Applications	3+0	7,5	MLZ 617	Inorganic Pigments and Pigments Interactions	3+0	7,5
MLZ 604	Inorganic Powder Synthesis Technologies	3+0	7,5	MLZ 618	The Relationship between Structure and Properties in Industrial Glazes	3+0	7,5
MLZ 605	Sintering of Particulate Materials	3+0	7,5	SRM 604	Ceramic Sensors	3+0	7,5
MLZ 606	Phase Transformation Reactions of Metals	3+0	7,5	SRM 606	Structural Advanced Ceramics	3+0	7,5
MLZ 607	Alloy Development-Principles, New Horizons and Extreme Applications	3+0	7,5	USM 901	Research in Area of Specialization	5+0	7,5
MLZ 610	Kinetics	3+0	7,5	USM 902	Research in Area of Specialization	5+0	7,5
MLZ 611	Diffusion in Solids	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

Materials Science and Engineering is an interdisciplinary field of science that studies ceramic, metallic, polymeric and composite materials and is strongly interrelated with the basic sciences of physics, chemistry and biology as well as chemical and mechanical engineering. The courses offered in the Materials Science and Engineering program especially emphasize the microstructure-property-performance relationships as well as factors that affect the materials behaviour in service. Materials are critical to all fields of engineering since design is often constrained by their limited availability. Furthermore, innovations in materials may lead to new design criteria and result in emergence of new products. Thus, most programs within the Faculty of Engineering involve one or two courses on Materials Science and Engineering. In spite of the fact that the metals and their alloys still constitute the most widely used family of engineering materials, improvements and developments in ceramic, polymer and composite materials are being achieved at an increasing rate.

The department was established in 1993 as Ceramic Engineering Department then in 2002 the curriculum was extended and its name was changed to Department of Materials Science & Engineering. The department is located at the İki Eylül Campus and occupies a covered area of 5000 m<sup>2</sup>. 3 Professors, 4 Associate Professors, 4 Assistant Professors and 13 Assistants are currently working in the department. The decisions related with the department are made by the department academic board which is composed of all faculty members of the department. The department is governed by one head of department and two deputy head of department. One of the head of department takes care of technical activities of the department while the other deputy head of department assists the head of department in academic activities in the department.

### PROGRAM

I. SEMESTER				II. SEMESTER			
MLZ 501	The Structure-Property Relationships in Materials	3+0	7,5	MAT 517	Applied Mathematics	3+0	7,5
SRM 501	Ceramic Forming Techniques	3+0	7,5	MLZ 502	Thermodynamic Applications in Material Science	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0	SRM 592	Seminar	3+0	7,5
			<u>30,0</u>		<i>Elective Courses (1)</i>	-	7,5
							<u>30,0</u>
III. SEMESTER							
SRM 790	Thesis	0+1	30,0				
			<u>30,0</u>				
ELECTIVE COURSES							
CAM 513	Metallic Glasses	3+0	7,5	MLZ 517	X-Ray Diffraction Techniques in Materials Characterisation	3+0	7,5
CAM 514	Chemical Durability of Glasses	3+0	7,5	SRM 502	Rheological Behavior of Ceramics	3+0	7,5
CAM 515	Engineering Glasses	3+0	7,5	SRM 510	High Temperature Properties of Ceramic Materials	3+0	7,5
ENM 501	Design and Analysis of Experiments	3+0	7,5	SRM 513	Making of Heavy-Clay Products	3+0	7,5
MLZ 504	Fracture Mechanics of Materials	3+0	7,5	SRM 517	Ceramic Body and Glaze	3+0	7,5
MLZ 509	Advanced Composite Materials	3+0	7,5	SRM 520	Ceramic Tiles and Sanitary ware Production	3+0	7,5
MLZ 510	Thin Film Production and Vacuum Technologies	3+0	7,5	SRM 526	Ceramic-Metallic Thin Films and Coatings	3+0	7,5
MLZ 511	Dielectric Materials and Devices	3+0	7,5	USM 701	Research in Area of Specialization	3+0	4,5
MLZ 512	Applications of Crystallography	3+0	7,5	USM 702	Research in Area of Specialization	3+0	4,5
MLZ 513	Raw Materials and Mineral Processing	3+0	7,5				
MLZ 514	The use of Glass Materials in Industry	3+0	7,5				
MLZ 515	Refractory Technology	3+0	7,5				
MLZ 516	Coating Techniques	3+0	7,5				

## DEPARTMENT OF CHEMICAL ENGINEERING

Head : Prof. Dr. Süleyman KAYTAKOĞLU



## DOCTORATE DEGREE (PH.D)

Chemical Engineering involves in the design, construction and operation of processes which convert raw materials into useful products by changing their chemical or physical state. The discipline of chemical engineering has its origins in oil refining and petrochemical production, but the skills of a chemical engineer are now applied in a wide range of other industries, such as food and drink manufacture, pharmaceuticals, paper, plastics, water purification, electricity generation, metals, textiles, medical products, semi-conductors, perfumes and fragrances, detergents and cosmetics.

The department was established in 1997. The department is located at the İki Eylül Campus and occupies a covered area of 5000 m<sup>2</sup>. 4 Professors, 1 Associate Professors, 6 Assistant Professors and 5 Assistants are currently working in the department. The decisions related with the department are made by the department academic board which is composed of all faculty members of the department. The department is governed by one department head and two deputy department head. One of the deputy department head takes care of technical activities of the department while the other deputy department head assists the department head in academic activities in the department.

### PROGRAM

I. SEMESTER			II. SEMESTER		
<i>Elective Courses (4)</i>	-	30,0	<i>Elective Courses (3)</i>	-	22,5
		<u>30,0</u>			<u>22,5</u>
III. SEMESTER			IV. SEMESTER		
KMH 890 Thesis	0+1	30,0	KMH 890 Thesis	0+1	30,0
		<u>30,0</u>			<u>30,0</u>
<b>ELECTIVE COURSES</b>					
KMH 601 Stage Separation Processes I	3+0	7,5	KMH 613 Coal Technology	3+0	7,5
KMH 602 Stage Separation Processes II	3+0	7,5	KMH 622 Mathematical Methods in Chemical Engineering II	3+0	7,5
KMH 604 Petroleum Refinery Engineering	3+0	7,5	KMH 630 Numerical Methods in Chemical Engineering II	3+0	7,5
KMH 605 Heterogeneous Reaction Kinetics and Reactor Design	3+0	7,5	UKH 901 Research in Area of Specialization	5+0	7,5
KMH 606 Advanced Mathematical Modeling in Chemical Engineering	3+0	7,5	UKH 902 Research in Area of Specialization	5+0	7,5
KMH 609 Synthetic Fuel Production By Thermochemical Methods	3+0	7,5			

## MASTER OF SCIENCE (MS) DEGREE

Chemical Engineering involves in the design, construction and operation of processes which convert raw materials into useful products by changing their chemical or physical state. The discipline of chemical engineering has its origins in oil refining and petrochemical production, but the skills of a chemical engineer are now applied in a wide range of other industries, such as food and drink manufacture, pharmaceuticals, paper, plastics, water purification, electricity generation, metals, textiles, medical products, semi-conductors, perfumes and fragrances, detergents and cosmetics.

The department was established in 1997. The department is located at the İki Eylül Campus and occupies a covered area of 5000 m<sup>2</sup>. 4 Professors, 1 Associate Professors, 6 Assistant Professors and 5 Assistants are currently working in the department. The decisions related with the department are made by the department academic board which is composed of all faculty members of the department. The department is governed by one department head and two deputy department head. One of the deputy department head takes care of technical activities of the department while the other deputy department head assists the department head in academic activities in the department.

## PROGRAM

I. SEMESTER				II. SEMESTER			
KMH 513	Advanced Transport Phenomena	3+0	7,5	KMH 501	Advanced Chemical Engineering Thermodynamics	3+0	7,5
KMH 521	Mathematical Methods in Chemical Engineering I	3+0	7,5	KMH 510	Advanced Reactor Design	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0	KMH 592	Seminar	3+0	7,5
			<u>30,0</u>		<i>Elective Courses (1)</i>	-	7,5
							<u>30,0</u>
III. SEMESTER							
KMH 790	Thesis	0+1	30,0				
			<u>30,0</u>				
ELECTIVE COURSES							
KMH 505	Advanced Mass Transfer	3+0	7,5	KMH 525	Supercritical Fluid Extraction	3+0	7,5
KMH 506	Advanced Process Control	3+0	7,5	KMH 526	Membrane Separation Processes	3+0	7,5
KMH 507	Advanced Heat Transfer	3+0	7,5	KMH 527	Electrochemical Engineering	3+0	7,5
KMH 509	Fuel and Energy	3+0	7,5	KMH 528	Fuel Cells	3+0	7,5
KMH 511	Advanced Instrumental Analysis	3+0	7,5	KMH 529	Numerical Methods in Chemical Engineering I	3+0	7,5
KMH 516	Physical Operations in Food Technologies	3+0	7,5	KMH 530	Design of Experiments in Chemical Engineering	3+0	7,5
KMH 517	Advanced Stoichiometry	3+0	7,5	KMH 531	Bioseparation Engineering	3+0	7,5
KMH 518	New and Renewable Energy Sources	3+0	7,5	KMH 532	Biochemical Engineering	3+0	7,5
KMH 519	Advanced Fluid Mechanics	3+0	7,5	KMH 533	Polymer Synthesis	3+0	7,5
KMH 520	Chromatographic Separation Processes	3+0	7,5	KMH 535	Porous Materials	3+0	7,5
KMH 523	Advanced Separations Processes	3+0	7,5	UKH 701	Research in Area of Specialization	3+0	4,5
KMH 524	Materials' Synthesis, Characterization and Applications	3+0	7,5	UKH 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF CHEMISTRY

Head : Prof. Dr. İbrahim KANİ

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM IN ANALYTICAL CHEMISTRY

PROGRAM				PROGRAM			
I. SEMESTER				II. SEMESTER			
KİM 523	Complex Equilibria in Analytical Chemistry	3+0	7,5	KİM 532	Modern Analysis Methods II	3+0	7,5
KİM 531	Modern Analysis Methods I	3+0	7,5		<i>Elective Courses (3)</i>	-	22,5
	<i>Elective Courses (2)</i>	-	15,0				<u>30,0</u>
			<u>30,0</u>				
III. SEMESTER							
KİM 599	Term Project	3+0	15,0				
	<i>Elective Courses (2)</i>	-	15,0				
			<u>30,0</u>				

**ELECTIVE COURSES**

KİM 506	Polymer Chemistry	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5
KİM 521	Adsorption	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5
KİM 536	Chromatographic Techniques	3+0	7,5
KİM 537	Organic Macro Molecules	3+0	7,5

KİM 539	Quantitative Structure Property Relationship	3+0	7,5
KİM 550	Reagents In Organic Synthesis	3+0	7,5
KİM 551	Sensors and Their Applications	3+0	7,5
KİM 558	Biochromatography	3+0	7,5
KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 562	Inorganic Polymers	3+0	7,5
KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 569	Structure Determination of Organic Chemistry	3+0	7,5

**PROGRAM IN BIOCHEMISTRY****PROGRAM****I. SEMESTER**

KİM 531	Modern Analysis Methods I	3+0	7,5
KİM 571	Molecular and Cellular Biochemistry	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

**II. SEMESTER**

KİM 532	Modern Analysis Methods II	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			<hr/> 30,0

**III. SEMESTER**

KİM 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

**ELECTIVE COURSES**

KİM 506	Polymer Chemistry	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5
KİM 521	Adsorption	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5
KİM 536	Chromatographic Techniques	3+0	7,5
KİM 537	Organic Macro Molecules	3+0	7,5
KİM 539	Quantitative Structure Property Relationship	3+0	7,5

KİM 550	Reagents In Organic Synthesis	3+0	7,5
KİM 551	Sensors and Their Applications	3+0	7,5
KİM 558	Biochromatography	3+0	7,5
KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 562	Inorganic Polymers	3+0	7,5
KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 569	Structure Determination of Organic Chemistry	3+0	7,5

## PROGRAM IN INORGANIC CHEMISTRY

### PROGRAM

I. SEMESTER			II. SEMESTER		
KİM 531	Modern Analysis Methods I	3+0 7,5	KİM 515	Complexes Chemistry	3+0 7,5
KİM 534	Organometallic Chemistry	3+0 7,5	KİM 518	Selected Topics in Inorganic Chemistry II	3+0 7,5
	<i>Elective Courses (2)</i>	- 15,0		<i>Elective Courses (2)</i>	- 15,0
		<u>30,0</u>			<u>30,0</u>
III. SEMESTER					
KİM 599	Term Project	3+0 15,0			
	<i>Elective Courses (2)</i>	- 15,0			
		<u>30,0</u>			
ELECTIVE COURSES					
KİM 506	Polymer Chemistry	3+0 7,5	KİM 539	Quantitative Structure Property Relationship	3+0 7,5
KİM 509	Carbon-Carbon Bond Formation	3+0 7,5	KİM 550	Reagents In Organic Synthesis	3+0 7,5
KİM 510	Advanced NMR Techniques	3+0 7,5	KİM 551	Sensors and Their Applications	3+0 7,5
KİM 511	Electrochemistry	3+0 7,5	KİM 558	Biochromatography	3+0 7,5
KİM 516	Physical Organic Chemistry	3+0 7,5	KİM 560	Alternative Reaction Systems	3+0 7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0 7,5	KİM 561	Novel Tendencies in Liquid Chromatography	3+0 7,5
KİM 521	Adsorption	3+0 7,5	KİM 562	Inorganic Polymers	3+0 7,5
KİM 524	Bioinorganic Chemistry	3+0 7,5	KİM 563	Natural Product Synthesis I	3+0 7,5
KİM 525	Quantum Chemistry	3+0 7,5	KİM 564	Natural Product Synthesis II	3+0 7,5
KİM 526	Microwave Organic Synthesis	3+0 7,5	KİM 565	Literature Search in Chemistry	3+0 7,5
KİM 529	Catalytic Chemistry	3+0 7,5	KİM 566	Stereo Selective Reactions and Practical Approach	3+0 7,5
KİM 533	Electroanalytical Chemistry	3+0 7,5	KİM 567	Applications of Computational Chemistry	3+0 7,5
KİM 535	Data Analysis in Chemistry	3+0 7,5	KİM 568	Solvent-free Organic Synthesis	3+0 7,5
KİM 536	Chromatographic Techniques	3+0 7,5	KİM 569	Structure Determination of Organic Chemistry	3+0 7,5
KİM 537	Organic Macro Molecules	3+0 7,5			

## PROGRAM IN ORGANIC CHEMISTRY

### PROGRAM

I. SEMESTER			II. SEMESTER		
KİM 501	Selected Topics in Organic Chemistry I	3+0 7,5	KİM 502	Selected Topics in Organic Chemistry II	3+0 7,5
KİM 519	Heterocyclic Chemistry I	3+0 7,5	KİM 520	Heterocyclic Chemistry II	3+0 7,5
	<i>Elective Courses (2)</i>	- 15,0		<i>Elective Courses (2)</i>	- 15,0
		<u>30,0</u>			<u>30,0</u>
III. SEMESTER					
KİM 599	Term Project	3+0 15,0			
	<i>Elective Courses (2)</i>	- 15,0			
		<u>30,0</u>			

**ELECTIVE COURSES**

KİM 506	Polymer Chemistry	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5
KİM 521	Adsorption	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5
KİM 536	Chromatographic Techniques	3+0	7,5
KİM 537	Organic Macro Molecules	3+0	7,5

KİM 539	Quantitative Structure Property Relationship	3+0	7,5
KİM 550	Reagents In Organic Synthesis	3+0	7,5
KİM 551	Sensors and Their Applications	3+0	7,5
KİM 558	Biochromatography	3+0	7,5
KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 562	Inorganic Polymers	3+0	7,5
KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 569	Structure Determination of Organic Chemistry	3+0	7,5

**PROGRAM IN PHYSICAL CHEMISTRY****PROGRAM****I. SEMESTER**

KİM 504	Chemical Kinetics	3+0	7,5
KİM 531	Modern Analysis Methods I	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

**II. SEMESTER**

KİM 513	Chemical Thermodynamics	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			<hr/> 30,0

**III. SEMESTER**

KİM 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<hr/> 30,0

**ELECTIVE COURSES**

KİM 506	Polymer Chemistry	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5
KİM 521	Adsorption	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5
KİM 536	Chromatographic Techniques	3+0	7,5
KİM 537	Organic Macro Molecules	3+0	7,5
KİM 539	Quantitative Structure Property Relationship	3+0	7,5

KİM 550	Reagents In Organic Synthesis	3+0	7,5
KİM 551	Sensors and Their Applications	3+0	7,5
KİM 558	Biochromatography	3+0	7,5
KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 562	Inorganic Polymers	3+0	7,5
KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 569	Structure Determination of Organic Chemistry	3+0	7,5

## DOCTORATE DEGREE (PH.D)

Chemistry is an interdisciplinary field of science that is strongly interrelated with the basic sciences of biology, physics and pharmaceutical chemistry and places in technology with the application of polymeric materials, catalysis, organic and inorganic synthesis. Analytical Chemistry, Inorganic Chemistry, Organic Chemistry and Physical Chemistry are the four Major Branches of the Department. The courses offered in Chemistry program especially emphasize the fundamentals of Chemistry and then advanced Chemistry considering all these major subjects. B.2.1 Information About the Department The department of Chemistry was established in 1993 and is located at the Yunus Emre Campus. 1 Professor, 4 Assoc. Prof., 8 Assist. Prof, 4 Instructors and 10 Assistants are currently working in the department. The research laboratories of the department are equipped with all the research equipment and facilities needed to do scientific research with the support of Scientific and Technical Research Council of Turkey (TUBITAK), DPT and Anadolu University. The decisions related with department are made by the department academic board which is composed of faculty members of the department or only chairs of Divisions. The department is governed by one department head and two deputy department head. One of the deputy department head takes care of technical activities of the department while the other deputy department head assists the department head in academic activities in the department.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
KİM 890	Thesis	0+1	30,0	KİM 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
<b>ELECTIVE COURSES</b>				KİM 645	Bioorganic Chemistry	3+0	7,5
KİM 601	Investigations of Mechanisms in Organic Chemistry I	3+0	7,5	KİM 646	Nanochemistry	3+0	7,5
KİM 602	Investigations of Mechanisms in Organic Chemistry II	3+0	7,5	KİM 647	Molecular Structure Calculations and Theories	3+0	7,5
KİM 603	Organic Synthesis	3+0	7,5	KİM 648	Named Reactions in Organic Chemistry	3+0	7,5
KİM 606	Molecular Symmetry and Spectroscopy	3+0	7,5	KİM 649	Organic Functional Group Preparations I	3+0	7,5
KİM 609	Advanced Polymer Chemistry	3+0	7,5	KİM 650	Organic Functional Group Preparations II	3+0	7,5
KİM 612	Pericyclic Chemistry	3+0	7,5	KİM 651	Biosensors	3+0	7,5
KİM 614	Conducting Polymers	3+0	7,5	KİM 654	Proteomics and Genomics	3+0	7,5
KİM 615	Chemistry of Drugs I	3+0	7,5	KİM 657	Asymmetric Organic Synthesis I	3+0	7,5
KİM 616	Chemistry of Drugs II	3+0	7,5	KİM 658	Asymmetric Organic Synthesis II	3+0	7,5
KİM 617	Statistical Thermodynamics	3+0	7,5	KİM 659	Synthesis of Amino Acids and Peptides	3+0	7,5
KİM 618	Molecular Imprinted Polymers and Applications	3+0	7,5	KİM 665	Bioorganometallic Chemistry	3+0	7,5
KİM 619	Organic Electrochemistry	3+0	7,5	KİM 667	Metals in Catalytic Reactions I	3+0	7,5
KİM 620	Surface Chemistry	3+0	7,5	KİM 669	Analytical Method Development and Validation	3+0	7,5
KİM 621	Supercritical Fluids	3+0	7,5	UKM 901	Research in Area of Specialization	5+0	7,5
KİM 622	Ion Selective Electrodes	3+0	7,5	UKM 902	Research in Area of Specialization	5+0	7,5
KİM 623	Affinity Chromatography	3+0	7,5				
KİM 624	Solvent Extraction Chemistry	3+0	7,5				
KİM 642	Photochemistry	3+0	7,5				
KİM 643	Named Reactions in Heterocyclic Chemistry	3+0	7,5				
KİM 644	Stereochemistry	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

Chemistry is an interdisciplinary field of science that is strongly interrelated with the basic sciences of biology, physics and pharmaceutical chemistry and places in technology with the application of polymeric materials, catalysis, organic and inorganic synthesis. Analytical Chemistry, Inorganic Chemistry, Organic Chemistry and Physical Chemistry are the four Major Branches of the Department. The courses offered in Chemistry program especially emphasize the fundamentals of Chemistry and then advanced Chemistry considering all these major subjects. B.2.1 Information About the Department The department of Chemistry was established in 1993 and is located at the Yunus Emre Campus. 1 Professor, 4 Assoc. Prof., 8 Assist. Prof, 4 Instructors and 10 Assistants are currently working in the department. The research laboratories of the department are equipped with all the research equipment and facilities needed to do scientific research with the support of Scientific and Technical Research Council of Turkey (TUBITAK), DPT and Anadolu University. The decisions related with department are made by the department academic board which is composed of faculty members of the department or only chairs of Divisions. The department is governed by one department head and two deputy department head. One of the deputy department head takes care of technical activities of the department while the other deputy department head assists the department head in academic activities in the department.

### PROGRAM IN ANALYTICAL CHEMISTRY

#### PROGRAM

I. SEMESTER				II. SEMESTER			
KİM 523	Complex Equilibria in Analytical Chemistry	3+0	7,5	KİM 532	Modern Analysis Methods II	3+0	7,5
KİM 531	Modern Analysis Methods I	3+0	7,5	KİM 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0		<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>				<u>30,0</u>
III. SEMESTER							
KİM 790	Thesis	0+1	30,0				
			<u>30,0</u>				
ELECTIVE COURSES							
KİM 506	Polymer Chemistry	3+0	7,5	KİM 551	Sensors and Their Applications	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5	KİM 558	Biochromatography	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5	KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5	KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5	KİM 562	Inorganic Polymers	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5	KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 521	Adsorption	3+0	7,5	KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5	KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5	KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5	KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5	KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5	KİM 569	Structure Determination of Organic Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5	UKM 701	Research in Area of Specialization	3+0	4,5
KİM 536	Chromatographic Techniques	3+0	7,5	UKM 702	Research in Area of Specialization	3+0	4,5
KİM 537	Organic Macro Molecules	3+0	7,5				
KİM 539	Quantitative Structure Property Relationship	3+0	7,5				
KİM 550	Reagents In Organic Synthesis	3+0	7,5				

## PROGRAM IN BIOCHEMISTRY

### PROGRAM

I. SEMESTER			II. SEMESTER		
KİM 531	Modern Analysis Methods I	3+0 7,5	KİM 532	Modern Analysis Methods II	3+0 7,5
KİM 571	Molecular and Cellular Biochemistry	3+0 7,5	KİM 592	Seminar	3+0 7,5
	<i>Elective Courses (2)</i>	- 15,0		<i>Elective Courses (2)</i>	- 15,0
		<u>30,0</u>			<u>30,0</u>
III. SEMESTER					
KİM 790	Thesis	0+1 30,0			
		<u>30,0</u>			
ELECTIVE COURSES					
KİM 506	Polymer Chemistry	3+0 7,5	KİM 551	Sensors and Their Applications	3+0 7,5
KİM 509	Carbon-Carbon Bond Formation	3+0 7,5	KİM 558	Biochromatography	3+0 7,5
KİM 510	Advanced NMR Techniques	3+0 7,5	KİM 560	Alternative Reaction Systems	3+0 7,5
KİM 511	Electrochemistry	3+0 7,5	KİM 561	Novel Tendencies in Liquid Chromatography	3+0 7,5
KİM 516	Physical Organic Chemistry	3+0 7,5	KİM 562	Inorganic Polymers	3+0 7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0 7,5	KİM 563	Natural Product Synthesis I	3+0 7,5
KİM 521	Adsorption	3+0 7,5	KİM 564	Natural Product Synthesis II	3+0 7,5
KİM 524	Bioinorganic Chemistry	3+0 7,5	KİM 565	Literature Search in Chemistry	3+0 7,5
KİM 525	Quantum Chemistry	3+0 7,5	KİM 566	Stereo Selective Reactions and Practical Approach	3+0 7,5
KİM 526	Microwave Organic Synthesis	3+0 7,5	KİM 567	Applications of Computational Chemistry	3+0 7,5
KİM 529	Catalytic Chemistry	3+0 7,5	KİM 568	Solvent-free Organic Synthesis	3+0 7,5
KİM 533	Electroanalytical Chemistry	3+0 7,5	KİM 569	Structure Determination of Organic Chemistry	3+0 7,5
KİM 535	Data Analysis in Chemistry	3+0 7,5	UKM 701	Research in Area of Specialization	3+0 4,5
KİM 536	Chromatographic Techniques	3+0 7,5	UKM 702	Research in Area of Specialization	3+0 4,5
KİM 537	Organic Macro Molecules	3+0 7,5			
KİM 539	Quantitative Structure Property Relationship	3+0 7,5			
KİM 550	Reagents In Organic Synthesis	3+0 7,5			

## PROGRAM IN INORGANIC CHEMISTRY

### PROGRAM

I. SEMESTER			II. SEMESTER		
KİM 531	Modern Analysis Methods I	3+0 7,5	KİM 515	Complexes Chemistry	3+0 7,5
KİM 534	Organometallic Chemistry	3+0 7,5	KİM 518	Selected Topics in Inorganic Chemistry II	3+0 7,5
	<i>Elective Courses (2)</i>	- 15,0	KİM 592	Seminar	3+0 7,5
		<u>30,0</u>		<i>Elective Courses (1)</i>	- 7,5
					<u>30,0</u>
III. SEMESTER					
KİM 790	Thesis	0+1 30,0			
		<u>30,0</u>			



**ELECTIVE COURSES**

KİM 506	Polymer Chemistry	3+0	7,5	KİM 551	Sensors and Their Applications	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5	KİM 558	Biochromatography	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5	KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5	KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5	KİM 562	Inorganic Polymers	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5	KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 521	Adsorption	3+0	7,5	KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5	KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5	KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5	KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5	KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5	KİM 569	Structure Determination of Organic Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5	UKM 701	Research in Area of Specialization	3+0	4,5
KİM 536	Chromatographic Techniques	3+0	7,5	UKM 702	Research in Area of Specialization	3+0	4,5
KİM 537	Organic Macro Molecules	3+0	7,5				
KİM 539	Quantitative Structure Property Relationship	3+0	7,5				
KİM 550	Reagents In Organic Synthesis	3+0	7,5				

**PROGRAM IN ORGANIC CHEMISTRY****PROGRAM****I. SEMESTER**

KİM 501	Selected Topics in Organic Chemistry I	3+0	7,5
KİM 519	Heterocyclic Chemistry I	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

**II. SEMESTER**

KİM 502	Selected Topics in Organic Chemistry II	3+0	7,5
KİM 520	Heterocyclic Chemistry II	3+0	7,5
KİM 592	Seminar	3+0	7,5
	<i>Elective Courses (1)</i>	-	7,5
			<u>30,0</u>

**III. SEMESTER**

KİM 790	Thesis	0+1	30,0
			<u>30,0</u>

**ELECTIVE COURSES**

KİM 506	Polymer Chemistry	3+0	7,5	KİM 537	Organic Macro Molecules	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5	KİM 539	Quantitative Structure Property Relationship	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5	KİM 550	Reagents In Organic Synthesis	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5	KİM 551	Sensors and Their Applications	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5	KİM 558	Biochromatography	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5	KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 521	Adsorption	3+0	7,5	KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5	KİM 562	Inorganic Polymers	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5	KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5	KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5	KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5	KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5				
KİM 536	Chromatographic Techniques	3+0	7,5				

KİM 567	Applications of Computational Chemistry	3+0	7,5	UKM 701	Research in Area of Specialization	3+0	4,5
KİM 568	Solvent-free Organic Synthesis	3+0	7,5	UKM 702	Research in Area of Specialization	3+0	4,5
KİM 569	Structure Determination of Organic Chemistry	3+0	7,5				

## PROGRAM IN PHYSICAL CHEMISTRY

### PROGRAM

#### I. SEMESTER

KİM 504	Chemical Kinetics	3+0	7,5
KİM 531	Modern Analysis Methods I	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### II. SEMESTER

KİM 513	Chemical Thermodynamics	3+0	7,5
KİM 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

#### III. SEMESTER

KİM 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

KİM 506	Polymer Chemistry	3+0	7,5
KİM 509	Carbon-Carbon Bond Formation	3+0	7,5
KİM 510	Advanced NMR Techniques	3+0	7,5
KİM 511	Electrochemistry	3+0	7,5
KİM 516	Physical Organic Chemistry	3+0	7,5
KİM 517	Selected Topics in Inorganic Chemistry I	3+0	7,5
KİM 521	Adsorption	3+0	7,5
KİM 524	Bioinorganic Chemistry	3+0	7,5
KİM 525	Quantum Chemistry	3+0	7,5
KİM 526	Microwave Organic Synthesis	3+0	7,5
KİM 529	Catalytic Chemistry	3+0	7,5
KİM 533	Electroanalytical Chemistry	3+0	7,5
KİM 535	Data Analysis in Chemistry	3+0	7,5
KİM 536	Chromatographic Techniques	3+0	7,5
KİM 537	Organic Macro Molecules	3+0	7,5
KİM 539	Quantitative Structure Property Relationship	3+0	7,5
KİM 550	Reagents In Organic Synthesis	3+0	7,5

KİM 551	Sensors and Their Applications	3+0	7,5
KİM 558	Biochromatography	3+0	7,5
KİM 560	Alternative Reaction Systems	3+0	7,5
KİM 561	Novel Tendencies in Liquid Chromatography	3+0	7,5
KİM 562	Inorganic Polymers	3+0	7,5
KİM 563	Natural Product Synthesis I	3+0	7,5
KİM 564	Natural Product Synthesis II	3+0	7,5
KİM 565	Literature Search in Chemistry	3+0	7,5
KİM 566	Stereo Selective Reactions and Practical Approach	3+0	7,5
KİM 567	Applications of Computational Chemistry	3+0	7,5
KİM 568	Solvent-free Organic Synthesis	3+0	7,5
KİM 569	Structure Determination of Organic Chemistry	3+0	7,5
UKM 701	Research in Area of Specialization	3+0	4,5
UKM 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF CIVIL AVIATION

Head : Prof. Dr. Mehmet Şerif KAVSAOĞLU

## DOCTORATE DEGREE (PH.D)

The School of Civil Aviation was established as a vocational school in 1986 to provide qualified personnel for rapidly growing Turkish Aviation industry with funds provided by the Turkish Government, United Nations Development Programme and International Civil Aviation Organization. Through a bilateral agreement that was signed between French and Turkish Governments in 1989, French Government has provided a long-term loan of 115 million French Francs for the development of the School of Civil Aviation. About 70 faculty members and technical staff from the School of Civil Aviation attended academic, research or non-degree programmes of French aviation training institutions like IAS, SUPAERO, ENAC, ENSICA and EMA. Some other faculty members and technical staff have been trained by French aviation companies like SOFREAVIA SERVICE, THOMSON-CSF, SOCATA and EUROCOPTER. In 1992, the school started to provide Bachelor's Degree programmes due to the advancements in aeronautical technology and aviation education standards. All the students of academic degree programmes have to attend one year English language preparation classes before starting their four year training at the school. The School has a Maintenance Center which has a closed surface area of 7.500 squaremeter to practice students on aircraft and an apron of 11.000 squaremeter. The Center is equipped with computer controlled instruments to repair various types of aircrafts in fleets of aviation companies. Beyond academic instruction activities The School also provides non-degree programmes to train helicopter maintenance technicians to meet the needs of organizations such as the Police. These courses are custom designed according to the needs of demanding organizations. The School is already training Turkish Air Force Depot Level Maintenance Centres Aircraft Maintenance Technicians for upgrading the Turkish Air Force to JAR145 standards.

Department of Avionics was first established as two departments; Department of Aircraft Electrical Systems and Department of Aircraft Electronic Systems. When The School changed its programs to graudate level both Departments had a new concept and got new names as Department of Ground Equipments and Department of Aircraft Equipments. According to new trends in aviation industry and education and to meet the international standards two Departments organized as one and had a new name; Department of Avionics, in 1995.

Presently, there are ten full-time faculty members, six research associates, five research assistants and five teaching maintenance technicians working with the Department. Furthermore, some faculty members from other departments in our university and from other universities also work as adjunct faculty members in our department. Moreover there 3 student who are attending postgraduate programs which is awarded by the Graduate School of Sciences.

There are plenty of laboratories in the Department such as electronics, electrotechnics, avionics, communication and navigational aids which are used in training and research activities. Each academic staff member of the department is given a personal computer for her/his own exclusive use. A computer laboratory equipped with 32 personal computers, which are connected to the Internet, is open to our students. Another computer laboratory which has 36 personal computers and a data show system is used for seminars and educational purposes. In addition, the School's conference hall of capacity of 110 which is fully equipped can be used by the Department at any time.

Qualified personnel meeting JAR 66 standards have been trained by avionics programme. Our graduates can easily find job oppurtunities in Turkish Airlines, Turkish Air Force Air Supply Maintenance Centers, General Directorate of State Airports and throughout the aviation industry. We have graduates and undergraduates attending to The Department of Avionics programmes from other nations such as Azerbaijan, Bulgaria, Germany, Greece, Jordan, Kazakhstan, Kirghistan, Syria, Switzerland, Tadjikistan and Turkmenistan.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
SHA 890	Thesis	0+1	30,0	SHA 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>

**ELECTIVE COURSES**

MLZ 651	Materials Science and Advanced Materials Technology	3+0	7,5
MLZ 652	Fatigue and Creep Behaviour of Aircraft Materials	3+0	7,5
SHA 601	Airline Management	3+0	7,5
SHA 602	Aircraft Dynamics	3+0	7,5
SHA 604	Engineering Economic Analysis	3+0	7,5
SHA 608	Optimization Methods in Flight Mechanics	3+0	7,5
SHA 614	Airport Design	3+0	7,5
SHA 615	Advanced Mechanical Vibrations	3+0	7,5
SHA 617	Sliding Mode Control Theory	3+0	7,5
SHA 618	Fault Tolerant Flight Control System Design	3+0	7,5
SHA 619	Cogeneration -Combined Heat Power Systems	3+0	7,5
SHA 620	Aircraft Performance and Operational Analysis II	3+0	7,5
SHA 621	Advanced Gas Thermodynamics	3+0	7,5

SHA 625	Fatigue of Thermal Barrier Coating Systems	3+0	7,5
SHA 626	Genetic Algorithms and Applications of Control Systems	3+0	7,5
SHA 627	Sizing of Propeller-Driven and Jet-Powered Aircraft	3+0	7,5
SHA 628	Airspace Management	3+0	7,5
SHA 629	Non-Destructive Inspection Methods for Aircraft Maintenance	3+0	7,5
SHA 630	Current Issues in Gas Turbine Engine Combustion Systems	3+0	7,5
SHA 631	Aerothermodynamic Optimization of Aircraft Propulsion Systems	3+0	7,5
SHA 632	Free Flight Concept and Analysis	3+0	7,5
USİ 901	Research in Area of Specialization	5+0	7,5
USİ 902	Research in Area of Specialization	5+0	7,5

**DEPARTMENT OF CIVIL ENGINEERING**

Head : Prof. Dr. Recep BAKIŞ

**(NON-THESIS) MASTER OF SCIENCE (MS) DEGREE****PROGRAM****I. SEMESTER**

İNŞ 526	Construction Management	3+0	7,5
MAT 517	Applied Mathematics	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

**II. SEMESTER**

İNŞ 536	Law in Construction Projects	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			<u>30,0</u>

**III. SEMESTER**

İNŞ 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

**ELECTIVE COURSES**

HİD 501	Watershed Hydrology	3+0	7,5
İNŞ 503	Advanced Foundation Engineering	3+0	7,5
İNŞ 508	Stochastic Methods in Hydrology	3+0	7,5
İNŞ 509	River Hydraulics	3+0	7,5
İNŞ 510	Economic Analysis of Engineering Systems	3+0	7,5
İNŞ 511	Flood Control	3+0	7,5
İNŞ 513	Dams	3+0	7,5
İNŞ 514	Planning and Design of Dams	3+0	7,5
İNŞ 519	Water Resources Systems	3+0	7,5
İNŞ 520	Advanced Groundwater Hydrology	3+0	7,5

İNŞ 522	Matrix Methods for Computing Structural Systems	3+0	7,5
İNŞ 528	Construction Cost Analysis and Estimating	3+0	7,5
İNŞ 531	Contract and Cost Management	3+0	7,5
İNŞ 539	Introduction to Finite Elements	3+0	7,5
İNŞ 540	Advanced Highway Materials	3+0	7,5
İNŞ 541	Advanced Pavement Design	3+0	7,5
İNŞ 542	Neural Network Applications In Transportation Engineering	3+0	7,5
İNŞ 543	Theory of Elasticity	3+0	7,5
İNŞ 544	Structural Dynamics	3+0	7,5
İNŞ 545	Advanced Structural Analysis	3+0	7,5

İNŞ 546	Theory and Design for Tests and Measurements on Construction Materials	3+0	7,5	İNŞ 558	Hydrology of Floods and Droughts	3+0	7,5
İNŞ 547	Urban Hydrology and Hydraulics	3+0	7,5	İNŞ 559	Hydrologic Modeling	3+0	7,5
İNŞ 548	Applications of Geosynthetics	3+0	7,5	İNŞ 560	Bituminous Mixtures Design and Technology	3+0	7,5
İNŞ 549	Deep Excavations and Retaining Structures	3+0	7,5	İNŞ 561	Pavement Maintenance-Rehabilitation and Recycling Strategies	3+0	7,5
İNŞ 551	Repair and Strengthening of Structures	3+0	7,5	İNŞ 563	Advances in Sediment Transport Research	3+0	7,5
İNŞ 552	Advanced Railway Design	3+0	7,5	İNŞ 565	Cold-Formed Steel Structures	3+0	7,5
İNŞ 553	Advanced Highway Design	3+0	7,5	İNŞ 567	Experimental Methods in Advanced Fluid Mechanics	3+0	7,5
İNŞ 554	International Construction Project Management	3+0	7,5	İNŞ 569	Design of Composite Structures	3+0	7,5
İNŞ 555	Advanced Concrete Technology	3+0	7,5	MAT 507	Applied Mathematics I	3+0	7,5
İNŞ 556	Plastic Design of Steel Structures	3+0	7,5	MAT 508	Applied Mathematics II	3+0	7,5
İNŞ 557	Soil Structures and Ground Improvement Techniques	3+0	7,5	MEK 501	Advanced Soil Mechanics	3+0	7,5

### DOCTORATE DEGREE (PH.D)

The department was established in 1998 as Civil Engineering Department. The department is located at the İki Eylül Campus and occupies a covered area of 5000 m<sup>2</sup>. 3 Professors, 7 Assistant Professors, 2 Instructor and 7 Research Assistants currently have been working in the department. The decisions related with the department are made by the department council which is composed of all faculty members of the department. The department is governed by one chairman and two deputy chairmen. One of the deputy chairmen takes care of technical activities of the department while the other deputy chairman assists chairman in academic activities in the department.

The principal education philosophy of the Department has been to provide a sound professional training which has been consistent with the current scientific and technological state of the art background supported by practice through laboratory applications in Civil Engineering discipline. The department is in collaboration with several international universities. The laboratories of the department are equipped with all the modern research equipment and facilities needed to do scientific research on both traditional and high technology construction works.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			30,0				22,5
III. SEMESTER				IV. SEMESTER			
İNŞ 890	Thesis	0+1	30,0	İNŞ 890	Thesis	0+1	30,0
			30,0				30,0

### ELECTIVE COURSES

İNŞ 605	Mechanics of Continua I	3+0	7,5	İNŞ 626	Cross-Cultural Management in International Construction Projects	3+0	7,5
İNŞ 606	Mechanics of Continua II	3+0	7,5	İNŞ 627	Advanced Labor Health and Job Safety Management	3+0	7,5
İNŞ 607	Soil Behavior	3+0	7,5	İNŞ 628	Knowledge Management in Construction	3+0	7,5
İNŞ 611	Earthquake Engineering	3+0	7,5	İNŞ 629	Pavement Management Systems	3+0	7,5
İNŞ 614	Project Management	3+0	7,5	İNŞ 630	Experimental and Computational Methods to Characterize Bituminous Materials	3+0	7,5
İNŞ 615	Quality Management in Construction	3+0	7,5	İNŞ 631	Design of Seismic Isolated Structures	3+0	7,5
İNŞ 616	Computational Hydraulics	3+0	7,5				
İNŞ 621	Soil Dynamics	3+0	7,5				
İNŞ 622	Measurement of Soil Properties	3+0	7,5				
İNŞ 623	In-situ Testing of Concrete	3+0	7,5				

İNŞ 633	Hydrological Forecasting and Early Warning Systems	3+0	7,5	İNŞ 637	Remote Sensing and Geographic Information Systems Applications in Water Resources	3+0	7,5
İNŞ 635	Seismic Performance Assessment of Buildings	3+0	7,5	UİN 901	Research in Area of Specialization	5+0	7,5
				UİN 902	Research in Area of Specialization	5+0	7,5

### MASTER OF SCIENCE (MS) DEGREE

The department was established in 1998 as Civil Engineering Department. The department is located at the İki Eylül Campus and occupies a covered area of 5000 m<sup>2</sup>. 3 Professors, 7 Assistant Professors, 2 Instructor and 7 Research Assistants currently have been working in the department. The decisions related with the department are made by the department council which is composed of all faculty members of the department. The department is governed by one chairman and two deputy chairmen. One of the deputy chairmen takes care of technical activities of the department while the other deputy chairman assists chairman in academic activities in the department.

The principal education philosophy of the Department has been to provide a sound professional training which has been consistent with the current scientific and technological state of the art background supported by practice through laboratory applications in Civil Engineering discipline. The department is in collaboration with several international universities. The laboratories of the department are equipped with all the modern research equipment and facilities needed to do scientific research on both traditional and high technology construction works.

### PROGRAM

I. SEMESTER				II. SEMESTER			
İNŞ 526	Construction Management	3+0	7,5	İNŞ 536	Law in Construction Projects	3+0	7,5
MAT 517	Applied Mathematics	3+0	7,5	İNŞ 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0		<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>				<u>30,0</u>
III. SEMESTER							
İNŞ 790	Thesis	0+1	30,0				
			<u>30,0</u>				

### ELECTIVE COURSES

İNŞ 501	Watershed Hydrology	3+0	7,5	İNŞ 542	Neural Network Applications In Transportation Engineering	3+0	7,5
İNŞ 503	Advanced Foundation Engineering	3+0	7,5	İNŞ 543	Theory of Elasticity	3+0	7,5
İNŞ 508	Stochastic Methods in Hydrology	3+0	7,5	İNŞ 544	Structural Dynamics	3+0	7,5
İNŞ 509	River Hydraulics	3+0	7,5	İNŞ 545	Advanced Structural Analysis	3+0	7,5
İNŞ 510	Economic Analysis of Engineering Systems	3+0	7,5	İNŞ 546	Theory and Design for Tests and Measurements on Construction Materials	3+0	7,5
İNŞ 511	Flood Control	3+0	7,5	İNŞ 547	Urban Hydrology and Hydraulics	3+0	7,5
İNŞ 513	Dams	3+0	7,5	İNŞ 548	Applications of Geosynthetics	3+0	7,5
İNŞ 514	Planning and Design of Dams	3+0	7,5	İNŞ 549	Deep Excavations and Retaining Structures	3+0	7,5
İNŞ 519	Water Resources Systems	3+0	7,5	İNŞ 551	Repair and Strengthening of Structures	3+0	7,5
İNŞ 520	Advanced Groundwater Hydrology	3+0	7,5	İNŞ 552	Advanced Railway Design	3+0	7,5
İNŞ 522	Matrix Methods for Computing Structural Systems	3+0	7,5	İNŞ 553	Advanced Highway Design	3+0	7,5
İNŞ 528	Construction Cost Analysis and Estimating	3+0	7,5	İNŞ 554	International Construction Project Management	3+0	7,5
İNŞ 531	Contract and Cost Management	3+0	7,5	İNŞ 555	Advanced Concrete Technology	3+0	7,5
İNŞ 539	Introduction to Finite Elements	3+0	7,5	İNŞ 556	Plastic Design of Steel Structures	3+0	7,5
İNŞ 540	Advanced Highway Materials	3+0	7,5	İNŞ 557	Soil Structures and Ground Improvement Techniques	3+0	7,5
İNŞ 541	Advanced Pavement Design	3+0	7,5				

İNŞ 558	Hydrology of Floods and Droughts	3+0	7,5	İNŞ 567	Experimental Methods in Advanced Fluid Mechanics	3+0	7,5
İNŞ 559	Hydrologic Modeling	3+0	7,5	İNŞ 569	Design of Composite Structures	3+0	7,5
İNŞ 560	Bituminous Mixtures Design and Technology	3+0	7,5	MAT 507	Applied Mathematics I	3+0	7,5
İNŞ 561	Pavement Maintenance-Rehabilitation and Recycling Strategies	3+0	7,5	MAT 508	Applied Mathematics II	3+0	7,5
İNŞ 563	Advances in Sediment Transport Research	3+0	7,5	MEK 501	Advanced Soil Mechanics	3+0	7,5
İNŞ 565	Cold-Formed Steel Structures	3+0	7,5	UİN 701	Research in Area of Specialization	3+0	4,5
				UİN 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF COMPUTER ENGINEERING

Head : Assoc. Prof. Dr. Hüseyin POLAT

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM IN INFORMATICS

Department of Computer Engineering leading to a graduate degree started in the 2000-2001 academic year. Currently, Master's with and without thesis degree programs are being offered. In this department the medium of instruction is Turkish

The aim of graduate program is to provide qualified personnel for the needs of Computer Engineering and Software Engineering fields as well as to train students who plan to enter academic profession in universities. The graduate program has been designed to meet the demands of specialized computer scientists and engineers in industry and in higher education. It provides opportunity to qualified students from various academic disciplines for further education at an advanced level in Computer Engineering and Software Engineering. The graduate students fulfilling the requirements of the University are granted the degree of Master of Science (M.S.) in Computer Engineering.

The department is furnished with the most recent technological hardware laboratories, personal computers, which are connected to both Intranet and Internet.

#### PROGRAM

##### I. SEMESTER

BİL 505	Data Systems: Analysis and Design	3+0	7,5
BİL 527	Computer Programming I	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

##### II. SEMESTER

BİL 528	Computer Programming II	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			<u>30,0</u>

##### III. SEMESTER

BİL 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			<u>30,0</u>

##### ELECTIVE COURSES

BİL 503	Object Oriented Programming	3+0	7,5	BİL 513	Numerical Analysis	3+0	7,5
BİL 504	Data Structure and Algorithms	3+0	7,5	BİL 514	Decision Support Systems	3+0	7,5
BİL 506	Database Management Systems	3+0	7,5	BİL 517	Logic Design	3+0	7,5
BİL 507	Introduction to Operating Systems	3+0	7,5	BİL 518	Microprocessors	3+0	7,5
BİL 509	Simulation and Modeling	3+0	7,5	BİL 520	Advanced Communication Technology	3+0	7,5
BİL 510	Artificial Intelligence	3+0	7,5	BİL 521	Management Information Systems	3+0	7,5
BİL 511	Computer Aided Design	3+0	7,5	BİL 522	Computer Organization	3+0	7,5

BİL 523	Computer Networks	3+0	7,5	BİL 560	Data Access Systems	3+0	7,5
BİL 525	Fast Application Development	3+0	7,5				

### DOCTORATE DEGREE (PH.D)

#### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
BİM 890	Thesis	0+1	30,0	BİM 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>

#### ELECTIVE COURSES

BİL 604	Information Technology Management	3+0	7,5	BİL 616	Pattern Recognition Applications	3+0	7,5
BİL 605	Distributed Computing Methods	3+0	7,5	BİL 617	Cryptology	3+0	7,5
BİL 606	Natural Language Processing	3+0	7,5	BİL 619	Advanced Discrete Mathematics	3+0	7,5
BİL 607	Advanced Information Retrieval Systems	3+0	7,5	BİL 620	Multi Agent Systems	3+0	7,5
BİL 612	Data and Text Mining	3+0	7,5	BİL 621	Text Analytics	3+0	7,5
BİL 613	Machine Learning	3+0	7,5	UBM 901	Research in Area of Specialization	5+0	7,5
BİL 615	Special Topics in Information Technologies	3+0	7,5	UBM 902	Research in Area of Specialization	5+0	7,5

### MASTER OF SCIENCE (MS) DEGREE

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The department is furnished with the most recent technological hardware laboratories, personal computers, which are connected to both Intranet and Internet.

#### PROGRAM

I. SEMESTER				II. SEMESTER			
BİL 519	Advanced Algorithm Analysis	3+0	7,5	BİL 551	Advanced Database Management Systems	3+0	7,5
<i>Elective Courses (3)</i>		-	22,5	BİL 553	Object Oriented Systems	3+0	7,5
			<u>30,0</u>	BİL 591	Seminar	3+0	7,5
				<i>Elective Courses (1)</i>		-	7,5
							<u>30,0</u>
III. SEMESTER							



BİL 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

BİL 552	Programming Languages	3+0	7,5	BİL 563	Fuzzy Logic	3+0	7,5
BİL 554	Operating Systems	3+0	7,5	BİL 564	Data Acquisition and Mining	3+0	7,5
BİL 555	Advanced Computer Networks	3+0	7,5	BİL 565	Rough Sets Theory	3+0	7,5
BİL 556	Computer Graphics	3+0	7,5	BİL 566	Pattern Analysis	3+0	7,5
BİL 557	Internet Software	3+0	7,5	BİL 567	Introduction to Recommender Systems	3+0	7,5
BİL 558	Parallel Programming	3+0	7,5	BİL 569	Big Data Systems	3+0	7,5
BİL 559	Software Engineering	3+0	7,5	UBM 701	Research in Area of Specialization	3+0	4,5
BİL 561	Fuzzy Neural Networks	3+0	7,5	UBM 702	Research in Area of Specialization	3+0	4,5
BİL 562	Network Security	3+0	7,5				

### PROGRAM IN INFORMATICS

Department of Computer Engineering leading to a graduate degree started in the 2000-2001 academic year. Currently, Master's with and without thesis degree programs are being offered. In this department the medium of instruction is Turkish

The aim of graduate program is to provide qualified personnel for the needs of Computer Engineering and Software Engineering fields as well as to train students who plan to enter academic profession in universities. The graduate program has been designed to meet the demands of specialized computer scientists and engineers in industry and in higher education. It provides opportunity to qualified students from various academic disciplines for further education at an advanced level in Computer Engineering and Software Engineering. The graduate students fulfilling the requirements of the University are granted the degree of Master of Science (M.S.) in Computer Engineering.

The department is furnished with the most recent technological hardware laboratories, personal computers, which are connected to both Intranet and Internet.

### PROGRAM

#### I. SEMESTER

BİL 505	Data Systems: Analysis and Design	3+0	7,5
BİL 527	Computer Programming I	3+0	7,5
<i>Elective Courses (2)</i>		-	15,0
			<u>30,0</u>

#### II. SEMESTER

BİL 528	Computer Programming II	3+0	7,5
BİL 592	Seminar	3+0	7,5
<i>Elective Courses (2)</i>		-	15,0
			<u>30,0</u>

#### III. SEMESTER

BİL 790	Thesis	0+1	30,0
			<u>30,0</u>

#### ELECTIVE COURSES

BİL 503	Object Oriented Programming	3+0	7,5	BİL 520	Advanced Communication Technology	3+0	7,5
BİL 504	Data Structure and Algorithms	3+0	7,5	BİL 521	Management Information Systems	3+0	7,5
BİL 506	Database Management Systems	3+0	7,5	BİL 522	Computer Organization	3+0	7,5
BİL 507	Introduction to Operating Systems	3+0	7,5	BİL 523	Computer Networks	3+0	7,5
BİL 509	Simulation and Modeling	3+0	7,5	BİL 525	Fast Application Development	3+0	7,5
BİL 510	Artificial Intelligence	3+0	7,5	BİL 560	Data Access Systems	3+0	7,5
BİL 511	Computer Aided Design	3+0	7,5	UBL 701	Research in Area of Specialization	3+0	4,5
BİL 513	Numerical Analysis	3+0	7,5	UBL 702	Research in Area of Specialization	3+0	4,5
BİL 514	Decision Support Systems	3+0	7,5				
BİL 517	Logic Design	3+0	7,5				
BİL 518	Microprocessors	3+0	7,5				

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING (ENGLISH)

Head : Prof. Dr. Hüseyin AKÇAY

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM IN CIRCUITS AND SYSTEMS THEORY (ENGLISH)

##### PROGRAM

##### I. SEMESTER

EEM 541 (Eng) Linear Systems Theory I	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		30,0

##### II. SEMESTER

MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		30,0

##### III. SEMESTER

EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		30,0

##### ELECTIVE COURSES

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5
EEM 551 (Eng) Control Design Methods	3+0	7,5

EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5

#### PROGRAM IN CONTROL SYSTEMS (ENGLISH)

##### PROGRAM

##### I. SEMESTER

EEM 541 (Eng) Linear Systems Theory I	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		30,0

##### II. SEMESTER

MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		30,0

##### III. SEMESTER

EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		30,0

**ELECTIVE COURSES**

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5

EEM 551 (Eng) Control Design Methods	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5

**PROGRAM IN ELECTRICAL INSTALLATION SYSTEMS (ENGILSH)****PROGRAM****I. SEMESTER**

EEM 504 (Eng) Random Variables and Stochastic Processes	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

**II. SEMESTER**

MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		<hr/> 30,0

**III. SEMESTER**

EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

**ELECTIVE COURSES**

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5

EEM 551 (Eng) Control Design Methods	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5

**PROGRAM IN ELECTRICAL MACHINERY (ENGILSH)****PROGRAM****I. SEMESTER**

EEM 541 (Eng) Linear Systems Theory I	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

**II. SEMESTER**

MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		<hr/> 30,0

**III. SEMESTER**

EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

**ELECTIVE COURSES**

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5
EEM 551 (Eng) Control Design Methods	3+0	7,5

EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5

**PROGRAM IN ELECTROMAGNETIC FIELDS AND MICROWAVE TECHNIQUE (ENGILSH)****PROGRAM****I. SEMESTER**

MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		<u>30,0</u>

**II. SEMESTER**

EEM 552 (Eng) Micro-Nanodevices and Thin Film Applications	3+0	7,5
MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<u>30,0</u>

**III. SEMESTER**

EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		<u>30,0</u>

**ELECTIVE COURSES**

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5

EEM 551 (Eng) Control Design Methods	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5

**PROGRAM IN ELECTRONICS (ENGILSH)****PROGRAM****I. SEMESTER**

EEM 567 (Eng) Advanced Computer Architecture	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<u>30,0</u>

**II. SEMESTER**

MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		<u>30,0</u>

**III. SEMESTER**

EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0

			30,0		
<b>ELECTIVE COURSES</b>				EEM 551 (Eng) Control Design Methods	3+0 7,5
EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5		EEM 553 (Eng) Digital Control Theory	3+0 7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5		EEM 554 (Eng) Nonlinear Control Systems	3+0 7,5
EEM 545 (Eng) System Modeling	3+0	7,5		EEM 561 (Eng) Machine Vision	3+0 7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5		EEM 562 (Eng) Signal Coding	3+0 7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5		EEM 564 (Eng) Artificial Neural Networks	3+0 7,5
EEM 548 (Eng) Power System Protection	3+0	7,5		EEM 565 (Eng) Image Processing	3+0 7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5		EEM 566 (Eng) Pattern Recognition	3+0 7,5

## PROGRAM IN TELECOMMUNICATIONS (ENGLISH)

### PROGRAM

<b>I. SEMESTER</b>			<b>II. SEMESTER</b>		
EEM 504 (Eng) Random Variables and Stochastic Processes	3+0	7,5	MAT 508 (Eng) Applied Mathematics II	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5	<i>Elective Courses (3)</i>	-	22,5
<i>Elective Courses (2)</i>	-	15,0			30,0
		30,0			

<b>III. SEMESTER</b>		
EEM 599 (Eng) Semester Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		30,0

<b>ELECTIVE COURSES</b>			EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5	EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5	EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5	EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5	EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5	EEM 565 (Eng) Image Processing	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5	EEM 566 (Eng) Pattern Recognition	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5			
EEM 551 (Eng) Control Design Methods	3+0	7,5			

## DOCTORATE DEGREE (PH.D)

### PROGRAM

<b>I. SEMESTER</b>			<b>II. SEMESTER</b>		
<i>Elective Courses (4)</i>	-	30,0	<i>Elective Courses (3)</i>	-	22,5
		30,0			22,5
<b>III. SEMESTER</b>			<b>IV. SEMESTER</b>		
EEM 890 (Eng) Thesis	0+1	30,0	EEM 890 (Eng) Thesis	0+1	30,0

30,0

30,0

### ELECTIVE COURSES

EEM 603 (Eng) Function Space Methods in Engineering	3+0	7,5
EEM 604 (Eng) Optimization in Power Systems	3+0	7,5
EEM 605 (Eng) Power Systems Stability	3+0	7,5
EEM 606 (Eng) Parallel Computer Architecture	3+0	7,5
EEM 607 (Eng) Parallel Computing	3+0	7,5
EEM 608 (Eng) Advanced Linear Control Design	3+0	7,5
EEM 609 (Eng) Multivariable Control Systems I	3+0	7,5
EEM 610 (Eng) Multivariable Control Systems II	3+0	7,5
EEM 618 (Eng) Power Quality Analysis	3+0	7,5
EEM 619 (Eng) Wireless Communication	3+0	7,5
EEM 621 (Eng) Nano and Micro-Fabrication Techniques	3+0	7,5
EEM 623 (Eng) Advanced Digital Signal Processing	3+0	7,5
EEM 641 (Eng) Sensor Array Signal Processing	3+0	7,5

EEM 642 (Eng) Linear Systems Theory II	3+0	7,5
EEM 643 (Eng) Estimation Theory	3+0	7,5
EEM 645 (Eng) System Identification	3+0	7,5
EEM 646 (Eng) Fuzzy Systems	3+0	7,5
EEM 651 (Eng) Signal Transforms	3+0	7,5
EEM 652 (Eng) Optimal Control	3+0	7,5
EEM 656 (Eng) Large-scale Systems	3+0	7,5
EEM 657 (Eng) Control of Robotic Systems	3+0	7,5
EEM 658 (Eng) Adaptive Control	3+0	7,5
EEM 660 (Eng) Discrete Event Systems	3+0	7,5
EEM 661 (Eng) Advantage in Cryptology	3+0	7,5
EEM 667 (Eng) Statistical Signal Processing	3+0	7,5
UEE 901 (Eng) Research in Area of Specialization	5+0	7,5
UEE 902 (Eng) Research in Area of Specialization	5+0	7,5

## MASTER OF SCIENCE (MS) DEGREE

### PROGRAM IN CIRCUITS AND SYSTEMS THEORY (ENGLISH)

#### PROGRAM

#### I. SEMESTER

EEM 541 (Eng) Linear Systems Theory I	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		30,0

#### II. SEMESTER

EEM 592 (Eng) Seminar	3+0	7,5
MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		30,0

#### III. SEMESTER

EEM 790 (Eng) Thesis	0+1	30,0
		30,0

### ELECTIVE COURSES

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5
EEM 551 (Eng) Control Design Methods	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5

EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5
UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
UEE 702 (Eng) Research in Area of Specialization	3+0	4,5

## PROGRAM IN CONTROL SYSTEMS (ENGLISH)

### PROGRAM

#### I. SEMESTER

EEM 541 (Eng) Linear Systems Theory I	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

#### II. SEMESTER

EEM 592 (Eng) Seminar	3+0	7,5
MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

#### III. SEMESTER

EEM 790 (Eng) Thesis	0+1	30,0
		<hr/> 30,0

#### ELECTIVE COURSES

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5	EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5	EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5	EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5	EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5	EEM 565 (Eng) Image Processing	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5	EEM 566 (Eng) Pattern Recognition	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5	UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
EEM 551 (Eng) Control Design Methods	3+0	7,5	UEE 702 (Eng) Research in Area of Specialization	3+0	4,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5			

## PROGRAM IN ELECTRICAL MACHINERY (ENGLISH)

### PROGRAM

#### I. SEMESTER

EEM 541 (Eng) Linear Systems Theory I	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

#### II. SEMESTER

EEM 592 (Eng) Seminar	3+0	7,5
MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

#### III. SEMESTER

EEM 790 (Eng) Thesis	0+1	30,0
		<hr/> 30,0

#### ELECTIVE COURSES

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5	EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5	EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5	EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5	EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5	EEM 565 (Eng) Image Processing	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5	EEM 566 (Eng) Pattern Recognition	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5	UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
EEM 551 (Eng) Control Design Methods	3+0	7,5	UEE 702 (Eng) Research in Area of Specialization	3+0	4,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5			

## PROGRAM IN ELECTRICAL INSTALLATION SYSTEMS (ENGLISH)

### PROGRAM

I. SEMESTER			II. SEMESTER		
EEM 504 (Eng) Random Variables and Stochastic Processes	3+0	7,5	EEM 592 (Eng) Seminar	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5	MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0	<i>Elective Courses (2)</i>	-	15,0
		<u>30,0</u>			<u>30,0</u>
III. SEMESTER					
EEM 790 (Eng) Thesis	0+1	30,0			
		<u>30,0</u>			
ELECTIVE COURSES					
EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5	EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5	EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5	EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5	EEM 565 (Eng) Image Processing	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5	EEM 566 (Eng) Pattern Recognition	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5	UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5	UEE 702 (Eng) Research in Area of Specialization	3+0	4,5
EEM 551 (Eng) Control Design Methods	3+0	7,5			
EEM 553 (Eng) Digital Control Theory	3+0	7,5			
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5			

## PROGRAM IN ELECTROMAGNETIC FIELDS AND MICROWAVE TECHNIQUE (ENGLISH)

### PROGRAM

I. SEMESTER			II. SEMESTER		
MAT 507 (Eng) Applied Mathematics I	3+0	7,5	EEM 552 (Eng) Micro-Nanodevices and Thin Film Applications	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5	EEM 592 (Eng) Seminar	3+0	7,5
		<u>30,0</u>	MAT 508 (Eng) Applied Mathematics II	3+0	7,5
			<i>Elective Courses (1)</i>	-	7,5
					<u>30,0</u>
III. SEMESTER					
EEM 790 (Eng) Thesis	0+1	30,0			
		<u>30,0</u>			
ELECTIVE COURSES					
EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5	EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5	EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5	EEM 548 (Eng) Power System Protection	3+0	7,5
			EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5



EEM 551 (Eng) Control Design Methods	3+0	7,5	EEM 565 (Eng) Image Processing	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5	EEM 566 (Eng) Pattern Recognition	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5	UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
EEM 561 (Eng) Machine Vision	3+0	7,5	UEE 702 (Eng) Research in Area of Specialization	3+0	4,5
EEM 562 (Eng) Signal Coding	3+0	7,5			
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5			

### PROGRAM IN ELECTRONICS (ENGILSH)

#### PROGRAM

##### I. SEMESTER

EEM 567 (Eng) Advanced Computer Architecture	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

##### II. SEMESTER

EEM 592 (Eng) Seminar	3+0	7,5
MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

##### III. SEMESTER

EEM 790 (Eng) Thesis	0+1	30,0
		<hr/> 30,0

#### ELECTIVE COURSES

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5
EEM 551 (Eng) Control Design Methods	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5

EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5
UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
UEE 702 (Eng) Research in Area of Specialization	3+0	4,5

### PROGRAM IN TELECOMMUNICATIONS (ENGILSH)

#### PROGRAM

##### I. SEMESTER

EEM 504 (Eng) Random Variables and Stochastic Processes	3+0	7,5
MAT 507 (Eng) Applied Mathematics I	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

##### II. SEMESTER

EEM 592 (Eng) Seminar	3+0	7,5
MAT 508 (Eng) Applied Mathematics II	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<hr/> 30,0

##### III. SEMESTER

EEM 790 (Eng) Thesis	0+1	30,0
		<hr/> 30,0

**ELECTIVE COURSES**

EEM 527 (Eng) Advanced Power Electronics Circuits	3+0	7,5
EEM 534 (Eng) Data-Communication Networks	3+0	7,5
EEM 545 (Eng) System Modeling	3+0	7,5
EEM 546 (Eng) Fundamentals of Robotics	3+0	7,5
EEM 547 (Eng) Fundamentals of Detection and Estimation	3+0	7,5
EEM 548 (Eng) Power System Protection	3+0	7,5
EEM 549 (Eng) Advanced Electrical Machinery	3+0	7,5
EEM 551 (Eng) Control Design Methods	3+0	7,5
EEM 553 (Eng) Digital Control Theory	3+0	7,5
EEM 554 (Eng) Nonlinear Control Systems	3+0	7,5

EEM 561 (Eng) Machine Vision	3+0	7,5
EEM 562 (Eng) Signal Coding	3+0	7,5
EEM 564 (Eng) Artificial Neural Networks	3+0	7,5
EEM 565 (Eng) Image Processing	3+0	7,5
EEM 566 (Eng) Pattern Recognition	3+0	7,5
UEE 701 (Eng) Research in Area of Specialization	3+0	4,5
UEE 702 (Eng) Research in Area of Specialization	3+0	4,5

**DEPARTMENT OF ENVIRONMENTAL ENGINEERING**

Head : Prof. Dr. Ülker ÖĞÜTVEREN

**(NON-THESIS) MASTER OF SCIENCE (MS) DEGREE****PROGRAM****I. SEMESTER**

ÇEV 523 Instrumental Techniques and Data Evaluation Methods in Environmental Engineering	3+0	7,5
ÇEV 531 Statistical Analysis of Engineering Data	3+0	7,5
<i>Elective Courses (2)</i>	-	15,0
		<u>30,0</u>

**II. SEMESTER**

MAT 517 Applied Mathematics	3+0	7,5
<i>Elective Courses (3)</i>	-	22,5
		<u>30,0</u>

**III. SEMESTER**

ÇEV 599 Term Project	3+0	15,0
<i>Elective Courses (2)</i>	-	15,0
		<u>30,0</u>

**ELECTIVE COURSES**

ÇEV 501 Special Topics in Environmental Engineering I	3+0	7,5
ÇEV 517 Modeling of Air Pollution	3+0	7,5
ÇEV 524 Ecotoxicological Risks of Pollutants	3+0	7,5
ÇEV 525 Biomonitoring of the Environmental Quality and Techniques	3+0	7,5
ÇEV 526 Integrated Waste Management Economics	3+0	7,5
ÇEV 527 Advanced Solid Waste Management I	3+0	7,5
ÇEV 528 Industrial Air Pollution and Control	3+0	7,5
ÇEV 530 Anaerobic Biotechnology for the Treatment of Wastes	3+0	7,5
ÇEV 533 Nonpoint Source Pollution	3+0	7,5
ÇEV 535 Groundwater Pollution and Treatment	3+0	7,5
ÇEV 536 Natural Treatment Systems	3+0	7,5

ÇEV 539 Life Cycle Assessment	3+0	7,5
ÇEV 540 Modelling of Environmental Systems	3+0	7,5
ÇEV 541 Water Treatment Technologies and Applications	3+0	7,5
ÇEV 542 Nitrogen and Phosphorus Removal from Municipal Wastewater	3+0	7,5
ÇEV 543 Accreditation Process of Test Laboratories	3+0	7,5
ÇEV 544 Metal Pollution and Environment	3+0	7,5
ÇEV 545 Advanced Microbial Ecology	3+0	7,5
ÇEV 546 Advanced Treatment Techniques	3+0	7,5
ÇEV 547 Special Waste Management	3+0	7,5

## DOCTORATE DEGREE (PH.D)

The department was established in the 1994-1995 academic year. With the re-location of the Faculty of Engineering and Architecture to its new facility on İki Eylül Campus, the Environmental Engineering Department has improved its education with new classrooms, laboratories, computer labs and other physical facilities.

2 Professors, 2 Associate Professors, 7 Assistant Professors and 6 Assistants currently working in the department. The department is governed by one chairman and two deputy chairmen. One of the deputy chairmen takes care of technical activities of the department while the other deputy chairman assists chairman in academic activities in the department.

The Environmental Engineering Department aims at educating young people who will be experts in their field, who are dynamic, culturally engaged, active, research-oriented and capable of finding solutions to present and future environmental problems. Graduates of Environmental Engineering Department, can work in municipal and industrial water and wastewater treatment plants, both as designers and operators, they can also find environment-related jobs in firms, enterprises and organizations, or within the Ministry of Environment and its related branches.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
ÇEV 890	Thesis	0+1	30,0	ÇEV 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
ELECTIVE COURSES							
ÇEV 601	Special Topics in Environmental Engineering II	3+0	7,5	ÇEV 621	Advanced Techniques for Atmospheric Analyses	3+0	7,5
ÇEV 610	Industrial Environmental Quality Management	3+0	7,5	ÇEV 623	Global Warming Parameters and Control Techniques	3+0	7,5
ÇEV 612	Transfer Mechanisms of Incineration Processes	3+0	7,5	ÇEV 624	Atmospheric Chemistry	3+0	7,5
ÇEV 614	Advanced Solid Waste Management II	3+0	7,5	ÇEV 625	Integrated Natural Resource Management	3+0	7,5
ÇEV 616	Advanced Disinfection Techniques	3+0	7,5	ÇEV 627	Environmental Biotechnology	3+0	7,5
ÇEV 617	Thermal Conversion Technologies	3+0	7,5	ÇEV 629	Biodiversity and Protected	3+0	7,5
ÇEV 619	Environment Quality Development Plans	3+0	7,5	UÇV 901	Research in Area of Specialization	5+0	7,5
ÇEV 620	Transport and Fate of Pollutants in Water Systems	3+0	7,5	UÇV 902	Research in Area of Specialization	5+0	7,5

## MASTER OF SCIENCE (MS) DEGREE

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### PROGRAM

I. SEMESTER				II. SEMESTER			
ÇEV 523	Instrumental Techniques and Data Evaluation Methods in Environmental Engineering	3+0	7,5	ÇEV 592	Seminar	3+0	7,5
				MAT 517	Applied Mathematics	3+0	7,5
ÇEV 531	Statistical Analysis of Engineering Data	3+0	7,5		<i>Elective Courses (2)</i>	-	15,0
	<i>Elective Courses (2)</i>	-	15,0				
			30,0				30,0
III. SEMESTER							
ÇEV 790	Thesis	0+1	30,0				
			30,0				
ELECTIVE COURSES							
ÇEV 501	Special Topics in Environmental Engineering I	3+0	7,5	ÇEV 540	Modelling of Environmental Systems	3+0	7,5
ÇEV 517	Modeling of Air Pollution	3+0	7,5	ÇEV 541	Water Treatment Technologies and Applications	3+0	7,5
ÇEV 524	Ecotoxicological Risks of Pollutants	3+0	7,5	ÇEV 542	Nitrogen and Phosphorus Removal from Municipal Wastewater	3+0	7,5
ÇEV 525	Biomonitoring of the Environmental Quality and Techniques	3+0	7,5	ÇEV 543	Accreditation Process of Test Laboratories	3+0	7,5
ÇEV 526	Integrated Waste Management Economics	3+0	7,5	ÇEV 544	Metal Pollution and Environment	3+0	7,5
ÇEV 527	Advanced Solid Waste Management I	3+0	7,5	ÇEV 545	Advanced Microbial Ecology	3+0	7,5
ÇEV 528	Industrial Air Pollution and Control	3+0	7,5	ÇEV 546	Advanced Treatment Techniques	3+0	7,5
ÇEV 530	Anaerobic Biotechnology for the Treatment of Wastes	3+0	7,5	ÇEV 547	Special Waste Management	3+0	7,5
ÇEV 533	Nonpoint Source Pollution	3+0	7,5	UÇV 701	Research in Area of Specialization	3+0	4,5
ÇEV 535	Groundwater Pollution and Treatment	3+0	7,5	UÇV 702	Research in Area of Specialization	3+0	4,5
ÇEV 536	Natural Treatment Systems	3+0	7,5				
ÇEV 539	Life Cycle Assessment	3+0	7,5				

### DEPARTMENT OF FLIGHT TRAINING

Head : Prof. Dr. Mustafa CAVCAR

### MASTER OF SCIENCE (MS) DEGREE

### PROGRAM

I. SEMESTER				II. SEMESTER			
PLT 501	Aircraft Performance and Operation Analysis	3+0	7,5	PLT 509	Advanced Flight Mechanics	3+0	7,5
PLT 503	Aviation Research	3+0	7,5	PLT 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0		<i>Elective Courses (2)</i>	-	15,0
							30,0

30,0

### III. SEMESTER

PLT 790	Thesis	0+1	30,0
			30,0

### ELECTIVE COURSES

HTK 505	Multi-Criteria Decision-Making	3+0	7,5	SHA 538	Flight Procedures And Airspace Design	3+0	7,5
PLT 504	Aviation Safety Cases	3+0	7,5	SHA 539	Advanced Aerodynamics	3+0	7,5
PLT 505	Statistical Methods in Aviation	3+0	7,5	SHY 508	Air Traffic Management	3+0	6,0
PLT 506	Airlines	3+0	7,5	SHY 517	Aviation Safety Management	3+0	6,0
PLT 508	Aircraft Performance Optimization	3+0	7,5	UPL 701	Research in Area of Specialization	3+0	4,5
PLT 511	Aircraft Icing	3+0	7,5	UPL 702	Research in Area of Specialization	3+0	4,5
SHA 535	Helicopter Theory and Flight Principles	3+0	7,5				

## DEPARTMENT OF GEOSCIENCES

Head : Prof. Dr. Yücel GÜNEY

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

#### I. SEMESTER

YBL 501	Earth Sciences	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			30,0

#### II. SEMESTER

YBL 509	Engineering Properties of Soils	3+0	7,5
YBL 512	Earth Systems	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			30,0

#### III. SEMESTER

YBL 599	Semester Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			30,0

### ELECTIVE COURSES

ARK 555	Geophysical Methods in Archeology: Archeogeophysics	3+0	7,5	UCS 555	Theoretical Basics of Remote Sensing	3+0	7,5
UCS 508	Interpretation and Analysis Techniques on Geographic Information Systems	3+0	7,5	UCS 601	Use of GIS in Earth Sciences	3+0	7,5
UCS 511	Remote Sensing and Geographic Information Systems Techniques in Disaster Management	3+0	7,5	UCS 604	Environmental Hydrogeology	3+0	7,5
UCS 525	Digital Photogrammetry	3+0	7,5	UCS 609	Use of Geographic Information Systems in the Applications of Seismic Microzoning and Urban Transformation	3+0	7,5
UCS 527	Multicriteria Decision Making Methods	3+0	7,5	UCS 611	Use of Geographic Information Systems in the Planning of Earthquake Origin Risk/Damage Mitigation	3+0	7,5
UCS 533	Fundamentals of Mapping and Geographical Information Systems	3+0	7,5	UCS 617	Special Subject at Remote Sensing	3+0	7,5
UCS 534	Geostatistics	3+0	7,5	UYB 701	Research in Area of Specialization	3+0	4,5
UCS 551	Seismic Stratigraphy and Tectonics	3+0	7,5	UYB 702	Research in Area of Specialization	3+0	4,5
				YBL 502	Geotechnical Earthquake Engineering	3+0	7,5
				YBL 503	Geophysical Methods in Civil and Environmental Engineering	3+0	7,5

YBL 504	Shallow Marine Geophysics	3+0	7,5	YBL 511	Geological and Hydro-meteorological Hazard Analysis	3+0	7,5
YBL 505	In-situ Testing and Evaluation	3+0	7,5	YBL 513	Project Preparation and Management	3+0	7,5
YBL 506	Geosynthetics	3+0	7,5	YBL 514	Sustainability of Cities	3+0	7,5
YBL 507	Experimental Soil Mechanics	3+0	7,5	YBL 516	Geomorphology	3+0	7,5
YBL 508	Theoretical Soil Mechanics and Soil Models	3+0	7,5				
YBL 510	Groundwater Hydraulics	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

### PROGRAM

#### I. SEMESTER

YBL 501	Earth Sciences	3+0	7,5		
	<i>Elective Courses (3)</i>	-	22,5		
			<u>30,0</u>		

#### II. SEMESTER

YBL 509	Engineering Properties of Soils	3+0	7,5		
YBL 512	Earth Systems	3+0	7,5		
YBL 592	Seminar	3+0	7,5		
	<i>Elective Courses (1)</i>	-	7,5		
			<u>30,0</u>		

#### III. SEMESTER

YBL 790	Thesis	0+1	30,0		
			<u>30,0</u>		

#### ELECTIVE COURSES

ARK 555	Geophysical Methods in Archeology: Archeogeophysics	3+0	7,5		
UCS 508	Interpretation and Analysis Techniques on Geographic Information Systems	3+0	7,5		
UCS 511	Remote Sensing and Geographic Information Systems Techniques in Disaster Management	3+0	7,5		
UCS 525	Digital Photogrammetry	3+0	7,5		
UCS 527	Multicriteria Decision Making Methods	3+0	7,5		
UCS 533	Fundamentals of Mapping and Geographical Information Systems	3+0	7,5		
UCS 534	Geostatistics	3+0	7,5		
UCS 551	Seismic Stratigraphy and Tectonics	3+0	7,5		
UCS 555	Theoretical Basics of Remote Sensing	3+0	7,5		
UCS 601	Use of GIS in Earth Sciences	3+0	7,5		
UCS 604	Environmental Hydrogeology	3+0	7,5		
UCS 609	Use of Geographic Information Systems in the Applications of Seismic Microzoning and Urban Transformation	3+0	7,5		

UCS 611	Use of Geographic Information Systems in the Planning of Earthquake Origin Risk/Damage Mitigation	3+0	7,5		
UCS 617	Special Subject at Remote Sensing	3+0	7,5		
UYB 701	Research in Area of Specialization	3+0	4,5		
UYB 702	Research in Area of Specialization	3+0	4,5		
YBL 502	Geotechnical Earthquake Engineering	3+0	7,5		
YBL 503	Geophysical Methods in Civil and Environmental Engineering	3+0	7,5		
YBL 504	Shallow Marine Geophysics	3+0	7,5		
YBL 505	In-situ Testing and Evaluation	3+0	7,5		
YBL 506	Geosynthetics	3+0	7,5		
YBL 507	Experimental Soil Mechanics	3+0	7,5		
YBL 508	Theoretical Soil Mechanics and Soil Models	3+0	7,5		
YBL 510	Groundwater Hydraulics	3+0	7,5		
YBL 511	Geological and Hydro-meteorological Hazard Analysis	3+0	7,5		
YBL 513	Project Preparation and Management	3+0	7,5		
YBL 514	Sustainability of Cities	3+0	7,5		
YBL 516	Geomorphology	3+0	7,5		
YBL 518	Soft Computing and Data Mining in Earth Sciences	3+0	7,5		

## DEPARTMENT OF INDUSTRIAL ARTS

Head : Assoc. Prof. Dr. Nilay ERTÜRK

## MASTER OF SCIENCE (MS) DEGREE

### PROGRAM IN FASHION DESIGN

Fashion Design Department which was established in 2001. Education program can be classified as basic, supporting, professional and elective. Students can be easily focused on the different aspects of the fashion design profession by the elective courses, which are updated according to Fashion Design working area. Students who graduated from this department get the title of Fashion Designer. The Fashion Design Department which is department of School of Industrial Arts is located in main Campus of Anadolu University. The department is governed by one department head. The department is in collaboration with private sector and other universities.

### PROGRAM

I. SEMESTER				II. SEMESTER			
MOD 513	Advanced Projects in Fashion Design I	2+2	7,5	ENT 592	Seminar	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5	MOD 510	Fashion Concept in Design	3+0	7,5
			30,0	MOD 514	Advanced Projects in Fashion Design II	2+2	7,5
					<i>Elective Courses (1)</i>	-	7,5
							30,0
III. SEMESTER							
ENT 790	Thesis	0+1	30,0				
			30,0				
ELECTIVE COURSES							
ARY 505	Scientific Research Planning and Evaluation	3+0	7,5	MOD 519	New Approaches to Design of Fashion Accessories	3+0	7,5
MOD 501	Pattern Design in Textile	3+0	7,5	MOD 521	Fiber Art I	3+0	7,5
MOD 511	Intelligent Textiles and Clothing	3+0	7,5	MOD 522	Fiber Art II	3+0	7,5
MOD 512	Art and Design	2+2	7,5	MOD 523	Philosophy of Design	3+0	7,5
MOD 515	Fashion Design Presentation and Graphic Design Relation	3+0	7,5	UET 701	Research in Area of Specialization	3+0	4,5
MOD 517	Design, Art and Fashion Relationship	3+0	7,5	UET 702	Research in Area of Specialization	3+0	4,5

### PROGRAM IN INDUSTRIAL DESIGN

In globalized world, concept of Industrial design gets an important place in production, while products get importance both in function and in aesthetic by increasing competition in markets. Definition of industrial design, which is designing and making visual and functional definition of every mass produced products, emphasizes the place of this science in industrial field. In Industrial Design Department; which established in 2000; computer aided design education which is a requirement of contemporary design education, is supported by softwares which are products of latest technology. Design studios, computer laboratories and workshops supply transition from theory to application.

Students graduated from Industrial Design Department get the title of INDUSTRIAL DESIGNER. They can work as freelance designers and as designers in firms and government establishments' research and development departments and also in design studios.

### PROGRAM

I. SEMESTER				II. SEMESTER			
ENT 501	Industrial Design I	3+0	7,5	ENT 502	Industrial Design II	3+0	7,5
ENT 513	Creation of Brand and Market Strategies	3+0	7,5	ENT 510	New Approaches in Design	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0	ENT 592	Seminar	3+0	7,5
					<i>Elective Courses (1)</i>	-	7,5

30,0

30,0

### III. SEMESTER

ENT 790	Thesis	0+1	30,0
			30,0

#### ELECTIVE COURSES

ARY 505	Scientific Research Planning and Evaluation	3+0	7,5	ENT 520	Advanced Presentation Techniques II	2+2	7,5
ENT 503	Design Management	3+0	7,5	ENT 521	Computer Aided Design I	2+2	7,5
ENT 504	Portfolio Presentation Techniques	3+0	7,5	ENT 522	Computer Aided Design II	2+2	7,5
ENT 506	Media and Design	3+0	7,5	ENT 523	Visualisation	3+0	7,5
ENT 507	Quality in Industrial Design	3+0	7,5	ENT 525	Advanced Computer Aided Industrial Design I	2+2	7,5
ENT 508	Product Identity	3+0	7,5	ENT 526	Advanced Computer Aided Industrial Design II	2+2	7,5
ENT 509	Cultural Problems	3+0	7,5	UET 701	Research in Area of Specialization	3+0	4,5
ENT 511	Advanced Computer Aided Manufacturing	3+0	7,5	UET 702	Research in Area of Specialization	3+0	4,5
ENT 512	Role of Sector in Product Development	2+2	7,5				
ENT 519	Advanced Presentation Techniques I	2+2	7,5				

## DEPARTMENT OF INDUSTRIAL ENGINEERING

Head : Prof. Dr. Refail KASIMBEYLİ

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

Nowadays, technical improvement takes an important role in progressing country. It is important to efficiency use together machine, man and money with ergonomic circumstance. Industrial Engineering set the relationships between machine, man and money with todays modern technology and provides the efficiency and ergonomic work conditions.

Industrial engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, and equipment; drawing upon specialized knowledge and skill in the mathematics, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems.

Anadolu University, Industrial Engineering Department was established in 2002. The decisions related with the department are made by the department council which is composed of all faculty members of the department. The research projects are supported with Anadolu University Scientific Research Project Commission. The capacity of the department is 40 students per year for undergraduate program. Students must attend English preparatory class or pass proficiency examination before beginning their four-year Industrial Engineering education. Advanced computer facilities are offered to the students. They can manage production planning, inventory control, work force planning, management etc. with computer based system design. Industrial Engineering Department supports the computer-based education in theory and application. The Industrial Engineering undergraduate program offers courses which enable students to acquire theoretical knowledge, to develop the optimization and planning skills and abilities necessary for the application of industrial engineering techniques on computer. Accordingly, the computer laboratories of the department are equipped with 60 modern computers and 10 computers have additional advanced feature. Software like SPSSMINITAB, LINDO, LINGO, GAMS, ARENA the ERP program is SAP and etc.

## PROGRAM

### I. SEMESTER

ENM 501	Design and Analysis of Experiments	3+0	7,5
ENM 503	Advanced Techniques in Linear Programming	3+0	7,5

### II. SEMESTER

ENM 502	Production Management Systems	3+0	7,5
İST 522	Stochastic Processes	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0



	<i>Elective Courses (2)</i>	-	15,0				<u>30,0</u>
			<u>30,0</u>				
<b>III. SEMESTER</b>							
ENM 599	Term Project	3+0	15,0				
	<i>Elective Courses (2)</i>	-	15,0				
			<u>30,0</u>				
<b>ELECTIVE COURSES</b>				ENM 516	Multi Criteria Decision Making	3+0	7,5
ENM 504	Decision Making Methods	3+0	7,5	ENM 517	Special Topics in Facilities Planning	3+0	7,5
ENM 505	Sequencing and Scheduling	3+0	7,5	ENM 518	Metaheuristics	3+0	7,5
ENM 508	Reliability of Systems	3+0	7,5	ENM 519	Strategic Choice and Planning in International and National Context	3+0	7,5
ENM 509	Supply Chain Management	3+0	7,5	ENM 520	Advanced Management Technics	3+0	7,5
ENM 512	Research Techniques in Human Engineering	3+0	7,5	MAT 515	Engineering Mathematics	3+0	9,0
ENM 514	Mathematical Programming	3+0	7,5				
ENM 515	Energy Systems	3+0	7,5				

**MASTER OF ARTS (MA) DEGREE**

Industrial engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, and equipment; drawing upon specialized knowledge and skill in the mathematics, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems.

I. SEMESTER				II. SEMESTER			
ENM 501	Design and Analysis of Experiments	3+0	7,5	ENM 502	Production Management Systems	3+0	7,5
ENM 503	Advanced Techniques in Linear Programming	3+0	7,5	ENM 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0	IST 522	Stochastic Processes	3+0	7,5
			30,0		<i>Elective Courses (1)</i>	-	7,5
							30,0
III. SEMESTER							
ENM 790	Thesis	0+1	30,0				
			30,0				
ELECTIVE COURSES							
ENM 504	Decision Making Methods	3+0	7,5	ENM 517	Special Topics in Facilities Planning	3+0	7,5
ENM 505	Sequencing and Scheduling	3+0	7,5	ENM 518	Metaheuristics	3+0	7,5
ENM 508	Reliability of Systems	3+0	7,5	ENM 519	Strategic Choice and Planning in International and National Context	3+0	7,5
ENM 509	Supply Chain Management	3+0	7,5	ENM 520	Advanced Management Technics	3+0	7,5
ENM 512	Research Techniques in Human Engineering	3+0	7,5	MAT 515	Engineering Mathematics	3+0	9,0
ENM 514	Mathematical Programming	3+0	7,5	UEN 701	Research in Area of Specialization	3+0	4,5
ENM 515	Energy Systems	3+0	7,5	UEN 702	Research in Area of Specialization	3+0	4,5
ENM 516	Multi Criteria Decision Making	3+0	7,5				

## DEPARTMENT OF MATERIAL SCIENCE AND ENGINEERING

Head : Prof. Dr. Servet TURAN

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

I. SEMESTER				II. SEMESTER			
MLZ 501	The Structure-Property Relationships in Materials	3+0	7,5	MAT 517	Applied Mathematics	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5	MLZ 502	Thermodynamic Applications in Material Science	3+0	7,5
			30,0		<i>Elective Courses (2)</i>	-	15,0
							30,0
III. SEMESTER							
MLZ 599	Term Project	3+0	15,0				
	<i>Elective Courses (2)</i>	-	15,0				
			30,0				
ELECTIVE COURSES							
CAM 513	Metallic Glasses	3+0	7,5	MLZ 506	Mathematical Methods in Polymer Science and Technology	3+0	7,5
CAM 514	Chemical Durability of Glasses	3+0	7,5	MLZ 507	Fundamentals of Polymer Engineering	3+0	7,5
CAM 515	Engineering Glasses	3+0	7,5	MLZ 508	Mechanics of Polymer-Based Laminated Composites	3+0	7,5
ENM 501	Design and Analysis of Experiments	3+0	7,5	MLZ 509	Advanced Composite Materials	3+0	7,5
MLZ 503	Electrical Properties of Materials	3+0	7,5	MLZ 510	Thin Film Production and Vacuum Technologies	3+0	7,5
MLZ 505	Thermal Analysis of Polymeric Materials	3+0	7,5	MLZ 511	Dielectric Materials and Devices	3+0	7,5

MLZ 512	Applications of Crystallography	3+0	7,5	MLZ 518	Strengthening Mechanisms in Materials	3+0	7,5
MLZ 513	Raw Materials and Mineral Processing	3+0	7,5	MLZ 519	Atomic Force Microscopy and Applications	3+0	7,5
MLZ 514	The use of Glass Materials in Industry	3+0	7,5	MLZ 521	Fracture Mechanics of Materials	3+0	7,5
MLZ 515	Refractory Technology	3+0	7,5				
MLZ 516	Coating Techniques	3+0	7,5				
MLZ 517	X-Ray Diffraction Techniques in Materials Characterisation	3+0	7,5				

### DOCTORATE DEGREE (PH.D)

#### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
MLZ 890	Thesis	0+1	30,0	MLZ 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
<b>ELECTIVE COURSES</b>				MLZ 613	Crystal Anisotropy	3+0	7,5
CAM 601	Ionic Diffusion in Oxide Based Glasses	3+0	7,5	MLZ 614	Spintronic and Applications	3+0	7,5
CAM 602	Glass Science and Technological Improvements	3+0	7,5	MLZ 615	Material and Energy Balance in Production	3+0	7,5
MLZ 601	Scanning Electron Microscopy and Chemical Analysis Techniques	3+0	7,5	MLZ 616	Colloid Chemistry and Rheological Behaviour	3+0	7,5
MLZ 602	Transmission Electron Microscope and Chemical Analysis Techniques	3+0	7,5	MLZ 617	Inorganic Pigments and Pigments Interactions	3+0	7,5
MLZ 603	Special X-Ray Techniques and Their Applications	3+0	7,5	MLZ 618	The Relationship between Structure and Properties in Industrial Glazes	3+0	7,5
MLZ 604	Inorganic Powder Synthesis Technologies	3+0	7,5	MLZ 619	Phase Transformation Mechanisms of Metals	3+0	7,5
MLZ 605	Sintering of Particulate Materials	3+0	7,5	MLZ 651	Materials Science and Advanced Materials Technology	3+0	7,5
MLZ 607	Alloy Development-Principles, New Horizons and Extreme Applications	3+0	7,5	MLZ 652	Fatigue and Creep Behaviour of Aircraft Materials	3+0	7,5
MLZ 608	Polymer Rheology	3+0	7,5	UMM 901	Research in Area of Specialization	5+0	7,5
MLZ 609	Modeling of Polymer Composites Manufacturing Processes	3+0	7,5	UMM 902	Research in Area of Specialization	5+0	7,5
MLZ 610	Kinetics	3+0	7,5				
MLZ 611	Diffusion in Solids	3+0	7,5				
MLZ 612	Ferroelectric Materials and Devices	3+0	7,5				

### MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

I. SEMESTER				II. SEMESTER			
MLZ 501	The Structure-Property Relationships in Materials	3+0	7,5	MAT 517	Applied Mathematics	3+0	7,5
<i>Elective Courses (3)</i>		-	22,5	MLZ 502	Thermodynamic Applications in Material Science	3+0	7,5
			<u>30,0</u>	MLZ 592	Seminar	3+0	7,5
				<i>Elective Courses (1)</i>		-	7,5

30,0

### III. SEMESTER

MLZ 790	Thesis	0+1	30,0
			30,0

### ELECTIVE COURSES

CAM 513	Metallic Glasses	3+0	7,5
CAM 514	Chemical Durability of Glasses	3+0	7,5
CAM 515	Engineering Glasses	3+0	7,5
ENM 501	Design and Analysis of Experiments	3+0	7,5
MLZ 503	Electrical Properties of Materials	3+0	7,5
MLZ 505	Thermal Analysis of Polymeric Materials	3+0	7,5
MLZ 506	Mathematical Methods in Polymer Science and Technology	3+0	7,5
MLZ 507	Fundamentals of Polymer Engineering	3+0	7,5
MLZ 508	Mechanics of Polymer-Based Laminated Composites	3+0	7,5
MLZ 509	Advanced Composite Materials	3+0	7,5
MLZ 510	Thin Film Production and Vacuum Technologies	3+0	7,5
MLZ 511	Dielectric Materials and Devices	3+0	7,5

MLZ 512	Applications of Crystallography	3+0	7,5
MLZ 513	Raw Materials and Mineral Processing	3+0	7,5
MLZ 514	The use of Glass Materials in Industry	3+0	7,5
MLZ 515	Refractory Technology	3+0	7,5
MLZ 516	Coating Techniques	3+0	7,5
MLZ 517	X-Ray Diffraction Techniques in Materials Characterisation	3+0	7,5
MLZ 518	Strengthening Mechanisms in Materials	3+0	7,5
MLZ 519	Atomic Force Microscopy and Applications	3+0	7,5
MLZ 521	Fracture Mechanics of Materials	3+0	7,5
UMM 701	Research in Area of Specialization	3+0	4,5
UMM 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF MATHEMATICS

Head : Prof. Dr. Nedim DEĞİRMENÇİ

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

#### I. SEMESTER

MAT 502	Analysis	3+0	7,5
MAT 532	Functional Analysis	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			30,0

#### II. SEMESTER

MAT 519	Algebra	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			30,0

#### III. SEMESTER

MAT 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			30,0

### ELECTIVE COURSES

MAT 503	Topology	3+0	7,5
MAT 504	Differential Equations	3+0	7,5
MAT 506	Real Analysis	3+0	7,5
MAT 507	Applied Mathematics I	3+0	7,5
MAT 508	Applied Mathematics II	3+0	7,5
MAT 509	Algebraic Topology I	3+0	7,5
MAT 510	Algebraic Topology II	3+0	7,5

MAT 511	Dynamical Systems I	3+0	7,5
MAT 512	Dynamical Systems II	3+0	7,5
MAT 513	Axiomatic Sets Theory	3+0	7,5
MAT 517	Applied Mathematics	3+0	7,5
MAT 520	Lie Algebras	3+0	7,5
MAT 521	Geometric Topology	3+0	7,5
MAT 523	Introduction to Riemann Geometry	3+0	7,5
MAT 524	Geometry of Differential Forms	3+0	7,5

MAT 525	Equations of Mathematical Physics I	3+0	7,5	MAT 534	Selected Topics in Algebra	3+0	7,5
MAT 526	Equations of Mathematical Physics II	3+0	7,5	MAT 535	Hyperbolic Geometry	3+0	7,5
MAT 527	Numerical Solutions of Partial Differential Equations	3+0	7,5	MAT 545	Integral Equations I	3+0	7,5
MAT 528	Optimization Methods I	3+0	7,5	MAT 546	Integral Equations II	3+0	7,5
MAT 529	Optimization Methods II	3+0	7,5	MAT 547	Asymptotic Methods in Analysis	3+0	7,5
MAT 530	Introduction to the Theory of Nonlinear Optimization	3+0	7,5	MAT 548	Numerical Solutions of Ordinary Differential Equations	3+0	7,5
MAT 531	Tensor Analysis	3+0	7,5	MAT 549	Introduction to Graph Theory	3+0	7,5
MAT 533	Differentiable Manifolds	3+0	7,5	MAT 552	Introduction to Mathematical Elasticity	3+0	7,5

## PROGRAM IN MATHEMATICS (DISTANCE EDUCATION EVENING)

### PROGRAM

I. SEMESTER				II. SEMESTER			
MAT 536	Applications of Integration and Differential Equations	3+0	7,5	MAT 532	Functional Analysis	3+0	7,5
MAT 537	General Topology	3+0	7,5	<i>Elective Courses (3)</i>		-	22,5
<i>Elective Courses (2)</i>		-	15,0				30,0
			30,0				
III. SEMESTER							
MAT 599	Term Project	3+0	15,0				
<i>Elective Courses (2)</i>		-	15,0				
			30,0				
ELECTIVE COURSES							
MAT 533	Differentiable Manifolds	3+0	7,5	MAT 541	Selective Topics from Theory of Functions of a Complex Variable	3+0	7,5
MAT 534	Selected Topics in Algebra	3+0	7,5	MAT 542	Game Theory	3+0	7,5
MAT 538	Axiomatic Geometry	3+0	7,5	MAT 543	Introduction to Optimization Theory	3+0	7,5
MAT 539	Fractal Geometry	3+0	7,5	MAT 544	Combinatorial Knot Theory	3+0	7,5
MAT 540	Introduction to Convex Analysis	3+0	7,5				

## DOCTORATE DEGREE (PH.D)

Mathematics is fundamental in the University education that is why apart from doing research in the field of mathematics, the department gives a wide variety of services to almost all of the faculties of the university. The main mathematics subject areas of the department is applied mathematics, fractal geometry , fractal analysis, analysis and topology. Also considering the developing information technologies the departmant gives a particular importance to the computer sciencess especially to the soft-ware and programming.

The department of mathematicies was established in 1993 and is located at the Yunus Emre Campus. 4 Professor, 4 assoc. Prof., 9 Assist. Prof., 3 Instructors and 9 Assistants are currently working in the department.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			30,0				22,5

III. SEMESTER				IV. SEMESTER			
MAT 890	Thesis	0+1	30,0	MAT 890	Thesis	0+1	30,0
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MAT 509	Algebraic Topology I	3+0	7,5	MAT 530	Introduction to the Theory of Nonlinear Optimization	3+0	7,5
MAT 510	Algebraic Topology II	3+0	7,5	MAT 531	Tensor Analysis	3+0	7,5
MAT 511	Dynamical Systems I	3+0	7,5	MAT 533	Differentiable Manifolds	3+0	7,5
MAT 512	Dynamical Systems II	3+0	7,5	MAT 534	Selected Topics in Algebra	3+0	7,5
MAT 513	Axiomatic Sets Theory	3+0	7,5	MAT 535	Hyperbolic Geometry	3+0	7,5
MAT 517	Applied Mathematics	3+0	7,5	MAT 545	Integral Equations I	3+0	7,5
MAT 520	Lie Algebras	3+0	7,5	MAT 546	Integral Equations II	3+0	7,5
MAT 521	Geometric Topology	3+0	7,5	MAT 547	Asymptotic Methods in Analysis	3+0	7,5
MAT 523	Introduction to Riemann Geometry	3+0	7,5	MAT 548	Numerical Solutions of Ordinary Differential Equations	3+0	7,5
MAT 524	Geometry of Differential Forms	3+0	7,5	MAT 549	Introduction to Graph Theory	3+0	7,5
MAT 525	Equations of Mathematical Physics I	3+0	7,5	MAT 552	Introduction to Mathematical Elasticity	3+0	7,5
MAT 526	Equations of Mathematical Physics II	3+0	7,5	UMT 701	Research in Area of Specialization	3+0	4,5
MAT 527	Numerical Solutions of Partial Differential Equations	3+0	7,5	UMT 702	Research in Area of Specialization	3+0	4,5
MAT 528	Optimization Methods I	3+0	7,5				
MAT 529	Optimization Methods II	3+0	7,5				

## DEPARTMENT OF PHYSICS

Head : Prof. Dr. Müjdat ÇAĞLAR

### DOCTORATE DEGREE (PH.D)

The Department of Physics was established in 1993 and is located at the Yunus Emre Campus. General Physics, High Energy and Plasma Physics, Atom and Molecule and Solid State Physics are Major Branches of the Department. 5 Professors, 11 Assist. Prof., 5 Instructors and 13 Assistants are currently working in the department. The courses offered in Physics program especially emphasize the fundamentals of Physics and then advanced Physics considering all these major subjects. The research laboratories of the department are equipped with the research equipments and facilities needed to do scientific research with the support of Scientific Research Projects Fund of Anadolu University, DPT and TUBITAK. The Department's educational aim is to graduate modern physics and future scientists guided by the basic knowledge and know-how necessary for them to handle and solve the problems they face in their careers as well as to contribute to developments in science and technology. The graduate of this Department can work in various research and development laboratories.

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
FİZ 890	Thesis	0+1	30,0	FİZ 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
ELECTIVE COURSES				FİZ 607	Optical Properties of Semiconductors I	3+0	7,5
FİZ 601	Clay and Clay Minerals I	3+0	7,5	FİZ 608	Optical Properties of Semiconductors II	3+0	7,5
FİZ 602	Clay and Clay Minerals II	3+0	7,5	FİZ 610	Selected Topics on Clay and Clay Minerals II	3+0	7,5
FİZ 604	Selected Topics in Zeolite Molecular Sieves	3+0	7,5	FİZ 611	Selected Topics in Solid State Physics	3+0	7,5
FİZ 605	Selected Topics on Clay and Clay Minerals I	3+0	7,5	FİZ 612	Dielectric Physics	3+0	7,5
FİZ 606	Selected Topics in Electromagnetic Wave Theory	3+0	7,5	FİZ 614	Selected Topics in Classical Mechanics	3+0	7,5

FİZ 616	Group Theory and Applications to Physics	3+0	7,5	FİZ 636	Molecular Beam Epitaxy: Instrument and Application	3+0	7,5
FİZ 617	Lie Groups and Physical Applications	3+0	7,5	FİZ 637	Fundamental Properties and Gas Adsorption Applications of Naturel Adsorbents	3+0	7,5
FİZ 619	Conduction Mechanisms in Solids	3+0	7,5	FİZ 638	Fundamentals of Semiconductor Device and Technology	3+0	7,5
FİZ 621	Selected Topics in Adsorption Technology	3+0	7,5	FİZ 639	Physical Mechanisms of Variables Stars	3+0	7,5
FİZ 622	Selected Topics of Advanced Statistical Physics	3+0	7,5	FİZ 640	Structural Properties of Accretion Disc in Binary Stars	3+0	7,5
FİZ 623	Selected Topics in Mathematical Physics	3+0	7,5	FİZ 641	Gas Adsorption Applications of Clay Type Naturel Adsorbents	3+0	7,5
FİZ 624	Selected Topics in Semiconductors	3+0	7,5	FİZ 642	Infrared and Raman Spectroscopy	3+0	7,5
FİZ 627	Selected Topics in Ion Exchange	3+0	7,5	FİZ 644	Nuclear Magnetic Resonance Spectroscopy	3+0	7,5
FİZ 629	Electromagnetic Wave Theory	3+0	7,5	UFZ 901	Research in Area of Specialization	5+0	7,5
FİZ 630	Magnetic Properties of Solids	3+0	7,5	UFZ 902	Research in Area of Specialization	5+0	7,5
FİZ 631	Organic Semiconductor Physics	3+0	7,5				
FİZ 632	Classical Electrodynamics	3+0	7,5				
FİZ 633	Band Theory in Semiconductors	3+0	7,5				
FİZ 634	Gravitation and Cosmology	3+0	7,5				
FİZ 635	Ultra Cold Atomic Gases	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

The department of Physics was established in 1993 and is located at the Yunus Emre Campus. General Physics, High Energy and Plasma Physics, Atom and Molecule and Solid State Physics are Major Branches of the Department. 5 Professors, 11 Assist. Prof., 5 Instructors and 13 Assistants are currently working in the department. The courses offered in Physics program especially emphasize the fundamentals of Physics and then advanced Physics considering all these major subjects. The research laboratories of the department are equipped with the research equipments and facilities needed to do scientific research with the support of Scientific Research Projects Fund of Anadolu University, DPT and TUBITAK. The Department's educational aim is to graduate modern physics and future scientists guided by the basic knowledge and know-how necessary for them to handle and solve the problems they face in their careers as well as to contribute to developments in science and technology. The graduate of this Department can work in various research and development laboratories.

## PROGRAM

I. SEMESTER				II. SEMESTER			
FİZ 501	Mathematical Physics	3+0	7,5	FİZ 508	Quantum Mechanics	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5	FİZ 542	Electromagnetic Theory	3+0	7,5
			30,0	FİZ 592	Seminar	3+0	7,5
					<i>Elective Courses (1)</i>	-	7,5
							30,0
III. SEMESTER							
FİZ 790	Thesis	0+1	30,0				
			30,0				
ELECTIVE COURSES							
FİZ 503	Ion Exchange	3+0	7,5	FİZ 515	Analysis of the X-ray Spectrum	3+0	7,5
FİZ 505	Physical Adsorption	3+0	7,5	FİZ 522	Geometric Algebra and Applications	3+0	7,5
FİZ 507	Quantum Mechanics and Molecular Spectroscopy	3+0	7,5	FİZ 523	Optoelectronic Physics I	3+0	7,5
FİZ 509	Instrumental Analysis Methods	3+0	7,5	FİZ 524	Optoelectronic Physics II	3+0	7,5
FİZ 510	Evolution of Stars	3+0	7,5	FİZ 525	Some Biophysical Techniques Connected With Waves	3+0	7,5
FİZ 512	High Energy Astrophysics	3+0	7,5	FİZ 526	Classical Mechanics	3+0	7,5
FİZ 514	Electromagnetic Wave Theory	3+0	7,5	FİZ 527	Advanced Statistical Physics	3+0	7,5
				FİZ 528	Adsorption Technology	3+0	7,5



FİZ 529	Thin Film Characterization	3+0	7,5	FİZ 544	Condensed Matter Physics II	3+0	7,5
FİZ 530	Thin Film Technology	3+0	7,5	FİZ 545	Characterization Methods of Porous Solids and Powder Minerals	3+0	7,5
FİZ 531	Amorphous Material Physics	3+0	7,5	FİZ 546	Infrared Detection Systems: Physics and Technology	3+0	7,5
FİZ 532	Particle Physics	3+0	7,5	FİZ 547	Lab VIEW: Graphical Programming Language	3+0	7,5
FİZ 533	Special Function in Physics I	3+0	7,5	FİZ 549	Hypercomplex Numbers in Physics	3+0	7,5
FİZ 537	Fundamentals of Impedance Spectroscopy	3+0	7,5	FİZ 550	Geometry and Topology in Physics	3+0	7,5
FİZ 538	Special Functions in Physics II	3+0	7,5	UFZ 701	Research in Area of Specialization	3+0	4,5
FİZ 539	Dynamics and Relativity	3+0	7,5	UFZ 702	Research in Area of Specialization	3+0	4,5
FİZ 540	Characterization of Solids	3+0	7,5				
FİZ 541	Semiconductors	3+0	7,5				
FİZ 543	Condensed Matter Physics I	3+0	7,5				

## DEPARTMENT OF REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS

Head : Prof. Dr. Alper ÇABUK

### (NON-THESIS) MASTER OF SCIENCE (MS) DEGREE

#### PROGRAM

##### I. SEMESTER

UCS 533	Fundamentals of Mapping and Geographical Information Systems	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5
			30,0

##### II. SEMESTER

UCS 508	Interpretation and Analysis Techniques on Geographic Information Systems	3+0	7,5
UCS 555	Theoretical Basics of Remote Sensing	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0
			30,0

##### III. SEMESTER

UCS 599	Term Project	3+0	15,0
	<i>Elective Courses (2)</i>	-	15,0
			30,0

##### ELECTIVE COURSES

İST 533	Fundamentals Statistics	3+0	7,5
UCS 506	Methods of Numerical Analysis	3+0	7,5
UCS 511	Remote Sensing and Geographic Information Systems Techniques in Disaster Management	3+0	7,5
UCS 512	Special Topics in the Natural Resources Management with the Use of GIS	3+0	7,5
UCS 513	Special Topics on City Information Systems	3+0	7,5
UCS 514	Environmental Management and Integration With Geographical Information Systems	3+0	7,5
UCS 519	Automated Mapping and Facility Management Systems	3+0	7,5
UCS 527	Multicriteria Decision Making Methods	3+0	7,5
UCS 534	Geostatistics	3+0	7,5

UCS 535	Integration of Geographic Information Systems and Global Positioning Systems	3+0	7,5
UCS 536	Remote Sensing	3+0	7,5
UCS 537	Geographic Information Systems in Social Sciences	3+0	7,5
UCS 538	Geographic Information Systems and Health	3+0	7,5
UCS 542	Raster and Grid Modeling on Remote Sensing	3+0	7,5
UCS 543	Applications of New Technologies in Geographic Information Systems	3+0	7,5
UCS 544	Seismic Data Acquisition Techniques and Quality Control	3+0	7,5
UCS 545	Bore-Hole Seismic Methods and Professional Software	3+0	7,5
UCS 546	Seismic Tomography and Professional Software	3+0	7,5
UCS 547	Seismic Surface Waves	3+0	7,5

UCS 548	Data-Processing in Seismic Refraction Methods and Professional Software	3+0	7,5	UCS 552	Satellite Technologies and Communication	3+0	7,5
UCS 549	Data-Processing in Seismic Reflection Methods and Professional Software	3+0	7,5	UCS 553	Satellite Managership	3+0	7,5
UCS 550	Seismic Interpretation and Professional Software	3+0	7,5	UCS 557	Microzoning	3+0	7,5
UCS 551	Seismic Stratigraphy and Tectonics	3+0	7,5				

## DOCTORATE DEGREE (PH.D)

### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
UCS 890	Thesis	0+1	30,0	UCS 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
<b>ELECTIVE COURSES</b>				UCS 616	Physical Principles of Energy and Matter Interactions in Remote Sensing	3+0	7,5
UCS 601	Use of GIS in Earth Sciences	3+0	7,5	UCS 617	Special Subject at Remote Sensing	3+0	7,5
UCS 602	Earth Systems	3+0	7,5	UCS 618	Network Analysis in Geographic Information Systems	3+0	7,5
UCS 603	Advanced Photogeology	3+0	7,5	UCS 620	Remote Sensing and Geographic Information Systems Applications for Mine Reclamation	3+0	7,5
UCS 604	Environmental Hydrogeology	3+0	7,5	UCS 622	Basic Programming and Geometric Problems	3+0	7,5
UCS 606	Hydraulics in Porous Media	3+0	7,5	UCS 624	Airborne Laser Scanning (LIDAR) Systems	3+0	7,5
UCS 607	Advanced Technology Supported Archaeological and Architectural Documentation	3+0	7,5	UCS 626	Logistics Optimization	3+0	7,5
UCS 608	Multiple Criteria Stable Support System Applications in Disaster Management	3+0	7,5	UCS 628	National Standards, Legislations and Public Applications	3+0	7,5
UCS 609	Use of Geographic Information Systems in the Applications of Seismic Microzoning and Urban Transformation	3+0	7,5	UCS 630	Geographical Information Applications for Water Resources Planning	3+0	7,5
UCS 610	Application of High Speed Ground Penetrating Radar to Ballast and Subsoil Inspections of Runways, Highways and Railways	3+0	7,5	UCS 632	Government Projects and Spatial Relations in Turkey	3+0	7,5
UCS 611	Use of Geographic Information Systems in the Planning of Earthquake Origin Risk/Damage Mitigation	3+0	7,5	UCS 634	Property Law and Introduction to Land Survey Applications	3+0	7,5
UCS 612	Modern Approaches to the City Planning	3+0	7,5	UCS 636	Project Management in Geographic Information Systems	3+0	7,5
UCS 613	Urban Conservation-Restoration	3+0	7,5	UCS 901	Research in Area of Specialization	5+0	7,5
UCS 614	Urban Regeneration	3+0	7,5	UCS 902	Research in Area of Specialization	5+0	7,5
UCS 615	Resource Inventory and Analysis	3+0	7,5				

## MASTER OF SCIENCE (MS) DEGREE

Master of Science program (M.S.) about Remote Sensing and Geographic Information System have been started since 2003-2004 education season. Master of Science program about Remote Sensing and Geographic Information System is mainly divided into two types (with thesis and without thesis). The selected candidates of the program must be decide the type of the thesis before beginning to the program.

The program will mainly continued with the experience and hardware-software opportunities of the Satellite and Space Science Research Institute of Anadolu University. The studies about Remote Sensing (RS) and Geographic Information Systems (GIS) beneath the Anadolu University Computer Research and Application Center have continued officially in the Satellite and Space Sciences Research Institute which was founded in 1993. Research Institute replaced in their new building in the new campus area at the end of 1996.

Remote sensing studies which were begun with the aim of interpretation of digital data which were taken from satellite with the help of computers according to different subjects (geology, mining, tectonics, land use, vulnerability maps, erosion, water pollution, forestry, etc.), have been carried in the institute since 1993. In addition to these studies, the applications about Geographic Information Systems were started in 1993. Due to the consideration that, different disciplines of specialists must be used in the remote sensing and geographic information system projects, wide range of specialist (geological and mining engineers, geodesy, and physicists, etc.) have found application opportunity in the institute.

Institute have finished many projects and researches about the interested bid. The relevant experiences are generally about preparation of geological and engineering geological maps, earthquake risk maps, land use planning by using remote sensing data, erosion risk maps and etc. Remote Sensing and Geographic Information System Techniques were used for all the projects. In addition to these projects, many courses about applications of Remote Sensing and Geographic Information System were given to different governmental organizations (General Directorate of Rural Service, TC Prime Ministry Southeastern Anatolia Project-GAP, Ministry of Public Works, etc.) and municipalities (Kahramanmaraş, Eskişehir).

The one of the biggest project which interested all the people lives in the urban area of the Eskişehir was "Preparation of Geological and Geotechnical Studies Report of Greater Eskişehir Municipality in Respect to Settlement?". Geological and geotechnical studies in respect to settlement of 64 districts which belong to Eskişehir Municipality, was prepared in this study. This study was done according to demand of Eskişehir Municipality by Anadolu University. The maps and results which were obtained at the end of the study, have helped in determination of land use in respect to preparation of 1/25.000 scaled environmental order plan, 1/5.000 scaled public improvements plan and 1/1.000 scaled application plan. In this study, preparation of engineering geology map of Eskişehir urban area was based on earthquake risk. From this point of view, earthquake is considered as the most effective natural disaster which could effect the city and microzonation map of the alluvium which most of the city located on it. At the end of these studies, the final report was prepared in the norms of General Directorate of Disaster Affairs of Ministry of Public Works. This report was approved at the end of the verification. This study was one of the first and more detailed research, which the new in-situ technique like Seismic Conic Penetration Test results were evaluated with 3-Dimensional Geographic Information System.

### PROGRAM

I. SEMESTER				II. SEMESTER			
UCS 533	Fundamentals of Mapping and Geographical Information Systems	3+0	7,5	UCS 508	Interpretation and Analysis Techniques on Geographic Information Systems	3+0	7,5
	<i>Elective Courses (3)</i>	-	22,5	UCS 555	Theoretical Basics of Remote Sensing	3+0	7,5
				UCS 592	Seminar	3+0	7,5
					<i>Elective Courses (1)</i>	-	7,5
			30,0				30,0
III. SEMESTER							
UCS 790	Thesis	0+1	30,0				
			30,0				
ELECTIVE COURSES							
İST 533	Fundamentals Statistics	3+0	7,5	UCS 506	Methods of Numerical Analysis	3+0	7,5

UCS 511	Remote Sensing and Geographic Information Systems Techniques in Disaster Management	3+0	7,5	UCS 543	Applications of New Technologies in Geographic Information Systems	3+0	7,5
UCS 512	Special Topics in the Natural Resources Management with the Use of GIS	3+0	7,5	UCS 544	Seismic Data Acquisition Techniques and Quality Control	3+0	7,5
UCS 513	Special Topics on City Information Systems	3+0	7,5	UCS 545	Bore-Hole Seismic Methods and Professional Software	3+0	7,5
UCS 514	Environmental Management and Integration With Geographical Information Systems	3+0	7,5	UCS 546	Seismic Tomography and Professional Software	3+0	7,5
UCS 519	Automated Mapping and Facility Management Systems	3+0	7,5	UCS 547	Seismic Surface Waves	3+0	7,5
UCS 527	Multicriteria Decision Making Methods	3+0	7,5	UCS 548	Data-Processing in Seismic Refraction Methods and Professional Software	3+0	7,5
UCS 534	Geostatistics	3+0	7,5	UCS 549	Data-Processing in Seismic Reflection Methods and Professional Software	3+0	7,5
UCS 535	Integration of Geographic Information Systems and Global Positioning Systems	3+0	7,5	UCS 550	Seismic Interpretation and Professional Software	3+0	7,5
UCS 536	Remote Sensing	3+0	7,5	UCS 551	Seismic Stratigraphy and Tectonics	3+0	7,5
UCS 537	Geographic Information Systems in Social Sciences	3+0	7,5	UCS 552	Satellite Technologies and Communication	3+0	7,5
UCS 538	Geographic Information Systems and Health	3+0	7,5	UCS 553	Satellite Managership	3+0	7,5
UCS 542	Raster and Grid Modeling on Remote Sensing	3+0	7,5	UCS 557	Microzoning	3+0	7,5
				UCS 701	Research in Area of Specialization	3+0	4,5
				UCS 702	Research in Area of Specialization	3+0	4,5

## DEPARTMENT OF STATISTICS

Head : Prof. Dr. Embiya AĞAOĞLU

### DOCTORATE DEGREE (PH.D)

Our research cover a wide range of areas in theoretical and applied Statistics and Probability. Graduates are able to get positions in the Universities or in General Companies.

#### PROGRAM

I. SEMESTER				II. SEMESTER			
<i>Elective Courses (4)</i>		-	30,0	<i>Elective Courses (3)</i>		-	22,5
			<u>30,0</u>				<u>22,5</u>
III. SEMESTER				IV. SEMESTER			
İST 890	Thesis	0+1	30,0	İST 890	Thesis	0+1	30,0
			<u>30,0</u>				<u>30,0</u>
<b>ELECTIVE COURSES</b>							
İST 604	Econometric Models	3+0	7,5	İST 614	Artificial Neural Networks and Statistical Models II	3+0	7,5
İST 608	Mathematical Methods of Statistics	3+0	7,5	İST 615	Mathematics Foundation in Regression Analysis I	3+0	7,5
İST 610	Conjoint Analysis	3+0	7,5	İST 616	Mathematics Foundation in Regression Analysis II	3+0	7,5
İST 611	Pearson System I	3+0	7,5	İST 617	Modern Regression Techniques	3+0	7,5
İST 612	Pearson System II	3+0	7,5	İST 618	Information Theory and Statistics	3+0	7,5
İST 613	Artificial Neural Networks and Statistical Models I	3+0	7,5				

IST 621	Advanced Circular Data Analysis	3+0	7,5	IST 627	Fundamentals of Stochastic Differential Equations	3+0	7,5
IST 622	Fuzzy Neural Integrated Systems	3+0	7,5	IST 628	Stochastic Differential Equations and Applications	3+0	7,5
IST 623	Fuzzy Artificial Neural Networks	3+0	7,5	IST 629	Stochastic Modeling and Analysis	3+0	7,5
IST 625	Entropy Optimization Methods With Applications	3+0	7,5	IST 631	Robust Statistical Methods	3+0	7,5
IST 626	Numerical Methods in Modeling with Entropy Optimization Distributions	3+0	7,5	UIS 901	Research in Area of Specialization	5+0	7,5
				UIS 902	Research in Area of Specialization	5+0	7,5

## MASTER OF SCIENCE (MS) DEGREE

Our research cover a wide range of areas in theoretical and applied Statistics and Probability. Graduates are able to get positions in the Universities or in General Companies.

### PROGRAM

I. SEMESTER				II. SEMESTER			
IST 506	The Theory of Measure and Probability	3+0	7,5	IST 531	Linear Models	3+0	7,5
IST 530	Theory of Statistics	3+0	7,5	IST 592	Seminar	3+0	7,5
	<i>Elective Courses (2)</i>	-	15,0		<i>Elective Courses (2)</i>	-	15,0
			30,0				30,0
III. SEMESTER							
IST 790	Thesis	0+1	30,0				
			30,0				

### ELECTIVE COURSES

ARY 505	Scientific Research Planning and Evaluation	3+0	7,5	IST 523	Nonparametric Models With Spline Regression	3+0	7,5
IST 505	Econometric Analysis	3+0	7,5	IST 524	Generalized Additive Models With Spline Regression	3+0	7,5
IST 507	Circular Data Analysis	3+0	7,5	IST 526	Advanced Experimental Design	3+0	7,5
IST 510	Nonparametric Statistical Techniques	3+0	7,5	IST 528	Probabilistic Mixture Theory	3+0	7,5
IST 511	Advanced Regression Analysis	3+0	7,5	IST 532	Fuzzy Statistical Methods	3+0	7,5
IST 512	Artificial Neural Networks and Statistics	3+0	7,5	IST 536	Statistical Softwares	3+0	7,5
IST 514	Advanced Statistical Techniques for Researchers	3+0	7,5	IST 537	Actuarial Models	3+0	7,5
IST 517	Multiple Relation Techniques for Questionnaires Analysis	3+0	7,5	IST 539	Statistical Simulation	3+0	7,5
IST 520	Maximum Entropy Method and Its Applications	3+0	7,5	IST 541	Time Series Analysis with Application	3+0	7,5
IST 521	Continuous Markov Processes	3+0	7,5	UIS 701	Research in Area of Specialization	3+0	4,5
				UIS 702	Research in Area of Specialization	3+0	4,5

### COURSE CONTENTS

**ARK 546 Construction Elements in Archaic Age 3+0 7,5**  
Architectural Materials; Construction Techniques from Foundation to Roof; Masonry Systems; Functions of Construction Elements; Architectural Styles: Doric, Ionic, Corinth styles; Basic Characteristics and the Comparison of Greek and Roman Architecture; Analysis and Dating of Construction Elements.

**ARK 547 Architecture and Urbanization in Archaic Age 3+0 7,5**  
Greek and Roman Cities; Urbanization Approaches, Intramuros in cities, Extramural elements; Defense systems, Sacred places, Temples, Altars, Propylons, Stoa, Bouleuterions, Agoras, Gymnasions, Theatres, Stadions, Houses, Water systems, Nymphaions, Baths, Latrines, City monuments; Necropolises.

**ARK 555 Geophysical Methods in Archeology:****Archeogeophysics 3+0 7,5**

General review of geophysical prospection methods in archeology: Gravity, magnetic, electric, electromagnetic, seismic and ground-penetrating-radar. Instrumentation, 2D/3D data-acquisition, data-quality-control, data-processing and data-interpretation. Shallow geophysical methods in sea, lake, swamp, dam, and stream environments: Underwater-cameras, high-resolution-seismic, multibeam-echosounder, side-scan-sonar techniques.

**ARY 505 Scientific Research Planning and Evaluation****3+0 7,5**

Scientific Research: Description of scientific research, Descriptive approaches, Qualitative differences according to scientific branches, Features of a scientific research, Determination techniques of scientific research problem; Resource Searching Methods in Scientific Research: Reaching to resource and techniques of evaluation, Data obtained for scientific research, Description of the reliable data; Using possibility of statistical techniques in evaluation of scientific research: The importance of body and contents relations on the interpretation of results, Writing types of research, How to show resources, Tabulation.

**BEL 501 Terrestrial Photogrammetry and Laser Scanning****2+2 7,5**

Architectural Surveys and Survey Methods: Horizontal transformation, Photoplan, Surveys in excavation sites and archaeological protected areas, Survey of art works; Photogrammetric Applications for the Examination and Conservation of Historical Centers and Protected Areas: Plan and section, Digital analysis of historical centres, Documentation of historical monuments, Problems in photogrammetric documentation of monuments, Digital use of traditional photogrammetry on architectural objects; Using Photogrammetric Methods for Surveying Global Deposits: Digital opportunities for the survey of a single photo, Quantity in photogrammetry, Finance and practical applications; Architectural Photogrammetry Applications: Deformation, Displacement, Standards and methodology for building surveys, Optimization in architectural photogrammetry.

**BEL 505 Construction History Researches****3+0 7,5**

History of Construction History Research; Works within the Scope of Construction History Research; Architectural Resources from the Archaic Age; Renaissance Period Resources; Modern Age Studies; Systematic Resource Evaluation; Evaluations of Disparities and Similarities; Research Methodology.

**BEL 599 Term Project****3+0 15,0****BİL 503 Object Oriented Programming****3+0 7,5**

Comparison Between Traditional Programming Language And Object Oriented Programming Languages; Properties of Object Oriented Programming; Encapsulation; Data Hiding; Inheritance; Polymorphism; Programming With

C++ and JAVA; Function Overloading; Inline Functions; Data Abstraction; Classes; Abstract Classes; Methods; Constructor; Destructor; Static Functions; Public; Private and Protected Functions; Pointers; References; Operator Overloading; Exception Handling; Visual Programming.

**BİL 504 Data Structure and Algorithms****3+0 7,5**

Definition of Data; Linear Lists; Arrays; Stack; Queue; Linked Lists; Memory Allocation and Arrangement; Many Conjunction Lists; Tree Structures; Operation on the System; Search Methods; Sorting Methods; Merging Methods; Register and Minutes Concepts; Physical Register Arrangement; Addressing Methods; Indexed Arrangement in Ordered Register Regularity; Distributed Addressing; Pointers; Chain and Ring Structures.

**BİL 505 Data Systems: Analysis and Design****3+0 7,5**

System Concept; System Analysis Principles; Organization And Management As A System; Management and Data; Data Production Process; Development of Data Systems; Data Management Systems; Decisions Support Systems; Analysis; Design; Application.

**BİL 506 Database Management Systems****3+0 7,5**

Database Concept; Database Models; Relational Database Model; Hierarchical Database Model, Network Model; Logical Design of Databases; Physical Design of Relational Database Model; Integration of Relational Databases and SQL/DS; Distributed Databases; Object Oriented Database Management Systems; Expert Database Systems; Uncertainty In Database Systems; Office Data Systems; Application With ORACLE PL/SQL.

**BİL 507 Introduction to Operating Systems****3+0 7,5**

Fundamental Concepts of Operating Systems; Services Provided By Operating Systems; Resource Management; Job Management; Job Scheduling; Time Sharing; Multitasking; Memory Management; Process Management; Virtual Memory; Paging; Interrupt Structures and Interrupt Processing; Arithmetic Processing Unit Management; Input/Output Inferior System; Register Management Inferior System; UNIX O/S Features and Internal Structure.

**BİL 509 Simulation and Modeling****3+0 7,5**

Fundamental Concepts of Probability and Statistics; Discrete Simulation; Selecting Input Probability Distribution; Analog Computer Simulation; Generating Rational Number; Output Data Analysis; Statistical Methods For Comparing Alternative Systems; Simulation Languages and GPPS.

**BİL 510 Artificial Intelligence****3+0 7,5**

Concept of Artificial Intelligence; Turing Test; Introduction to the Studies About Artificial Intelligence; Problem Solution And Searching Strategies; State-Space Approach; Problem Reduction Approach; Problem Representation; Search Techniques; Breadth-First Search; Depth-First Search; Iterative Deepening; Game-Playing; Knowledge Representation and Reasoning; Expert Systems and Rule Chaining; Vision; Natural Language Processing; Machine

Learning; Artificial Neural Networks; Supervised Learning; Unsupervised Learning; Back propagation.

**BİL 511 Computer Aided Design 3+0 7,5**

Using Computer For Design; Existing Computer Software to Be Used For Design; Designing Methods Using Autocad; Sample Designs.

**BİL 513 Numerical Analysis 3+0 7,5**

Arithmetic Operations In Computers; Calculators; Errors And Algorithms; Finding Mid-Value Methods; Interpolation Methods; Lagrange; Hermite; Least Squares; Spline, Linear; Finite Distinctions; Numerical Derivation and Integration; Rounding Errors and Accelerating Convergence; Linear Equation Systems; Differential Equations; Runge-Kutta and Multi-Step Improvement Algorithms.

**BİL 514 Decision Support Systems 3+0 7,5**

Decision Process and Knowledge in Managerial Decisions; Decision Making Process and System Approach; Critical Success Factors; Human's Intelligent Properties and Decision Forms; Management Process and Knowledge Support At Managerial Decisions; Models and Modeling Process; Using Models At Managerial Decisions; Static and Dynamic Models; Definiteness; Indefiniteness and Risk Environments; Mathematical Programming and Optimization; Simulation and Procedural Approaches; Decisions Support Systems (DSS) Structure and Properties; DSS Elements, Properties And Abilities of DSS; DSS Components; Setting Up Decision Support Systems; DSS Development Process; Users; Participants; Options of KDS Setup and Team Working; Decision Support System Tools; Database Systems; Dialog; Model and Database Inferior Systems; Programming Languages and Calculation Table Software; DSS Generators; Top Manager Data Systems; Expert Systems; Introduction to Artificial Intelligence; Sample Events.

**BİL 517 Logic Design 3+0 7,5**

Logic Gates; Logic Variables; Number Systems; Data Representation; Computer Organization; Boolean Algebra; Logic Functions; State Tables; State Minimization; State Assignment; Karnaugh Maps; Instruction Formats and Addressing; Data Circuits (Coders, Multipliers); Flip-Flops; Clock-Mode; Sequential Circuits; Counters; Shift Registers.

**BİL 518 Microprocessors 3+0 7,5**

Introduction to Eight Bit Microcontrollers; Motorola 68 HC11; Instructions and Machine Language; Addressing Modes; Advanced Programming; Indexing, Stacks; Procedures; Bit-Byte Processing; System Design With Microcontrollers; Memory Code Solution; Bus; Input/Output Units; Interrupts; Parallel Input/Output; A/D and D/A Processes; Serial Communication; Interrupt Systems; Real-Time Clock Program Timing; Working With COP Timing.

**BİL 519 Advanced Algorithm Analysis 3+0 7,5**

Algorithm Analysis Techniques; Asymptotic Notation; Recursive Algorithms Design and Analysis; Randomized

Algorithm Techniques; Greedy Algorithms; Dynamic Programming Techniques; Introduction to Graph Algorithms; Breath-First Search; Depth-First Search; Minimum Spanning Tree Algorithms; Shortest Path Algorithms; NP-Completeness and Undecidability; Approximation Algorithms.

**BİL 520 Advanced Communication Technology 3+0 7,5**

Fundamental Concepts; Digital Technology; Sound and Image Compressing Methods; Data Communication Technology; Data Broadcasting Systems; Communication Satellites; Satellite Technology; Satellite Services; Use of Satellites; Advanced Television Systems; Digital Television; Advanced Radio Systems; Digital Radio; Computer Applications in Communication Technologies; Teleconference Systems; Multimedia Technologies.

**BİL 521 Management Information Systems 3+0 7,5**

Information Technologies and Organizations; Developments in Computer Technologies; Roles of Information in Organizations; Strategic Effects of Development in Information Technologies; Internet and Organizations; Intranet; Electronic Management Environment; System Approach; System Concept; System Analysis; System Design; Database Management Systems; Management Information Systems; Concepts; Principles; Design; Application; Control and Improvement; Information Technologies Management; Trends in Information Systems.

**BİL 522 Computer Organization 3+0 7,5**

Computer Hardware and Fundamental Structure of Software; Addressing Methods and Sequential Regularity of Machine Program; Processing Unit; Input-Output Organization; Memory; Arithmetical Operations; Pipelining; CISC, RISC and Heap Processor Samples; Computer Environment Units; Large Computer Systems.

**BİL 523 Computer Networks 3+0 7,5**

OSI Reference Model and Fundamentals of Layered Network; TCP/IP Reference Model; Physical Layer; Data Communication; Transmission Media; Wireless Transmission; Communication Satellites; Data Link Layer; Error Detection and Error Correction; Stop-And-Wait Protocol; Sliding Window Protocol; Medium Access Sub layer; ALOHA; CSMA; Ethernet Protocol; Bridges; LAN; Network Layer; Routing Algorithms; Congestion Control Algorithms; IP Protocol.

**BİL 525 Fast Application Development 3+0 7,5**

Using Traditional Programming Languages in Software Development; Easiness Provided By Object-Oriented Programming Languages; Visual Programming; Integrated Development Environments and Their Advantages; Team-Working; Application Development Using Visual Basic or Delphi; Visual Programming Objects; Components; File Access; Database Operations; Using SQL.

**BİL 527 Computer Programming I 3+0 7,5**

Computer Basics: Software, Hardware, Operating Systems; Number Systems: Decimal, Binary, Octal, Hexadecimal;

Algorithms; Flowcharts; Program Coding, Programming with Java: Primitive Data Types and Operations, Selection Statements, Looping Constructs, Reading from Keyboard, Printing to Screen; Methods; Arrays.

**BİL 528 Computer Programming II 3+0 7,5**

Objects and Classes; Strings and Text I/O; Object Oriented Programming Concepts: Inheritance, Encapsulation, Polymorphism; Abstract Classes and Interfaces; Inner Classes; GUI Basics and Event Driven Programming; Exception Handling.

**BİL 551 Advanced Database Management Systems 3+0 7,5**

Relational Database Theory; Data Models and Query Languages; Object-Relation Model; Functional Data Models; Semantic Data Models; Object Oriented Databases; Next Generation Databases; Realization Techniques; Access Way Selection, Query Improvements; Locks; Parallelism Control; Process Data Concept; Pillow Management; Distributed Database Systems; User Interfaces.

**BİL 552 Programming Languages 3+0 7,5**

Syntax; Semantics; Data Concept; Flow Control Structures; Methods and Parameters; Block Structure and Activities Depending on the Static or the Dynamic Structure of the Program; Defining New Data Types; Dynamic Data Types; Functions and Recursion; Modules; Modular Program Structures; Using Modules; Separate Compilation; Parallel Tasks.

**BİL 553 Object Oriented Systems 3+0 7,5**

Comparison Between Traditional Languages and Object Oriented Languages; Properties of Object Oriented Programming Languages; Encapsulation; Data Hiding; Inheritance; Polymorphism; Object Oriented Analysis and Design; Instances; Abstract Classes; Defining Class Structure; Member Variables, Methods; Object Oriented Software Engineering; Graphics Projection and Methodology With Object Oriented Software Development; Design for Reuse; Productivity and Related Subjects.

**BİL 554 Operating Systems 3+0 7,5**

Main Concepts; Functions of Operating Systems; Single and Multiple Processing Systems; Tasking: Multitasking; Interactive Processes; Real-Time Processes; Interrupts; Interrupt Vector; Returning From Interrupt Handler; Interrupt Management; I/O Interfaces: I/O Programming Techniques; I/O Interface Programming; Selective and Interrupted Programming; Direct Memory Access; Memory Management: Single and Agglutinative Memory Management; Segmented Memory Management; Image Memory: Paging; Segmenting; Job Management; Task Management: Parallel Processing; Tasks Working Together; Response Exclusion; Time Harmonization With Semaphores, Communication Between Tasks; Deadlocks: Dealing With Deadlocks; Register Management; Guide Structures; UNIX.

**BİL 555 Advanced Computer Networks 3+0 7,5**

Routing: Optimality Principle; Shortest Path Algorithm, Flooding; Distance Vector and Connection Statue Algorithms; Flow and Traffic Control: Approved and Threshold Flow Control; Traffic Shaping; Congestion Avoiding; Connecting Networks: Bridges; Routers; Tunneling; Routing In Internet: OSPF and BGF Protocols; Point to Point Connection: Connection Management and Flow Control; Multiplexing, TCP Protocol; Management: Management in OSI; ANSI Notation; CMIP Protocol; Management in Internet; SNMP Protocol; Network Security; Cryptography Principles; Public and Secret Key Methods; Decryption; Digital Signature.

**BİL 556 Computer Graphics 3+0 7,5**

Fundamental Concepts; Use of Computer Graphics in Engineering; Principles of Graphics; Polygons; Transformations; Segment Concept; 2D And 3D Graphics; Windowing Concept; Representation of Surfaces; Hidden Lines and Surfaces; Color; Shading and Lighting Methods; Curves and Surfaces; Graphical Databases; Graphics Standards; Texture Mapping; Controlled Deformations; Simulation; Animation.

**BİL 557 Internet Software 3+0 7,5**

Client/Server Mechanism; Programming Methods From Client Aspect; Application Development From Server Aspect: Basic Introduction to CGI, Perl and PHP; Introduction to XML; E-Commerce and XML; ASP: Using HTML in Web Pages; Response and Request Objects; Form Elements, Application Objects; Session Objects; Server Objects; Cookies; File Operations; Vb script; Java script; Database Connections; Search Techniques; Application Areas.

**BİL 558 Parallel Programming 3+0 7,5**

Parallel Programming Concept; Application Areas; Problems About Parallel Algorithms: Synchronization; Communication; Critical Sections; Synchronization Mechanisms: Semaphores; Monitors; and Others; Verification Methods and Application Examples; Communication Principles Based on Message Transmission; Rendez-Vous Structure; Parallel Programming Methods in Operating Systems; Parallel Programming Languages: CSP; OCCAM; ADA; and Others; Designing of Classic Parallel Programming Algorithms and Examining.

**BİL 559 Software Engineering 3+0 7,5**

Computer-Based System Engineering; Project Management; Requirements Analysis; System Models; Software Prototyping; Software Design: Architectural Design; Object-Oriented Design; Function-Oriented Design; Real-Time Systems Design; User Interface Design; Multilanguage Software Design Principles; CASE; Management: Managing People; Teaming; Socio-Psychological Analysis; Software Cost Estimation; Program Productivity; Quality Management; Process Improvement.

**BİL 560 Data Access Systems 3+0 7,5**

Increasing Scientific and Technical Information and Data Access Problem; Automation Data Access; Naming: Data



Access (DA) Term, Information Science; Data Access System Concept: Main Concepts; Theoretical Bases; Elements; Approaches; Automation Text Processing; Automation Natural Language Analysis; Mechanic Dictionary; Automation Summarizing; Indexing Language and Embedded Systems: Definition and Structural Relations; Choosing Terms; Remembrance and Sensitiveness Devices; Synonymous Control; Word Forms Control; Classifying the Terms; United Terms and Idioms; Tasks and Roles; Term Measuring; Automation Classifying Approaches: Document-Defining Vectors; Measuring Similarity Among Documents; Heap Approaches.

**BİL 561 Fuzzy Neural Networks 3+0 7,5**

An introduction to fuzzy logic, Operations on fuzzy sets, Fuzzy relations, Fuzzy implications Linguistic variables, The theory of approximate reasoning, Defuzzification methods, Inference mechanisms, The perceptron learning rule, The delta learning rule, Winner-take-all learning, Integration of fuzzy logic and neural networks, Fuzzy neurons, Hybrid neural nets, ANFIS, Gradient based training algorithms, Trainable neural nets for fuzzy IF-THEN rules, Fuzzy rule extraction from numerical data, Neuro-fuzzy classifiers, Applications of fuzzy neural systems

**BİL 562 Network Security 3+0 7,5**

Introduction to Network Security; Problems; Terminology; Private Key Cryptography Techniques: DES, 3DES, AES, Public Key Cryptography Techniques: RSA, Diffie-Hellman, One-Way and Mutual Authentication Techniques; Message Integrity Techniques: MD-5, SHA-1, Digital Signatures; Network Security Standards: Secure-E-mail (PGP), S-MIME, SSL, TLS, IPSec.

**BİL 563 Fuzzy Logic 3+0 7,5**

Fuzzy Sets and Basic Operations on Fuzzy Sets; Fuzzy Relation and Extension Principle; Linguistic Variables; Fuzzy Logic and Approximate Reasoning; Fuzzy Rule Base; Fuzzy Inference Engine; Fuzzifiers and Defuzzifiers; Fuzzy System Design for Function Approximation, Fuzzy Systems as Nonlinear Mappings; Design of Fuzzy Systems from Input-Output Data; Table Look-Up Scheme; Gradient Descent Training; Fuzzy Clustering.

**BİL 564 Data Acquisition and Mining 3+0 7,5**

Data and knowledge representation, Data preprocessing, Data mining algorithms, Decision trees, Association rules, Clustering, Classification, Web mining, Text mining, Collaborative filtering, Privacy preserving data mining, Regression analysis

**BİL 565 Rough Sets Theory 3+0 7,5**

Rough Sets; Information Systems; Discernibility Set Approach; Reductions and Process of Reduction Algebra; Decision Rules and Synthesis; Data Gathering and Digitalization; Discernibility Matrix and Functions; Decision Based Discernibility Matrix; Decision Based Discernibility Functions; Reduction Algorithms; Reductions by Using ROSETTA and Evaluating of

Decision; To Use Genetic Algorithms, Johnson, Holte 1 and RSES Extended Algorithms in Reduction Process.

**BİL 566 Pattern Analysis 3+0 7,5**

Mathematical and Statistical Foreknowledge; Pattern Types; Feature, Feature Extraction; Feature Selection, Optimal and Sub-Optimal Feature Selection Methods, Univariate and Multivariate Feature Selection Approaches, Classification and Classifier Types; Analysis of Recognition Performance; Various Pattern Analysis, Feature Selection and Classification Applications.

**BİL 567 Introduction to Recommender Systems 3+0 7,5**

Collaborative Recommendation: User- and item-based predictions, Ratings, Practical solutions; Content-Based Predictions: Content, Similarity-based retrieval; Knowledge-Based Predictions: Knowledge representation, Constraint- and case-based predictions; Hybrid Predictions: Hybridization opportunities, Monolithic and parallelized hybridization; Explanations in Recommender Systems: Explanations in constraint- and case-based predictions, Explanations in collaborative filtering; Evaluation: General evaluation, Popular evaluation, Evaluation data sets.

**BİL 569 Big Data Systems 3+0 7,5**

Big Data Infrastructure: Apache hadoop, MapReduce, Analysis tools, Interactive analysis tools, Scalable machine learning; Collecting and Transferring Big Data: Transferring bulk data from databases, Collecting streaming data; Storing Big Data: Apache HDFS, NoSQL and google bigTable, Apache HBase; Simple Data Processing: MapReduce framework, Implementing MapReduce applications; Big Data Analysis: SQL, Apache pig, Apache hive; Interactive Big Data Analysis: Google dremel, Dremel and impala; Machine Learning on Big Data: Scalable machine learning, Apache mahout, Machine learning algorithms, Evaluating models.

**BİL 591 Seminar 3+0 7,5**

**BİL 592 Seminar 3+0 7,5**

**BİL 599 Term Project 3+0 15,0**

**BİL 604 Information Technology Management 3+0 7,5**

Information Technology Concept; ITM Resources: Manpower, Hardware, Software, Money and support systems, Management information systems, Computer networks; Internet, Intranet and Extranet Concepts; E-Society and Its Fundamental Properties; E-Government; E-Business: Intranet policies and strategies; Information Technologies and Applications; Database Management Systems: Concept, Analysis and Design; Decision Support Systems; Information Sharing Policies; Information Security Principles; Data Mining; Project Management: Concepts, Management software.

**BİL 605 Distributed Computing Methods** 3+0 7,5  
 Distributed Computational Structures; Implementations of Different Algorithms in Popular Distributed Architectures; Shared Memory, Distributed Memory Implementations; Emphasis on Map and Reduce Algorithm As Made Popular by Its Recent Applications in Scientific Computing

**BİL 606 Natural Language Processing** 3+0 7,5  
 General Introduction to Natural Language Processing Applications; Grammars and Parsing; Morphological Analysis; Semantic Notations; Entity Extraction and relations; Shallow Parsing; Syntactic and Semantic Analysis; Text Generation and Summarization; Ontology and Knowledgebase Creation; Sense Disambiguation; Statistical and Rule Based Approaches for NLP Using Machine Learning.

**BİL 607 Advanced Information Retrieval Systems** 3+0 7,5  
 Information Retrieval Problem: Automation in information retrieval; Term Information Retrieval (IR); Information Science; Indexing and Searching Techniques; Advanced Query Optimizations; Focus on Ranking Functions and Using Machine Learning to Learn the Ranking Functions for the Specific Problems.

**BİL 612 Data and Text Mining** 3+0 7,5  
 Data and Text Mining; Algorithms used in Data Mining; Application of Data Mining Applications to Text Mining; Classification and Clustering Algorithms; Rule-Based Systems.

**BİL 613 Machine Learning** 3+0 7,5  
 Introduction to Learning Theory, Learning Algorithms and their Applications; Learning Theory; Estimation; Regression, Categorization with specific algorithms: Least squares, Maximum entropy, Hidden markov models, Artificial neural networks, Support vector machines.

**BİL 615 Special Topics in Information Technologies** 3+0 7,5  
 Using Information Technologies in Distance Education Applications; Using Information Technologies in Medical Service Applications; Special Software Design Techniques for the Disabled People; Text-to-Speech, Speech-to-text conversion and applications.

**BİL 616 Pattern Recognition Applications** 3+0 7,5  
 Mathematical Preliminaries; Pattern and Feature; Feature Extraction; Feature Selection; Classification; Linear and Quadratic Classifiers; Bayes Decision Theory; Subspace Methods; Principal Component Analysis (PCA); Linear Discriminant Analysis (LDA); Cluster Analysis; Combined Classifiers; Pattern Pre-Processing and Post-Processing; Recognition Performance Analysis; Various Pattern Recognition Applications.

**BİL 617 Cryptology** 3+0 7,5

Classical Cryptography and Cryptoanalysis; Number Theory; Shannon Theory; Cryptographic Hash Functions; Iterative Hash Functions; Message Correction Codes; RSA and Prime Factorization Algorithms; Discrete Logarithm Method and Elgamal Crypto System; Elliptic Curves; Signature Methods.

**BİL 619 Advanced Discrete Mathematics** 3+0 7,5  
 Linear Algebra; Subspace Fundamentals; Probability Theory and Random Variables; Principal Component Analysis; Nonlinear Optimization; Graphs; Trees; Path Problems; Planar Graphs; Pairing Problems; Coding Theory.

**BİL 620 Multi Agent Systems** 3+0 7,5  
 Introduction to Intelligent Agents; Deductive Reasoning Agents; Practical Reasoning Agents; Reactive and Hybrid Agents; Multiagent Interactions; Communication; Working Together; Methodologies; Multiagent Decision Making; Applications of Multi Agent Systems.

**BİL 621 Text Analytics** 3+0 7,5  
 Business Analytics; Text Analysis; Text Analytics; Text Representation: Preprocessing techniques, Feature extraction, Feature selection, Feature projection; Information Extraction from Text; Crawling; Indexing; Searching; Text Categorization; Text Clustering; Application of Text Algorithms over Big Data; Algorithm Selection and Evaluation; Multilingual Text Analytics; Semantic Analysis.

**BİL 790 Thesis** 0+1 30,0

**BİM 790 Thesis** 0+1 30,0

**BİM 890 Thesis** 0+1 30,0

**BİY 501 Herbarium Techniques** 3+0 7,5  
 What is Herbarium? Collecting Plant Samples; Plant Drying Method; Sticking the Plant Samples on the Herbarium Cartons; Labeling the Plant Samples and Recording to Cartotext; Settling the Herbarium Material to Herbarium With a Specific Order; Herbarium Types; Preservation of the Plant Taxa; How Can We Benefit From the Herbarium?

**BİY 502 Methods of Plant Identification** 3+0 7,5  
 Collecting Plants; Studying Plant Specimens in Herbarium; Herbarium Techniques; Necessities When Making Herbarium Materials; How to Use Flora of Turkey and the East Aegean Islands; Key Types For Determining Plant Taxa; Determining Comparison Material; Publication Process After Determining the Plant Specimens.

**BİY 505 Bacteriology** 3+0 7,5

The Bacteria; What Are Bacteria; The Bacterial Cell; Growth and Reproduction; Differentiation; Metabolism; Energy Metabolism; Carbon Metabolism; Bacteria Genes; Bacteria Ophages; Bacteria in the Living World; Applied Bacteriology; Food-Bacteria; Feeding Animal; Biopol; Bacteria in Meolicine; Some Pratical Bacteri Ology; the Identification and Classification of Bacteria.

#### **BiY 506 Enzymatic Regulation 3+0 7,5**

Enzymes; Description; Biochemical Structures; Classification; Factors That Are Affecting the Enzymes Activities; Enzymatic Inhibitors; Competitive and Non-Competitive Inhibition; Determination of the Active Center In Enzymes; Co-Factors and Co-Enzymes; Allosteric Enzymes and the Regulation of Allosteric Enzyme's Metabolic Pathways; Synthesis; Gaining of Tertiary Structure And Release of Enzymes Will Be Taught.

#### **BiY 507 Biology of Lichens 3+0 7,5**

Historical Development of Lichenology; Anatomical and Morphological Features of Lichens: Cortex; Medulla; Algal Layer, Structure and Functions; Reproduction Mechanisms of Lichens; Sexual Reproduction; Types of Fructification; Vegetatif Reproduction; Isidia; Soredia; Blastidia; Physiological Features; Photosynthesis; Respiration; Unique Lichen Substances; Ecological Features; Biogeographical Features; Economical Usages of Lichens; Classification of Lichens.

#### **BiY 509 Special Histology 3+0 7,5**

Cardiovascular System; Blood Vessels; Lymphatic System; Reticuloendothelial System; Endocrine System; Urinary System; Reproductive System; Male Reproductive System; Female Reproductive System; Respiratory System; Excretory Respiratory Organs; Lungs; Digestive System; Stomach; Intestines; Pancreas; Liver.

#### **BiY 510 Flora of Turkey 3+0 7,5**

Historical Development on the Floristic Studies in Turkey: Algae; Liverworts; Fungi; Vascular Plants; What Is a Flora Element?; Floristic Regions in the World; Geographical Areas of Turkey: Their Topographic and Climatic Features; Composition of Flora of Turkey; Evaluation of Floristic Regions of Turkey (Euro-Sibirian, Mediterranean and Irano-Turanian); Their Features and Characteristic Taxa; Endemism: Endemic Taxa of Turkey and their Distribution Areas.

#### **BiY 511 Gene Regulation 3+0 7,5**

Evidence For Gene Regulation in the Cell and Related Methods; Gene Regulation at DNA Level; Amount and Types of DNA in Different Cell Types; DNA Loss; DNA Amplification; DNA Rearrangement; Tissue-Specific Expression of Proteins and Mrnas; Regulation at Trancription Level: Chromatin Structure; DNA Sequence Elements; Transcription Factors; Post-Transcriptional Regulation; Mrna Splicing; Life of RNA; Regulation of Translation; Gene Regularion and Cancer; Genetic

Regulation of Immune System; Regulation of Mating-Type in Yeast.

#### **BiY 512 Principles of Zoological Nomenclature 3+0 7,5**

Zoological Nomenclature; Number of Words in Zoological Names; Criteria of Publication; Criteria of Availability; Date of Publication; Validty of Names; Formation and Emendation of Names; Taxa of the Family 'Group and Their Names; Taxa of The Genus 'Ggroup And their Names; Taxa of the Species 'Group and their Names; Authorship; Homonymy; the Type-Concept.

#### **BiY 513 Advanced Cell Physiology 3+0 7,5**

Macromolecular Structures That are Forming Cellular Organelles; Biochemistry of Membrane and Membranal Transportation; Connective Complexes in-Between Cells And Cellular Communication; Function and Structure of the Golgi Complex; Mitochondria; Lysosome and Peroxisome; the Role of Camp in the Regulation of Cellular Physiology; the Functional Mechanisms of Calcium-Calmodulin; Mechanisms of Cellular Differentiation Will Be Taught.

#### **BiY 514 The Harmful Insects 3+0 7,5**

Introduction; Living and Nutrition of Insects; Parasits of Fur and Pelt; Ceratine Consuming Insects; Predatory Insects; Water Insects; Plant Insects; Harmful Insects of Wood; the Poisonous Insects; Patogenic Insects; Insects as Vectors of Diseases; Groups of Harmful Insect and their Damages.

#### **BiY 515 Forest Ecology 3+0 7,5**

Introduction; Basic Principles of Ecology; Definition of Factors Forming Forest Ecosystems; Reciprocal Effects and Relations Between Factors Forming Forest Ecosystems; Yield Power of Forest Ecosystems; Prediction and Classification of Yield Power; Investigation of Forest Community According to Sociological Principles.

#### **BiY 516 Bioenergetics 3+0 7,5**

Principles of Bioenergetics, Glycdysis and the catabolism of Hexoses, The citric acid cycle and control of ATP prodiction, Oxidation of Fatty Acidy, Amino Acid Oxidation and the prodiction of urea, Oxidative Phosphorylation and Photophosphorylation. Carbohydrate Biosynthesis, Lipid Biosynthesis, Biosynthesis of AminoAcids, Nucleotides and Related Molecules Intey Integration and Hormonal Regulation of Mammalian Metabolism.

#### **BiY 517 Water Pollution and Biological Effect 3+0 7,5**

The Factors That Cause Pollution in the Marine and Freshwater; the General Characteristics and Effects of Various Types of Pollutants on the Aquatic Environment; Chemical Pollution: Hydrocarbons, Pesticides; Detergents; Heavy Metals; Domestic Pollution; Aerobic and Anaerobic Mineralization; Radioactive Pollution; Red-Tide and Pollution; General Effects and Results of Eutrophication in the Standing Water; Bioaccumulation: Accumulation in Plants; Invertebrates and Vertebrates; Water Quality.

**BIY 518 Signal Transduction in The Cell 3+0 7,5**

Types and Structure of Receptors Located on the Cell Membrane; Types and Structure of Ligands Bound Receptors; Mechanism of Signal Transduction Through the Cell Membrane; Mechanism of Signal Transduction in the Cell; Secondary-Messenger Molecules and Their Functions; Importance of Calcium Ion in Signal Transduction; SH2; SH3 and PH Domains of Proteins; MAP-Kinases; Termination of Signal; Signalling in the Nucleus; Nuclear Responses; Transcription Factors; the P53 Tumor Repressor; Cell Cycle Regulation; Cancer and Signalling Through Growth Factors.

**BIY 519 Limnology 3+0 7,5**

Introduction to Limnology; Features of Freshwater and their Classification; Standing Water; Physical; Chemical and Biologic Features of the Standing Water; Thermal Stratification and Classification of Lakes; Running Water; Physical; Chemical and Biologic Features of the Running Water; Food-Chain Dynamics in the Water; the Major Groups of Organisms in Lakes and Streams; Phytoplankton; Zooplankton; Periphyton; Neuston; Nekton; Applied Limnology.

**BIY 520 Bacterial Plant Diseases 3+0 7,5**

Introduction; Role of Bacteria in Plant Diseases; Classification of Plant Pathogenic Bacteria; Agrobacterium; Corynebacterium; Erwinia; Pseudomonas; Xanthomonas; Streptomyces; Symptoms of Bacterial Diseases; Identification of Plant Pathogenic Bacteria; Host-Pathogen Relations; Pathogenicity and Virulence Factors; Genetics of Bacterial Plant Diseases; Epidemiology of Bacterial Plant Diseases and Control of Disease.

**BIY 521 Biophotography 3+0 7,5**

Variety of Photographic Cameras; Using Objectif for Photographic Cameras; Filters; Using Diafram; Obturator; Visor and Its Variety; Macro and Mikro Photography; Lighting and Periods; Arroneous Photography; Photographic Solutions; Films Developing; Card Developing; Measuring With Photograph; Photograph Reading.

**BIY 522 Investigation Methods of Ecosystems 3+0 7,5**

Natural Selection and Speciation; Conditions for Life; Population Ecology; Community Organization and Structure; Ecosystem Dynamics; Diversity of Ecosystems; Definition of Genus and Characteristics of Elements Forming Ecosystem; Production of Organic Substance in Ecosystems; Energy and Material Flow and Their Depositions and Changes; Circulation of Food Substances; Investigation of Ecosystems.

**BIY 523 Zootaxonomy 3+0 7,5**

The Principles of Animal Classification; Importance of Taxonomy; Category of Species; Categories of Subspecies; Taxonomy of Population; Theories of Classification; Aims of Classification; The High Categories; The High Taxa; Methods of Animal Classification; Taxonomic Collections;

Methods of Identification; The Materials Point of Revision and Monography; Taxonomic Characters.

**BIY 524 Fishery Biology and Population Dynamics 3+0 7,5**

The Factors that Effect on Efficiency of Fish Stocks in the Marine and Freshwater; Fish and Fisheries; Sampling and Statistical Methods for the Fishery Biology; Metric and Countable Features for the Fishery Biology; Studies of the Age; Growth; Sexual Distinction and Spawning of the Fishes; the Relationships Between Length and Weight of the Fishes; Methods for Estimating the Potential Fish Population Dynamics of Aquatic Environment; Up Welling and Fish Production.

**BIY 525 The Collection Methods of Invertabrate Animals 3+0 7,5**

Introduction; Biological Ecozones; Terrestrial Environment; Maritime Environment; Aquatic Environment; Collecting; Killing; Fixation; Preserving; Collections of the Main Invertabrate Animal Groups; Collection of Protozoa; Collection of Porifera; Collection of Coelenterata; Collection of Ctenophora; Collection of Plathelminthes; Collection of Rotifera; Collection of Nematoda; Collection of Annelida; Collection of Arthropoda; Collection of Mollusca; Collection of Echinodermata.

**BIY 526 Cytogenetics 3+0 7,5**

Molecular Organization of Chromosome. Chromosome Morphology; Chromosome banding techniques. Structural and numerical chromosome mutations: Description and interpretation of mutations on chromosomes. Obtaining and Marking of the Prophase and Prometaphase Cells. Determination Procedure about Number and Size of Ginosomes without the Use of Karyotype Analyze. Slide Preparation Procedures Invitro and In vivo Cytogenetic Investigations: Investigation and evaluation of mitosis and meiosis chromosome on plant; Investigation and evaluation of mitosis and meiosis chromosome on animal.

**BIY 527 Plant Microbiology 3+0 7,5**

Introduction; Microorganisms as Saprotrophs and Plant Pathogens; Penetration of Pathogens Into Host; Mechanical and Chemical Barriers to Infection; The Hypersensitive Reaction; Microbiology of Flowers; Microbiology of Seeds; Microbiology of Fruits; Microbiology of Living Leaves; Microbiology of Stems; Microbiology of Roots and Mycorrhizas; Decomposition of Plant Litters; Industrial Fermentations of Plant Litter.

**BIY 528 DNA Repair Mechanisms 3+0 7,5**

Mutations: Spontaneous v.s induced mutations, Gametic v.s somatic mutations, Other categories of mutations; Mutations arise in different ways: Tautomeric shifts, Base analogues, Alkylating agents, Apurinic sites and other lesions, UV Radiation and Thymine dimers; DNA Repair Systems: Photoreactivation repair, Excision repair, Proofreading and Mismatch repair, Double strand break repair in Mammals

**BIY 529 Landscape Ecology 3+0 7,5**

Natural Ecological Factors Forming Structure of Landscape and Their Relation; Climatic Factors; Definition; Ecological Importance and Functions in Landscape; Soil Factor; Definition; Ecological Importance and Functions in Landscape; Relief Factor; Definition; Ecological Importance and Functions in Landscape; Biotic Factors and their Ecological Importance; Plant as Structure Element of Landscape; Definitions of Air Pollution; Water Pollution; Soil Pollution; Radiation Pollution and Noise Pollution; Ecological Importance and Reciprocal Relation of Landscape Elements; Basic Knowledge Concern to Ecological Need of Plants.

#### **BIY 530 Plant Tissue Culture 3+0 7,5**

Culture of Plant Cells; Tissues and Organs; A Plant Tissue Culture Laboratory; Aseptic Techniques; Nutritional Components of Tissue Culture Media; Protoplast Fusion; Protoplast Isolation; Protoplast Culture; Callus Culture; Embryo and Ovule Culture; Meristem Culture; Anther and Pollen Culture; Secondary Products From Cultured Cells and Organs; Recombinant DNA Isolation; Organogenesis.

#### **BIY 531 Immunology 3+0 7,5**

Introduction; Cells and Organs of Immune System; Properties of Antigens; Immunoglobulins; Polyclonal and Monoclonal Antibodies; Immune Response; The Complement System; Immune Tolerance and Autoimmunity; Antigen-Antibody Reactions; Serological Reactions; Agglutination; Precipitation; Immunoelectrophoresis; Neutralisation; Fluorescent Antibodies; Enzyme-Linked Immunosorbent Assay; Radioimmunoassays.

#### **BIY 535 Mineral Feeding Physiology in Plants 3+0 7,5**

Element Concepts in Plants; Necessary Elements for Vascular Plants; Research Methods for Plant Nutrition; Types of Different Elements in Soil; Incoming the Mineral Elements to Plant and Transportation; Transportation of Mineral Elements in Plants; Circulation of Mineral Elements; Functions of Necessary Mineral Elements and Mineral Deficiency Symptoms; Köklerin Tuz Alınımı Etkileyen Faktörler; Temperature; Light; Airing Position; pH; Interactions Among Ions; Growing; Plant Nutrition From Leaves.

#### **BIY 537 Stress Physiology in Plants 3+0 7,5**

Stress Terminology; Responses of Plants to Stress Factors; Levels of Expression; Submolecular Level; Free Radicals (FR) and Related Active Oxygen (AO) Species. Uç Functions of FR and AO; Protection; Damage; Signalling; Regulation of FR and AO; Molecular Level; Secondary Metabolites Involved in Stress; Polysaccharides; Stress Proteins; Normal Cell Constituents of Particular Importance for Stress; Subcellular Level; Regulation of Stress Responses; Hierarchy of Stresses. Cross Protection; Bases and Practical Use; Methods for Stress Diagnostic and Stress Control.

#### **BIY 538 Vegetation Ecology 3+0 7,5**

Description of the Vegetation in a Specific area; Definition of Vegetation Science; Vegetation Types and Determining

Plant Associations Floristically and Ecologically; Determining Analytic and Synthetic Characters; Determining Systematic Categories of Plant Associations in Methodology (Analytic And Synthetic Categories).

#### **BIY 539 Microbial Enzymes and Biotechnology 3+0 7,5**

Enzyme Structures; Classification and Nomenclature; Production of Enzymes by Fermentation; Methods of Enzyme Purification; Enzymes Immobilization; Production of Enzymes by Microorganisms; Bacterial Enzymes; Fungal Enzymes; Application of Enzymes in Textile; Detergent and Leather Industries. Application of Enzymes on Food and Production of Animal Nutrition; Application of Enzymes in Pharmaceutical and Chemical Industries.

#### **BIY 543 Plant Molecular Biology 3+0 7,5**

Tripartite plant genomes and their inheritance; Overview of nuclear gene structure and function; Organization of nuclear genomes; Agrobacterium-mediated transformation; Transgenic plants and biotechnology: Creating transgenic plants, Gene systems for crop improvement, Herbicide resistance, Salt tolerance, Ethylene and fruit ripening, Disease resistance, Edible vaccines, Plantibodies, Gene silencing; Promoter activity and transcription factors: Cauliflower mosaic virus 35S promoter, Auxin-responsive promoters; Pre-mRNA processing; Chloroplast genomes: Organization of chloroplast DNA, Regulation of chloroplast gene expression, Transplastomic plants; Mitochondrial genomes: Organization of mitochondrial DNA, Mitochondrial gene expression, Cytoplasmic male sterility; Transposable elements in plants; Self-incompatibility in flowering plants.

#### **BIY 545 Advanced Biochemistry 3+0 7,5**

Chemistry of Carbohydrates; Carbohydrate Metabolism; Oxidative Phosphorylation; Pentose Phosphate Metabolic Pathway; Chemistry of Lipids; Oxidation of Fatty Acids; Lipid, Biosynthesis, Photosynthesis, Structure Of Nucleic Acids; Synthesis of Nucleic Acids; The Gene and Genetic Code; Description and Classification of Proteins; Classification of Amino Acids; Reactions of Amino Acids; Protein; Biosynthesis; Enzymes and Coenzymes; Amino Acid Oxidation.

#### **BIY 546 Methods of Genetic Toxicology 3+0 7,5**

Importance of Genetic Toxicology; Investigating Mutagenesis-carcinogenesis; Genotoxicity Detecting Methods: Bacterial tests for gene mutations, Mammalian cell tests for gene mutations, In vitro and in vivo mammalian cell tests for cytogenetic damage; Chromosome aberration assay, Sister chromatid exchange assay, Cytokinesis block micronucleus assay; Detecting Methods of Gene Mutations at Molecular Level.

#### **BIY 547 Forest and Park Trees 3+0 7,5**

Description of Organs of Woody Plants; Root; Stem, Bark; Shoot; Bud; Leaf; Flower; Fruit; Seed; Position of Forest and Park Trees in Plants World; Importance; Its Evaluation in Biodiversity Aspect; Nomenclature in Plants; General Characteristics of Spermatophyta; General Characteristics of Gymnospermae and Angiospermae; Spreaded Woody

Plant Taxa in the World and Their Characteristics; Forest and Park Trees Grown in Turkey: Biological Features; Ecological Demands; Evaluation of Woody Plants as Plant as Plant Material: Use; Production; Maintenance; Project Principles in Park and Garden Planning.

**BiY 548 Modern Biotechnology 3+0 7,5**

Isolation of Cultures; Screening for Activities; Culture Preservation and Inoculum Development; Small-Scale Liquid and Solid-State Fermentations; Cell and Enzyme Immobilization; Continuous Culture; Methods for Biocatalysis and Biotransformations; Raw Materials Selection and Medium; Development for Industrial Fermentation Processes; Purification and Characterization of Proteins; Biological Biocontrol; Polyhydroxyalkanoates; Antibiotic Resistance Mechanism of Bacterial Pathogens; Genetics of Bacteriocins Produced by Lactic Acid Bacteria and their Use in Novel Industrial Applications.

**BiY 549 Modern Methods for Microbial Identification and Typing 3+0 7,5**

Introduction; An Overview of Microbial Identification; Modern Methods for Microbial Classification; Numerical Taxonomy; Nucleic Acids in Bacterial Taxonomy; Analysis of Plasmid DNA; Analysis of Chromosomal DNA; Restriction Enzymes in Analysis of Nucleic Acids; Nucleic Acid Hybridization Techniques; Nucleic Acid Amplification Techniques and Polymerase Chain Reaction (PCR); Analysis of Protein and Lipopolysaccharide Profiles; Typing and Identification With Antibodies; Fatty Acid Profiling for Identification and Typing; Taxonomical Properties of Bacterial Toxins; Taxonomical Features of Pigments.

**BiY 550 Molecular Techniques in Systematics 3+0 7,5**

Structure of macromolecules and their use in systematics; Electrophoretic separation of proteins; Electrophoresis of seed storage proteins; Enzyme electrophoresis, generation and analysis of data; The nuclear genome of plants: General features and use in systematic studies; Nuclear ribosomal DNA: Structure and use in Systematics; The chloroplast genome and plant systematics

**BiY 551 Stem Cell Biology 3+0 7,5**

What is a Stem Cell?; Embryonic Stem Cells; Adult Stem Cells; Similarities and Differences between Embryonic and Adult Stem Cells; Regulation of Stem Cell Function; Hematopoietic Stem Cells; Mesenchymal Stem Cells; Isolation of Stem Cells from Different Organs; Stem Cells and Cancer Treatment; Embryonic Stem Cells and Tissue Repair; Adult Stem Cells and Tissue Repair; Stem Cells and Gene Therapy; Development of Stem Cell Policy at World.

**BiY 552 Plant Science 3+0 7,5**

Characteristics of Plant Cell: Characteristics of Plant Tissues; Characteristics of Plant Organs; Reproduction of Plants: Flower Structure, Fruit; Nutrition Intake in Plants; Plant Growth Conservation; Genetic Sources of Plant, Nomenclature in Plants: Taxonomic Systems; General Characteristics of Spermatophyte, Gymnospermae and Angiospermae; Environment and Adaptation in Plants:

Relation Between Plant and Ecosystem: Ecological Life Cycle in Plants; Ecological Adaptation and Evolution: Floristic Plant Geography; Plant Groups and Their Dispersal; World flora Regions; Vegetation Formation and Classes; Ecological Conditions of Vegetation in Turkey; Phytogeographical Regions of Turkey.

**BiY 553 The Ecology of Bird Communities 3+0 7,5**

The Foundation of Avian Community Ecology; The Assembly of Communities; Numbers of Species and Their Abundances; Niche Theory; Ecomorphological Patterns of Communities; Distributional Patterns of Species; Habitat Distributions of Species; Resources and Their Use; Convergence of Species and Communities; Bioenergetic Approaches to Communities; Competition; Other Factors Influencing Community Structure; Temporal Variation of Communities; Future Directions In Avian Community Ecology.

**BiY 555 Birds of Turkey 3+0 7,5**

Basic Characteristics of Birds; Threats to Bird Populations; Extinctions of Bird Species; Red Lists for Birds; Red List Categories and Criteria; Important Bird Regions in Turkey; Nonpasseriformes Species: Status, Distribution and Ecology of Species and Threats; Passeriformes Species: Status, Distribution, Ecology of Species and Threats.

**BiY 556 Transmission Electron Microscopy and its Applications I 3+0 7,5**

History of Microscopes; Light Microscopes and their Varieties; Stereo Microscopes; Dark Field Microscopes; Polarisation Microscopes; Scanning Electron Microscope and Transmission Electron Microscope; Functions of Light and Electron Microscopes their Differences and Similarities; Systems of Electron Microscopes; Trimming and Ultramicrotome Techniques; Staining; Other Techniques; Enzyme Histochemistry; Electron Immunocytochemistry; Cryofixation; Ultracryotomy; Preparation of Several Samples for the Transmission Electron Microscope; Preparation of Biological and Metal Samples; Microtomes and Knives.

**BiY 557 Transmission Electron Microscopy And its Applications II 3+0 7,5**

Preparation Techniques in Transmission Electron Microscopy; Handling of Specimens and Fixation; Fixative Solutions; Dehydration; Dehydration Transitional Fluids; Embedding Media; Epoxy Resin; Araldite Embedding Mixture; Araldite Embedding Schedules; Epon Embedding Schedules; Epon Embedding Mixture; Three Hour Embedding Schedule for Biopsies; Non-Urgent Biopsies; Sectioning and Staining; Staining of Thin Sections; Lead Staining Methods; Knives; Block Trimming; Sectioning; Toluidine Blue Staining; Preparation of Blocks For Ultramicrotomy; Ultramicrotomy Techniques; Collection of Ultrathin Sections; Staining of Material For Electron Microscopy.

**BiY 560 Instrumental Analyses in Biochemistry 3+0 7,5**

Risk Factors in Laboratory and Precautions: Risk Sources, Precautions (R ve S indicators) ; Measurement Units, Weight, Balances: Units, Weight measurement and balances; Volume Measurements: Equipments, Calibration; Quality of the Laboratory Water: Quality of the water and its usage, Distillation methods, Test of water purity; Sterilization: Dry and wet heat method; Centrifugation: Usage in clinic laboratory, Types, Theory, Usage, Care; Spectrophotometer: Structure of light, Beer Law, Components of spectrophotometer, Performance parameters, Multiple wavelength readings; pH meter: H+ Concentrations and pH concept, Working principles of pH meter, Usage, Applications; Electrophoresis: Theory, General method, Types of electrophoresis; Chromatographic Methods: Gas and Liquid chromatography, HPLC.

#### **BIY 561 Animal Cell Culture 3+0 7,5**

Introduction; Advantages and Limitations of Tissue Culture; Biology of Cultured Cells; Planning and Layout of The Lab, Requirements of a Tissue Culture Laboratory, Aseptic Technique, Safety; Culture Vessels; Media; Preparation and Sterilization; Primary Culture; Cell Lines; Cloning and selection; Cell Separation and Characterization; Differentiation and Transformation; Contamination; Cryopreservation; Quantitation; Cytotoxicity; Specialized Cells; Tumor Cells; Molecular Techniques.

#### **BIY 562 Molecular Biotechnology 3+0 7,5**

Introduction to Recombinant DNA technology, Molecular biological systems, Manipulation of prokaryotic gene expression, gene expression from strong and regulable promoters, expression of fusion proteins, types of expression vectors, Protein Engineering; Methods of directed mutagenesis in protein engineering, addition of disulphide bonds, Molecular Diagnostics of human diseases based on DNA and DNA sensors; polyclonal and monoclonal antibody production, PCR based diagnostics; Diagnosis of Malaria and sickle cell anemia, Fundamentals of microbial production of therapeutic human proteins, Human gene therapy, patents and patent analysis in Biotechnology.

#### **BIY 563 Halophilic Microorganisms and Their Potential in Biotechnology 3+0 7,5**

Definition of Halophilic organisms; Halophilic Archaea; Halophilic Bacteria; Halophilic Eucarya; Isolation and cultivation of halophilic microorganisms; Microbial biotechnology; Halophilic Archaea in biotechnology; Halophilic Bacteria in biotechnology; Halophilic Eucarya in biotechnology; General Overview.

#### **BIY 565 Extremophiles 3+0 7,5**

Extremophile Microorganisms and Techniques Used to Handle Them; Thermophiles; Psychrophiles; Alkaliphiles; Acidophiles; Halophiles; Barophiles; Radiation-Resistant Microorganisms; Applications with Extremophiles; General Overview.

#### **BIY 567 In-Vitro Techniques 3+0 7,5**

Cell line techniques, cell adhesion, Cell proliferation, Cell differentiation, Energy metabolism of cell, In-vitro cell proliferation techniques, Cytotoxicity techniques, Mutagenicity and toxicity techniques, Flow-cytometry, In-situ hybridization, Cell dye and preparation techniques, Fluorescent- imminofluorescent dye techniques, apoptosis techniques.

#### **BIY 571 Taxonomy 3+0 7,5**

Taxonomy and Systematic: Development of species concept, Classification systems, Rules of nomenclature; Viruses, Viroid and Prions; Diagnostic Characters and their classification of Archaea and Bacteria: Techniques and applications; Classification of Eucaria: Current methods and classification systems of microorganisms Algae, Fungi, Plants.

#### **BIY 572 Molecular Biology Methods 3+0 7,5**

Methods in Protein Analyses: Micro methods in protein chemistry, Qualitative protein methods, Protein purification, Affinity chromatography, Spectrophotometric methods, Electrophoretic methods; Methods in Nucleic Acid Analyses: DNA analysis, DNA isolation and purification, RNA analysis and purification, PCR methods, Hybridisation methods, Cloning and genetic transfer; Serological Methods: Antibody production, Antibody-antigen reactions, ELISA, radio immune and fluorescence assays; Microbial Methods.

#### **BIY 573 Scientific Research in Biology 3+0 7,5**

Basic steps in scientific research; Preparation of a Research Project; Rules of Scientific ethic and their Applications; Research Process and its Results; Publishing Scientific Results; Authors, Scientific Reviewers; Members of Thesis Committee and Academic Advisers; Writing a Thesis or a Scientific Paper; Oral Presentations and Reporting; Introducing Technology to Help with Presentations: PowerPoint, Word, and Endnotes; Curriculum Vitae.

#### **BIY 574 Foodborn Pathogen Microorganisms 3+0 7,5**

Aeromonas; Bacillus Cereus; Brucella; Campylobacter Fefuni; Clostridium Perfringens; Clostridium Botulinum; Pathogenic Escherichia Coli; Listeria Monocytogenes; Pseudomonas; Yersinia Enterocolitica; Salmonella; Shigella; Staphylococcus Aureus; Streptococcus; Other Pathogenic and Toxigenic Bacteria; Toxigenic Fungi and their Mycotoxins; Protozoan and Helminthic Parasites; Selective Isolation Techniques.

#### **BIY 575 Microorganisms and Biotechnology 3+0 7,5**

Isolation of Cultures; Screening for Activities; Culture Preservation and Inoculum Development; Small-Scale Liquid and Solid-State Fermentations; Cell and Enzyme Immobilization; Continuous Culture; Methods for Biocatalysts and Biotransformation; Raw Materials Selection and Medium; Development for Industrial Fermentation Processes; Purification and Characterization of Proteins; Biological Biocontrol; Polyhydroxyalkanoates; Antibiotic Resistance Mechanism of Bacterial Pathogens; Genetics of Bacteriocins Produced by Lactic Acid Bacteria and their Use in Novel Industrial Applications.

**BIY 577 Enzyme Technology 3+0 7,5**

Structure and functions of the enzymes, catalysis mechanisms of the enzymes and enzyme kinetics, enzyme activity units and fundamental of activity measurements, classification of the enzymes and characteristic enzyme reactions, inactivation and control of the enzymes. Sources of the enzymes, principles of the enzyme production from microorganisms, enzyme extraction, isolation from different sources and industrial applications.

**BIY 578 Arachnology 3+0 7,5**

Taxonomy of Arachnida; Scorpionida: Taxonomy, Morphology, Anatomy, Biology, Ecological specifications: Solifugae: Taxonomy, Morphology, Anatomy, Biology, Ecological specifications: Acarina: Taxonomy, Morphology, Anatomy, Biology, Ecological specifications, Struggle methods; Opilionida: Taxonomy, Morphology, Anatomy, Biology, Ecological specifications: Pseudoscorpionida: Taxonomy, Morphology, Anatomy, Biology, Ecological specifications: Araneae: Taxonomy, Morphology, Anatomy, Biology, Ecological specifications: Arachnida venoms and effects.

**BIY 579 Plant Bacteriology 3+0 7,5**

Plant associated bacteria: Molecular phylogeny and genomics; beneficial bacteria: Rhizobium-legume symbioses, nitrogen fixing bacteria, epiphytic bacteria, bacterial endophytes; Rhizosphere bacteria: plant growth promoting rhizobacteria, systemic resistance and root colonization; Plant pathogenic bacteria: Agrobacterium, Clavibacter, the soft rot Erwinia, Pseudomonas, Xanthomonas, Ralstonia, Burkholderia, Acidovorax and Herbaspirillum.

**BIY 581 Permaculture 3+0 7,5**

Introduction to Permaculture (Ecological Design): The philosophy of permaculture, Ethics, Concepts and themes in permaculture, Methods in Permaculture: Analysis, Observation, Data overlay, Flow charts, Zone and sector analyses, Design: Ecological systems and their characteristics, usage of ecosystem principles in design, design of sustainable agroecosystems, Ecological Cycling in Design; Usage of Biotic and Abiotic Factors in Permacultural Applications: Climatic factors, Plants, Water factor, Soil factor, Strategies for Different Ecological Environments: Humid Areas, Drylands, Wetlands, The Strategies of an Alternative Global Nation.

**BIY 582 Cyanobacteria and Biotechnological Applications 3+0 7,5**

Cyanobacteria and Morphological Diversity, Biodiversity of Marine Cyanobacteria, Biodiversity of Freshwater Cyanobacteria, Cyanobacteria of Extreme Environments, Cyanobacterial Associations, Molecular Identification Methods of Cyanobacteria, Potential Applications of Cyanobacteria in Biotechnology, Cyanobacterial Bioactive Compounds, Cyanobacterial Bioplastics, Cyanobacterial Consortia for Bioremediation Purposes, Cyanobacterial Alternative Energy Sources, Cyanobacteria as

Biofertilizers, Cyanobacteria as a Healthy Food Source, Cyanobacterial Emulsifiers

**BIY 583 Methods of Ecological Analysis 3+0 7,5**

Introduction to Ecological Analysis: Basic Principles, Importance and necessity of ecological analyses; Quantitative Ecology; Application Related to Climatic Factors, Application Related to Plant and Soil Factors; Determination of Biological Diversity and Species Richness: Simpson index, Shannon diversity index, McIntosh diversity index; Floristic Quality Index: Basic principles and methods, Relationships between ecological factors and floristic quality index; Water Quality Index; Conservation Priority Areas; Analysis and evaluation; Applications Related to Classification Methods of Vegetation; Evaluation of the Data.

**BIY 584 Advanced Microbial Physiology 3+0 7,5**

Introduction to Microbial Physiology, Macromolecular Synthesis and Processing: DNA, RNA, and protein synthesis, cell structure and function, bacterial growth, environmental effects and strategies, Genetic Adaptation I: Bacterial genomes, plasmids and mutations, Genetic Adaptation II: Transposable elements and genetic exchange, Regulation of Enzyme Activity and Gene Expression, Energy and Metabolism: Carbohydrate metabolism, Energy production and metabolite transport, metabolism of substrates other than glucose, Fermentation pathways, photosynthesis and inorganic metabolism, bacterial cell division, Microbial Stress Responses, Bacterial Differentiation, Host-Parasite Interactions.

**BIY 585 Advanced Biochemistry and Metabolism 3+0 7,5**

Metabolism of Carbohydrates: Energy metabolism of glucose, Pyruvate metabolism, Biosynthesis of carbohydrates, Regulation of metabolism; Production of NADH and NADPH: Citric acid, glyoxylate and phosphogluconate cycles; Electron Transport Chain: Mitochondrial electron transport, Oxidative phosphorylation, Photosynthetic electron transport; Metabolism of Fatty Acids: Catabolism and biosynthesis of fatty acids, Regulation of metabolism; Metabolism of Amino Acids: Nitrogen cycle, Biosynthesis and catabolism of amino acids, Urea cycle; Integration and Coordination in Metabolism: Overall strategies of metabolism, Metabolic control by hormones.

**BIY 586 Systematics of Lichens 3+0 7,5**

Taxonomic Classification of Lichens; Important Taxonomical Characteristics Used for the Identification of Lichens; Classical, Chemotaxonomic and Molecular Methods Used for the Identification of Lichens; Collection of Lichens: Field study and collection methods; Use of Different Keys in Lichen Identification; Identification of Crustose, Foliose and Fruticose Lichens; Designing Different Types of Identification Keys; Describing Lichens, and Defining Diagnostic Characteristics of Lichens; Lichens Used as Herbarium Samples: Entry into database and use of preservation techniques.



**BIY 591 Advanced Molecular Biology and Genetics 4+0 7,5**

Cell Chemistry: Chemical equilibrium, Biochemical energetics; Proteins: Biosynthesis, Folding, Post-modifications after folding, Functions and regulation of proteins; Nucleic Acids: Organizations, Functions and regulation of nucleic acids; Cell Structure and Function: Transport of molecules, Signal transduction, Organization and movement of the cell; Cell Growth and Development: Cell cycle and regulation; Genetic Mechanisms: Genome replication, gene mutations and recombination mechanisms, DNA repair; Applications of Molecular Genetics: Physical and genetic mapping, Identification of genes, DNA sequencing techniques, Transcriptome and the proteome studies.

**BIY 592 Seminar 3+0 7,5**

**BIY 601 Microbial Laboratory Techniques 3+0 7,5**

General Information, Cultural Counting Methods, Microscopic Counting Methods, Standard Based Counting Methods, Metabolism Based Counting Methods, Other Counting Methods, Biochemical Tests, Media and Sterilization; Indicator Microorganisms, Taking Sample for Analysis and Preparation of Samples for Analysis; Hydrophobic Grid Membrane Filter Technique; Direct Epifluorescence Microscopy Technique; Electric Impedance Method; Bioluminescence Method.

**BIY 602 Water Microbiology 3+0 7,5**

Microbiology of Source Water; Freshwater Microbiology; Marine Microbiology; Microbiology of Drinking Water; Waste Water Microbiology Deep-Sea Microbiology Hydrothermal Vents; Methods in Water Microbiology; Sampling Methods; Determination of Biomass; Isolation Methods; Identification; Viability Using Staining Techniques; Microbial Activity Measurements; Radio Isotopes and Microelectrodes.

**BIY 603 Environmental Pollution and Plants 3+0 7,5**

Evaluation of Environmental Pollution; Morphological; Anatomical and Physiological Effects of Air Pollution on Plants; Morphological; Anatomical and Physiological Effects of Water Pollution on Plants; Physiological; Morphological and Anatomical Effects of Soil Pollution on Plants; Description of Biomonitor and Bioindicator Organisms; Their Features and Uses for Determination of Environmental Pollution; Databanks; Their Purposes and Methods.

**BIY 604 Recombinant DNA Technology 3+0 7,5**

What is Gene Cloning; What are used for Gene Cloning; Purification of Fragments by Restriction Enzymes; Analyzes of Fragments; Ligation; Transformation; Selection of the Cell Having Recombinant DNA; Why is the Gene Cloning is Important; What are the Areas That Recombinant DNA can be used for.

**BIY 605 Animal Tissue Culture 3+0 7,5**

Advantage and Disadvantage of Tissue Culture; Using Technical Materials of Tissue Culture; Investigation Techniques of Tissue and Cell Culture; Peculiarity of Cell Culture Laboratory; Interactions of Cell; Cell and Human Interactions; Damaging for Tissue and Cell Culture; Some Special Solutions for Cell Culture; Serums for Cell Culture; Isolation of Tissue and Cell; Primer Cell Culture; Cell Lines; Keeping and Storing Cells; Investigation Techniques of Cultured Cells.

**BIY 606 Yeast Science 3+0 7,5**

Introduction and History of Yeast; History of Yeast Classification; The Architecture of Yeast Cell; Nutrition and Metabolism of Yeast; Nutritional Requirements; Regulation of Metabolism; Cell Biology of Yeast; Cell Growth and Division in Yeast; Cell Cycle; Sexual Reproduction in Yeast; Isolation and Identification of Yeast; Yeast Genetics and Genetic Manipulation; Yeasts in Industry.

**BIY 607 Oceanology 3+0 7,5**

Historical Development of Oceanology; Biological Oceanography; Classification of Marine Environment; Classification of Marine Organisms; Organic Matter Yields of Marines. Marine Resources and Their Benefits: Biological Resources; Chemical Resources; Geological Resources; Physical Resources. Chemical Oceanography; Physical Oceanography; Geological Oceanography; Some Subjects from Practical Biological Oceanography; Fouling and Boring Organisms; Main Tools Needed in Oceanographic Research.

**BIY 608 Advanced Endocrinology 3+0 7,5**

Hormones; Description and Classification; Synthesis and Secretion of Hormones; the Effects Mechanisms of Hormones; Control of Hormonal System By Hypothalamus; Hormones of Pituitary Gland; Hormones of Thyroid; Hormones of Parathyroid Glands; Hormones of Pancreas; Hormones of Adrenal Glands; Hormones of Gonadal (Sexual) Glands and Hormones of Gastrointestinal Glands Will Be Taught.

**BIY 609 Parasite Plants 3+0 7,5**

Nutrition and Living Types among Plants: Symbiosis, Parasitism, Definition of Parasite Plant: Evolution of Parasite Plants, Parasite Plants, Semi-Parasite Plants, General Ecological Characteristics of Parasite Plants: Host Plant-Parasite Plant Relationship, Host Specificity of Parasite Plants, Adaptations in Parasite Plants, Classification of Parasite Plants: Some Parasite Plant Group in Turkey, Damages Caused by Parasite Plants.

**BIY 611 Genomics 3+0 7,5**

What is the Genome? Structure Prokaryotic and eukaryotic Genomes, Comparative Genome Sizes of Living things, Packing Stills of Genomes, Genomes of Organelles, Organization of Genes and the Rest of the Genome, Modifications of Genomes, Re-organizations of Genomes, DNA Technology and the Development of Genomics, Genomic Manipulations, Types and Formations of Genomic Libraries, Classic and High-Throughput DNA Sequencing

Techniques, Ordering of Genomic DNA Sequences; Bioinformatics, Study of the Published Genomic Projects, the Use of the Produced Genomic Information; Comparative Genomics and Introduction to Proteomics, Influences of the Genomics on Other Sciences, Use and Construction of the DNA Chips and Nanotechnology, The possibility of Developing a High Through Put Machine That Will Evaluate the Genomic Information in Protein Level?

**BIY 612 Microbial Physiology 3+0 7,5**

Metabolical Reactions; Enzymes; Role of ATP and Synthesis of ATP; Oxidation and Reduction Reactions; Electron Transport System; Energy Conservation From Electron Transport; Aerobic Respiration; Anaerobic Respiration; Fermentation; Metabolic Diversity in Microorganisms; Photosynthesis; Oxygenic and Anoxygenic Photosynthesis; Chlorophyll and Bacteriochlorophyll; Nutrition and Sugar Metabolism.

**BIY 613 Modern Mycology 3+0 7,5**

Introduction: Define of Fungi; Growth Forms of Fungi; Activities of Fungi; Fungi in Biotechnology; the Major Taxonomic Groups of Fungi; Structure and Ultra Structure; Fungal Growth; Differentiation; Nutrition; Metabolism; Environmental Conditions for Growth; Genetics; Spores and their Structures; Spore Dormancy and Spore Dispersal; Fungal Decomposer Communities; Fungal Interactions; Fungi as Plant Parasites; Fungal Parasites of Humans; Insects and Nematodes; Prevention and Control of Fungal.

**BIY 614 Basic Bioinformatics 3+0 7,5**

Introduction To Bioinformatics; Basic Molecular Biology; The Evaluation of Nucleotide Sequencing Results; Gene Banks and Their Use; Genomic Databases and Their Use; Protein Expression Databases And Their Use; Cdna And Est Databases and Their Use; Working With Multiple DNA and Amino Acid Sequences By Alignment; Assembly And Phylogenetic Analyses; The Use Of Various Packet Bioinformatics Programs Such As Web Cutter, Primer Dizayn, Genetool, Petool, BLAST, Entrez, Webphylip, Clustalx, Electronic PCR, Orffinder, and Homologene.

**BIY 616 Biogeography 3+0 7,5**

Physiological Reaction of the Living Things and Adaptation to Habitat; Factors Affecting Spread of the Living Things and Classification of Habitats; Principal Flora Regions of World and Classification of Floristic Unit; Plant Formations and Classes; Biogeography Ecols and Field Relationship; Biological Richness of Turkey; Ecological Comment on Near Geologic Periods.

**BIY 617 Cellular Signal Transduction Pathways 3+0 7,5**

Overview of Plants; Bacterial, Animal and Mammalian Signaling Mechanisms and their Origins; Basic Concepts of Cell Surface Receptors; Heptahelical Receptors and Heterotrimeric G Proteins; Receptor-G Protein-Adenylyl Cyclase Coupling; Protein Kinase A; Receptor-G Protein-Phospholipase C-Coupling; Synthesis of Polyphosphoinositides And heir Regulation; Protein Kinase C; Calcium Signaling Via Calmodulin; Growth Factor

Receptor Protein Tyrosine Kinases; Ras Signalling; PI 3-Kinase And MAP Kinase Cascades; Cytokine Receptors and JAK/STAT Signaling, Receptor Ion Channels; Two Component Pathways In Prokaryotes.

**BIY 618 Phylogenetic Systematics 3+0 7,5**

The Position of Systematics Among the Biological Sciences; General Concepts of Systematics; The Phylogenetic System and Its Position Among the Possible and Necessary System in biology; Tasks and Methods of Taxonomy: Taxonomic Tasks in the Area of the Lower Categories; The species Category in the Time Dimension; The Species Concept and Paleontology, Taxonomic Tasks in the Area of the Higher Group Categories; The Methods of Phylogenetics: The concepts.

**BIY 620 Forest Vegetation of Turkey 3+0 7,5**

Three Phytogeographical Areas of Turkey, Climates and Other Characteristics of these Three Areas of Turkey, Floristical and Syntaxonomic Analyses of Plant Associations Belong to Forest Vegetation Under the Influence of Climate; Main Rock; Soil and Biotic Factors Affected By Oceanic; Black Sea and Central Anatolia Region.

**BIY 621 Advanced Molecular Genetics 3+0 7,5**

Heredity and the phenotype: An Introduction to Genetics, Mendelian an Genetics: The Molecular Basis of Heredity, DNA Structure and Analysis, Translation and proteins; Genomics: Chromosome structure and DNA sequence organization, Organization of Genes in Chromosomes; Genetics of organisms and populations, Developmental Genetics, Genetics and Behavior, Population Genetics

**BIY 622 Soil Biology 3+0 7,5**

Soil ecosystem and properties; Soil organisms; Soil bacteria Actinomycetes, fungi, algae, lichens, viruses Soil fauna, protozoa, worms, pot worms, arthropods, vertebrates; Microbial interactions, competition; The opposite interaction, hunting, co-existence; Mutual benefit Enzyme properties and soil functions; Soil ecosystem development; Decomposition of soil; Organic matter and carbon cycle; Soil nitrogen cycle; Microbiological fertilizer and biocontrol; Soil phosphorus cycle; Soil sulfur cycle, Some trace elements; Microbial transformations

**BIY 624 Use of Bioindicators in Environment 3+0 7,5**

Determination of Environmental Conditions by Using Plants and Animals: Which kind of organisms are useful for this purpose?; Physiological and Morphological Effects of Pollutants on Living Organisms: Changes on the distribution patterns of organisms due to environmental pollution, Some methods and their application on the determination of sulphurdioxide and heavy metal; Determination and Monitoring of Special Habitats of Living Organisms: Lichens and Algae.

**BIY 625 Special Microscopic Techniques 3+0 7,5**

Introduction of High Technology Observation Tools For Biological Studies; Technical Preparation of Microscope, Special Fitness of Microscope; Using a Microscope and

Study Principles; Preparation of Biological Materials For Fluorescence Microscope; Co focal Microscope and Scanning Microscope; Techniques of Single and Double Immunochemical Staining; Techniques of Biological Macro graphing; Using Special Microscopic Techniques for Observation And/Or Results; Techniques of Discussions For Microscopy.

**BIY 626 Enviromental Microbiology 3+0 7,5**

Soil Microbiology and Environmental Microbiology Biogeochemical Cycles; Aquatic Microbiology; Air Microbiology; Microorganisms and some novel pollution problems; Xenobiotia molecule; Recalcitrant halocarbons; Poly chlorinateol biphenyl and dioxins; Synthetic polymers; Alkyl benzyl sulfonates; Oil pollution; Crude oil Biodegradation; Pesticides; Microbial Accumulation of Heavy Metals and Radio Nualides Bioremediation.

**BIY 627 Ecophysiology 3+0 7,5**

Introduction; Ecological Factors and their Effects on Plants; Metabolism Physiology in Plants; Translocation in Plants; Biochemical Explanation of Photosynthesis and Respiration in Plants; Nutrition Methods in Plants; Growth; Growth Substances and Their Functions in Plants; Functions of Hormones During Seed Growth; Germination and Germination Types of Plant Seeds; Conditions of Seed Germination and Eliminating the Germination Obstacle; Seed Germination Properties of Economically Important Plants.

**BIY 628 Genetic Regulation of Development 3+0 7,5**

Introduction; Differentiation and Proliferation: Regulation of cell cycle and related molecules; Genetic control of Nematode development: Control Genes And Cell Behavior; Genetic Control Of Drosophila Development: Regional differentiation during embryogenesis, Neurogenesis, Homologous of Drosophila in mammals; Neurogenesis in Mice; Myogenesis in Mammals: Transcription factors and their functions; Oncogenesis.

**BIY 629 Molecular Taxonomy 3+0 7,5**

The Past and Future of Taxonomy; Methods of Systematic; Molecular Taxonomy; Molecular Systematic in Classification of Species; Partial Evolutionary Changes of Local Populations; Variation at DNA Level; Recognition With DNA (DNA Fingerprint); Satellite's DNA in Molecular Taxonomy; Sequences of Ribosomal RNA; Molecular Taxonomy Studies in Various Species.

**BIY 630 Modern Methods in Plant Taxonomy 3+0 7,5**

Cytotaxonomy; Concept and Application Methods; Chemotaxonomy; Concept and Application Methods on the Different Plant Groups; Molecular Biological Methods in Plant Classification: Algae, Mosses and Vascular Plants; Numerical Methods in Taxonomy; Descriptions and Geometric Models; Grouping; Ordination and Discrimination Functions; Pyhlogenetic (Cladistic) Systematic; Introduction of Phylogenetic Methods and their Applications.

**BIY 631 Ecological Economics 3+0 7,5**

What is Ecological Economics?: Basic principles and concepts; The history of ecological economics; Analytic vision for ecological economics; Valuation and Decision-Making Process in Ecological Economics: Ecosystem services, their function and evaluations; Relationship Between Ecological Conservation and Economy; Sustainability in Nature: Indicators of sustainability; Carrying capacity; Human impacts on nature: Ecological footprint and its importance; Calculation; Consumption; Relationships Between Economic Development and Sustainability of Natural Sources: Ecological macroeconomics; Economics of resources; Cost-benefit analyses in nature; Environmental Economy; Environmental Politics; Environmental Planning.

**BIY 632 Biochemistry of Cancerogens and Mutanges 3+0 7,5**

Enzymatic Activation of Polycyclic Aromatic Hydrocarbons; Monoxygenases, Arylhydrocarbon Hydrolases, Cytochrome P-450 Mechanism, NADPH-Cytochrome P450 Reductase System; Epoxide Hydrolases; (Mechanisms, Inductions Etc.); Conjugation Enzymes; Glutathione-S Transferases; Sulfotransferases; UDP-Glucuronil Transferases, Conjugation Reactions; and Carcinogenity Relations; Nucleosid and Nucleotid Alkylating; Invitro Alkylating of Nucleic Acids; in Vivo Alchylation of Nucleic Acids; Bifunction; Alkylating Agents; Circular Alchylation Agents.

**BIY 633 Economic Botany 3+0 7,5**

Classification of Economic Botany; Nutritive Plants; Grain Plants; Vegetables; Plants With Edible Roots; Stems; Leafs; Fruits and Seeds; Plants Having Oil; Seeds Having Oil; Fruits; Fleshy Fruits; Baccate Fruits; Drupe Fruits; Aggregate Fruits; Dry Fruits; Plants That Contain Sugar; Starch and Oil; Flavoring Plants; the Stimulation Plants; Industrial Plants; Pharmacologic and Ornamental Plants.

**BIY 634 Evolution of Microbial Pathogens 3+0 7,5**

Origin of life and earth as a microbial habitat; General concepts of microbial evolution: Studying evolution using genome sequence data; Population dynamics of bacterial pathogens; Microbial adaptation; Pathogenicity islands and evolution; Evolution of microbial pathogens and environment; Evolution of soil pathogens; Evolution of bacterial toxins; Evolution of bacterial resistance; Evolution of enteric pathogens; Evolution of human fungal pathogens.

**BIY 635 Characteristic Behaviour of Animal Groups 3+0 7,5**

The Science of Behavior; Etholoji; Hereditary Behavior; Learned Behavior; Social Behavior; Nest-Building Behavior of Invertebrate Animals; Nest-Building and Mating Behavior of Pisces; Migration Behavior of Pisces; Characteristic Nest-Building Behavior of Birds; Dating Behavior of Birds; Characteristic Feeding Behavior of Birds; Community Behavior in Mammals.

**BIY 636 Biochemistry of Free Radicals 3+0 7,5**

Free Radicals and Reactive Oxygen; Super oxide Radicals; Peroxide Radicals; Biochemical Mechanisms of Free Radicals; Free Radical Enzymes; Glutathione Peroxides; Catalase; Glutathione Reductase; Glutathione-S-Transferase; Free Radicals and Cancer; Free Radicals and Antioxidant Defense Mechanism.

**BIY 637 Aquatic Entomology 3+0 7,5**

Classification of Aquatic Insects; Aquatic Insect Orders and Their Morphologic and Biologic Features: Collembolan; Ephemeroptera; Odonata; Plecoptera; Orthoptera; Hemiptera; Megaloptera; Neuroptera; Coleoptera; Diptera; Lepidoptera; Trichoptera; Hymenoptera; Define Methods of Aquatic Insects; Biological Features of Temporary and Permanent Water; Morphological and Physiological Adaptations of Aquatic Insects; Sampling Techniques; Economic and Ecologic Importance of Aquatic Insects.

**BIY 638 Archaeobacteria 3+0 7,5**

Cell Biology; Euryarchaeota; Extreme Hemophilic Archae, Archae Producing Methane; Thermoplasmates, Hyper thermopilic Euryarchaeota; Crenarchaeota; Habitat and Energy Metabolism; Sulfolobales and Thermoproteales, Desulfurococcales; Living in High Temperature; Isolation Methods of Archaeobacteria.

**BIY 640 Basic Virology 3+0 7,5**

Virology and Viral Diseases; General Properties of Viruses and Their Classification; The Virus Host; Quantification and Visualization of Viruses; Host Response to Viral Infection; Replicating and Measuring Biological Activities of Viruses; Characterization of viral genomes; Manipulation of viral genomes; Bacteriophages; Lytic viruses; Lysogeny and Phage Lambda; Animal viruses; Plant viruses; Viroids and Prions.

**BIY 641 Soil Science 3+0 7,5**

Topics and Aim of Soil Science; Main Structure of Soil; Formation and Factors in This Matter; Rocks and Minerals Forming Soil; Decomposition Events Forming Soil; Physical Properties of Soil; Physicochemical Properties of Soil and Soil Organic Material; Chemical Properties of Soil; Biological Properties of Soil; Soil Yield; Main Soil Properties Affecting Yield.

**BIY 642 Protein and Nucleic Acid Analysis Techniques 3+0 7,5**

Molecular analysis of nucleic acids, Restriction enzymes, Restriction and modification of nucleic acids, Marking and identifying nucleic acids, DNA sequence analyses, Micro-array and super-array techniques, Protein purification, Purification techniques, electrophoretic techniques, proteomix.

**BIY 644 Intracellular Traffic 3+0 7,5**

Biosynthetic pathways; Transport of newly synthesized proteins; Vesicular and tubular clusters; Trans- golgi network (TGN); Secretory vesicles; Endocytic pathway; Endosomes and peroxisomes.

**BIY 645 Biochemistry of Nucleic Acids 3+0 7,5**

Biological Functions of Nucleic Acids; Discovery of Nucleic Acids; and Biochemical Formation of Nucleic Acids; Isolation and Characterization of Nucleic Acids; Structures of RNA; Viral Nucleic Acids; Nuclease and their Relationship to Enzymes; Biosynthesis of Mononucleotides; Replication and Biosynthesis of DNA and Biosynthesis of RNA: Transcription; Translation (Biological Function of RNA to Produce Proteins); Catabolism of Nucleic Acids Will Be Taught.

**BIY 646 Eutrophication in Lakes 3+0 7,5**

What is the Eutrophication?; Cultural Eutrophication; Natural Eutrophication; Sources of Nutrients; Prediction in Lake Eutrophication; Importance of Phosphorus as a Limiting Nutrient; General Effects of Eutrophication on the Aquatic Ecosystem and the Problems to Man Associated With These Effects; Community Interactions and Eutrophication; Controlling Eutrophication: Biological Control in Lakes; Chemical Control in Lake;s Mechanical Control in Lakes.

**BIY 647 Human Biochemistry 3+0 7,5**

Constituents of Cells; Functions of These Chemicals; Proteins; Lipids; Carbohydrates; Nucleic Acids; Dissolved Materials; Membranes; Metabolism and It's Control Mechanism; Mitochondria; Bioenergetics; Thermodynamic; Electron Transport; Nucleus; Gene Expression; Plasma Membranes; Synthesis of Proteins; Surface of Cell; Transport; Specification of Cells; Jessel System; Digestion System; Nutrition; Digestion an Absorption; Function of Liver; Amino acid; Lipid and Carbohydrate Metabolisms; Hormonal System; Immune System; Immune Response; Preservation; Sensitivity; Cell System; Illness of Immune Systems; Nervous System and It's Properties; Structure of Nerve Cells; Chemical Flow; Illness of Nervous System.

**BIY 648 Applied Mycology and Biotechnology 3+0 7,5**

Fungi; Applied Mycology and Biotechnology; Applied Mycology and Biotechnology for Agriculture; Applied Mycology and Biotechnology for Food; Filamentous Fungi Biotechnology; Fungal solid state fermentation; Fungal enzymes; Organic acids; Secondary metabolites; Yeast Biotechnology; Strain improvement in fungi; Detection of toxigenic molds.

**BIY 649 Plant Genetic Resources 3+0 7,5**

Biodiversity; Its Disappearances and Importance; Conservation of Ecosystems; Factors Threatening Plants; Natural Factors; Artificial Factors; Plant Gene Resources; Its Importance; In-Situ (In Natural Habitats) Conservation; Ex-Situ (Out Of Natural Habitats) Conservation; Endemic Plants; Botanical Garden; Seed Banks; Plant Reproduction Techniques; Main Principles in Plant Growth.

**BIY 651 Vegetation Research Methods 3+0 7,5**

Floristic Methods; Braun-Blanquet Method; Calculation of Contans Degree; Finding the Differential Species; Position of Plant Associations Which Sociological Units Were Not Described; Describing the Plant Species and Charasteric Plants; Importance of Alliance; Different Sampling

Methods Using for Vegetation Studies; Statistical Methods; the Concept of Ecologic Group; the Nomenclature Code of Plant Association; Counting Methods for Environmental Vegetation Research; Mapping Natural Environment and Vegetation.

#### **BIY 652 Microbiyal Genomics 3+0 7,5**

What Is The Genome and Genomics - Principles of Genomic Molecular Structure; Role of Other Related Scientific Fields Such as Proteomics and Bioinformatics; Methods And Techniques Used In Genomics; Alternative Approaches In Genome Projects; Evaluation of Results From Genome Projects; Observation and Study of Microbial Projects Already Finished Such As E. Coli O157:H7, E.Coli K-12, Deinococcus Radiodurans, Enterococcus Faecalis and Bacillus Subtilus.

#### **BIY 653 Advanced Molecular Biology 3+0 7,5**

Genes: Genes are DNA, The interrupted gene, The content of the genome, Clusters and repeats; Proteins: Messenger RNA, Protein synthesis, Using the genetic code, Protein localization; Gene expression: Transcription, The operon, Regulatory circuits, Phage strategies, DNA: The replicon, DNA replication, Recombination and repair, Transposons, Retroviruses and retroposons, Rearrangement of DNA; The Nucleus: Chromosomes, Nucleosomes, Promoters and enhancers, Activating transcription, Controlling chromatin structure, RNA splicing and processing, Catalytic RNA, Immune diversity; Cells: Protein trafficking, Signal transduction., Cell cycle and growth regulation, Oncogenes and cancer, Gradients, Cascades, and signaling pathways.

#### **BIY 654 Ecological Genetics 3+0 7,5**

Ecological Genetics: Why does ecological genetics work?; Markers and Sampling in Ecological Genetics: Methods of data generation, Principles of sampling, Within-population sampling, Among-population sampling, Power analysis; Genetic Diversity and Differentiation: Factors influencing diversity and differentiation, Use of genetic diversity statistics; Gene Flow and Mating System: Factors governing gene flow, The importance of biological and environmental factors on gene flow; Intraspecific Phylogenies and Phylogeography: Homology, gene trees, and species trees, Speciation and hybridization.

#### **BIY 655 Natural Antimicrobial Agents and Food 3+0 7,5**

Introduction; Nisin; Bacteriocins; Natamycin; Organic Acids; Antimicrobials from Plants; Natural Antifungal Agents; New Food Additives.

#### **BIY 656 Chemotaxonomy 3+0 7,5**

Importance of Taxonomy, Classification methods, Classic Taxonomic Methods, Taxonomic Characters, Biogenetic Classification of Plant Constituents, Classification Methods According to Chemical Constituents, Chemotaxonomy and Biochemical Systematics, Correlation between Chemo and Classic Taxonomy, Affinity of Chemotaxonomic Parameters with Systematics.

#### **BIY 657 Food, Human Health and Probiotics 3+0 7,5**

Introduction to Prebiotics and Probiotics; Development of Probiotic Food Ingredients; Taxonomy and Biology of Probiotic; Primary Sources of Probiotic Cultures; Genetic Engineering of Probiotic Bacteria; Immunochemical Methods for Detection of Probiotics; Genetical Modified Probiotics; Use of Probiotics in Food; Probiotics as Biopreservatives for food; Probiotics in Cancer Prevention.

#### **BIY 658 Cell Regulation 3+0 7,5**

Introduction; Cell Cycle and Function; Regulation of Cell Cycle and Function; Differentiation Mechanisms of Cell According to Their Structure and Function; Occurrence of Cell Types During Developmental Stage; Cell Death and Apoptosis.

#### **BIY 659 Cancer Genetics 3+0 7,5**

The Genetic Bases of Cancer: Regulation of gene expression, Genetic controls of cell cycle, Tumor suppressor genes, Proto-oncogenes and oncogenes, Genes for metastasis, Genes related apoptosis; The Causes of Carcinogenesis: Epigenetic changes, The role of chromosome and gene mutations, Carcinogens, Inheritance of familial cancer; Cancer Cytogenesis; New Development and Approaches to Cancer Genetics.

#### **BIY 660 Medical Genetics 3+0 7,5**

Introduction to Human Genetics; Genetic Mechanisms for Humans: Mendelian inheritance, Sex-linked inheritance, Gene linkage, Multiple allelic inheritance, Multifactor inheritance, Maternal inheritance; Chromosomal Disorders: Autosomal disorders, Gonosomal disorders; Single Gene Inheritance: Autosomal dominant and recessive gene diseases, X-linked diseases; Multifactorial Diseases; Investigation Methods of Medical Genetics: Cytogenesis and molecular analysis, Prenatal diagnosis; Genetic Counseling.

#### **BIY 661 The Molecular Basis of Cell Differentiation 3+0 7,5**

Definition of Cells Differentiation; Fundamental Factors in Cell Differentiation; Growth Factors and Signal Molecules: Cell membrane receptors and proliferate response, Ligand receptor relations, Phosphorylation of growth factors; The Cell Differentiation in Early Embryonic Stage: The molecules involved in the Process of Development and Differentiation; Mechanism of Gene Activation in Cell Differentiation: The gene expression in differentiated cells, Constancy of the Genome in differentiated cells; Differentiation of Cancer Cells: Proto-Onkogenes functions in development and cell differentiation, Biological effects of Ontogenesis in the process of transformation.

#### **BIY 662 Basis of Molecular Evolution 3+0 7,5**

What is Molecular Evolution; Structure of Gene; Mutations and their Types; Dynamics of Genes in Populations: Mechanism of Evolution: Natural selection, Random genetic drift, Genetic polymorphism; the Neutral Mutations and Evolution; Evolutionary Changing in Nucleotide Sequences: Indirect estimation of the number of nucleotide substitutions, Rates and patterns of nucleotide substitution, Causes of variation in substitution rates; A Case of Positive

Selection; Molecular Clocks; Molecular Phylogeny; Evolution by Gene Duplication; Evolution by Transposition; Genome Organization and Evolution.

**BIY 663 Araneology 3+0 7,5**

Taxonomy and specification of Aranea: Morphology; Anatamoy: Endoskeleton, Exoskeleton; Biology of spiders, Ecological specifications; Metabolism; Digestion systems; Circulation systems; Respiration systems; Neural systems; Spider Webs: Structure and evolution; Locomotion and prey capture; Reproduction: Female and Male reproductive organs; Development; Venomous spiders: Venoms and effects.

**BIY 664 Ecological Restoration 3+0 7,5**

Introduction to Ecological Restoration Concept: Philosophy of Ecological restoration; Concepts and themes in ecological restoration; Effective and Sustainable Use of Natural Sources: Waste management; Usage of water; Recycling of wastes; Productivity; Rehabilitation of Ecosystems by Using Natural Sources: Environmentally friendly green technologies and their applications; Phytoremediation; Basic concepts; Advantages and disadvantages; Wetlands: Importance and characteristics of wetlands; Constructed wetlands; Usage areas of constructed wetlands.

**BIY 665 Advanced Biochemistry and Biochemical Techniques I 3+0 7,5**

Carbohydrates; Nucleic acids and water-soluble vitamin metabolisms; The structure of water-insoluble vitamins; Lipid biosynthesis; Carbohydrate biosynthesis; Clinical enzymology; Glycolysis; Glukoliziz; Hexoses degradation; Glukoneogenesis; Citric acid cycle; Regulation of the citric acid cycle; Oxidative phosphorylation; Regulation of oxidative phosphorylation; Lipid oxidation; Urea cycle; homogenization, centrifugation, separation techniques; Electrophoresis technique; Enzyme immunoassay measurement methods; Basic principles of flow cytometry; Foundations of spectrophotometry; Absorption laws; High-performance liquid chromatography; Imaging techniques.

**BIY 666 Advanced Biochemistry and Biochemical Techniques II 3+0 7,5**

Interaction between proteins and ligands: Immune response and specialized regulatory properties of proteins; Molecular motors; Enzyme kinetics; Allosteric effect; Kinetic tests; Bioenergetics and anaplerotik reactions; Glukosilat cycle; Porphyrin synthesis and degradation of hemoglobin production; Glukoconjugates; Carbohydrate analysis; DNA methylation; Fosfotidilinozitoits; Eikosanoits; Synthesis of saturated fatty acids and unsaturated fatty acids; Cholesterol and other lipids are transported and degradation of purine and pyrimidine synthesis; Cholesterol; steroids and izoprenitlerin synthesis; Enzyme activities and purifying methods of measurement

**BIY 667 Actinomycetes in Biotechnology 3+0 7,5**

Physiological Biochemical and morphological Properties of Actinomycetes; Genetic properties of Actinomycetes; Ecology of actinomycetes; Actinomycete Diversity;

Isolation of Actinomycetes from Environmental Sources; Classification of Actinomycetes; Identification of Actinomycetes; Pathogenic Actinomycetes; Actinomycete Biotechnology; Actinomycetes and Lignin Degradation; Actinomycetes and their Antibiotics; Actinomycetes and enzymes.

**BIY 668 Advanced Protein Biochemistry 3+0 7,5**

Amino Acids, Peptides and Proteins: Definition and classification, Polypeptides and proteins, Protein size, Composition and properties, Determination of primary structure; Protein Structure: Structure of peptide bonds, Secondary structure, Tertiary structure, Quaternary structure; Biological Functions of Proteins: Myoglobin, Hemoglobin, Cooperative binding, Sick-cell anemia; Protein Purification: Homogenate preparation, Centrifugation, Dialysis, Chromatography applications, Electrophoresis; Enzymes: Naming of enzymes, Kinetic properties of enzymes, Characteristics of enzyme reactions, Enzyme inhibition, Coenzymes, Allosteric enzymes, Cellular regulation of enzymes, Abzymes, Ribozymes.

**BIY 669 Biology of Lichenicolous Fungi 3+0 7,5**

What are lichenicolous fungi? Interactions of lichenicolous fungi with lichens; Saprotrophic interactions; Biotrophic and necrotrophic interactions; Gall forming lichenicolous fungi; Host specificity; The reasons for host specificity; The diversity of lichenicolous fungi; Important taxonomical characters for the identification of lichenicolous fungi; Classification of lichenicolous of fungi; Identification of lichenicolous fungi.

**BIY 671 Statistical Analyses in Biology 3+0 7,5**

Introduction: Aim and scope, Importance and use of statistical analyses in biology, Basic concepts; Statistical Software: SPSS programme, SPSS menu, Methods of data entry into SPSS programme; Decision Making: Choosing appropriate analysis; Statistical Analyses; Descriptive Statistics; Some non-parametric tests: Chi-square test; Some Parametric tests: z and t tests, One and two way variance analyses (ANOVA), Covariance analysis (ANCOVA), Simple and multivariate linear regression and correlation analyses, Multivariate variance analysis (MANOVA), Cluster analysis, Discriminant Analysis; Interpretation of the results.

**BIY 672 Advanced Biochemistry and Bioenergetics 3+0 7,5**

Biochemistry: Definition, Macromolecules; Enzymes: Classifications, Kinetic properties of enzyme reactions, Membranes, Membrane Transport: Chemistry of Different Reactions: Oxidation- reduction reactions, Group-transfer reactions, Hydrolysis reactions, Nonhydrolytic cleavage reactions, Isomerization and rearrangement reactions, Bond formation reactions using energy from ATP; Concepts of Bioenergetics: Standard free energy change, Measurement of  $\Delta G^\circ$ , ATP and phosphoanhydride bonds, Other reactive biomolecules for energy transfer.

**BIY 673 Molecular Industrial Biotechnology 3+0 7,5**

Fermentation Technology; Commercial Production of Microorganism; Molecular Analysis and Amplification Techniques; Production of Gene Probes; The Expression of Foreign DNA in Bacteria; Yeast Cloning and Biotechnology; Cloning Genes in Eukaryotic Cell Lines; Biosensors; Protein Engineering; Vaccination and Gene Manipulation; Metagenomics in Biotechnology; Industrial Enzymes for Biopolymer Degradation.

**BIY 674 Molecular Microbial Ecology Techniques 3+0 7,5**

Introduction to Molecular Microbial Ecology; Molecular Techniques in Microbial Ecology; Isolation of Nucleic Acids; DNA and RNA Extraction from Soil; Amplification; Polymerase Chain Reaction (PCR); Quantitative PCR of Environmental Samples; Detection of Microbial Nucleic Acids by Polymerase Chain Reaction in Aquatic Samples; Fluorescence In Situ Hybridization (FISH); Denaturing Gradient Gel Electrophoresis (DGGE); General overview.

**BIY 705 Insect Behavior 3+0 7,5**

Insect Anatomy and Morphology; Development of Insects; Species Diversity of Insects; History of Insect Behaviour; Behaviour Diversity and Its Origin; Control of Behaviour; Programmed and Integrated Behaviour; Spatial Alignment; Finding Food and Nutrition; Defense; Physical Communication; Chemical Communication; Mechanical Communication; Reproductive Behaviour; Parental Behaviours and Social Life.

**BIY 790 Thesis 0+1 30,0****BIY 890 Thesis 0+1 30,0****CAM 513 Metallic Glasses 3+0 7,5**

Introduction; The Types of Metallic Glass Alloys, Structure of Metallic Glasses, Formation Theories of Metallic Glasses, Investigations on Behaviour and Properties of Non Crystalline Phases, Theoretical Mechanism of Deformation and Fracture, Effects of Crystallisation on the Mechanical Properties, General Application Fields of High Temperature Metallic Glasses.

**CAM 514 Chemical Durability of Glasses 3+0 7,5**

Definition and Importance of Chemical Durability; Chemical Endurance in Certain Corrosive Environments; Behaviour of Several Glass Systems in Different Environments; Factors Affecting Chemical Durability; Measuring Methods of Chemical Durability and Standard Tests; Improvement Method of Chemical Endurance; Highly Durable Commercial Glass Systems and Their Applications.

**CAM 515 Engineering Glasses 3+0 7,5**

Commercial Glass Systems; Soda-Lime-Silica Glasses; Borosilicate Glasses; Phosphate Based Glasses; Germanate Glasses; Chalcogenide Glasses; Metallic Glasses; Organic

Glasses; Industrial Raw Materials Used in Glass Production and Their Properties; Glass Production; Certain Physical, Chemical, Mechanical and Optical Properties of Glasses; Glass Characterization Techniques; Technologically Important Glasses; Crystallization in Glass, Glass Ceramics and Their Applications

**CAM 601 Ionic Diffusion in Oxide Based Glasses 3+0 7,5**

Structure of Oxide Glasses; Investigation Methods for Glass Structure; Results of Experimental Studies; Diffusion Mechanisms in Glass; Chemical Diffusion; Impurity Diffusion; Activation Energy and Frequency Factor; Correlations Between Causes and Results.

**CAM 602 Glass Science and Technological Improvements 3+0 7,5**

Introduction; Lacks of Present Glass Systems and the Efforts on Their Eliminations; Latest Developments in the World of Technical Glasses; Interdisciplinary Relationships of Glasses with Other Materials and the Effects of Such an Interaction on Final Products; New Glass Production Processes; Precautions to be Taken for Cost Reduction; Relations Between Technology and Design; New Properties of Final Products and Their Characterisation; Environmental Consciousness and its Effect on the Production.

**ÇEV 501 Special Topics in Environmental Engineering I 3+0 7,5**

Current Subjects and Nationwide and Local Problems Will Be Covered in this Course.

**ÇEV 517 Modeling of Air Pollution 3+0 7,5**

Atmospheric Physics and Atmospheric Chemistry; Air Pollution and Meteorological Events; Air Pollution Models; Mathematical Modeling; Meteorological Modeling; Eulerian Dispersion Models; Gaussian Models; Lagrangian Dispersion Models; Statistical Models; Utilization of Computer Software Related to Modeling and Case Problem Solutions.

**ÇEV 523 Instrumental Techniques and Data Evaluation Methods in Environmental Engineering 3+0 7,5**

Terminology of Instrumental Analysis in Environmental Engineering; Unit Conversions and Computations; Basic Principles; Theory of the Working Principles of Basic and Frequently Used Instruments; Preparations Before Use: Sample preparation, Calibration, Working Data etc.; Post-assessment; Choosing the Best Analysis Method; Use of the Present Instruments and Practical Considerations.

**ÇEV 524 Ecotoxicological Risks of Pollutants 3+0 7,5**

General Information About Ecotoxicology; Sources of the Pollutants Qualified as Toxic; Influence Mechanisms and the Ways of Take Into and Discharge From the Body; Determination of the Toxicity and Dose-Response Relations; Suggesting Threshold Values; Examples of Investigation on Ecotoxicology; Bioaccumulation and Biomagnification.

**ÇEV 525 Biomonitoring of the Environmental Quality and Techniques 3+0 7,5**

General Descriptions of Factors that Affect Environmental Quality; Importance of Biomonitoring; Suitable Organisms and Their Features; Methods of Biomonitoring; Comparison of the Reliabilities of Biomonitoring Studies with Other Analysis; Case Studies on Biomonitoring.

**ÇEV 526 Integrated Waste Management Economics 3+0 7,5**

The Selection and Application of Suitable Techniques; Technologies and Management Programs to Achieve Specific Waste Management Objectives; Cost-Benefit Analysis on the Selection of Some Disposal Alternatives; Life Cycle Inventory; Basic Environmental Effects on Sanitary Landfilling and Incineration and Their Economic Evaluation.

**ÇEV 527 Advanced Solid Waste Management I 3+0 7,5**

Integrated Solid Waste Management: Solid Waste Generation, Separation at the Source and Storage, Solid Waste Collection Systems, Analysis of Collection Systems, Unit Operations Used for the Separation and Processing of Solid Wastes; Transfer and Transport of Solid Wastes: Types of Transfer Stations; Recycling Processes; Recycling / Recovery Systems; Biological and Chemical Conversion Technologies: Aerobic and Anaerobic Composting Processes and Technologies, Energy Recovery of Biological Conversion Processes.

**ÇEV 528 Industrial Air Pollution and Control 3+0 7,5**

Planning Industrial Air Pollution Survey; Sources, Inventories, Emission Factors Field Sampling for Various Industrial Pollutants; Air Quality Monitoring Studies for Industrial Areas; Various Strategies Related to Industrial Pollution Control; Air Pollution Control at Combustion and Non-Combustion Emission Sources; Control of Fugitive Emissions; Control Technologies for Pollutants at Gaseous and Vapor Phase and Control Equipment Design; Control Technologies for Particulate Pollutants and Dust Collector Design; Control Costs; Economic Analysis.

**ÇEV 530 Anaerobic Biotechnology for the Treatment of Wastes 3+0 7,5**

Basic Principles of Anaerobic Biotechnology; Advantages and Disadvantages of Anaerobic Biotechnology over Aerobic Biotechnology; Basic Process Microbiology; Kinetics and Stoichiometry of Anaerobic Reactions; Protocol of Anaerobic Treatability; Management Concepts; Basics of Process Design; Alkalinity; Nutrition and Trace Element Requirement; Toxicity and Microbiological Adaptation; Energy Production in Anaerobic Systems; Examples of Anaerobic Treatment of Industrial; Agricultural; Solid and Hazardous Wastes.

**ÇEV 531 Statistical Analysis of Engineering Data 3+0 7,5**

Basic Statistical Concepts; Regression and Correlation Analysis; Analysis of Variance; Identification of the Method for Experimental Studies; Reduction of the Experimental Errors During Experimental Data Collection;

Determination of the Relations Between Parameters that Affect Experimental Results; Analysis in Experimental Design; t, f and  $\chi^2$  Tests; Establishing Mathematical Models; Testing of Hypothesis Related to Mathematical Modeling and Related Rules of Decision; Factorial Design and Applications Related to Engineering Topics; Computer Aided Data Analysis Systems and Data Evaluation; Utilization of Software in Data Analysis.

**ÇEV 533 Nonpoint Source Pollution 3+0 7,5**

Point and Nonpoint Sources in Water Pollution: Definition of the nonpoint source pollution; Its characterization; Sources and Causes; Transport Routes of Pollutants from Diffuse Sources; Hydrological Aspects of Nonpoint Source Pollution; Erosion and Soil Loss; Nonpoint Source Pollution Management; Watershed Management; Pollution Control; Best Management Practices; Modeling of Nonpoint Source Pollution; Model Classification; Characteristics of the Models Used in Nonpoint Source Pollution Modeling and Their Comparison.

**ÇEV 535 Groundwater Pollution and Treatment 3+0 7,5**

Formation of Groundwater; Introduction to Groundwater Geochemistry: Solution Equilibrium; Carbonate Chemistry; Weathering; Redox Processes; Origins and Scenarios of Groundwater Contamination; Pollutant Transport: Retardation of the Chemicals; Dispersion and Diffusion; Flushing and Aquifer Clean-Up; Physical/Chemical Interactions of Pollutants With Soil Matrix and Water; In-Situ and Ex-Situ Treatment Technologies.

**ÇEV 536 Natural Treatment Systems 3+0 7,5**

Definition, Aim and Characteristics of Natural Treatment Systems; Types of Natural Treatment Systems; Wetlands: Natural Wetlands; Wetlands in Turkey and their Environmental Potentials; Constructed Wetlands; Surface Flow Systems; Subsurface Flow Systems; Aquatic Plants and Plant Selection; Fundamental Considerations in the Application of Natural Treatment Systems; Wastewater Characteristics; Treatment Mechanisms Applied; Public Health; Slow-Rate and Rapid Infiltration Systems; Design Principles of Natural Treatment Systems; Case Studies.

**ÇEV 539 Life Cycle Assessment 3+0 7,5**

Life Cycle Assessment (LCA): Concept and history; LCA Methodology: Goal and scope, Definition, Inventory analysis, Impact assessment; LCA and ISO 14000 Relation; Life Cycle Analysis Softwares and Applications.

**ÇEV 540 Modelling of Environmental Systems 3+0 7,5**

Modeling and General Principles; Characteristics of Natural Systems with Respect to Modeling; Modeling of Well-Mixed One-dimensional Systems; Advection and Dispersion; Modeling of One-dimensional Streams; Modeling of Two-dimensional Systems like Lakes and Oceans; Numerical Solutions; Presentation of the QUAL2E Model and Applications.

**ÇEV 541 Water Treatment Technologies and Applications 3+0 7,5**



Selection of Process for Water Treatment; Factors influencing the choice, Evaluating process options, Examples of treatment process; Filter Media; Filter Bed and Materials; Flow Through Porous Media; Rapid/Slow Sand Filters; Specifications and Operations; Ion-exchange and Adsorption; Theory, Materials and Reactions, Adsorption Kinetics, Columns, Regeneration; Adsorption of Organic Compounds; GAC/PAC Adsorption Systems; Membrane Filters and Design; Chemical Oxidation; Use of Oxidants for Water Treatment and Applications.

**ÇEV 542 Nitrogen and Phosphorus Removal from Municipal Wastewater 3+0 7,5**

Nitrogen Removal: Source of nitrogen in wastewater, Principles of nitrification and denitrification and options, Combined nitrification/denitrification systems; Physical/chemical nitrogen removal processes: Breakpoint chlorination, Air stripping of ammonia, Selective ion exchange; Phosphorus removal: Sources of phosphorus in wastewater, Principles of chemical phosphorus removal and options, Principles of biological phosphorus removal mechanisms; Affecting Factors and Systems.

**ÇEV 543 Accreditation Process of Test Laboratories 3+0 7,5**

General Definitions in Accreditation Process; Fundamentals of TS EN ISO/IEC 17025: Short history of accreditation, Developments of accreditation, Comparison with ISO 9001-2000; Advantages of Accreditation; Scope of TS EN ISO/IEC 17025: Main scope, Reference standards and documents, Terms and definitions, Management conditions, Technical conditions; Accreditation Practices: Preparation of documents, Preparation of standard operation procedure (SOP), Uncertainties.

**ÇEV 544 Metal Pollution and Environment 3+0 7,5**

Introduction to Metal Pollution: General evaluation of metal pollution, Definitions and topics; Metal Pollution in Water: Aquatic ecosystems, Toxic materials, Metal concentration in river, lake and ocean waters, Heavy metals in aquatic organisms; Metal Pollution in Soil and Sediment: Sources, Reasons, Accumulation, Pollution results; Metal Existence in Air: Causes and solutions, Cycle of elements; Relationship between metals and microorganisms: Metal extraction.

**ÇEV 545 Advanced Microbial Ecology 3+0 7,5**

Introduction to Microbial Ecology: Microbial variety and definitions, Microorganism nutrition; Factors affecting microorganisms: Physical, Chemical, Biological Factors; Types of Microorganism Surroundings: Terrestrial and aquatic environments; Microbial Interaction: Competition, Succession, Antimicrobial materials; Microorganism Relations: Symbiotic relation, Interrelations between microorganisms, Other cooperations; Biogeochemical Cycles: Chemical element, Soil and petroleum formation; Pathogenic Organisms: Bacterial, viral, fungal diseases; Pollution Microbiology: Toxins, Aerosols, Metals, Radiation.

**ÇEV 546 Advanced Treatment Techniques 3+0 7,5**

Electrochemical Engineering and Applications; Electrochemical Technologies and Water Pollution; Electrochemical Technologies and Air Pollution; Electrochemical Reactors and Electrodes Used in Pollution Control; Transfer Processes in Electrochemical Reactors; Performance Criteria for Electrochemical Reactors; Cost of Electrochemical Processes; Removal of Organic Compounds by Electrochemical Methods; Removal and Recovery of Metals; Removal of Inorganic Compounds; Sterilization of Water and Wastes; Electrochemical Applications for Nuclear Wastes; Removal of Gaseous Pollutants and Electrochemical Methods for their Conversion to Useful Products.

**ÇEV 547 Special Waste Management 3+0 7,5**

Terminology and Definitions; Principles of Waste Management; Electrical and Electronic Waste Management; Healthcare Waste Management; Waste Oil Management; Waste Vegetable Oil Management; Waste Batteries and Accumulators Management; Waste Tire Management; Excavation Soil, Construction and Demolition Waste Management; Nuclear Waste Management; Planning of Special Waste Programs: Using different decision making techniques; Case Studies.

**ÇEV 592 Seminar 3+0 7,5**

**ÇEV 599 Term Project 3+0 15,0**

**ÇEV 601 Special Topics in Environmental Engineering II 3+0 7,5**

Current Subjects and Nationwide and Local Problems Will Be Covered in This Course.

**ÇEV 610 Industrial Environmental Quality Management 3+0 7,5**

Management of Air and Water Quality; Solid Wastes; Hazardous and Toxic Wastes at Industrial Facilities; Industrial Hygiene and Risk Management; Quality of Work Environment at Industrial Facilities and its Effect on the Health of Workers; Worker Health-Worker Safety Procedures; Environmental Impact Assessment (EIA) Studies; Environmental Quality Management Systems (EQMS) - ISO 14000 Applications; Legislation and Standards Related to Conservation of Environmental Quality; Quality Monitoring and Evaluation Studies; Procedures Applied in Impact Assessment and Regulation; Studies Toward Conservation and Improvement of Environmental Quality.

**ÇEV 612 Transfer Mechanisms of Incineration Processes 3+0 7,5**

Design and Engineering Principles of Incineration Processes; Destruction and Removal Efficiency; Excess Air, Temperature and Turbulence Effects on Flow Regime; Steady-State Mass and Heat Transfer; Combustion and Chemical Kinetics.

**ÇEV 614 Advanced Solid Waste Management II 3+0 7,5**

Thermal Conversion Technologies: Fundamentals of Thermal Processing, Combustion Systems, Pyrolysis Systems, Gasification Systems; Environmental Control Systems; Air Pollution Control, Water Pollution Control, Ash Disposal; Energy Recovery Systems; Sanitary Landfills: Landfill Siting Considerations, Landfill Design, Control of Leachate, Energy Recovery Processes of Landfill Gas; Restoration and Rehabilitation of Landfills.

**ÇEV 616 Advanced Disinfection Techniques 3+0 7,5**

Investigation of Disinfection and Sterilization in the Laboratory; Various Methods: Filtration; Interilization; Sterilization; Tyndalization; Sterilization With Chemical Addition; General Disinfection And Affecting Factors; Type of Disinfectant; Type of Microorganism; Disinfection Duration; Ultraviolet Radiation; Fluorine; Chlorine; Hypochlorite; Alcohols; Techniques Based on Photoactivation; Electrochemical Disinfection; Disinfection With Electrooxidation; Bacteria Removal by Electroadsorption; Disinfection With Electrocoagulation; Disinfection With Ultrasound.

**ÇEV 617 Thermal Conversion Technologies 3+0 7,5**

Fundamentals of Thermal Processing: Stoichiometric Combustion, Excess Air Combustion, Heat released from combustion; Materials and Heat Balance for the Combustion of Solid Waste; Combustion Systems: Types of combustion systems; Heat Recovery Systems; Pyrolysis Systems; Gasification Systems: Description of the gasification process, Gasifier Types; Environmental Control Systems; Energy Recovery Systems: Flow diagrams.

**ÇEV 619 Environment Quality Development Plans 3+0 7,5**

Pollution Prevention Concept; Properties and Fates of Environmental Contaminants: Organic chemicals, Metals, Contaminant transport and transformation processes; Industrial Activities and Environment: Air pollution, Solid wastes, Hazardous wastes, Water pollution, Energy usage; Resource depletion; Improved Manufacturing Operations: Process development and design; Pollution Prevention Economics: Organizing the program, Preliminary assessments, Plan development; Reclamation Technologies: Environmental Management Systems; Environmental Audit Mechanisms.

**ÇEV 620 Transport and Fate of Pollutants in Water Systems 3+0 7,5**

Fundamentals of Pollutant Transport in Water Systems (Streams, Lakes, Marine Environment); One-dimensional and Two-dimensional Transport; Continuity and Momentum Equations; Diffusion and Dispersion of Pollutants; Analytical and Numerical Solutions; Behavior of Pollutants in Water Systems; Conservative and Nonconservative Behavior; Degradation Reactions (Hydrolysis, Photolysis, Biodegradation); Other Mechanisms (Volatilization, Settling).

**ÇEV 621 Advanced Techniques for Atmospheric Analyses 3+0 7,5**

Atmospheric pollutants, organic and inorganic pollutants present in liquid, solid and gaseous phases in the atmosphere. Pre-treatment procedures for the atmospheric samples and advanced techniques applied for the extraction of samples. Analytical techniques such as GC, GC-MS, LC, LC-MS for the determination of organic pollutants and their working principles, calibrations; Analytical techniques such as UV-VIS, AAS, GFAAS, ICP, ICP-MS for the determination of inorganic pollutants and their working principles, calibrations; Qualitative and quantitative Instrumental analysis; standard reference materials, accuracy and precision calculations in quality control analysis.

**ÇEV 623 Global Warming Parameters and Control Techniques 3+0 7,5**

Cause-Effect Relations for Global Warming/Cooling and Different Views; Historical Earth-Temperature Profile; Greenhouse Effect and the Greenhouse Agents; Global Climate Systems; Natural Radiative Energy Interactions; Earth Energy Balance; Equivalent Carbon Dioxide Concentration and Earth Carbon Balance; Deforestation Issues; Relationships between Population and Economic Growth, Global Energy, Temperature and Carbon Cycle, and the Related Models; New Technology Designs and Principles for Controlling Global Temperature Changes; International Economic Allocation Models such as Carbon Tax, etc. for the Contributors of Global Warming Agents; Forecasting Capabilities of the Models and Evaluation of Scenario-Based Data for the Future; International Protocols.

**ÇEV 624 Atmospheric Chemistry 3+0 7,5**

Introduction: Description of atmosphere, Composition of air, Solar radiation, Importance of atmospheric reactions; Atmospheric trace compounds: sulfur-containing compounds, nitrogen-containing compounds, halogen-containing compounds; Atmospheric ozone; particulate matter: Stratospheric aerosols, tropospheric aerosols, carbonaceous particulates, mineral dust; Overview of stratospheric chemistry: Chapman reactions, nitrogen oxide cycle, ozone; Overview of tropospheric chemistry: Photochemical cycles of NO<sub>2</sub>, NO and Ozone, Chemistry of methane, Tropospheric ozone budget, Chemistry of nonmethane organic compounds, chemistry of biogenic hydrocarbons; Acid rain: Formation and fate of inorganic and organic acids in the troposphere.

**ÇEV 625 Integrated Natural Resource Management 3+0 7,5**

Description of Natural Resource; Fading and Inexhaustible Natural Resources; Importance of Natural Resource; Concept of Management; Biotic and Abiotic Resources Management; Sustainable Living; Sustainable Ecosystems; Threat Factors for Natural Resource; Integrated Natural Resource Management Principles and Tools; Variable-Sized Analysis and Methods; Re-source Management Practices in Different Areas.

**ÇEV 627 Environmental Biotechnology 3+0 7,5**

Introduction to Environmental Biotechnology: General definitions and notions; Chemical Microbiology: Chemical

components and function of cell, General biochemical reaction mechanisms; Biokinetics: Reaction kinetics and biokinetic levels; Treatment Microbiology: Biological treatment processes; Bioreactors; Nutrient Removal: Nitrogen removal, Phosphorus removal; Production of Biofuel: Bioethanol production, Biogas production; Bioremediation; Current literature surveys about environmental biotechnology

**ÇEV 629 Biodiversity and Protected** **3+0 7,5**

Description of Biodiversity: Genetic diversity, Species diversity, Ecosystem diversity, Processing diversity; Importance of Biodiversity; Loss of Biodiversity; Protection of Biodiversity: Protection efforts and methods, National and international responsibilities, Protected areas, Conventions; Threat to Biodiversity; Turkey's Biodiversity; Methods for Sustainable Use for Biological Resources.

**ÇEV 790 Thesis** **0+1 30,0**

**ÇEV 890 Thesis** **0+1 30,0**

**EEM 504 Random Variables and Stochastic Processes** **3+0 7,5**

Random variables: Introduction to concepts; Probability distribution functions; Probability density functions; Joint probability functions; Functions with random variables; Solutions of function sets; Averages: Expected values of random variables; Conditional expected values; Moments; Chebyshev and Schwarz inequalities; Moment generating functions; Chernoff bounds; Characteristic functions; Vector random variables, joint distributions and densities, means of random vectors, covariance matrices, diagonalization of covariance matrices; Decision and estimation theory: Parameter estimation; means and covariance matrices of random vectors; Random sequences: Linear systems and random sequences; Large number theory; Stochastic processes: Important stochastic processes; Random input linear systems; Classification of random processes; Mean square calculus: Continuity and derivatives; Stochastic integrals; Stochastic differential equations; Ergodicity; Karhunen-Loeve expansion; Stationary processes and sequences: White noise; Stationary processes and linear systems; Wide sense stationarity; Vectoral processes; State equations; Estimation theory: Orthogonality and linear estimation; Kalman filters; Wiener filters.

**EEM 527 Advanced Power Electronics Circuits** **3+0 7,5**

Industrial Applications of Power Electronics; Brief Review on Converters; Various Industrial Applications of Converters. Motor Speed Drives; High Voltage DC Transmission and Utility Applications; Harmonic Standards; Converter Harmonic Mitigation Techniques; Gate and Base Drive Circuits; Snubber Circuits; Component Temperature Control and Heat Sinks; Design of Magnetic Materials.

**EEM 534 Data-Communication Networks** **3+0 7,5**

Overview on ISO Model; TCP/IP Stack Base Applications; Wireless Networks and Recent Protocols on Wireless Communications; Security on Networks; Network Security and Vulnerability; Data Security; New Trends and Technologies on Fast Communications; ATM Network Principles; Gigabit Ethernet, 10-Gigabit Ethernet; Voice Over IP Protocols; Fast Multimedia Information Transfer Preliminaries.

**EEM 541 Linear Systems Theory I** **3+0 7,5**

Linear Spaces and Linear Transformations; Mathematical Description of Continuous- and Discrete-time Systems (Modeling); Input-Output Modeling; Impulse and Pulse Response; Transfer Matrices; State Variables and State-Space Modeling; System Response; Solution to the State Equations of Continuous- and Discrete-Time Linear Time-Varying and Time-Invariant Systems; Similarity Transforms; Controllability and Observability; Stability; Input-Output Stability; Internal Stability.

**EEM 545 System Modeling** **3+0 7,5**

Systems and Models; Examples of Models; Models for Systems and Signals; Principles of Physical Modeling; Some Basic Relationships in Physics; Bond Graphs; Computer-Aided Modeling; Introduction to Identification; System Identification as a Tool for Model Building; Program Packages for Identification; Simulation and Model Use.

**EEM 546 Fundamentals of Robotics** **3+0 7,5**

Introduction to the Fundamental Concepts of Robotics; Description of Local Positions; Orientation and Frames; Transformation Arithmetic; Manipulator Kinematics; Link Description; Actuator Space; Joint Space and Cartesian Space; Inverse Manipulator Kinematics; Algebraic Solution and Geometric Solution; Jacobians; Velocities and Static Forces; Manipulator Dynamics; Trajectory Generation; Control Of Manipulators.

**EEM 547 Fundamentals of Detection and Estimation** **3+0 7,5**

Random Vectors: Joint distribution and densities, Multiple transformation of random variables, Multidimensional Gaussian distribution, Conditional distributions, Conditional expected values; Parameter Estimation: Linear estimation of vector parameters, Smoothing, prediction and filtering, Maximum likelihood estimators, Significance testing, Hypothesis testing, Bayesian analysis, Confidence intervals; Stochastic Processes: Stationary processes, Ergodicity, systems with stochastic inputs; Spectral Analysis: Correlations and spectra, Linear systems, Factorization and innovations, Matched filter, Spectral representation and Fourier transforms; Karhunen-Loeve Expansion; Queuing Theory and Markoff Processes.

**EEM 548 Power System Protection** **3+0 7,5**

Principles of Protection of Power Systems: System grounding, Circuit breakers, Fuses, Relay input sources, Optical voltage and current transducers; Fundamental

Protection Concepts: Differential, Directional impedance, etc.; Generator Protection: Differential, Negative sequence, Loss of excitation, etc.; Motor Protection: Grounding fault, Locked rotor, Undervoltage, Phase rotation, etc.; Bus Protection; Reactor Protection; Capacitor Bank Protection; Transformer Protection: Differential, Sudden pressure, Over temperature, Low oil, etc.; Line Protection: Directional comparison, Blocking, etc.; Types of Faults in Power Systems.

#### **EEM 549 Advanced Electrical Machinery 3+0 7,5**

Synchronous and Induction Motors; Doubly Fed Induction Motor; High Frequency Motors; Linear Machines; Braking Motors; Motors with External Rotors; Oscillating Motors; Poly-phase Commutator Motors; Schrage Motors; Single-Phase Commutator Motors; Brushless Motors; Hysteresis Motors; Reluctance Motors; Step Motors; Repulsion Motors; Universal Motors; Permanent Magnet Synchronous Machines.

#### **EEM 551 Control Design Methods 3+0 7,5**

Performance Criteria; Design and Compensation Techniques Using Frequency Response Methods; Minor-Loop Design; Improving System Performance By Feed-Forward Control; Controllability; Observability; and Canonical Forms; Relations Between Modern and Classical Techniques; Luenberger Observer; State Feedback; Pole-Zero Assignment Methods.

#### **EEM 552 Micro-Nanodevices and Thin Film Applications 3+0 7,5**

Semiconductor Materials: Material properties, Charge carriers and transport, Generation and recombination, Doping; Solid State Devices Basic Physics: Schrödinger equation, Semiconductor quantum wires-wells-dots; Microelectronic Device Structures: MOS field effect transistor, Bipolar junction transistor, Device operation through energy band diagrams; Thin Films: Fabrication techniques, Vacuum technology, Growth mechanisms, Film characterization techniques, Surface treatments, Thin film solar cells; Nanotechnology: Nanomaterials and nanodevices, State-of-the-arts devices, Future trends; Sustainable Energy Production Technologies.

#### **EEM 553 Digital Control Theory 3+0 7,5**

Discrete-Time Systems; Z Transform; Sampling; Reconstruction; Digital to Analog and Analog to Digital Transformations; Open-Loop and Closed-Loop Discrete-Time Systems; Sampled Data Systems; Response of Discrete-Time Systems; Stability; Digital Controller Design; Pole Assignment; State Estimation; Quantization Errors.

#### **EEM 554 Nonlinear Control Systems 3+0 7,5**

Lyapunov Stability; Advanced Stability Analysis; Stability of Perturbed Systems; Input-Output Stability; Periodic Orbits; Perturbation Theory and Averaging; Singular Perturbations; Analysis of Feedback Systems; Feedback Control; Exact Feedback Linearization; Lyapunov Based Design.

#### **EEM 561 Machine Vision 3+0 7,5**

Introduction: Human and computer vision systems; Cameras and Optics; Light and Color; Stereo and Range Images; Segmentation; Feature Detection and Mapping; Edge detection, Line fitting, Template matching; Multi-Resolution Representations and Applications; Machine Learning Overview: Clustering, Classification; Subspace Methods: PCA, ICA; Recognition: Feature extraction, Object detection and recognition; Motion and Tracking; Feature Tracking.

#### **EEM 562 Signal Coding 3+0 7,5**

Principles of Signal Representation and Codes; Scalar and Vector Quantization; Quantizer Optimization; Lossless Coding and Entropy; Huffman-Shannon Type Coders; Dictionary Techniques; Predictive Coding; Optimum Prediction Filter Design; DPCM, Signal Space Representations; Transforms; KLT; Orthogonal and Biorthogonal Systems; Basis Signals and Projections; Sub band Decomposition; Wavelet - Sub band Filter Relation; Wavelet Design; Transform and Wavelet Coding; International Standards Relating to the Covered Subjects.

#### **EEM 564 Artificial Neural Networks 3+0 7,5**

Learning and Generalizing; Perceptron and Linear Decomposition; Multi-Layered Perceptron and Nonlinear Decomposition By Back Propagation Algorithm; Hopfield Model and BAM; Self-Organizing Mapping and Unsupervised Learning Models; Simulated Annealing and Boltzman Machine.

#### **EEM 565 Image Processing 3+0 7,5**

Introduction to Image Processing; Two-Dimensional Discrete-Time Signals; Fourier Representation; Two-Dimensional Sampling and Restoration; Two-Dimensional Anti-Aliasing Techniques; Image Representations; Image Transforms; Basis Vector - Basis Image Relations; Optimum Transforms and Representations; Transforms Such As KLT, DCT, Etc, Dithering, Imaging and Color Spaces; Morphology; Edge Detection and Other Binary Image Operations; Image Enhancement; Projection Based Restoration; Image Reconstruction; Image Segmentation and Object Extraction.

#### **EEM 566 Pattern Recognition 3+0 7,5**

Introduction to 1-D, 2-D and Multi-Dimensional Pattern Recognition; Bayes Decision Theory; Decision Boundaries; Classifiers and Discriminating Functions; Parameter Estimation; Clustering; Specification Selection; Image Grammar and Language; Artificial Intelligence in Pattern Recognition; Applications of Artificial Neural Networks.

#### **EEM 567 Advanced Computer Architecture 3+0 7,5**

Introduction: Technological trends, Cost and performance; Quantitative Principles of Computer Design; Instruction Set Architecture Design: Classifying ISAs, Role of compilers, MIPS Architecture; Pipelining: Data and control hazards; Pipelining Implementations and Multicycle Operations, MIPS R4000 Pipeline; Instruction Level Parallelism: Dynamic scheduling and branch prediction, Overview of superscalar, Loop unrolling; Static Branch Prediction;

Memory hierarchy Design and Caches: Cache performance, Cache design issues, Main memory design issues; Overview of Interconnection Networks: Connecting two computers, Connecting more than two computers, Examples of interconnection Networks.

**EEM 592 Seminar** 3+0 7,5

**EEM 599 Semester Project** 3+0 15,0

**EEM 603 Function Space Methods in Engineering** 3+0 7,5

Sequences; Series; Limit; Continuity; Differentiation; Riemann Integral; Proof Methods; Lebesgue Spaces; Fourier Series; Fourier Transformations; Hardy Spaces and Engineering Applications of Hardy Spaces; Optimization Methods; Optimization Applications in Engineering.

**EEM 604 Optimization in Power Systems** 3+0 7,5

Optimisation Theory; Classification of Mathematical Programming Methods; Hydro-electric and Thermal Plant Modelling; Economic Dispatch of Thermal Units; Transmission Losses; Unit Commitment Problem in Interconnected Network; Methods of Load Forecasting; Optimal Power Flow; Cost Models for Planning.

**EEM 605 Power Systems Stability** 3+0 7,5

Stability Definitions; Simulation Methods; One-Machine System Stability; Swing Equations; Equal Area Criteria; Multi-Machine System Stability; Mathematical Models of Synchronous Machine; Phase Models; (d-q-0) Model; State-Space Models; Excitation and Prime Mover System Models; Stability Analysis.

**EEM 606 Parallel Computer Architecture** 3+0 7,5

Introduction: Why parallel architecture, Convergence of parallel architectures; Fundamental Design Issues; Shared Memory Multiprocessors: Cache coherence, Memory consistency, Synchronization; Snoop-Based Multiprocessor Design: Single-Level Caches with an Atomic Bus, Multilevel Cache Hierarchies, Split-Transaction Bus, Case Studies; Scalable Multiprocessors; Directory-Based Cache Coherence: Directory Protocols, Memory-Based Directory Protocols, Cache-Based Directory Protocols, Synchronization; Hardware/Software Trade-Offs; Interconnection Network Design: Interconnection Topologies, Routing, Switch Design, Flow Control, Case Studies.

**EEM 607 Parallel Computing** 3+0 7,5

Introduction: What is parallel computing?, The scope of parallel computing; Models of Parallel Computers: Parallel architectures, Interconnection networks, Routing and communication cost; Basic Communication Operations: One-to-All and All-to-All Broadcast, One-to-All and All-to-All Personalized Communication, Circular shift; Performance and Scalability of Parallel Systems: Performance metrics, The Scalability of Parallel Systems,

The Isoefficiency Metric; Parallel Programming: Parallel Programming Paradigms, Message-Passing Programming Paradigm, Shared-Address-Space Programming Paradigm, Data-Parallel Languages; Dense Matrix Algorithms; Solving Sparse Systems of Linear Equations; Sorting; Parallel I/O.

**EEM 608 Advanced Linear Control Design** 3+0 7,5

Elements of convex analysis; Special algorithms for convex optimization: cutting-plane algorithms, ellipsoid algorithms, Ritz approximations; Controller design specifications and approaches: multi-criterion optimization; Robustness specifications.

**EEM 609 Multivariable Control Systems I** 3+0 7,5

Review of linear algebra: Invariant subspaces, matrix dilation problems; Linear dynamical systems: Lyapunov equations, balanced realizations; Performance specifications: Hilbert and Hardy spaces, Induced system gains; Stability and performance of feedback systems; Performance limitations; Model reduction by balanced truncation and Hankel norm approximation; Model uncertainty and robustness.

**EEM 610 Multivariable Control Systems II** 3+0 7,5

Linear Fractional Transformation; Structured Singular Values; Parameterization Of Stabilizing Controllers; Algebraic Riccati Equations; H-2 Optimal Control; Linear Quadratic Optimization; H-Infinity Control; Controller Order Reduction.

**EEM 618 Power Quality Analysis** 3+0 7,5

Definition of Power System Transients; Transient Events During Normal Operation; Transient Events During Faults; Monitoring Methods of Transients and Detection of Quality Features; Analysis Methods Using DFT and Wavelet Transforms; Analysis of Power Quality Using Symmetrical Sequence Components; Simulation Methods and Applications; Analysis of Example Systems Through Simulations.

**EEM 619 Wireless Communication** 3+0 7,5

Wireless Channel Modeling: Path loss and shadowing; Statistical Fading Models; Time Diversity: Coding and Interleaving; Antenna (Spatial) Diversity; Frequency Diversity; Direct-Sequence Spread Spectrum; Multi-Carrier Systems: OFDM; Narrowband Cellular Systems; CDMA: Generation of Pseudonoise Sequences, Power Control, Handoff, Averaging; Capacity of Wireless Channels.

**EEM 621 Nano and Micro-Fabrication Techniques** 3+0 7,5

Cleanroom Environment, Safety and Processing; Micrometrology and Materials Characterization; Material Properties, Crystal Structure and Growth of Silicon; Thin-Film Materials and Processes: PVD, CVD, PECVD, ALD, Metallic thin films, Oxide and nitride thin films, Polymer films; Advanced Thin Films; Pattern generation and optical lithography; Wet, Dry and Ion Beam Etching; Thermal Oxidation; Nano and Micro-Fabrication Equipment.

**EEM 623 Advanced Digital Signal Processing 3+0 7,5**

Signal Models; Adaptive Filtering; Signal Spaces: Orthogonality; Hilbert and Banach Spaces; Projection Theorem Representation and Approximation: Least squares fitting; Minimum Mean Square Estimation; Wiener Filtering; Lp Optimization Linear Operators and Matrix Inversion; Matrix Factorizations: LU Factorization; Cholesky Decomposition; Unitary Matrices; Householder Transformation; Givens Rotations Eigenvalues and Eigenvectors; Matrix Diagonalization; PCA; Eigenfilters; Signal Subspace Techniques Singular Value Decomposition and Its Applications; Special Matrices and Their Applications: Toeplitz and Circulant Matrices; Durbin Algorithm; Lattice Filters.

**EEM 641 Sensor Array Signal Processing 3+0 7,5**

Introduction: Sensor array geometry and mathematical model, Narrowband model and assumptions; Direction of Arrival Estimation: Classical methods, Spectral-MUSIC, Root-MUSIC, ESPRIT, Min-Norm, Stochastic and deterministic maximum likelihood methods, Spatial smoothing, Virtual array, Array interpolation, Cramer Rao lower bound; Array Signal Processing for Communications: Beamforming, Delay-and-sum beamforming, Filter and-sum beamforming, Capon, MVDR beamforming, Robust beamforming; Source Localization: Triangulation, Least squares methods, Error ellipse, Stansfield, Maximum likelihood methods, Time-difference of arrival techniques for source localization.

**EEM 642 Linear Systems Theory II 3+0 7,5**

Polynomial Matrices; Multi-Input Multi-Output (MIMO) Poles and Zeros; Minimal Realization of MIMO Systems; Equivalent Systems; Identification By Markov Parameters; State Feedback; State Observers; Static and Dynamic Output Feedback; Pole Assignment; Servomechanism Problem; Diagonalization; Composite Systems; Mathematical Description; Controllability; Observability; Stability; Controller Design.

**EEM 643 Estimation Theory 3+0 7,5**

Deterministic Least-Squares Parameter Estimation and the RLS Adaptive Filter Algorithm; Stochastic Least-Squares Parameter Estimation: Least-squares estimation and linear least-squares estimation, MAP estimation; ML estimation and Cramer-Rao lower bound, Innovations process; Wiener Theory For Scalar Processes: Continuous-time and discrete-time Wiener smoothing, Continuous-time and discrete-time Wiener-Hopf equations and causal Wiener filters., Application to prediction and additive white-noise problems; The Discrete-time Kalman Filter: Predicted estimator, Time and measurement-update, Filtered estimator forms, Linearized and extended Kalman filters, Kalman Filter For Smoothed Estimators: Bryson-Frazier formulas; Array Algorithms.

**EEM 645 System Identification 3+0 7,5**

Systems and Models; Signal Spectra; Singular Realization Behavior and Ergodicity Results; Simulation and Prediction; Modal Sets; Modal Structures and Identifiability; Nonparametric Time and Frequency Domain Methods;

Transient Response Analysis and Correlation Analysis; Frequency Response Analysis; Parameter Estimation Methods; Using Frequency Domain Data to Fit Linear Models; Convergence and Consistency; Consistency and Identifiability; Asymptotic Distribution of Parameter Estimates; Subspace Methods for Estimating State Space Models.

**EEM 646 Fuzzy Systems 3+0 7,5**

Fuzzy Control from an Industrial Perspective; Capabilities and Restrictions of Fuzzy Control; Knowledge Based Controllers; Classical Set Theory; Mathematics of Fuzzy Control; Fuzzy Sets; Fuzzy Relations; Approximate Logic; Representation of a Rule Set. Fuzzy Knowledge Based Controller (FKBC) Design Parameters; Structure of FKBC; Rule Base; Knowledge Base; Decision Mechanism; Fuzzification and Defuzzification Methods; Nonlinear Fuzzy Control; FKBC Types; Adaptive Fuzzy Control; Stability of Fuzzy Systems.

**EEM 651 Signal Transforms 3+0 7,5**

Concept of Signal Space; Signal Representations; Orthogonal Spaces and Transforms: Least-squares representation, decorrelation, 2D expansions; Short-time Fourier Transforms and Frames; Subband decomposition, Filterbank structure and implementation constraints; Time-frequency Representations and Wavelets; Relations of Discrete Wavelets and Subband Decomposition, Wavelet Design - Filterbank Design; Compression and Efficient representation applications.

**EEM 652 Optimal Control 3+0 7,5**

Pontryagin's Minimum Principle; Hamilton-Bellman-Jacobi Equations; Calculus of Variations; Fundamental Concepts; Functionals of a Single Function; Functionals Involving Several Independent Functions; Piecewise-Smooth Extremals; Constrained Extrema; Optimal Control Problems; Necessary Conditions; Minimum-Time and Minimum-Energy Problems; Singular Intervals; Linear Quadratic Optimal Control; Finite Horizon and Infinite Horizon Problems.

**EEM 656 Large-scale Systems 3+0 7,5**

An Overview of Large-Scale Systems; Interconnected Systems; Decentralized Systems; Hierarchical Systems; Multi Time-Scale Systems; Stability of Large-Scale Systems; Decentralized Fixed Modes; Decentralized Control; Hierarchical Control; Multi Time-Scale Control; Disjoint and Overlapping Decompositions; Constrained Optimization and Decentralized Optimal Control; Robust Controller Design Methods for Large-Scale Systems.

**EEM 657 Control of Robotic Systems 3+0 7,5**

Robot Dynamics; Fundamental Control Methods Applied to Robotic Systems; Control Problems for Robot Manipulators; Position and Velocity Control; Multi-Input Multi-Output Control Systems and Robotics Applications; Cartesian Based Control Systems; Computed Torque Method; Robust Control for Robot Manipulators; Adaptive Control; Force Control; Hybrid Position and Force; Industrial Robot Control Systems.

**EEM 658 Adaptive Control 3+0 7,5**

Real-time Parameter Estimation; Least-squares and Regression Models; Estimating Parameters in Dynamical Systems; Self-Tuning Regulators; Model-Reference Adaptive Systems; Properties of Adaptive Systems; Stability; Convergence; Robustness; Averaging; Auto-Tuning; Gain Scheduling; Design of Gain-Scheduling Controllers; Nonlinear Transformations; Practical Issues and Implementation.

**EEM 660 Discrete Event Systems 3+0 7,5**

Introduction to Discrete Event Systems; Modelling Methods: Petri nets, Automata, Formal languages; Mathematical Formalisms; Types, and Properties of Modelling Methods; Supervisory Control Design: Forbidden state control approach for all modelling methods, Structural and behavioural control approaches for Petri nets.

**EEM 661 Advantage in Cryptology 3+0 7,5**

Public-key cryptography: RSA systems, discrete logarithm systems, elliptic curve systems; Finite field arithmetic; Elliptic curve arithmetic: elliptic curves, point representation and the group law, point multiplication, Koblitz curves; Elliptic curve cryptography; Implementation issues, applications of elliptic curves: factoring, primality test.

**EEM 667 Statistical Signal Processing 3+0 7,5**

Signal Modeling; Least Squares Method; Pade Approximation; Stochastic Models; ARMA; AR; MA Models; Levinson Recursion; Lattice Filters; FIR and IIR Filters; Wiener Filter; FIR and IIR Types; Spectrum Estimation; Parametric and Nonparametric Methods; Minimum Variance Spectrum Estimation; Maximum Entropy Methods; Frequency Estimation; Adaptive Filters; FIR; IIR and Recursive Types.

**EEM 790 Thesis 0+1 30,0****EEM 890 Thesis 0+1 30,0****ENM 501 Design and Analysis of Experiments 3+0 7,5**

Introduction to Design of Experiments; One Factor Variance Analysis-ANOVA; Model Adequacy Checking; Blocking and Confounding; Introduction to Factorial Design; 2k Design; Fractional Factorial Design; 3k Factorial Design; Mixture Design and Analysis; Response Surface Method.

**ENM 502 Production Management Systems 3+0 7,5**

Concept of Computer Aided Production Management; Production Lines and Their Modeling; Using Analytical and Heuristic Approaches in Assembly Line Balancing; Pull and Push Production Systems; Just in Time Production (JIT) Approach; Kanban Systems and Design of Kanban Systems; Alternative Systems to Kanban; Optimum

Production Technology Approach; Group Technology and Cellular Manufacturing; Design and Application of Flexible Manufacturing Systems; Production Systems Scheduling and New Trends in Control.

**ENM 503 Advanced Techniques in Linear Programming 3+0 7,5**

Theoretical Foundation of Linear Programming and Simplex Algorithm: Big M, Two-Phase, Single-Artificial Variable, Dual Simplex, Revised Simplex Algorithms; Duality Theorem and Its Applications; Sensitivity Analysis and Parametric Programming; Goal Programming and Its Applications; Data Envelopment Analysis and Its Applications; Cutting Planes; Bounded Variable Technique; Interior Point Algorithms.

**ENM 504 Decision Making Methods 3+0 7,5**

Decision Analysis; Decision Analysis Basic Concepts; Decision Making Under Certainty; Uncertainty and Risk; Bayes Decision Theory; Decision Tree; Utility Theory; Multi Criteria Decision Making; Analytical Hierarchy Process; ELECTRE; Decision Model Applications.

**ENM 505 Sequencing and Scheduling 3+0 7,5**

Role of Sequencing and Scheduling; Classes of Scheduling Problems; Single Machine Scheduling; Parallel Processing and Batch Sequencing Assembly Line Balancing Problem; Network Based Scheduling; Manpower Scheduling; Common Scheduling Problems and Heuristics: Backward-forward Heuristic; Early and Late Penalties; Common Due Date; Scheduling with Meta-Heuristics: Simulated Annealing and Taboo Search.

**ENM 508 Reliability of Systems 3+0 7,5**

The Concept of Reliability; Obtaining Reliability Function; Weibull Distribution; Utility Time of Elements; System Reliability as a Function of Component Breakdown; Reliability Block Diagrams and Failure Trees; Abrasion and Reliability; Reliability of Serial and Parallel Systems; Network Reliability; Measurements and Tests of Reliability; Applications of Reliability in Manufacturing and Service Systems.

**ENM 509 Supply Chain Management 3+0 7,5**

Basic Concepts of Supply Chain and Logistics Systems; Using Mathematical Models and Numerical Techniques in the Analysis of Supply Chain and Logistics Systems; Analyzing Basic Components of Supply Chain: Procurement, Inventory, Production and Transportation; Structural Analysis of Production and Inventory Systems; Modeling Stochastic Supply-Timed Inventory Systems and Solution Approaches; Modeling Multi-Stage Inventory Systems and Solution Approaches; Coordination of Material, Information and Financial Flows in Supply Chain; SCOR Model.

**ENM 512 Research Techniques in Human Engineering 3+0 7,5**

Introduction to Human Factors Engineering: Definition, Scope, and Aims; The Importance of Human Factors Engineering with Respect to Industrial Engineering and

Management; Evolution of Working; Evolution of the Supply of Performance; Anatomical and Mechanical Structure of the Human Body; Analysis of Working Environments with Respect to Anthropometry; Working Conditions; Designing Workplaces According to Ergonomics Principles; Machine System Protections; Work Accidents; Shift Working.

#### **ENM 514 Mathematical Programming 3+0 7,5**

Importance of Modeling, Difficulties in Solving Process; Linear Modeling Examples; Integer Linear Modeling Examples; Network Models; Fundamental Solution Techniques for Linear Models; Fundamental Solution Techniques for Integer Linear Models; Non-Linear Modeling Examples; Fundamental Solution Techniques for Non-Linear Models; Introduction to GAMS and Lingo Software; Rules to Express a Model Using GAMS; Solving a Model With GAMS and Interpreting Solution Report; Tricks About Modeling and GAMS.

#### **ENM 515 Energy Systems 3+0 7,5**

Basic Concepts in Thermodynamics: Internal Energy; Enthalpy; Open and Closed Systems; Entropy and Exergy; Power Cycles; Power Cycles; Solar Energy: Passive Solar Systems; Active Solar Systems; Geothermal Energy: Heating; Ground Source Heat Pumps; Power Generation; Wind Energy: Wind Measurements and Power Estimation; Wind Energy: Wind turbines; Economic Analysis of Energy Systems.

#### **ENM 516 Multi Criteria Decision Making 3+0 7,5**

Multi Criteria Decision Making (MCDM) Terminology; MCDM Concepts; Relation between Multi Criteria and Multi Objective Decision Making; Methods for Discrete MCDM Problems; Multi Attribute Utility Theory; Analytic Hierarchy Process and Analytic Network Process; Outranking Procedures; ELECTRE I Method, ELECTRE III Method, Promethee Method; Theories of Interactive Methods; Interactive Approaches to Linear and Quasiconcave Utility Functions.

#### **ENM 517 Special Topics in Facilities Planning 3+0 7,5**

Facilities Planning Process; Quantitative Models for Facilities Planning; Facility Location Models; Constructing Iso-Cost Contour Lines; Special Facility Layout Planning Models and Design Algorithms; Machine Layout Models; Conventional Storage Models; Automated Storage and Retrieval Systems; Order Picking Systems; Fixed-Path Material Handling Models; Waiting Line Models; Simulation Models.

#### **ENM 518 Metaheuristics 3+0 7,5**

Optimization: Models and methods; Basic Concepts in Metaheuristics: Performance analysis for metaheuristics; Single Solution Based Metaheuristics: Local search, Simulated annealing, Taboo search, Iterated local search, Variable neighborhood search, Guided local search; Population Based Metaheuristics: Evolutionary algorithms, Scatter search, Ant colony optimization, Particle swarm optimization, Bees colony, Artificial immune system.

#### **ENM 519 Strategic Choice and Planning in International and National Context 3+0 7,5**

Basic Concepts of Strategic Management: Vision, Mission, Strategy, Policy; Strategic Management in Business: Definition, Purpose and characteristics of strategic management, Strategic management process and phases; Competitive Analysis Providing Strategic Choice and Decision-Making in Competitive Environment and Portfolio Analysis; Structure of the Strategy Implementation Process and Style of Planning; Review, Evaluation and Control of Strategies; Analysis of the Problems Faced by National and International Firms to Select Market; Market Entry Modes; Joint Venture; Direct Foreign Investment; International Strategic Alliances.

#### **ENM 520 Advanced Management Technics 3+0 7,5**

Basic Concepts of Advanced Management; Classical approaches, Scientific management, First managerial theories, Bureaucracy approaches, Human relations and Behavioral science approaches; First Contributions to the Theory of Organization and Decision-Making; Systematist Thought and the Emergence of Open Systems Approach; Modern Approaches to Management: Reengineering, Balanced Scorecard, Production methods, Total quality management; Chaos Theory and Methods of Decision-making in Chaos; Performance Measurement, Absenteeism; Case Study Discussions.

#### **ENM 592 Seminar 3+0 7,5**

#### **ENM 599 Term Project 3+0 15,0**

#### **ENM 601 Introduction to Convex Analysis 3+0 7,5**

Convex Sets; Topological Properties of Convex Sets; Hyperplanes; Polyhedral Sets; Separation Theorems for Convex Sets; Convex and Concave Functions; Continuity and Differentiability of Convex Functions; Directional Derivative; Subdifferential; Subdifferentiability of Convex Functions; Second Order Differentiability; Positive Definiteness; Positive and Negative Definite Matrices; Positive Definiteness and Convexity Conditions; Optimality Conditions for Convex Unconstrained Optimization Problems; Weierstrass Theorem.

#### **ENM 602 Stochastic Analysis 3+0 7,5**

Stochastic Functions and Characteristics of Stochastic Functions; Conditional Expectation; Conditional Independence; Types of Convergence of Sequence of Random Variables; Continuity, Differentiation and Integration of Stochastic Functions; Special Types of Stochastic Processes: Markov processes, Poisson processes, Gauss processes, Poisson processes, Gauss processes, Wiener processes; Stochastic Integral and Stochastic Differential Equation; Ito's Formula; Some Applications of Stochastic Integration and Stochastic Differential Equations.

#### **ENM 603 Unconstrained Optimization 3+0 7,5**



Examples of extremal problems; Mathematical modeling; Convex sets and convex functions; Directional derivative; Subdifferential; One-variable unconstrained optimization; Line search without using derivatives; Bisection search method; Newton's method; Multidimensional search using derivatives; Method of steepest descent; Multivariable method of Newton; Subgradient Optimization.

#### **ENM 604 Constrained Optimization 3+0 7,5**

General Definition of Constrained Optimization Problems; Convexity Properties; Optimality Conditions for Constrained Optimization Problems; Fritz John Optimality Conditions, Karush-Kuhn-Tucker Optimality Conditions; Definition of the Dual Problem and Formulation; Duality Theorems; Lagrangian Duality; Saddle Point Optimality; Solution Methods in Constrained Optimization; Subgradient Methods; Cutting Plane Method; Penalty Function Methods; Augmented Lagrangian Penalty Functions; Augmented Lagrangian Method of Multipliers; Modified Subgradient Method.

#### **ENM 605 Operations Research in Healthcare 3+0 7,5**

Fundamentals of Operations Research; Modeling; Assignment Problems: Nurse-to-patient assignment problems; Healthcare Planning: Demand forecasting, Location selection, Capacity planning; Queue Management and Design; Healthcare Systems Scheduling Problems: Patient scheduling, Nurse scheduling; Workforce and Workload Models; Workload Balancing; Application of Decision Making Methods.

#### **ENM 606 Multi-Objective Optimization 3+0 7,5**

Fundamentals of Decision Making in Multi-objective Environment; Ordering Relations in Vector Spaces; Cones; Ordering Relations and Cones; Various Concepts of Efficient Solutions in Multi-objective Optimization; Pareto Optimal Points and Pareto Optimal Solutions; Characterization of Efficient Solutions; Scalarization Methods: Epsilon constraints method, Benson method, Conic scalarization method; Comparison of Different Scalarization Methods; Goal Programming.

#### **ENM 608 Fuzzy Sets and Systems 3+0 7,5**

The Concept of Fuzziness and Linguistic Variables; Mathematical Expression of Fuzziness; Definition of Membership Function; Construction of Membership Functions; Fuzzy Numbers and Variables; Fuzzy Set Operations: Algebraic operations,  $\alpha$ -cuts; Convex Fuzzy Sets; Transpose Techniques; Analysis of Decision Models in Fuzzy Environments; Fuzzy Decision Models; Fundamental Application Areas of the Fuzzy Set Theory in Industrial Engineering.

#### **ENM 610 Finance Engineering 3+0 7,5**

Introduction to Brownian Motion: Properties and financial applications; Stochastic Processes with Jump; Poisson Process; Options; Options as an Instrument of Volatility; Tools for Volatility Engineering: Volatility swaps and volatility trading pricing; Tools in Financial Engineering: Classical Black- Scholes option pricing model, Merton's three asset option pricing model; Jump - Diffusion Option

Pricing; Cox- Rubenstein Model; Optimal Portfolio and Consumption Models; Scheduled and Unscheduled Stochastic Events.

#### **ENM 612 Data Mining with Mathematical Programming 3+0 7,5**

Overview of Data Mining; Data Mining Problems: Clustering, Classification, Association analysis; Clustering Problems and Solution Methods: Mathematical programming to solve clustering problem; Classification Problems and Solution Approaches: Approaches based on mathematical programming, Robust linear programming, H-polyhedral separation, Max-min separation, Support vector machines; Classification Approaches Based on Polyhedral Conic Functions (PCF): Polyhedral conic functions algorithm, Integer programming model, Kmeans clustering for large-scale problems; Association Analysis Problems and Solution Approaches.

#### **ENM 614 Material Handling and Warehousing Systems 3+0 7,5**

Fundamental Concepts of Material Handling: Importance and scope of material handling in manufacturing, Principles, Unit load; Material Handling Systems: Vehicles, Conveyors, Carousels, Automated guided vehicles (AGV); Warehousing: Importance of warehousing, Components, Operations; Warehouse Site Selection; Warehouse Design: Stock keeping unit (SKU), Storage methods, Racking systems, Warehouse layout; Automated Storage and Retrieval Systems (AS/RS); Efficiency in Material Handling and Warehousing; Measurement of Warehouse Performance; Modeling and Simulation of Material Handling and Warehousing Systems.

#### **ENM 616 Ergonomics and Occupational Biomechanics 3+0 7,5**

Ergonomics; Human Body: Motion system, Neural system, Energy expenditure, Muscular and skeletal systems; Applied Anthropometry; Topics Related to Work Physiology and Biomechanics; Principles of Ergonomics at Work; Engineering Anthropometry and Its Applications; Energy Expenditure at Work; Work Design: Principles of work design; Occupational Disorders; Low-Back Disorders.

#### **ENM 618 Advanced Techniques in Simulation 3+0 7,5**

General Principles of Simulation; Modeling of Complex Systems; Establishment of Reliable and Valid Simulation Models; Comparison and Evaluation of Alternative System Structures; Variance Reduction Methods; Experimental Design and Optimization; Simulation of Manufacturing and Material-Handling Systems with ARENA Program; Simulation of Computer Systems; Simulation of Computer Networks.

#### **ENM 790 Thesis 0+1 30,0**

#### **ENM 890 Thesis 0+1 30,0**

**ENT 501 Industrial Design I 3+0 7,5**

Scale; Function; Aesthetic; General Design Methods; Project Planning; General Design Strategy of Organization and Relationship Between Policies; Principles and Methods Valid in Plan that Produced for a New Product; Project Applications; Analysis of Design Language in Product Design Processes; Design Challenging Conditions; Interaction Analysis; Cultural Analysis.

**ENT 502 Industrial Design II 3+0 7,5**

Rapid Prototyping Methods and Applications; Formal and Functional Analysis of Potential Trends; Development of Alternative Solutions and Evaluation of Methods Used in Testing Steps; Using High Technology for Product Development end Sample Analysis; Examining Design and Cost Relation.

**ENT 503 Design Management 3+0 7,5**

Establishment of Design Units in Industrial Production; Examining the Designer's Role in this Establishment From Sketch Phase to Prototyping; Management of Design Group; Determining the Design Policy in Company; Comparison of Design Management Processes With Different Production Systems and Different Cultures.

**ENT 504 Portfolio Presentation Techniques 3+0 7,5**

Personalization Methods in Preparation and Presentation of Portfolio; Evaluation of Works By Exchanging Ideas in Group Criticizing Meetings and Proposing New Solution Methods; Interactive CD Or URL Portfolio Works; Modern Portfolio Presentation Techniques.

**ENT 506 Media and Design 3+0 7,5**

Concept of Communication; Theories and Principles of Communication; Communication Methods; Visual and Audio Visual Tools and their Usage; Effects of Visual and Audio Visual Tools; Future of Communication and its Possible Effects on Design; Multimedia and Internet; Communication By Means of Widespread Usage of Intranet and Such Networks and Communicating Feature of Design.

**ENT 507 Quality in Industrial Design 3+0 7,5**

What is Quality?; How Can Quality Can Be Achieved in Design?; Aims and Needs of Off-Line Quality Control Methods; Developing Quality in Design; Quality Function Deployment and Taguchi Method; Reflection of Customer Needs and Requirements to the Design and Customer.

**ENT 508 Product Identity 3+0 7,5**

Defining the Development Process of Product Identity in Industrial Production; Role of the Corporate Identity in the Product Identity; Effects of Cultural Structure and Technological Development on Product Identity; Brand Concept and Creation Process of a Brand.

**ENT 509 Cultural Problems 3+0 7,5**

Definition of Culture; Human and Culture; Affects of Notion of Culture on Design; Definition of Design and Industrial Design as a Cultural Notion; Cultural Problems in

Design and Solutions; Intercultural Relationships and Deviations on Design Dimension.

**ENT 510 New Approaches in Design 3+0 7,5**

German Expressionism; New Expressionism; Late Modernism; Pop Culture and Anti-Design, Postmodernism; New Design; Deconstructionist; Kitch; Minimal Design, Design and Emotion; Phenomenological Approach; Conceptual Design.

**ENT 511 Advanced Computer Aided Manufacturing 3+0 7,5**

Applications of Computer Aided Manufacturing; Production Applications of STL Modules; Modeling and Analysis; CNC Machines And Analysis of Production Formats, Computer Aided Applications on Worknc; Molds and Molding Technologies; Real Production of Application Models.

**ENT 512 Role of Sector in Product Development 2+2 7,5**

Product Development Process; Product Planning; Defining Customer Needs; Product Features; Concept Development; Concept Evolution; Concept Testing; Product Architecture; Industrial Design; Design for Manufacturing; Prototyping; Product Development Economics; Procet Management.

**ENT 513 Creation of Brand and Market Strategies 3+0 7,5**

Product Identity Concept in Design; Corporate Identity Concept in Design; Brand Concept: Creating a brand, Presentation of a brand, Brand and target market adaptation, Brand definition; Brand and Product Relation; Marketing Concept; Evaluation of Marketing Methods; Marketing the Brand: Collecting market data, Evaluating market data; Determining Marketing Strategies; Adaptation of Brand and Marketing Strategies; Testing Marketing Strategies: Collecting data, Evaluating data; Modifications on Marketing Strategies According to Gained Information.

**ENT 519 Advanced Presentation Techniques I 2+2 7,5**

First Step of Visualizing the Design; Sketch and Sketch Applications; Sketching Techniques; Black Lead Pencil; Marker; Pastel; Gouache; Colored Pencil; Presentation Posters; Aim; Definition; Dimensions and Poster Samples; 3D Presentation Techniques; Modeling and Prototyping Methods; Modeling Applications; Prototyping and Evaluations.

**ENT 520 Advanced Presentation Techniques II 2+2 7,5**

Personalization Methods in Preparation and Presentation of Portfolio; Evaluation of Works by Exchanging Ideas in Group Criticizing Meetings and Proposing New Solution Methods; Interactive CD Or URL Portfolio Works; Modern Portfolio Presentation Techniques.

**ENT 521 Computer Aided Design I 2+2 7,5**

Pixel and Vector Based Software; Menus and Virtual Tools Used in Two Dimensional Software; Image File Formats: Jpg; Jpeg; Bmp; Psd; Tiff; Tga; Resolution; Creation of Image Files; Determining the Size and Resolution; Processing; Recording; Transferring Images to Virtual Medium; Scanning; Preparing Images for Print; Plot Settings and Plotting.

**ENT 522 Computer Aided Design II** **2+2 7,5**

Introduction of the Concept of Designing in a Virtual Medium; Assistant Virtual Tools Used in Fashion Design; Introduction and Using of these Tools; Using the Virtual Tools for Production; Joining Design and Production Processes in Virtual Medium; Introduction and Use of Production Oriented Software; Applications and Evaluations.

**ENT 523 Visualisation** **3+0 7,5**

Concept of Visualization: What is visualization, Source, Message, Channel, Target, Feedback, Human factor in visualization; Perception; Signs; Elements of Visualization; Visualization; Tools of Visualization and Usage of Them; Importance of Visualization in Design; Product and User Relations; True Presentation of Product Itself to User; Importance of Visualization in Product and User Interaction; Ergonomics and Visualization.

**ENT 525 Advanced Computer Aided Industrial Design I** **2+2 7,5**

CAD/CAM Concepts (Computer Aided Design and Manufacturing Concept), CAID Design Steps and Software, Catia V5 Interface- Catia V5 Basic Structure, Integration Catia, V4-V5, Sketcher Modules, Basics of Geometrical-Dimensional Analysis, Basic of Solid Modeling, Assembly Design, Generative Drafting, Interactive Drafting, Photo-Realistic Render.

**ENT 526 Advanced Computer Aided Industrial Design II** **2+2 7,5**

Definition of parametric surfaces in NURBS-MESH concept; Types of 3D images; Lights and Materials; Selection of Appropriate visualization Methods; Works of Render Images; 3D vector based software Applications; Interactive Visualization in 3D; Generation of interactive 3D images.

**ENT 592 Seminar** **3+0 7,5**

**ENT 790 Thesis** **0+1 30,0**

**ETK 500 Ethics of Science** **2+0 5,0**

General Principles of Ethics and Application Fields: Theoretical introduction to ethics, Theory of ethics, Philosophy of ethics of science; Ethics of Scientific Research: Basic principles of scientific ethics, Ethical evaluation in scientific research; Publication Ethics in

Production of Information: Description of scientific authorship, Ethics and law, Legal property rights, Reasons, kinds and prevention of scientific misleading.

**FBE 601 Design, Science and Communication** **3+0 7,5**

Industrial Revolution in the Middle Ages: Structure of Modern Science; Kepler, Mechanical Science and Philosophy; Research on Design Problems; Concepts of the New Movements; Formation of Modern Science; Organization of Scientific Initiative and Communication; Structure of Scientific Revolutions; Concept of Nature and Modern Life: Inner Logic of Design Thinking; Technique of Replication and Corporations; Design, Communication and Perception.

**FİZ 501 Mathematical Physics** **3+0 7,5**

Formal Definitions of Vectors; Scalars and Invariants; Orthogonal Transformations; Cartesian Tensors; Vector and Tensor Fields; Generalized Coordinates; General Coordinate Transformations; Gradient; Divergence; Curl and Laplacian in Generalized Coordinates; Formal Properties of Matrices; Eigenvalue Problem; Cayley-Hamilton's Theorem; Functions of Matrices.

**FİZ 503 Ion Exchange** **3+0 7,5**

Crystal Systems; Analysis of Crystal Structures; Classification of Crystals According to Their Bound-structures; Metallic Crystals; Ionic Crystals; Covalent Crystals; Molecular Crystals; Packing in a Crystal; Faraday's Laws of Electrolysis; Molar Conductivity; Arrhenius' Theory; Debye-Hückel's Theory; Ionic Mobility; Transportation Coefficients; Ionic Conductivities; Ions in any Solution; Activity Coefficients in Ionic Media.

**FİZ 505 Physical Adsorption** **3+0 7,5**

Introduction to Physical Adsorption; Historical; Adsorption Isotherms; Adsorption Forces; Thermodynamics of Adsorption; Adsorbents; Porous and Nonporous Solids of High Surface Area; Classification of Pore Sizes; Micropores, Mesopores and Macropores; External and Internal Surface; Particle Size Distribution; Relationship Between Specific Surface and Particle Size Physical Adsorption of Gases by Nonporous Solids; Type II Isotherm; BET Model; Mathematical Nature of the BET Equation; Application of the BET Equation to Experimental Data; Point B Method; Determining the Molecular area; Step Like Isotherms.

**FİZ 507 Quantum Mechanics and Molecular Spectroscopy** **3+0 7,5**

General Formalism of Quantum Mechanics; The Harmonic Oscillator; Angular Momentum in Quantum Mechanics; Spin; Identical Particles Systems; Perturbation Theory; Quantum Mechanics Explanation of Molecular Structure; The Absorption and Emission of Electromagnetic Wave by Molecules; Rotational and Vibrational Spectrum of Two-Atom Molecules; Microwave Spectroscopy; Vibrational Spectroscopy.

**FİZ 508 Quantum Mechanics** **3+0 7,5**

Schrödinger Wave Equation; Eigenfunction and Eigenvalues; One Dimensional Potentials; General Formalism of Wave Mechanics; Operators in Quantum Mechanics; N-Particle Systems; The Schrödinger Equation in Three Dimensions; Angular Momentum and Spin; Spherical Symmetric Potential; Approximate Methods and Perturbation Theory; Symmetry and Transformations; Identical Particals; Scattering Theory.

#### **FİZ 509 Instrumental Analysis Methods 3+0 7,5**

Physical Properties of Matter and Electromagnetic Waves; Absorption Rules; Uv-Vis Spectroscopy; Vibrational Spectroscopy; Infrared Spectroscopy; Raman Spectroscopy; Nuclear Magnetic Resonance Spectroscopy; Mass Spectroscopy; Molecular Spectroscopic Applications.

#### **FİZ 510 Evolution of Stars 3+0 7,5**

Birth of Stars; Interstellar Environment; Gravitation; Stellar Formation; The Virial Theorem; The Hertzsprung-Russell Diagram; Evolution of Stars on the Main Sequence; Advanced Levels On Stellar Evolution; Evolution of the Sun as the Main Sequence Stars; Evolution of Small, Medium and Massive Stars; Nuclear Reactions on Stars; Hydrogen Flash and red Giant Level; Helium Flash; Carbon Flash; Neon Flash; Oxygen Flash; Silicon; Sulphur and Magnesium Flash; Death of Stars; White Dwarfs; Physical Formation of White Dwarfs; Degenerate Electron Gases; Falling Luminosity and Internal Structure; Collapse of Nuclei and Supernovae Explosion, Classification of Supernovae; Physical Structure of Nebula; Properties of Type II Supernovae Explosions; Properties of Type Supernovae Explosions; Neutron Stars; Binary Pulsar Systems; Observed Rotational Rate Increase; Physical Structure of Neutron Stars; Rotation and Magnetic Fields of Neutron Stars; Pulsars; Neutron Stars Comparison With Pulsars; Producing

#### **FİZ 512 High Energy Astrophysics 3+0 7,5**

Analysis of Light; Atoms and Sub Atomic Particles; Stimulation and Ionisation; Electromagnetic Spectrum; Radio Astronomy; X-ray and  $\gamma$ -ray astronomy; Ultraviolet and Infrared Astronomy; Neutral Hydrogen and Molecular Line Astronomy, Optical Astronomy; Theoretical Astronomy. Cosmic Ray Physics; Ionisation Losses and Non-relativistic Treatment; Relativistic Case and Ionisation Losses; Ionisation Losses of Electrons; The radiation of accelerated Charged Particles; Bremsstrahlung; Non-relativistic and Thermal Bremsstrahlung; Relativistic Bremsstrahlung. Interactions of High Energy Photons; Photoelectric Absorption; Compton Scattering; Electron Positron Pair Production; Cherenkov Radiation; Electron-Positron Annihilation and Positron Production Mechanism. Nuclear Interactions; High Energy Protons; Cosmic Ray Nuclei; Nuclear Emission Lines; Cosmic Rays in Atmosphere. Detectors For High Energy Particles; X-ray and  $\gamma$ -rays; Study of High Energy Particles; Gas-Filled Detectors-Proportional Counter

#### **FİZ 514 Electromagnetic Wave Theory 3+0 7,5**

Complex Vectors; Complex Algebra; Complex Representation of Time-Harmonic Scalars; Real Vectors;

Complex Vectors; Time Averages; Maxwell Equations; Maxwell Equations for Time-Harmonic Fields; Lorentz Force Law; Poynting's Theorem; Uniform Plane Waves; Uniform Plane Waves in Free Space; Polarization; Plane Waves in Dissipative Media; Reflection and Transmission of Waves; Boundary Conditions; Reflection and Transmission at a Dielectric Interface; Reflection by Perfectly Conducting Planes.

#### **FİZ 515 Analysis of the X-ray Spectrum 3+0 7,5**

X-Rays; The Properties of the X-Rays; Production of the X-Rays; Continuous Spectrum; Characteristic Spectrum; Crystalline Structures; Directions and Planes in the Lattice; Diffraction Theory; Bragg's Law; Directions of the Diffraction; Diffraction Methods; Diffraction by the Atoms; Diffraction by the Electrons; Diffraction by the Unit Cells; Calculations of the Intensities; Experimental Methods in X-Ray Diffraction; Laue Method; Rotating Crystal Method; Powder Method; The Use of Diffraction Pattern.

#### **FİZ 522 Geometric Algebra and Applications 3+0 7,5**

Vectors, Complex Numbers and Matrices: Pauli Spin Matrices and Spinors; Geometric Algebra and Applications: Subspaces, Bivectors, Three-vectors, Quaternions, Multi-vectors, Inner, Outer and Geometric Product, Matrices Representation of  $Cl_2$  and  $Cl_3$ ; Algebraic Operations in Geometric Algebra: The Rank and Inverse of Multi-vector, Pseudoscalar, The Dual of Multi-vector, The Projection and Perpendicular Component of Multi-vector; Reflection Operations in Geometric Algebra: Reflection Operations in Euclidian Plane, Reflection Operations in Euclidian Space; The Rotation Operations in Geometric Algebra: Rotation Operations in Euclidian Plane, Rotation Operations in Euclidian Space; Geometric Algebra Application in Physics: Mechanic, Electromagnetism, Quantum, Molecular Physics.

#### **FİZ 523 Optoelectronic Physics I 3+0 7,5**

Quantum Mechanics and Statistical physics of Electrons; Classical description of physics, Quantum description of physics, The Schrödinger equation for electrons, The free electron problem, Filling of electronic states: statistics, Scattering of electrons, Electrons In Crystals: Semiconductor Bandstructure; The challenge of solid state electronics, Periodicity of a crystal, Basic lattice types, Electrons in a periodic potential, Metals, Semiconductors, and Insulators, Holes in semiconductors, Bandstructures of some semiconductors, Modification of bandstructure, Doping Of Semiconductors; Intrinsic carrier concentration, Doping: donors and acceptors, Carriers in doped semiconductors, Modulation doping, Transport And Optical Properties In Semiconductors; Scattering in semiconductors, Velocity-Electric field relations, Very high field transport: breakdown, Carrier transport by diffusion, Transport by drift and diffusion, Optical properties of semiconductors, Charge injection and quasi-f

#### **FİZ 524 Optoelectronic Physics II 3+0 7,5**

Junctions In Semiconductors: P-N Diodes; Device demands, The unbiased p-n junction, P-N junction under bias, The real diode: consequences of defect, High voltage effects in diodes, Modulation and switching: ac response, Application of diodes, Semiconductor Junction With Metals And Insulators; Metals as a conductors: interconnects, The Schottky barrier diode, Ohmic contacts, Insulator-semiconductor junctions, Application and technology issues, Optoelectronic Devices.

**FİZ 525 Some Biophysical Techniques** **3+0 7,5**  
**Connected With Waves**

Microscope and Some Special Microscope Techniques, Light Microscope, Compound Microscope, Immersion Microscope, Acoustic Microscope, UV Microscope, Polarization Microscope; Electron Microscope, Electron Waves, Electrostatics Lens, Magnetic Lens; X-Rays and Applications, X-Rays Spectrum, Absorption of X-Rays, X-Rays Diffraction; Ultrasound and Applications, Absorption of Sound, Acoustic Impedance; Holography; NMR and Applications, Resonance Principles, Fundamental Concepts, Spin Magnetic Moment of Electron; Doppler and Applications.

**FİZ 526 Classical Mechanics** **3+0 7,5**

Kinematics of a Particle; D'alambert Principle and Lagrange's Equations; Simple Applications of Lagrange Formulations; Calculus of Variations; Hamilton's Principle; Symmetry Properties of Conservation Theorems; Two-Body Central Force Problem; Virial Theorem; Kepler's Problem; Rigid Body Kinematics; Euler's Angles; Euler's Equations.

**FİZ 527 Advanced Statistical Physics** **3+0 7,5**

Main Principles of Statistical Physics: Statistical distribution, Statistical independence, Liouville theorem, Statistical matrix, Distribution in quantum statistics, Energy, Entropy, Permanent increment principle of entropy; Thermodynamic Magnitudes: Temperature, Pressure, Work and heat amount, Heat function, Free energy and thermodynamic potential, Adiabatic process and the process of Jule-Thompson; Gibbs Distribution: Gibbs and Maxwell distributions, Free energy and Gibbs distribution, Thermodynamic perturbation theory, Gibbs distribution of system with variable number of particles, Finding out thermodynamic rules from Gibbs distribution; Theory Of Ideal Gas: Boltzmann distribution, Unbalanced ideal gas, Monoatomic gas, Twoatomic gas, and polyatomic gas; Fermi And Bose Distribution: Fermi distribution, Bose distribution, Degenerated electronic gas, Degenerated Bose gas, Radiation of black substance; Non-Ideal Gas: Serial development according to the density, Formula of Van Der Waals, Totally ionized gas; Balance Circumstances of Phase: Critical points, Properties of substances close to the critical points; Fluctuation: Gauss distribution, Fluctuations of thermodynamic magnitudes, Fluctuations in ideal gas, Formula of Poisson.

**FİZ 528 Adsorption Technology** **3+0 7,5**

Adsorption as a process; Basic Concepts, Regeneration, Practical Guidelines, Moving Bed, Experimental Design

and Testing, Adsorption Forces, Porosity, Surface Function Groups, Isostere, Isobar, Classification of Adsorption Isotherms: Equilibrium Models, Single Component Adsorption, Multi Component Adsorption, Adsorption Kinetics: External Diffusion, Internal Diffusion, Diffusion Model; Surface Diffusion Model, Combined Diffusion Model Concept of Differential Reactor; Theoretical Considerations, Materials, Equilibrium Studies, Kinetic Studies, Conclusions.

**FİZ 529 Thin Film Characterization** **3+0 7,5**

Importance of Materials Characterization; Techniques of Structural Characterization: X-ray analysis, Texture coefficient, Grain size, Morphological analysis, Determination of thickness; Optical Characterization of Materials: Optical properties, Optic band gap, Determination of direct and indirect band gap; Optical Constants: Some dispersion relations, Refractive index, Extinction coefficient, Absorption coefficient, Transmission, Reflection, Optical conductivity, Complex dielectric function; Electrical Characterization of Materials: Resistivity measurement techniques, Conductivity type measurement techniques, Hall and magnetoresistivity mobility measurement techniques.

**FİZ 530 Thin Film Technology** **3+0 7,5**

The Preparation Methods of Thin Films; Vacuum Technology: Kinetic theory of gases, Gas transport and pumping, Vacuum pumps, Vacuum systems, The role of the vacuum in the thin film technology; Evaporation Processes: The physics and chemistry of evaporation, Evaporation processes and applications; Chemical Vapor Deposition (CVD): Thermodynamics of CVD, Thermal CVD processes; Sputter Deposition Processes: Sputter sources, Sputter coating systems; Sol-Gel Coatings: The sol-gel process; Spray Pyrolysis Method.

**FİZ 531 Amorphous Material Physics** **3+0 7,5**

Theory of Electronic States in Amorphous Materials: Theoretical methods, The density of states, Anderson localization; Amorphous Materials: Definition of amorphous materials, Amorphous metals, Liquid metals and semi-metals, Amorphous semiconductors, Amorphous germanium and silicon, Alloys, Glassy materials, Ceramics; Amorphous Material Physics: Structural properties, Optical properties, Optical band gap, Electrical properties.

**FİZ 532 Particle Physics** **3+0 7,5**

Discoveries of Particles; Classification of Particles and Their Interactions; Introduction to Quantum Electrodynamics; The Feynman rules for QED; Parton model; Quantum Chromodynamics; Weak Interactions of Leptons and Quarks; Electroweak Unification; Introduction to Gauge Theories.

**FİZ 533 Special Function in Physics I** **3+0 7,5**

Differential Equations in Physics; Solutions of the Equations Using Separation of Variables and Green's Function; Sturm-Liouville Theory; Legendre Polynomials; Associated Legendre Polynomials; Laguerre Polynomials;

Hermite Polynomials; Bessel Functions; Hypergeometric Functions; Physical Applications.

**FİZ 537 Fundamentals of Impedance Spectroscopy** **3+0 7,5**

Basic Definitions, and History; The Importance of Interfaces, Impedance-Related Functions, History, Elementary Analysis of Impedance Spectra; Physical Models for Equivalent Circuit Elements, Simple RC Circuits, Selected Applications of IS; The Electrical Analogs of Physical and Chemical Processes; The Electrical Properties of Bulk Homogeneous Phases, Mass and Charge Transport, Interfaces and Boundary Conditions, Grain Boundary Effects, Current Distribution, Porous and Rough Electrodes, Physical and Electrochemical Models; The Modeling of Electrochemical Systems, Equivalent Circuits, Modeling Results.

**FİZ 538 Special Functions in Physics II** **3+0 7,5**

Partial Differential Equations in Physics; First Order and Second Order Partial Differential Equations; Heat Equations; Wave Equations; Green's Functions; Time Independent and Time Dependent Green's Functions; Solutions of the Differential Equations by Separation of Variables and Green's Function Technique; Integral Equations; Fredholm and Volterra Type Integral Equations; Calculus of Variations.

**FİZ 539 Dynamics and Relativity** **3+0 7,5**

Galilean Relativity, Conservation Laws In Physics; Central Forces? Problems; Mechanical Vibrations and Waves; Systems of n Particles; Solid Body Motion; Rotation and translation, Collisions; Problems in physics, Scattering of Particles and Applications; Special Relativity; Space-Time Geometry; 4-vectorial operations, Relativistic Dynamics; General Relativity, Principle of equivalence, Curved space.

**FİZ 540 Characterization of Solids** **3+0 7,5**

Electromagnetic spectrum, Interaction with material, Structural analysis with x-ray diffraction spectroscopy, Electrical characterization, Surface analysis with scanning electron microscope, Structural analysis with transition electron microscope, Photoluminescence, Electroluminescence, Magnetoresistance, IR, Raman.

**FİZ 541 Semiconductors** **3+0 7,5**

Crystal Structure of Solids and Energy Bands; Semiconductor Materials and Their Properties; Doping of Semiconductors; Carrier Transport in Semiconductors; Generation and Recombination of Carriers; Direct and Indirect Band Transitions; Photoconductivity; The p-n Junctions; Solar Cells.

**FİZ 542 Electromagnetic Theory** **3+0 7,5**

Boundary Value Problems in Electrostatics; Multipole Expansions; Electrostatics Problems in Dielectric Media; Boundary Value Problems in Magnetostatics; Maxwell Equations; Poynting Theorem; Conservation of Energy and Momentum.

**FİZ 543 Condensed Matter Physics I** **3+0 7,5**

Phonons and Lattice Dynamics, Electrons in solids, Electron-Phonon Interactions, Electron-Electron and Electron-Lattice Impurity Interactions, Transport Theory, Plasmons, Polaritons and polarons.

**FİZ 544 Condensed Matter Physics II** **3+0 7,5**

Classification of materials, Introduction to magnetic materials, Magnetic susceptibility, Langevin diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism and ferrimagnetism, Measurement techniques for magnetic properties.

**FİZ 545 Characterization Methods of Porous Solids and Powder Minerals** **3+0 7,5**

Gas Adsorption: Physisorption of gases by clays and zeolites, Energetics of physisorption, Interpretation and classification of physisorption-isotherms, Vacuum Volumetric Measurement (Manometry): Calibration of sample cells, Outgassing the adsorbent sample, Adsorption equilibrium, Temperature, Pressure, Volumetric sorption analyzer instruments (Autosorb-1C and Nova concepts), Determination of surface area from Langmuir and BET theories, Thermal Properties of Clays and Zeolites: Volumetric and structural changes on dehydration, TGA/DTA/DSC applications, Chemical (XRF) and Structural (XRD) Properties of Clays and Zeolites.

**FİZ 546 Infrared Detection Systems: Physics and Technology** **3+0 7,5**

Electromagnetic spectrum and infrared radiation: Atmospheric transmission and windows; Radiometry: Planck's Law; Black body radiation; Solid angle, radiance, emissivity; Optical detection processes; Thermal detectors: Bolometers; Pyroelectric detectors; Thermoelectric detectors; Photon detectors: MCT photodiodes; Schottky barrier photodetectors; Hetero-junction internal photoemission detectors; Blocked impurity band detectors; Homo-junction internal photoemission detectors; Quantum well and quantum dot photodetectors; Type-II superlattice photodetectors; Detector parameters: Responsivity, noise, signal-to-noise ratio, noise equivalent power;

**FİZ 547 Lab VIEW: Graphical Programming Language** **3+0 7,5**

Introduction to graphical programming language LabVIEW; Front panel; Block diagrams; Working with virtual instruments and error correction; Virtual instruments and sub-virtual instruments: Loops; Structures; Sequences; Graphs; Data collection; Analysis and presentation.

**FİZ 549 Hypercomplex Numbers in Physics** **3+0 7,5**

Hypercomplex Numbers and Their Basic Properties: Complex numbers, Split-complex numbers, Dual numbers, Basic operations, Matrix representations of hypercomplex numbers, Hyperbolic numbers in physical applications; Quaternions and Their Physical Applications: Real, Complex, Dual, Hyperbolic and split quaternions, Basic operations, Matrix representations of quaternions, Quaternionic representation of physical quantities; Octonions and Their Physical Applications: Real, Split and

hyperbolic octonions, Basic operations, Matrix representations, Octonionic representation of physical quantities; Sedenions: Definition, Basic operations, Sedenions in physical applications.

**FİZ 550 Geometry and Topology in Physics 3+0 7,5**

Vector Spaces; Topological Spaces; Differentiable Manifolds; Vectors and Tensors on a Manifold; Lie Derivatives; Exterior Forms; Exterior Derivatives; Inner Product Operators; Riemannian and non-Riemannian Geometries; Metric Tensor; Metric Compatibility; Connections; Riemann Tensor; Ricci Tensor; Torsion; Levi-Civita Connection; Connection with Torsion; Covariant Derivatives; Cartan Structure Equations; Bianchi Identities; Hodge Operator; Applications in Physics.

**FİZ 592 Seminar 3+0 7,5**

**FİZ 601 Clay and Clay Minerals I 3+0 7,5**

Definitions; Factors Controlling the Properties of Clay Materials; Clay-Mineral Composition; Nonclay-Mineral Composition; Classification and Nomenclature of Clay Minerals; Structures of Clay Minerals; Kaolinite Minerals; Halloysite Minerals; Montmorillonite Minerals; Definition of Structures By X-Ray Diffraction; Electron Microscope.

**FİZ 602 Clay and Clay Minerals II 3+0 7,5**

Ion Exchange Through Clays; Cation-Exchange Capacity, Causes of Cation Exchange; Theory of Cation Exchange; The Nature of Water Adsorbed by Clays; Clay-Water System; Heat of Wetting; Time Factor; Definition of Specific Surface Area in Clays; Hydration and Dehydration Through Clays; Dehydration Curves; Differential Thermal Analysis.

**FİZ 604 Selected Topics in Zeolite Molecular Sieves 3+0 7,5**

Physical Properties of Zeolite Crystals; Optical Properties; Dielectric Properties; Electrical Properties; Thermochemistry; Zeolite Water; Ionchange Reactions in Zeolites; Ion Exchange Theory; Hydrogen Exchange in Zeolites; Cation Sieve Effects in Zeolites; Adsorption on Zeolites; Heat of Adsorption; Character of the Adsorbed Phase in Zeolites; Adsorption Separation of Gas Mixtures.

**FİZ 605 Selected Topics on Clay and Clay Minerals I 3+0 7,5**

The Properties and the Structures of Clay and Clay Minerals; Structure and Composition; Clay-water Systems; Miscellaneous Properties; Clays in Ceramic Industry; Plasticity; Drying Properties; Firing Properties; Clays in Petroleum Industry; Search for Petroleum; Producing Operations; Investigation of Usability on Various Branches of Industry.

**FİZ 606 Selected Topics in Electromagnetic Wave Theory 3+0 7,5**

Waveguides and Resonators; Parallel-Plate Waveguides; Rectangular Waveguides and Resonators; Dielectric Slab

Waveguides; Coaxial Lines; Transmission Lines; Transmission-Line Equations; Impedances; Generalized Reflection Coefficient and Smith Chart; Antennas; Vector and Scalar Potential Functions; Fields of Antennas; Linear Antennas; Rayleigh Scattering; Fourier Optics and Holography; Doppler Effect; Plane Waves in Anisotropic Media.

**FİZ 607 Optical Properties of Semiconductors I 3+0 7,5**

Energy States in Semiconductors; Band Structure; Impurity States; Band Tailing; Excitons; Donor-Acceptor Pairs; Perturbation of Semiconductors by External Parameters; Pressure Effects; Temperature Effects; Electric Field Effects; Magnetic Field Effects; Absorption; Fundamental Absorption; Higher Energy Transitions; Exciton Absorption; Transitions Between a Band and an Impurity Level; Intraband Transitions; Free Carrier Absorption; Hot-Electron-Assisted Absorption.

**FİZ 608 Optical Properties of Semiconductors II 3+0 7,5**

Relationship Between Optical Constants; Absorption Coefficient; Index of Refraction; Kramers-Kronig Relations; Reflection coefficients; Absorption Spectroscopy; Radiative Transitions; Van Roosbroeck-Shockley Relation; Radiative Efficiency; Fundamental Transitions; Transitions Between a Band and an Impurity Level; Donor-Acceptor Transitions; Intraband Transitions; Nonradiative Recombination; Auger Effect; Surface Recombination.

**FİZ 610 Selected Topics on Clay and Clay Minerals II 3+0 7,5**

Dielectric Properties of Clays; Variation Of Permittivity Versus Humidity; Frequency of Electric Field; Cole-Cole Diagrams; Various Physicochemical Properties of Clays; Adsorption-Desorption Properties; Ion Exchange Properties; Effects of Various Factors on Adsorption Properties of Clays.

**FİZ 611 Selected Topics in Solid State Physics 3+0 7,5**

Metal-Semiconductor Contacts; Energy-Band Relation; Surface States; Current Transport Mechanisms; Thermionic Emission Theory; Diffusion Theory; Tunneling Current; Characterization of Potential Barrier; Current-Voltage Measurement; Activation Energy Measurement; Capacitance-Voltage Measurement; Photoelectric Measurement; Barrier Height Adjustment; Ohmic Contact.

**FİZ 612 Dielectric Physics 3+0 7,5**

Behavior of Dielectrics in Static Electric Fields; Electric Susceptibility and Permittivity; Dielectric Polarization; Polarization Vector and Molecular Quantities; Clausius-Mosotti's Equation and Lorenz's Local Field; Dipole Moments in Solutions; Mosotti's Catastroph; Onsager's Local Field; Electric Susceptibility of Dipolar Gases; Dielectric Theories of Kirkwood and Fröchlich; Behavior of Dielectrics in Alternative Electric Fields; Dielectric Polarization in Alternative Electric Fields; Debye's Absorption and Dipolar Dispersion; Cole-Cole's Diagram;

Cole-Cole's Equation; Cole-Davidson's Equation; Kramer-Kronig's Equations.

#### **FİZ 614 Selected Topics in Classical Mechanics 3+0 7,5**

Legendre Transformations and Hamilton Equations of Motion; Conservation Theorems and Physical Meaning of Hamilton's Equations; Some Applications of Hamilton's Equations; Canonical Transformations; Hamilton-Jacobi Theory; Vibrating Systems; Diatomic Molecule.

#### **FİZ 616 Group Theory and Applications to Physics 3+0 7,5**

Symmetry Elements and Operations; Point Groups; Non-Degenerate Representations; Matrices; Degenerate Representations; Applications to Molecular Bonding; Applications to Molecular Vibration.

#### **FİZ 617 Lie Groups and Physical Applications 3+0 7,5**

Basic Structure Blocks; Set; Group; Symmetry Operations; Symmetry Operations and Group; Extra Definitions; Subgroups; Classes; Matrices; Matrices and Symmetry Operations of Square; Matrix Representations of a Group; Field; Linear Vector Spaces; Algebra; Bases; For a Group; For Field; For a Vector Space; For An Algebra; Isomorphism; Homomorphism; Irreducible and Reducible Matrix Representations; Discrete Groups; Orthogonal Groups;  $O(3)$ ; Orthogonal Transformation and Orthogonal Group; Physical Applications; Lie Group  $U(n)$  and  $SU(n)$  Groups;  $U(n)$  and  $SU(n)$  Generators;  $SU(2)$  and  $SU(3)$  Generators; Rotation and Angular Momentum; Linear Representations of A Lie Group; Quantum Mechanics and Group Theory; Physical Applications.

#### **FİZ 619 Conduction Mechanisms in Solids 3+0 7,5**

Basic Concepts Related to Electrical Conduction; Energy Band Model; Tunneling Model; Hopping Model; Electrical Properties; Formation of Traps; Charge Carrier Injection from Contacts; Electrical Contacts; Types of Electrical Contacts; Charge Carrier Injection through Potential Barriers from Contacts; Conduction Mechanisms in Solids; Ionic Conduction; Tunnel or Field Emission; Ohmic Conduction; Space Charge Limited Conduction; Poole-Frenkel Emission; Schottky Emission.

#### **FİZ 621 Selected Topics in Adsorption Technology 3+0 7,5**

Gravimetric Differential Reactor for Adsorption Studies; Experimental Results and Discussion, Materials, Equilibrium Isotherm, Kinetic Studies, gravimetric Differential Reactor for Water Adsorption Studies; Experimental Results, Experimental Procedure, Equilibrium, Kinetic Analysis, Combined Diffusion Differential Reactor Models; Liquid-Solid Systems, Gas-Solid Systems, Ds-Dp Determination, Thermodynamics Analysis of Adsorption Systems: Methods and Models, Experimental Procedure, Method of Approach.

#### **FİZ 622 Selected Topics of Advanced Statistical**

##### **Physics 3+0 7,5**

Solids: Solids at low temperatures, Solid at high temperatures, Debye's interpolation formula, Thermal expansion of solids, Phonons, Quantum liquid, Bose spectrum, Super influent, Fermi spectrum, The electron spectrum of metals, The electron spectrum of solid insulators, Phonon creation and annihilation operators, Negative temperatures; Non-ideal gases: Deviation of gases from the ideal state, Expansion in powers of the density, Van der Waals? formula, Completely ionized gases, Degenerated Bose gas, Degenerated Fermi gas, Thermodynamic quantities for a degenerate plasma; Phase Equilibrium: Conditions of phase equilibrium, The Clapeyron-Clausius formula, The critical point, The law of corresponding states; Solutions: Systems containing different particles, The phase rule, Weak solutions, Osmotic pressure, Mixtures of ideal gases, Mixtures of isotopes, Gases and liquids; Fluctuations: The Gaussian distribution, The Gaussian distribution for more than one variable, Fluctuations of the fun

#### **FİZ 623 Selected Topics in Mathematical Physics 3+0 7,5**

Fourier Series; Average Value of a Function Complex Form of Fourier Series; Parseval Theorem; Power; Root; Logarithm and Trigonometric Functions of a Complex Number; Integral Transformations; Laplace and Fourier Integral Transformations; Gamma; Beta and Error Functions; Elliptic Integrals and Functions; Quaternions.

#### **FİZ 624 Selected Topics in Semiconductors 3+0 7,5**

Quantum Theory of Electrons in Periodic Lattices; Bloch theorem; Kronig-Penney Model; Crystal Momentum and Effective Mass; Electrons and Holes; Free-Electron Approximation; Tight-Binding Approximation; Constant Energy Surfaces and Brillouin Zones; Insulators; Semiconductors and Metals; Uniform Semiconductors in Equilibrium; IntrINŞic and Impurity in Semiconductors; Statistics of Electrons and Holes; Ionization Energy of Impurity Centers; Conductivity; Hall Effect and Magnetoresistance; Ellipsoidal Energy Surfaces; Excess Carriers in Semiconductors; Continuity Equation; Drift Mobility and Haynes-Shockley Experiment; Recombination Mechanisms.

#### **FİZ 627 Selected Topics in Ion Exchange 3+0 7,5**

Ion Exchange Procedures: Batch Operation; Column Process; Continuous Process; Types of Ion Exchangers; Synthetic; Natural; Cellulose; Ion Exchangers; Active Coals; Ion Exchange Membrans and Liquid Ion Exchangers; Properties of Ion Exchangers; Humidity Content and Density; Particle Size; Cross-Linking; Porosity; Swelling; Ion Exchange Capacity; Selectivity; Application Fields of Ion Exchangers.

#### **FİZ 629 Electromagnetic Wave Theory 3+0 7,5**

Spin: The spin operator, Spinors, The wave functions of particle with arbitrary spin; Identity of particles: The principle of indistinguishability of similar particles, Exchange interaction, Symmetry with respect to



interchange, Second quantization (the case of Bose statistics), Second quantization (the case of Fermi statistics); Addition of angular momentum: 3j-symbols, Calculation of matrix elements of tensors, 6j-symbols; The theory of elastic collisions: The general theory of scattering, The unitary condition for scattering, Born's formula, The quasi-classical case, Scattering at high energies, The scattering of slow particles, Resonance scattering at low energies; Inelastic collisions: Elastic scattering in the presence of inelastic processes, Inelastic scattering of slow particles, Breit and Wigner's formulae, Inelastic collisions between fast electrons and atoms, Scattering from the molecules.

### **FİZ 630 Magnetic Properties of Solids** **3+0 7,5**

Landau quantization and de Haas Alphen Effect, Integer quantum Hall Effect (IQHE), Fractional Quantum Hall Effect (FQHE), Geometric Magnetoresistance (GMR), Magnetic Anisotropy, Magnetostriction.

### **FİZ 631 Organic Semiconductor Physics** **3+0 7,5**

Introduction to the physics of organic semiconductor, Organic materials, Organic semiconductors and electronic properties of interfaces between organic semiconductors and metals, Electrical conductivity mechanism in organic semiconductors, Optical properties of organic semiconductors, Organic thin film transistors, Organic light emitted diodes, Organic solar cells.

### **FİZ 632 Classical Electrodynamics** **3+0 7,5**

Electromagnetic Waves in Conducting and Non-conducting Media; Wave Guides; Multipole Radiation; Electromagnetism and Special Theory of Relativity; Motion of Charged Particles in Electromagnetic Field; Radiation from Moving Charges.

### **FİZ 633 Band Theory in Semiconductors** **3+0 7,5**

Group theory and character tables for band theory, Effective mass theory, Plane wave approximation at band theory, K,p method, Pseudo-potential method.

### **FİZ 634 Gravitation and Cosmology** **3+0 7,5**

Concept of Absolute Space-time; Special Theory of Relativity; Minkowski Space-time; Lorentz Transformations; Geometric Structures in Gravitation; Connection Structure and Curvature; General Theory of Relativity; Einstein Field Equations; Derivation of Field Equations by Variation Principle; Generalized Theories of Gravitation; Theories of Gravitation with a Scalar Field; Schwarzschild Solutions.

### **FİZ 635 Ultra Cold Atomic Gases** **3+0 7,5**

The non-interacting Bose Gas; The Weakly Interacting Bose Gas; Atomic Properties; Trapping and Cooling of Atom; The Magneto Optical Trap; Interactions Between Atoms; Basic Scattering Theory; Theory of the Condensed State; Ground State of a Trapped Condensates; Energy, Chemical Potential and Virial Theorem; TF Approximation; Density and Momentum Distribution; Attractive Potential; Dynamics of the Condensate; Release of Trap and Expansion of The Gas; Solitons; Microscopic Theory of the

Bose Gas; Excitation in a Trapped Gas; Interference and the Josephson Effect; The Bose Einstein Condensation in Optical Lattice; The Bose Einstein Condensation in Low Dimension; Rotating Condensates; Quantized Vortices; Superfluidity; Quantum Hydrodynamics; ; Trapped Clouds at nonzero Temperatures; Mixtures and Spinor Condensates, Fermionic Condensates, The BCS Transition

### **FİZ 636 Molecular Beam Epitaxy: Instrument and Application** **3+0 7,5**

Components of molecular beam epitaxy (MBE) instrument: Vacuum chamber; Vacuum pumps; Effusion cells; Reflection high energy electron diffraction (RHEED) technique: Operation and applications; Temperature readers; Residual gas analyzer (RGA); Epitaxial film deposition parameters: Material flux measurements; Growth parameters calibration; Application and usage areas of epitaxial films

### **FİZ 637 Fundamental Properties and Gas Adsorption Applications of Naturel Adsorbents** **3+0 7,5**

Fundamental factors in designing adsorbents: Potential energy of adsorption; Heat of adsorption; Effects of adsorbate properties on adsorption (Polarizability (?), Dipol moment ( $\mu$ ) and quadrupole moment (Q)); Basic considerations for sorbent design: Polarizability (?); Electronic charge (q) and van der Waals radius (r); pore size and geometry; Investigation of adsorption behavior on natural zeolites: Structure and cations sites of natural zeolites; Natural zeolites and Molecular Sieving Properties; Unique adsorption properties of natural zeolites; Interactions of adsorbate with cation site; charge and ionic radius; Adsorption applications of various gases on natural zeolites

### **FİZ 638 Fundamentals of Semiconductor Device and Technology** **3+0 7,5**

Semiconductors: Fundamentals, doped-undoped structures; Fermi level; Electron and hole densities; Devices and operation basics: P-n junction; metal-oxide semiconductors (MOS); Bipolar junction transistors (BJT); Metal-oxide semiconductor field effect transistors (MOSFET); Elements of quantum mechanics: Black body radiation and atom models; Wave-particle duality; Basic formalism and Schrödinger equation; Particle in a box and quantum mechanical confinement; Energy-band theory: Kronig-Penney model; Particle motion and effective mass; E-k diagrams; Semiconductor hetero- and multi- junctions; Structures with quantum wells: Quantum wells; Calculations of the conduction bandenergy levels; Intersubband transitions; Design details of quantum well; infrared Quantum wire and quantum dot structures;

### **FİZ 639 Physical Mechanisms of Variables Stars** **3+0 7,5**

Types and Physical Properties of Variable Stars; Orbital Cycle: White dwarf and red dwarf, Keplerian motion; Ellipsoidal Variations; Mass Transfer; Bright Spot; Spectral Characteristics; Emission and Absorption Lines; Disc spectrums; Eclipse Mapping; Physical Properties of

Interaction Mechanisms: Accretion disc models, Siphons, Winds, Streams, Flickering, Oscillations.

**FİZ 640 Structural Properties of Accretion Disc in Binary Stars** **3+0 7,5**

Accretion as a Source of Energy: The Eddington limit, The emitted spectrum, Accretion theory and observation; Accretion in Binary Systems: Interacting binary systems, Roche Lobe overflow, Roche geometry and binary evolution; Disc Formation; Accretion Discs: Radial disc structure, Steady thin discs, Dwarf novae; Accretion onto Compact Objects: Boundary layers, Accretion columns; Thick Discs: Limiting luminosity, Dynamical stability; Accretion flows: Astrophysical applications.

**FİZ 641 Gas Adsorption Applications of Clay Type Naturel Adsorbents** **3+0 7,5**

Gas Adsorption by Clays: Structural features of layer silicates, Silicates with two-layer sheets and silicates with three-layer (Kaolinite, smectites and sepiolite), Physisorption of gases by kaolinite, Physisorption of gases by smectites: Adsorption of non-polar molecules and adsorption of polar molecules, Adsorption applications of various gases on clays.

**FİZ 642 Infrared and Raman Spectroscopy** **3+0 7,5**

Electromagnetic Wave and Matter Interaction; Molecular Vibrations; Vibration of Diatomic Molecules: Vibrational spectra of diatomic molecules, Rotational spectra of diatomic molecules; Infrared Spectroscopy: Basic concepts in infrared spectroscopy, Modes of vibration, Infrared spectrometer, Methods of infrared spectrum, Analysis of molecular structure by infrared spectroscopy; Raman Spectroscopy: Classical and quantum theory, Raman spectrometer, Methods of Raman spectrum, Analysis of molecular structure by Raman spectroscopy.

**FİZ 644 Nuclear Magnetic Resonance Spectroscopy** **3+0 7,5**

Introduction to NMR Spectroscopy and Resonance; Definition of Chemical Shift; Investigation of Spin-spin Interactions; Investigation of Proton-proton Interactions; Dynamic NMR Spectroscopy; <sup>13</sup>C NMR Spectroscopy; Pulsed NMR Spectroscopy; <sup>13</sup>C NMR and Chemical Shifts; Multi Pulsed NMR Experiments; Introduction to Two-dimensional NMR Spectroscopy; Interpretation of NMR Spectra.

**FİZ 790 Thesis** **0+1 30,0**

**FİZ 890 Thesis** **0+1 30,0**

**FKG 510 Pharmacobiotechnology** **3+0 7,5**

General definitions of biotechnology, history, drugs and therapeutics obtained by fermentation techniques, industrial production of antibiotics and points to consider, microbial transformation techniques, microorganisms used in

microbial transformations, mediums, practice and natural products used as raw materials.

**FKG 601 Advanced Pharmacognosy I** **3+0 10,0**

Biological and geographic sources of drugs, drugs derived from marine organisms, animal drugs, tissue cultures as sources of drugs; microorganisms as sources of drugs; factors considered in production of drugs; genetics and production of drugs; plant growth regulators, definition of drugs; chemical factors, physical factors, microbial, insects and other animals.

**FKL 501 Experimental Pharmacology** **3+0 7,5**

Mentality experimental approaches, knowledge, information and its importance, Methods of information retrieving, magnetic media and internet and their importance for experiments, relationship of knowledge-question-hypothesis, importance of information prior to experimental manipulations, materials and experiments, importance of control group, experiments and planning, pharmacological manipulation techniques, in vivo manipulations, in vitro models, data collection and handling, calculations of data and importance of statistics, evaluation, interpretation of results, documentation, application of an experimental technique.

**FKL 512 Receptors, Signal Transduction and Drug Action** **3+0 7,5**

Cell types and their distribution, cell membrane, membrane and action potential, signal transduction in a cell, receptor, ion channel, intracellular second messengers, regulatory mechanisms on intracellular calcium ion, excitation-contraction coupling, differences of excitation-contraction coupling in cell types, drug action mechanisms on signal transduction, agonism, antagonism, actions of drugs on signal transduction, observation of a drug action on signal transduction by a test model.

**FKL 602 Molecular Pharmacology** **3+0 10,0**

Receptor theories; quantitative dose-response relationships; apparent agonistic affinity constant; types of antagonism; physiological antagonism; pharmacological antagonism; competitive antagonism; noncompetitive antagonism; competitive and noncompetitive antagonist affinity constants; partial agonist; synergism; radioligand binding; affinity constant and receptor density; receptor isolation; reconstitution; 'knock-out' animal models; receptor cloning; site directed mutagenesis; ion channels; enzymes; ion pumps; mechanism of actions of drug at molecular level.

**FTK 501 Advanced Toxicology** **3+0 7,5**

General Concept and Principles in Toxicology: General Knowledge About Poisons: Intake, Absorption and the excretion of poisons, Metabolism of toxic substances: The Mechanisms of Effect of the Toxicants: Special Toxic Effects: Mutagenesis, Carcinogenesis and teratogenesis: Systemic Toxicology: Selective Toxicity: The Factors Affecting Toxicity: First Aid and Treatment Procedures in Acute Intoxications: Drug Toxicity: Drug Dependence: Factors causing dependence, Dependence types: Substances with Doping Effect Used in Sports.

**HEE 501 Satellite Based Navigation Systems 3+0 7,5**

Basic Principles of Satellite Orbiting; GPS (Global Positioning System): Space segment, Signal types, Ground control segment, User segment, Signal processing in GPS receiver, Error sources, Signal formats; GLONASS (Global Navigation Satellite System); Galileo; COM-PASS and Other Satellite Navigation Systems; Precision and Reliability Augmentation Techniques in Satellite Navigation: Space-based augmentation techniques, Ground-based augmentation techniques, Aircraft-based augmentation techniques; Concept of CNC/ATM and Its Development.

**HEE 592 Seminar 3+0 7,5****HEE 790 Thesis 0+1 30,0****HEE 890 Thesis 0+1 30,0****HİD 501 Watershed Hydrology 3+0 7,5**

Overland Flows; Sediment Transport by Overland Flows; Subsurface Storm flow; Unsaturated Flow and Groundwater Flows; River Flow Modeling, Computer Models for Watershed Hydrology.

**HTK 501 Air Traffic Management and Aircraft Performance I 3+0 7,5**

Air Traffic Management System; Aircraft Performances for Air Traffic Environment: Mission profile, Mission profile and aircraft movements, Air traffic control services in mission profile; Definitions of Speeds and Weights; Aero-Propulsive Models; General Equations of Motions; Level Flight Performances: Specific level flight performances for flight operations; Climb Performances: Specific climbing performances for flight operations; Descent Performances: Specific descending performances for flight operations; Take-off and Landing Performances: Specific take-off and landing performances for flight operations; Turning Performances: Specific turning performances for flight operations; Aircraft Trajectory: Trajectory prediction with Eurocontrol BADA model.

**HTK 502 Models and Simulation in Air Traffic Management I 3+0 7,5**

Fundamentals of Simulation and Modelling; Discrete-event Simulation Methodology; Taxonomy and Comparison of ATM Simulation Tools; Data Collection and Processing; Model Construction: Airport and airspace modeling; Experiment Design: Construction of baseline and alternative scenarios; Simulation: Test and production runs, Troubleshooting; Applications: Capacity and delay analysis, Conflict detection and resolution; Post Simulation Analysis: Analysis of results, Documentation, Animations and presentation; Verification and validation of simulation models.

**HTK 504 Air Traffic Flow Management and Airspace Capacity Analysis 3+0 7,5**

Components of Air Traffic Management: Airspace management, Air traffic services, Air traffic flow management; Functions of Air Traffic Management: Organization, Planning-Control, Co-ordination; Staffing; System of Air Traffic Management; Categorization of Problems in Air Traffic Management; Capacity: Definitions; Factors Determining Capacity: Airspace, Technical equipment, Aeroplane, Human performance, Procedure; Capacity Models; Literature Review; Scheduling Algorithm Method for Flow Planning; Short-term and Medium-term Conflict Models.

**HTK 505 Multi-Criteria Decision-Making 3+0 7,5**

Basic concepts: Decision-making, Decision process, Model, Types of models; Mathematical Programming: Model studies, Solution methods, Multi-criteria; Multi-Objective Decision Making: Criteria, Objective; Analytical Hierarchy Process: Sub-Criteria, Alternatives, Divided comparison, Spare analyses, Sensitivity analysis; Analytical Network Processes: Cluster, Element, Internal dependence, External dependence, Un-weighted Matrix, Limit matrix; TOPSIS: Positive ideal solution, Negative ideal solution; ELECTRE: Normalization, Concordance indexes, Dominancy; Utility Functions.

**HTK 506 Statistical Analysis for Air Traffic System 3+0 7,5**

Using Statistical Analysis in Air Traffic System Problems; Data Collection and Analysis; Basic Statistical Concepts: Summary of numerical knowledge, Probability, Sampling, Point forecast, Period forecast, Hypothesis testing, Correlation and regression analysis, Variance analysis; Using Softwares in Analysis; Flight Data Statistics Analysis for Specific Airport: Data collection, Categorization, Analysis, Reports.

**HTK 507 Research Methods for Air Traffic System 3+0 7,5**

History of Research on Air Traffic Control Problems; Researches in the USA, NASA and FAA, European research and strategies, Researches in Turkey; Research Requirements and Needs; Vision of Research and Development; R&D Politics and Strategies; R&D Methodologies; R&D Resources: Human resources, Finance, Technical infrastructure, Technology-Knowledge, Regulations, etc.; Innovation and Entrepreneurship; Industrial and Intellectual Property Rights; R&D Culture and Education; R&D Organization and Collaboration; Development of R&D Software; Strategic Management of R&D; Relationship Between R&D and Economic Growth; Examination of New Developments in Air Traffic System; Research Cases.

**HTK 508 Human Factors in Air Traffic Control 3+0 7,5**

Discussion of Relationship Between Safety and Human Factors in Air Traffic Management; General Concepts and Definitions; Safety Culture; Controller Performance and Affecting Factors: Individual differences, Information processing, Situational awareness, Organizational climate,

Team work, Stress, Shiftwork, Workload; Human Error: Importance of human error in aviation, Definition and classification; Error Models; Communication: Communication process, Communication models and modes; Working Environment: Ergonomics, Equipment and tools, Automation, Human-Machine interface; Human Factors in Future Systems; Examination of Cases Related to Human Factors .

**HTK 509 Real Time Simulation and Data Analysis in Air Traffic Control 3+0 7,5**

Basic Concepts: Definition of simulation, Using simulation in aviation, Air traffic management, air traffic control services, Non-radar control, Radar control, Area control services, Approach control services, Aerodrome control services; Simulation: Simulation techniques, Simulation requirements, Stage of preparing simulation, Real-time simulation, Using real-time simulation in education, Using real-time simulation in research, Methods for simulation techniques in non-radar environment, Methods for simulation techniques in radar environment; Assessment: Assessment and rating in simulation education, Exercises evaluation and assessment.

**HTK 510 Advanced Aircraft Controls and Navigation I 3+0 7,5**

Basic Concepts; Introduction to Aircraft Dynamics: Static stability and control, Dynamic stability and control, Lateral modes; Advanced Dynamics and Simulation Modelling for Aircrafts; Basic Navigation Techniques; Modern Control and Navigation Techniques for Air Vehicles: Linear techniques, Non-linear techniques and optimal control techniques, Sensor fusion, Modern avionics systems, Flight testing and system identification, Case studies and projects.

**HTK 511 Air Traffic System and Evaluation Criterion 3+0 7,5**

Concept of System; Concept of Transportation ve Systems; Air Transportation System and Sub-Systems; Elements of Air Transportation System; Importance of Air Transportation System; Definition of Air Traffic System; Functioning of Air Traffic System: Inputs of air traffic system; Processes in Air Traffic System, Outputs of Air Traffic System, Environment of Air Traffic System; Genel Specifications of Air traffic System; Place and Importance of Air Traffic System in Air Transportation System; Air Navigation Service Providers; Figures of Merit for Air Traffic Control Systems; Comparison of Air Navigation Service Providers Based on Figures of Merit.

**HTK 512 Performance Based Navigation and Design Methods 3+0 7,5**

Basic Definitions, The Concept of Performance Based Navigation (PBN): Lateral performance, Vertical performance; Specifications of Navigation; Required Navigation Performance (RNP); Types of RNP; RNP in the En-route and Terminal Control Area, Infrastructure of Navigation Aids; The Application of Navigation: Route Design Based on RNP and Point Merge System (PMS); RNP and PMS SIDs and STARs; Application of

Performance-Based Route Design in Simulation Environment.

**HTK 513 Quantitative and Qalitative Research Methods in Air Traffic Control 3+0 7,5**

Introduction; History of Scientific Research; Related Concepts and Definitions; Quantitative Research Methods; Qualitative Research Methods; Mixed Research Methods; Scientific Re-search Ethics and Integrity; Quantitative Research Methods in Air Traffic Control; Qualitative Research Methods in Air Traffic Control; Sample Problems and Solutions, Reporting and Presentation; Discussions.

**HTK 515 Human-Computer Interactin in Air Traffic Control 3+0 7,5**

History of Human and Computer Interaction; Related Concepts and Definitions; Human Per-ception, Ergonomics, Cognition, and Psychology; User-Centered Design; Task Analysis in User Interface Design; Principles of User Interface Design; Components of User Interface Design; Interface Programming; System Evaluation; Accessible Design; Ergonomic issues in air traffic control, Ergonomic issues for equipment, Ergonomic issues for displays; Related Studies.

**HTK 517 Scientific Research Projects in Air Traffic Control 3+0 7,5**

Aims of Scientific Research Projects; Introduction to Scientific Research Projects; Project Abstract; Project Purpose; Project Scope; Project Literature; Original Value of Projects; Pro-ject Management; Project Work Packages; Project Opportunities; Added-Value of Projects; Success Criteria for Project; Project Budget; Project Management; Analysis and Evaluation of Current Projects; Evaluation of Student Projects; Discussion of Projects.

**HTK 592 Seminar 3+0 7,5**

**HTK 601 Air Traffic Management and Aircraft Performance II 3+0 7,5**

Introduction to Air Traffic Management and Aircraft Performance ICAO Annex 6; g Factor; Maximum Structural Weights; Maneuvering Envelope; Engine Limitations; Take-off Performance and Limitations, The factors of effecting performance; Cruise Performance, Cruise speeds, Cruise range and endurance, The factors of effecting cruise performance; Landing Performance and Limitations, The factors of effecting landing; Weight and Balance, The determination of center of gravity; Mission Profile, Operational analysis of flight phases; Pre-flight; Determination of Fuel; Aircraft Airworthiness.

**HTK 603 Models and Simulation in Air Traffic Management II 3+0 7,5**

Simulation Models in Air Traffic System Problems; Fundamentals of Simulation; Definitions; Real Time Simulation, Fast time simulation; TAAM Tool; Fast Time

Simulation Tools for Air Traffic System Problems, SIMMOD, Definition of air traffic system capacity problems, Analysis of traffic structure, Exportation of sample airspace and airport data to SIMMOD environment, SIMMOD modelling for air traffic flow, SIMMOD outputs, Analysis of outputs.

**HTK 604 Aviation Safety Management Application 3+0 7,5**

Basic Concepts: Safety Culture; Basic Safety Management Rules and Procedures; The Effects of Safety Management Applications on Operators; Incident and Accident Investigations; Safety Policy: Policy Statement; Organizational Structure and Procedures; Safety Promotion: Culture; Training and Communication; Risk Management: Risk Identification; Risk Mitigation; Risk Assessment; Human Factors and Error Models; Safety Assurance: Internal and External Audits; Corrective Actions; Assessment of Safety Management Efforts.

**HTK 605 New Concepts and Visions in Air Traffic 3+0 7,5**

Related Literature of Air Traffic Management, Literature databases, Projects, ATM research and development seminars; Milestones of Air Traffic Management; The Structure of Modern Air Navigation System; New Projects and New Concepts, SESAR, Next-gen; The Problems Classifications of Air Traffic System; Technical Solutions of Airspace Management and Airport Design, Solutions of flow management, Airspace management strategies

**HTK 606 Advanced Aircraft Controls and Navigation II 3+0 7,5**

Introduction to Aircraft Dynamics, Basic principles, General Equations of Unsteady Motion, Longitudinal stability, Lateral stability; Navigation, Navigation techniques; Evaluation of real traffic environment, Aircraft Control, Open and Closed Loop Controls, Effects of Human Pilots; Advanced Aircraft Dynamics and Simulation Models, Analysis of current models; Sample Application for Each Students; Real time simulation for sample models; Real Time Trajectory Generation and Analysis; Conflict Detection and Resolution Models.

**HTK 607 Measuring of Quality and Costumer Satisfaction in Air Traffic Control Services 3+0 7,5**

Basic Concepts: Service, Air traffic control services, Quality, Customer; Service Quality: Significance of Measuring Service Quality, Models in measuring of service quality, Total perceived service quality, SERQUAL, SERVPERF; Customer Satisfaction: Inner Customer, Customer, Customer loyalty, The relationship between satisfaction and quality; Measurement Technics: Methods of Accepted All Over the World, Use of scales, Making of scale and assessment.

**HTK 609 Air Traffic Management and Environment 3+0 7,5**

Fundamental Combustion Thermodynamics; Emission Types: NOx, HC and CO; Greenhouse Gases; Contrails;

Emission Mechanisms; Emission Regulations; Emission Inventory Investigations: ICAO, SAGE, AERO2K, DLR; Emission Measurements; Emission Abatement Techniques in Engines; Emission Analyses with Flight Data; Engine Power and Emissions; Effect of Flight Phase on Emissions: Cruise, Climb, Descent; Emission Estimations Based on Airport; Effects of Continuous Descent Approach on Aircraft Emissions and Fuel Consumption; Noise.

**HTK 611 Artificial Intelligence Applications in Air Traffic Control 3+0 7,5**

Definitions and Introduction; Concept of Artificial Intelligence; Artificial Intelligence Tech-nologies; Expert Systems; Structure of Expert Systems; Artificial Neural Networks and Learn-ing; Multilayer Perceptron; Artificial Neural Networks Applications; Genetic Algorithms; Functioning of Genetic Algorithms; Fuzzy Logic; Artificial Intelligence Applications for Air Traffic Control Systems; Neural Network Applications for Air Traffic Control Systems; Ge-netic Algorithm Applications for Air Traffic Control Systems.

**HTK 613 Universal Design in Air Traffic Control 3+0 7,5**

Definitions; Introduction to Universal Design; History of Universal Design; Related Concepts and Definitions; Equitable Use; Flexibility in Use; Simple and Intuitive Use; Perceptible In-formation; Tolerance for Error; Low Physical Effort; Size and Space for Approach and Use; A Community of Learners; Learning Climate; Applications; Universal Design Approach for Air Traffic Control Systems; Analysis and Discussions.

**HTK 615 Critical Questioning in Air Traffic Control 3+0 7,5**

Definitions and Aims; Introduction to Critical Thinking, History of Critical Thinking; Founda-tions of Critical Thinking; Creative Thinking; Higher-Order Thinking; Reasoning; Problem Solving; Decision Making; Analysis; Synthesis; Evaluation; Socrates Questioning; Decision Making Structure for Air Traffic Control Systems; Problem Detections and Solution Methods; Analysis of Solution Methods; Evaluations.

**HTK 790 Thesis 0+1 30,0**

**HTK 890 Thesis 0+1 30,0**

**İNŞ 503 Advanced Foundation Engineering 3+0 7,5**

Subsurface Exploration; Retaining Walls; Sheet Pile Walls; Braced Cuts; Piles for Lateral Deformation; Anchored Wall; Shallow Foundations; Footing; Mat Foundations; Deep Foundations; Pile Foundations; Drilled-Pier and Caisson Foundations; Foundations on Difficult Soil; Reinforced Earth Structures; Soil Improvement Techniques.

**İNŞ 508 Stochastic Methods in Hydrology 3+0 7,5**

Principles of Probability Theory; Determination of Probability of Coincidence Events; Distribution of Variability Coincidence; Distribution of Frequencies; Principles of Statistics; Probability Distribution Function; Sampling Distributions and Statistic Hypothesis; Control of Hypothesis; Correlation and Regression; Hydrologic Processes; Classification of Stochastic Processes; Models of Flow Series; Stochastic Methods of Conservation Reservoir

#### **İNS 509 River Hydraulics 3+0 7,5**

Channel Flow and Its Classifications; Description; Types of Flow; River Morphology and Regime; River Survey; Open Channel and their Properties; Kind of Open Channel; Channel Geometry; Geometric Elements of Channel Section; Velocity Distribution in a Channel Section; Energy and Momentum Principles; Energy in Open Channel Flow; Specific Energy; Specific Force; Critical Flow; The Section Factor for Critical Flow Computation; Control of Flow; Flow Measurement; Flow Measuring Structures; Basic Parameters of Two-Phase Flow; Properties and Motion Forms of Fluid and Sediment; Dimensionless Parameters of Two-Phase Flow; Determination of Discharge of Bed Load; Suspended Load and Total Sedimentation; Sand Waves.

#### **İNS 510 Economic Analysis of Engineering Systems 3+0 7,5**

Goals of Engineering Economy; Usage of Resources; Basic Concepts of Engineering Economy; Determination of Choices; Unknown's And Risk; The Effect of Time at Engineering Economy; Parameters of Economic Analysis; Principles of Economic Comparison; Benefits; Determination of Benefits; Expenses; Environmental Impact Assessment; Studies of Environmental Impact Assessment; Optimization; Decision.

#### **İNS 511 Flood Control 3+0 7,5**

Flood Types; Historical Information About Floods; Damages and Losses Brought About By Floods; Relation Floods to Time; Flood Warnings; Remedies of Defense From Floods; Mathematical Modeling of Floods; Rainfall-Runoff Analysis; Infiltration Models; Hydrograph and Derivation of Unit Hydrograph; Flood Routing Trough Reservoir and Channels; Design of Spillway; Flood Measurement; Economic Analysis of Flood Control Project.

#### **İNS 513 Dams 3+0 7,5**

Introduction; Aims of Dams Construction; Hydrology in Dams; Element of Dam Engineering; General; Embankment dam and Types and Characteristic; Concrete Dam Types and Characteristic; Spillways; Outlets and Ancillary Works; Site Assessment and Selection of Dam Type; Load on Dams; Dam Outlet Works; Introduction; The Design Flood; Flood Routing; Sedimentation in Reservoirs; Cavitation; Gates and Wolves; Classification of Gates; Crest Gates; Hydrodynamic Forces Acting on Gates; Spillway; Motion of the Sediment in Dams; Properties of Rock in Foundation; Estimation of Dam Reservoirs Volume.

#### **İNS 514 Planning and Design of Dams 3+0 7,5**

Introduction; Classification of Dams; Parts of Dams; Planning of Dams; Feasibility Study; Planning Study;

Construction of Dams; Evaluation of Time Schedule and Required Equipment; Diversion of River Flow; Foundation Treatment; Concrete Gravity Dams; Stability Criteria; Forces Acting on Gravity Dams; Arch Dams; Type of Arch Dams; Design of Arch Dams; Buttress Dams; Design of Buttress Dams; Effect of Dams to Environments and Ecology; Sediment in Dams; Dam Geology; Dam Foundations; Derivation; Outlet Structures; Spillways; Dams Models; Heightening of Dams; Maintenance and Operation of Dams; Measurement Made on Dams and Failure of Dam.

#### **İNS 519 Water Resources Systems 3+0 7,5**

Water Resources; Introduction; Historical Perspective on Water Resources; A Perspective on Earth and Universe; Water in the Earth Atmosphere System; Principles of Flow of Water; Water Economics; Water Law; System Analysis; Uncertainty and Reliability Analysis; Water Resources Quality; Water Quality; Lakes and Reservoirs; Groundwater; Wetland; Water Resources Supply System; Surface Water Resources System; Groundwater System; Water Treatment System; Water Distribution; Wastewater Collection Systems; Irrigation Systems; Importance of Water Resources Development; Sources of System and System Analysis; Cost-Benefit Analysis; Classical Optimization Methods; Linear Programming; Dynamic Programming; Simulation Sampling Methods; Multi-Purpose Programming; Decision Theory; Cost-Benefit Analysis According to Project Objectives and Feasibility Study.

#### **İNS 520 Advanced Groundwater Hydrology 3+0 7,5**

Definitions and Equations of Groundwater Flow; One and Two Dimensional Steady Groundwater Flows and Their Analytical Solutions; One Dimensional Unsteady Groundwater Flows and Their Analytical Solutions; Numerical Solutions of Flow Equations: Finite Difference and Finite Element Methods; Unsaturated Flows Well Hydraulics; Introduction to Groundwater Contaminant Transport.

#### **İNS 522 Matrix Methods for Computing Structural Systems 3+0 7,5**

Structural Analysis Versus Actual Response; Principle of Virtual Displacements; Principal of Virtual Forces; Betti's Law; Influence Coefficients. Force and Displacement; Transformations; Transformations of Member Flexibility and Stiffness; Fixed end Forces; Automated Matrix Displacement and Force Methods of Structural Analysis; Releases; Substructures; Nonlinear Analysis; Introduction To Finite Element Method (R).

#### **İNS 526 Construction Management 3+0 7,5**

General Definitions and Introduction to Construction Management; Organizations of Construction Companies; Construction Field Management; Organization and Documentation; Project Management and Organization; Project Planning; Resource Analysis and Resources Management; Construction Machinery Usage; Internal Project Communication; Risk Management; Construction Bankruptcy; Construction Contract Systems and Type of

Construction Contracts; Disagreement and Resolving Methods; Labor Relations and Labor Safety.

**İNŞ 528 Construction Cost Analysis and Estimating 3+0 7,5**

Introduction to Construction Cost; Bidding Legislation; Bidding law and Applications; Bidding Types; Qualification for Projects; Preparing Optimum Bid Proposal; Bid Bond; Performance Bond; Exact Ending Cost; Project Acceptance; Punishment Application; Blueprint Reading; Quantity Takeoff; Estimate Application; Bidding Information Systems; Computer Based Bidding Management; Relationship Between Cost and Productivity; Cost Estimate Data Base Management.

**İNŞ 531 Contract and Cost Management 3+0 7,5**

Introduction to Contract Management; Turkish Construction Contract Law; Construction Contract Evaluation; Contract Strategy; Contract Documents; Contract Selection; Contractor Rights; Effect Factors for Decision Support Level; Contract Types; Build Operate Transfer; Design Build Operate Transfer and Finance Build Operate Contract Applications; Resolving Methods for Contract Conflicts; Court Decisions; Contract Risk Evaluation.

**İNŞ 536 Law in Construction Projects 3+0 7,5**

Introduction to Law in Construction Sector, Origins of the Construction Disputes, Construction Claims, Categories of Construction Problems, Resolution of Disputes, Productivity Dispute Relations, Disputes Arises From Project Change Orders, Reflections of Disputes to Parties.

**İNŞ 539 Introduction to Finite Elements 3+0 7,5**

Approximate solution methods: Finite Difference, Finite Element Construction the solution by the Finite Element Method One and Two dimensional problem applications Time dependent one dimensional problems Introduction to nonlinear and three dimensional problems.

**İNŞ 540 Advanced Highway Materials 3+0 7,5**

Nature, Sources And Uses of Bituminous Materials; Production And Classification of Asphalt; Detailed Analysis of Chemical Composition of Asphalts; Chemical And Physical Properties of Asphalt; Tests On Asphalt; Rheology And Behavior of Asphalt; Classification And Properties Of Mineral Aggregates; Tests On Aggregates; Calculation Methods For Aggregate Mixes; Types of Asphalt Aggregate Mixtures And Their Uses In Pavements; Significant Properties And Design of Asphalt Aggregate Paving Mixtures; Modified Asphalt Mixtures; Surface Treatments; Intensive Laboratory Studies And Field Application;

**İNŞ 541 Advanced Pavement Design 3+0 7,5**

Theories, Principles And Practice In The Structural Design And Construction of Highway And Airport Pavements Including Stabilization Techniques; Pavement Types, Wheel Loads And Design Factors; Stresses In Flexible Pavements; Stresses In Rigid Pavements; Vehicle And Traffic Consideration; Climate, Environment; Materials

Characterization; Sub grades; Bases And Sub bases; Bituminous Surfaces; Design of Pavement Evaluation Performance Evaluation Surveys And The Design of Asphalt Mixtures; Rigid Pavement Design; Design of Flexible Airport Pavements; Design of Flexible Highway Pavements; Design of Rigid Airport Pavements; Design of Rigid Highway Pavements; AASHTO Design Methods; Shell Method.

**İNŞ 542 Neural Network Applications In Transportation Engineering 3+0 7,5**

Formal Definition of Artificial Neural Networks; Simple Introduction To Neural Networks; Types of Artificial Neural Networks; Application Fields of Artificial Neural Networks; Some Basic Neural Network Theories; Kohonen Networks; Vector Quantization And K-Means; Self Organizing Map; Learning Vector Quantization; Other Kohonen Networks; The Architecture; That Means Layers And Neurons In Artificial Neural Networks; Back-Propagation Algorithm; Some Major Drawbacks of The Back-Propagation Algorithm; Applications of Artificial Neural Networks In Science; Special Applications of Neural Networks In Transportation Engineering; Applications of Some Computer Programs With The Related Subject; The Evaluation Techniques of These Computer Programs.

**İNŞ 543 Theory of Elasticity 3+0 7,5**

Analysis of Stress and Strain; Fundamental Equations in Theory of Elasticity; Stress Problem; Displacement Problem; Compatibility Conditions; General Theory of Plane Elasticity; Plane Stress (Thin Plate Problem); Plane Strain (Long Cylinder Problem); Solutions in Cartesian Coordinates; Stress Functions; Airy Stress Function; Boundary Conditions; Polynomial Solutions; Biharmonic Functions; Examples: Fourier Series Solutions; Examples: Solutions in Polar Coordinates; Examples.

**İNŞ 544 Structural Dynamics 3+0 7,5**

Seismic Hazards; Structural Deficiency; Soil Effects; Capacity Demand Concept; Step by Step Nonlinear (Pushover Analysis); Plastic Hinge Demand; According to FEMA 356; Response Spectra; Performance Point; Evaluation Procedure A;B And C; Retrofit.

**İNŞ 545 Advanced Structural Analysis 3+0 7,5**

Fundamentals of Flexibility Method: Joint displacements, Member end-actions and support reactions; Flexibilities of Prismatic Members; Formalization of Flexibility Method; Stiffness Method; Temperature Changes; Restraint and Support Displacements; Stiffness of Prismatic Members; Stiffness Matrices; Load Vector; Application to Plane Frame and Plane Truss Members; Additional Topics for Stiffness Method.

**İNŞ 546 Theory and Design for Tests and Measurements on Construction Materials 3+0 7,5**

Introduction, needs for tests and measurements, types and basic properties of construction materials, design for testing and measurement, types of tests on structural materials;

standard, destructive, semi-destructive, and nondestructive methods, evaluation of test results, relevant standards and specifications.

**İNS 547 Urban Hydrology and Hydraulics 3+0 7,5**  
Urban Climate; Hydrological Consequences of Urbanization; Design Hyetograph; Rainfall Losses: SCS method, Green and Ampt method; Rational Method; Overland Flow; Hydraulic Routing; Overview of Important Computer Models.

**İNS 548 Applications of Geosynthetics 3+0 7,5**  
Introduction; Basic Information on Geosynthetics; Geotextile Functions: Properties and test methods; Road and Railway (separation) Applications: Filtration, Drainage and erosion control applications; Soil Reinforcement Applications; Geomembranes;

**İNS 549 Deep Excavations and Retaining Structures 3+0 7,5**  
Earth Retaining systems for deep Excavations; Water Pressure Acting on Earth Retaining Systems and Related Problems; Lateral Earth Pressure Acting on Earth Retaining Systems; Lateral Supporting Elements: Ground anchors and struts, Types, Components, Production and installation, Dimensioning, Bearing capacity, Corrosion protection, Testing and pre-stressing anchors; Lateral and Vertical Displacements of Adjacent Ground; Modes of Failure of Retaining Systems; Sloped Excavations in Soil and Rock; Instrumentation and Monitoring of Deep Excavations; Soil Nailing: System description and design.

**İNS 551 Repair and Strengthening of Structures 3+0 7,5**  
Introduction; Assessment, Evaluation and Classification of Damage; Earthquake Damages: Wall damages, Slab, Beam, Column, Beam-Column Connections, Shear Wall and Foundation; General Principles of Repair: Repairing of Structural Elements; Repair and Strengthening Materials; Surface Preparation and the Use of Repair Mortars; Repair and Strengthening By Using Shot Crete, Epoxy Resin, Steel Plates and Carbon Fiber Reinforced Plastics; General Principles of Strengthening; Design of Strengthening Elements; Jacketing of Columns; Additional Shear Walls; Strengthening of Foundations; Strengthening Details of Structural Element; Repair and Strengthening of Masonry Structures; Rehabilitation of Structural Systems; Evaluation of Earthquake Safety of Available Structures.

**İNS 552 Advanced Railway Design 3+0 7,5**  
Rail transport systems; Types and features of rolling stocks; Generalized equation of train's motion; Propulsion resistances; Stages of train movements, acceleration, cruising and deceleration; Track layout and geometry; Sub grade and Drainage; Railway superstructure, sub-ballast, ballast, sleepers, rails and fastenings; Load distribution and wheel-rail interaction; Type of track cross-sections; Expansion and dilatation of rail; Railway track capacity; Advances in railway technology, high-speed rail, ballastless track system, ?smart? systems for vehicle and track health

monitoring, advances in propulsion and energy sources, noise and vibration controls.

**İNS 553 Advanced Highway Design 3+0 7,5**  
Highway Systems; Characteristics of Vehicles and Drivers; Characteristics of Traffic; Climbing Lane Design; Geometric Characteristics of Highways: Route choice, Sight distance criterion, Zero Line application, Compound and reverse curves, Horizontal alignment; Special Applications About Transition Length and Super Elevation; Transition Curves; Spirals; Vertical Alignment; Cross Section Elements; Cross Section and Volume Calculations; Special Applications about Mass Diagrams; Cost of Hauling; Introduction to in Roads Software and a Basic Application; Types of Pavements; Properties of Asphalt Concrete; Properties of Portland Cement Concrete; Pavement Thickness Designation: AASHTO 2002 Design Methods (Flexible And Rigid), Other Pavement Design Approaches; Properties of Asphalt Concrete; Surface and Subsurface Drainage; Culvert Design.

**İNS 554 International Construction Project Management 3+0 7,5**  
Globalization; The Structure of the International Construction Industry; International Strategic Alliances; International Construction Project Finance; International Standards; FIDIC Contracts; Disputes and Resolution Methods; Risk Management in International Construction Projects; Cultural Differences in International Construction Projects; Human Resources Management in International Construction Projects; Models Used in Multi-National Companies; Project Management in different Countries; Case Studies.

**İNS 555 Advanced Concrete Technology 3+0 7,5**  
Introduction; Concrete Making Materials; Cements; Types of Cements; Portland Cement; Aggregates; Admixtures; Mixing Water; Concrete Casting; Cold Weather Concrete; Hot Weather Concrete; Mass Concrete; Roller Compacted Concrete; Self-Compacted Concrete; Preplaced Aggregate Concrete; Underwater Concrete; Geopolymer Concrete; Fiber Reinforced Concrete.

**İNS 556 Plastic Design of Steel Structures 3+0 7,5**  
Introduction to Limit States Design; Comparison with Allowable Stress Design; Resistance Of Cross-Section Under Simple and Combined Forces; Interactions; Stability Controls; Limit Loads for Structural Systems; Mechanism and Step-By-Step Methods and Examples; Connections

**İNS 557 Soil Structures and Ground Improvement Techniques 3+0 7,5**  
Introduction; Retaining Structures; Earth Pressures; Effects of External Loads; Rigid Support Systems; The Mechanics and Construction of Reinforced Earth; Flexible Retaining Structures; Anchors; Calculation of Steel And Shot Crete Retaining Structures; Deep Vibro Techniques; Dynamic Compaction; Cement Grouting; Jet Grouting; Compaction



Grouting; Lime And Lime/Cement Columns; In Situ Soil Mixing.

**İNS 558 Hydrology of Floods and Droughts 3+0 7,5**

Hydrology of Floods: Introduction, The factors affecting flooding, rainfall-runoff relationships, methods of flood forecasting, regional flood frequency analysis, the displacement of flood, flood management. Hydrological drought: Input, Low flow and drought periods, low-flow analysis, analysis of the dry period, drought management.

**İNS 559 Hydrologic Modeling 3+0 7,5**

Basin delineation and determination of basin characteristics using Geographic Information Systems; Introducing hydrologic model types; Examples and computer applications; Hydrologic modeling routines; Precipitation, soil; runoff, routing; Model calibration and validation concepts; Manual and automatic calibration; Objective function, optimization; Goodness of fit tests for model performance

**İNS 560 Bituminous Mixtures Design and Technology 3+0 7,5**

Selection of Aggregates and Binders for Asphalt Mixtures; Engineering Properties of Bituminous Mixtures and Their Relation to Pavement Performance; Conventional Mix Design Methods: Marshall design method; Developments in Bituminous Mixtures Technology: SUPERPAVE mix design method; Type of Bituminous Mixtures: Asphalt concrete mixtures, Surface coating, Stone mastic asphalt (SMA), Porous asphalt pavements, Sullury seal, Mastic asphalts; Methods of Recycling Asphalt Pavement; Mixture Production and Construction; Quality Control; Pavement Performance and Management; Pavement Maintenance and Rehabilitation.

**İNS 561 Pavement Maintenance-Rehabilitation and Recycling Strategies 3+0 7,5**

Flexible and Rigid Pavement Structure; Layers and Properties of Pavement; Properties of Subgrade Soil, Pavement Drainage; Pavement Distress: Definition, Development of mechanism; Preventative Maintenance Practices: Sealing cracks, Full-depth repair, Seal coating, Technology and tools, Examples of preventative maintenance program; Techniques for Reconstruction of Pavement; Recycling Pavement Materials: Recycling methods of asphalt pavements: Cold planning, Hot recycling, Hot in-place recycling, Cold in-place recycling, Full-depth reclamation.

**İNS 563 Advances in Sediment Transport Research 3+0 7,5**

Properties of Sediment; Hydraulics of Open Channel Flow; Characteristics of Turbulent Flow; Sediment Movement: State of the art in the initiation of granular material movement, Measures of sediment transport, Relationship between movable bed and turbulent flow, Up-to-date sediment transport rate calculations; Experimental Investigation of Sediment Transport in Laboratory and

Field, New Methods; Interaction Between Sediment Transport and Erosion/Deposition and Details about Such Engineering Projects.

**İNS 565 Cold-Formed Steel Structures 3+0 7,5**

Introduction, General concepts; Manufacturing Process of Cold-Formed Steel; Design of Thin Planar Compression Members; Design of Cold-Formed Flexural Members; Design of Cold-Formed Members Subject to Concentric Compressional Load; Design of Cold-Formed Members Which May Be Subject to Torsional-Flexural Buckling; Design of Beam Columns, Connections; Current Design Codes for Cold-Formed Steel; Structural Behavior of Cold-Formed Steel.

**İNS 567 Experimental Methods in Advanced Fluid Mechanics 3+0 7,5**

Principles of Advanced Fluid Mechanics: Hydraulics of pipe and open channel flows, Turbulent flow; Instrumentation and Techniques for Laboratory and Field Investigations of Flow Parameters: Experimental matrix and sensor selection, Principles for acquiring digital signal; Digital Signal Analysis: Exploratory data analysis, Analysis of data using probabilistic methods, Data visualization techniques, Engineering computing applications in hydraulic engineering using numerical computing software; Introduction to Numerical Modeling.

**İNS 569 Design of Composite Structures 3+0 7,5**

Behavior and Design of Steel-Concrete Composite Members for Buildings: Composite slabs, Beams, Columns and frames; Methods of Analysis and Design: Plastic moment of resistance, Elastic moment of resistance, Longitudinal shear, Vertical shear, Deflection, Vibration, Crack-width control, Transverse reinforcement, Punching shear, Full and partial shear composite behavior; Behavior and Design of Shear Connectors: Ductile and non-ductile connectors; Continuous Beams and Slabs; Lateral Buckling; Connections.

**İNS 592 Seminar 3+0 7,5**

**İNS 599 Term Project 3+0 15,0**

**İNS 605 Mechanics of Continua I 3+0 7,5**

Tensors and Tensor Analysis; Strain (Coordinates, Base Vectors; Deformation Gradients and Tensors; Strain Tensors and Deformation Tensors; Strain Invariant and Principal Directions; Rotation; Area and Volume Changes); Motion (Motion; Time Rates of Vectors; Velocity end Acceleration, Material Derivative of the Element of arc; Surface and Volume; Kinematics of Line; Surface and Volume Integrals; Strain Rate); Stress (External and Internal Loads, Stress Hypothesis; Stress Tensor; Principles of Balance of Local Momentum).

**İNS 606 Mechanics of Continua II 3+0 7,5**

Stress and Strain; Thermodynamics of Continuous Media (Principle of Conservation of Energy; Potential Energy and Strain Energy; Entropy; Principle of Entropy; Thermodynamics Restrictions on Elastic Solids and Viscous Fluids); Constitutive Equations (The Need For Constitutive Equations; Axioms of Constitutive Theory; Thermo mechanical Materials; Elastic Materials; Isotropic Elastic Materials; Stokesian Fluids; Thermo elastic Solids); Theory of Elasticity (Linear Constitutive Equations; Restrictions on Elastic Coefficients; Experimental Determination of Elastic Constants); Fluid Dynamics; Thermo elasticity.

**İNS 607 Soil Behavior 3+0 7,5**

The nature of Soil; Bonding; Crystal Structure; and Surface Characteristics; Soil Mineralogy; Soil Formation and Soil Deposits; Determination of Soil Composition; Soil Water; Clay-Water-Electrolyte Systems; Soil Fabric and its Measurements; Soil Behavior; Soil Composition and Engineering Properties; Effective; Inter granular and Total Stress; Soil Structure and its Stability; Fabric; Structure Relationships; Volume Change Behavior; Strength and Deformation Behavior.

**İNS 611 Earthquake Engineering 3+0 7,5**

Earthquake Mechanism; Spectrum Concept; Multi Degree of Freedom System; Modal Analysis in Earthquake Response; Earthquake Resistant Design; Main Philosophy of Earthquake Codes; Earthquake Codes and Design Criteria; Spectral Analysis of Structures and Simplified Approaches; Behavior of Reinforced Concrete Structures Subjected to Earthquake Ground Motion; Plastic Hinge Concept; Capacity Concept in Design; Earthquake Resistant Design; Safety to Earthquakes; Limit States; General Behavior of Structures; Structural Irregularities; Design Spectra; Elastic Equivalent Earthquake Load; Effect of Earthquake Load; Acceleration Spectrum; Ductility of Structures; Equivalent Earthquake Load; Modal Superposition Method; Structural Systems; Construction Rules for Reinforced Concrete Structures; Story Displacements; Design of Base Isolated Structures; Retaining Walls.

**İNS 614 Project Management 3+0 7,5**

Introduction to Project Management and General Definitions; Project Management Responsibilities and Rights; Super Responsibilities and Rights; Project Classifications; Basic Structure of Project Organization; Organizational Work Flow; Classic Organizations; Developed Organizations; Matrix Organizations; Management Functions; Management for Employee; Managers Skills; Level and Work Definitions; Group and Team Management; Overcome Individuals Problems; Time Management; Project Planning; Comply Planning; Risk Management; Risk Identification; Evaluation; Classification; Manage; Quality Management.

**İNS 615 Quality Management in Construction 3+0 7,5**

Basic Concepts and Definitions; Quality Economy for Construction Sector; Quality Movement in Construction Business; Quality Leadership; Taguchi Approach; Quality Control Tools; Six Sigma Applications; Quality Circles; Quality Strategies and Quality Management for Clients; Quality Responsibilities; Production Quality Relations; Marketing Quality Relations; Total Quality Management and Applications.

**İNS 616 Computational Hydraulics 3+0 7,5**

Elements of Numerical Analysis; Introduction; Definition and General Concepts; Numerical Approximation and Interpolation; Numerical Integration; Numerical Solution of Partial Differential Equation Common in Hydraulics; Form and Occurrence of Some Partial Differential Equations; Numerical Solution of Parabolic Equations; Flow in Closed Conduits; Mathematical Models for Steady Flow in Pipes and Pipe Networks; Non Steady Flow; Open Channel Flow; Mathematical Models for Non- Steady Flow in Open Channels.

**İNS 621 Soil Dynamics 3+0 7,5**

Vibration of Elementary Systems; Wave Propagation in Elastic; Homogeneous and Isotropic Soils; Wave Propagation in Soil; Elastic Waves in Layered Soils; Wave Propagation in Saturated Soils; Dynamic Properties of Soils; Soil Behavior Under Earthquake; Settlement of Soil Due to Earthquakes; Liquefaction in Soil; Laboratory and Field Measurements.

**İNS 622 Measurement of Soil Properties 3+0 7,5**

Measurement of Engineering Properties of Soils in Laboratory and Field; Measurement of Shear Strength, : Compressibility and Permeability; Measurement Techniques in the Laboratory; Field Tests for Determining Shear Strength for Compressibility; Field Permeability Tests in Cohesive Soils; Basic Field Instruments in Soil Engineering and Principles of Measurement.

**İNS 623 In-situ Testing of Concrete 3+0 7,5**

Introduction; Needs for Testing Concrete; Quality Control of Concrete in Structures; Types and Basic Properties of Concrete; Design for Testing; Types of Tests on Concrete: Standard tests; Cube and cylinder tests, Destructive tests; Core test, Cast-in-place cylinder test, Semi-destructive tests; Pull-out test, Pull-off test, Break off test, Penetration resistance test, Internal fracture test, Nondestructive tests; Rebound hammer test, Ultrasonic pulse velocity test; Electric Resistance of Concrete; Radar Imaging of Concrete; Evaluation of Test Results; Relevant Standards and Specifications.

**İNS 626 Cross-Cultural Management in International Construction Projects 3+0 7,5**

Basic concepts of culture; Dimensions of culture; Organizational culture; National culture; High context?low context cultures; Monochronic?polychronic cultures; Cultural differences in international construction projects; Multicultural project teams in construction projects; Models used in multicultural organizations; Doing business with different cultures in construction projects; Cross-cultural

communication; Cultural differences and project success in construction projects; Effects of cultural differences on management practices; Culture shock; Cross-cultural training; Cross-cultural management in international construction projects.

**İNS 627 Advanced Labor Health and Job Safety Management 3+0 7,5**

Health and safety in construction; Workplace safety; Accident investigation and prevention; Occupational illnesses; Construction safety training methods; Types of construction accidents; Minor injury, major injury and fatal accident scenarios; Preparation of cartoons and animations; Investigation and analysis of construction accident statistics; Case studies.

**İNS 628 Knowledge Management in Construction 3+0 7,5**

Basic concepts of knowledge; Types of knowledge; Knowledge conversion processes; Fundamentals of knowledge management; Knowledge management strategies; Knowledge management tools; Knowledge management techniques and technologies; Knowledge management systems; Success in knowledge management; Knowledge management applications; Classification of knowledge in construction industry; Knowledge management cycle in construction projects; Knowledge transfer and knowledge sharing in construction projects; Knowledge management methods of construction firms; Advantages of knowledge management to construction firms; Barriers to knowledge management in construction projects; Knowledge management applications in construction projects.

**İNS 629 Pavement Management Systems 3+0 7,5**

Introduction to Pavement Management; Inventory Techniques; Distress surveys, Pavement condition surveys, Strength surveys, Friction survey, Ride quality survey; System Maintenance Strategies; Needs determination, Linear programming in pavement management; Rehabilitation and Maintenance Strategies; Priority Programming in Rehabilitation and Maintenance: Prioritization by weighting and combining, Prioritization by analytical hierarchy process; Project Selection Techniques; Project level design, A framework for pavement design, Physical design inputs; Variability, Reliability and Risk in Pavement Management System; Generating Alternative Design Strategies.

**İNS 630 Experimental and Computational Methods to Characterize Bituminous Materials 3+0 7,5**

Introduction to the Design and Performance Prediction of Asphalt Mixtures; Experimental and Computational Methods Used to Characterize Mechanical Properties and Performance of Bituminous Materials; Performance Modeling at Different Length Scales, Micro and Mezzo Scale Characterization; Characterization of Mix Microstructure; Internal Micro-structure; Mechanisms of Distresses and Techniques to Characterize Distresses:

Fatigue cracking, Moisture damage, Permanent deformation.

**İNS 631 Design of Seismic Isolated Structures 3+0 7,5**

Introduction: Basic concepts, History of seismic isolation; Principles of Seismic Isolation: Earthquake response spectra, Effects of seismic isolation, Linear and bilinear isolation systems, Energy dissipation; Analysis Methods in Isolated Structures: Modification of response spectrum, Time history analysis method; Isolator Devices: Friction pendulum systems, Lead rubber bearings; Mechanical Properties of Lead Rubber Bearings: Effect of loading history, Effect of velocity, Heating of lead core; Design of Elastomeric Bearings: Stability of elastomeric bearings, Design of reinforcing shims, Checks for design earthquake; Testing of Seismic Isolators; Prototype testing, Acceptance criteria.

**İNS 633 Hydrological Forecasting and Early Warning Systems 3+0 7,5**

Role of Real-Time Flood Forecasting and Warning in Flood Risk Management, Principles and Theory Underlying Flood Forecasting Methods, Overall System Design; Hydrological Data Systems: Monitoring systems, Data collection, Data processing, Data archiving; Precipitation Forecasting: Rainfall observations, Radar, Satellite products, Models; Real-Time Flood Forecasting Methods: Empirical, Transfer function, Rainfall runoff models, Flood routing models; Uncertainty in Flood Forecasts; Early Warning Systems: Flood forecast translation, Improvements in decision support systems; Data Assimilation: Combining data from different sources, Application of Kalman and ensemble Kalman filter; Case Studies for Real-Time Flood Forecasting and Warning Practice.

**İNS 635 Seismic Performance Assessment of Buildings 3+0 7,5**

Structural System: Structural members, Structural irregularities; Seismic Behavior of Buildings: Seismic hazard assessment, Strong ground motion properties, Structural damage, Non-structural damage; Structural Member Behavior: Material models, Moment curvature analysis, Interaction diagrams and surfaces; Structural Analysis: Linear elastic analysis, Modal analysis, Pushover analysis, Time history analysis; Condition Assessment: Building geometry, Member details, Material properties; Performance Assessment of Existing Buildings: Walk-down assessment, Preliminary assessment, Detailed assessment; Strengthening Methods; Component strengthening, System strengthening.

**İNS 637 Remote Sensing and Geographic Information Systems Applications in Water Resources 3+0 7,5**

Principles of Remote Sensing and Geographic Information Systems: Digital image interpretation and spatial data analysis; Mapping of Surface Water Systems; Determination of Evaporation, Soil Moisture and Snow Patterns; Hydrologic and Hydraulic Processes: Data collection, Data processing; Hydrologic/Hydraulic Modeling: Determination of flood magnitudes and flood

risk zones, Developing decision support tools for water resources; Statistical Data Analysis/Uncertainty; Case Studies of RS/GIS Applications in Water Resources Management.

**İNS 790 Thesis** **0+1 30,0**

**İNS 890 Thesis** **0+1 30,0**

**İST 505 Econometric Analysis** **3+0 7,5**

Simultaneous-Equation Models; Simultaneous Dependence of Economic Variables; Consequences of Simultaneous Relations; Solution to the Simultaneous-Equation Bias; Identification: the Problem of Identification; Formal Rules for Identification; Identifying Restrictions; Tests for Identifying Restrictions; Simultaneous-Equation Methods; Reduced-Form Method or Indirect Least Squares; The Method of Instrumental Variables; Two-Stage Least Squares; Mixed Estimation Methods; Mixed Estimation Methods; Restricted Least Squares; Pooling Cross-Section and Time-Series Data; Durbin S Generalized Least Squares; Theil and Goldbergers Mixed Linear Estimation; The Method of Principal Components.

**İST 506 The Theory of Measure and Probability** **3+0 7,5**

Lebesgue Measure of Plane Sets; The Concept of General Measure; Extension of Measure Defined on a Semiring to a Measure Defined on the Ring; Additivity and s-additivity of Measure; Measurable Functions; The Lebesgue Integral; Stieltjes Measures; The Lebesgue-Stieltjes Integral; Classification of random Variables for Distributions: Discrete, absolutely continuous and singular distributions; Applications of the Lebesgue-Stieltjes Integral to Probability Theory: Expressions of Mathematical Expectation and Variance of Random Variables by Lebesgue-Stieltjes Integral.

**İST 507 Circular Data Analysis** **3+0 7,5**

Circular Data: Diagrammatical representation, Forms of frequency distributions, Examples of directional data; Descriptive Statistics: Measures of location, Measures of concentration and dispersion, Trigonometric moments; Circular Probability Distributions: Uniform distribution, Cardioids distribution, wrapped normal distribution, circular normal distribution; Estimation of Parameters; Tests for Mean Direction and Concentration: Single sample tests, Two and multi-sample tests; Circular Correlation and Regression: Measures of Correlation, Regression models.

**İST 510 Nonparametric Statistical Techniques** **3+0 7,5**

The Properties of Nonparametric Techniques; Usage Purposes; Utilities; Limitations; One Sample Non Parametric Techniques; Binomial Test; Sign Test; Rank Sign Test of Wilcoxon; Runs Test; Independent Two samples; Median; Mann-Whitney; Small and Large Sample Tests of Kolmogorov-Smirnov; Dependent Two Sample Tests; Sign; Rank Sign test of Wilcoxon; McNemar Test for Repeated Data; Kruskal-Wallis Test for a Few Samples.

**İST 511 Advanced Regression Analysis** **3+0 7,5**

Regression Analysis With Matrixes and General Regression Theory and Model Validity; Regression With Dummy Variables; Analysis of Covariance; Comparison of Homogeneity of Two Regression Equations; Examining the Error Terms and Regression Problems; Transportations Used in Regression Analysis; Multiple Colinearity Problem; Biased Estimation Techniques; Ridge Regression; Non-Linear Regression; Calibration; Prediction Intervals.

**İST 512 Artificial Neural Networks and Statistics** **3+0 7,5**

Description of Artificial Neural Networks (ANN): Network Architecture, Activation Function, Training Algorithm; Simple ANN Algorithms in Sample Classification: Hebb, Perceptron Net; Some Applications: Connections with Regression and other Statistics Methods; Delta Rule; Multi-layer Perceptron: Back Propagation Algorithm, Generalized Delta Rule; Nonlinear Regression and Multi-layer Perceptron.

**İST 514 Advanced Statistical Techniques for Researchers** **3+0 7,5**

Location and Dispersion measurements for Different Measures; Comparison of Sample Distribution With Theoretical Distribution; Contingency Table; Design; Investigation; Levels of Relations Between Variables; Relations Between Differently Measured Data Sets; Linear Regression and Correlation Coefficient; Estimation of the Population Parameters; Significance of Correlation Coefficients; Basics of Experimental Design.

**İST 517 Multiple Relation Techniques for Questionnaires Analysis** **3+0 7,5**

Dependent and Independent Variables and their Importance to be Identified In Surveys; Linear Relationships Between Variables; Qualitative and Quantitative Properties; Confidence Intervals for the Relationships; Examination and Interpretation; Inference; Some Special Properties of the Variables; Multi collinearity; Interpretation of the Results; Examination of the Applied and Interpreted Surveys; Critique and Review; Some Applications.

**İST 520 Maximum Entropy Method and Its Applications** **3+0 7,5**

Maximum entropy (MaxEnt) method, MaxEnt method for discrete random variables, MaxEnt method for continuous random variables. Entropy: Joint entropy and conditional entropy. Information: Relative entropy and information. The maximum entropy distribution, Application of MaxEnt Method, Application to statistics, Application to economics, Application to regional and urban planning.

**İST 521 Continuous Markov Processes** **3+0 7,5**

Stochastic Processes; Markov Processes; Poisson Processes; Markov Property; Properties of the Transition Probabilities; Ratio Matrix and Kolmogorov's Differential Equations; Limit Distribution; Birth and Death Processes; Pure Birth Processes; Branching Processes; Generating Processes in Branching Processes; Probability of Lost Call and Lost Call Time.

**IST 522 Stochastic Processes 3+0 7,5**

Multi-Dimensional Stochastic Variables; Expected Values of Random Variables; Moment Generating Functions; Characteristic Functions; Limit Theorems about Probability Theory; Conditional Probabilities; Probability Generating Functions; Random Sums; Laplace Transforms of Probability Distributions; Stochastic Processes; Markov Chains for Discrete and Continuous Parameter Spaces; Transition probabilities, Probability matrices; Exponential Distribution and Poisson Process, Birth and Death Process; Queuing Theory and Models.

**IST 523 Nonparametric Models With Spline Regression 3+0 7,5**

Introduction to Nonparametric Regression; Roughness Penalty Approach in Regression; Spline Functions, Signifying Spline Functions as the Sum of Basis Functions; Introduction to R, Solution of Linear and Generalized Linear Models in R; Applications of Nonparametric and Semiparametric Models with Spline Regression in R.

**IST 524 Generalized Additive Models With Spline Regression 3+0 7,5**

Additive Models, Estimating Equations; Generalized Linear Models (GLMs); Generalized Additive Models (GAMs); Algorithms of GAM Solutions; Selection of Smoothing Parameters, Degrees of Freedom; Specification of Knots and Basis Functions; Additive and Generalized Additive Model Applications in R; Applications of Suitable Model Selection for A Specific Model.

**IST 526 Advanced Experimental Design 3+0 7,5**

Factorial Models with Mixed Levels; Factors at Two and Three Levels; Factors at Two and Four Levels Nested and Split-Plot Designs; The Two-Stage Nested Design; The M-Stage Nested Design; The Split-Plot Design; The Split-Split-Plot Design; Response Surface Methods; Location of the Stationary Point; Characterizing the Response Surface; Ridge Systems; Multiple Response; Experimental Designs for Fitting Response Surface; Mixture Experiments; Evaluatory Operation; Taguchis Contributions to Experimental Designs.

**IST 528 Probabilistic Mixture Theory 3+0 7,5**

Lebesgue Measure; Lebesgue Integral; Stieltjes Measure; Lebesgue- Stieltjes Integral; Characteristic Functions of Random Variables; Definition of Mixture Distribution; Identifiability of Mixture Distribution Theorem; Poisson and Binomial Mixture Distribution; Normal Mixture Distribution; Exponential Mixture Distribution; Maximum Entropy Mixture Distribution; Parameter Estimation Methods for Mixture Distribution; Some Software for Mixture Distribution.

**IST 530 Theory of Statistics 3+0 7,5**

Probability theory. Probability distribution; Discrete and continuous distributions, multivariate distributions. Some inequalities; Markov, Chebyshev, Hölder, Minkovski, and Jensen. Principle of data reduction; the sufficient principle, likelihood principle. Point Estimation. Methods of finding an estimator; Method of moment, maximum likelihood

asymptotic properties of maximum likelihood, fisher information matrix, Bayes estimators, invariant estimator. Methods of evaluating estimators; Mean square error, best unbiased estimators. Hypothesis testing; methods of finding test, likelihood ratio test, Walt test, Lagrange multipliers test, invariant test, bayesian test, asymptotic distribution of LRTs. Methods of evaluating test; Power function, unbiased and invariant test. Interval estimation; Methods of finding interval estimator.

**IST 531 Linear Models 3+0 7,5**

Concepts of Matrix Algebra; Orthogonality, eigenvalues and rank, idempotent matrices, derivatives of matrices and vectors. Quadratic Forms and their Distributions; Expectation and variance of quadratic forms, distributions of some special quadratic forms, independence of quadratic forms. Estimation in Full-Rank Model; Least squares estimators and maximum likelihood estimators, interval estimation, generalized least squares. Hypothesis Testing in Full-Rank Model; Model adequacy, partial and sequential tests, general hypothesis, likelihood ratio criteria. Estimation in Less-than-Full-Rank Model; Conditional inverse, a less than full rank model, estimability, estimating variance in less-than-full-rank model, interval estimation. Hypothesis Testing in Less-than-Full-Rank Model; Hypothesis testing in a general setting, one-way classification model, hypothesis testing on a treatment contrast, two factor design (fixed effect) with interaction and without interaction. Analysis of Covariance. I

**IST 532 Fuzzy Statistical Methods 3+0 7,5**

Aristotle Logic, Fuzzy Logic and Uncertainty; Possibility and Probability Theory; Basics of Fuzzy Set Theory: Fuzzy sets, Crisp sets, Fuzzy logic membership functions: Description of membership function; Fundamental Definitions in Fuzzy Set Theory: Support sets, Normality,  $\alpha$ -cuts, Fuzzy numbers, Convex sets; Fuzzy Sets Operations: Fuzzy union operators, Fuzzy intersection operators,  $\alpha$ -cuts set operations with fuzzy numbers; Fuzzy Inference Systems: Adaptive neuro fuzzy inference systems (ANFIS); Fuzzy Statistical Methods and Interdisciplinary Applications.

**IST 533 Fundamentals Statistics 3+0 7,5**

Definition of statistics and its functions: Obtaining data sets, Presentation, Examining the distributions; Sampling: Sampling errors, Inference; Hypothesis tests; Hypothesis tests for two populations; Comparison of the ratios; Hypothesis tests for large and small sample sizes; Chi-square distribution and Chi-square test for relations between the qualitative variables, Definition of Correlation; Simple linear correlation coefficient and its function, Regression coefficient and its function, Determination coefficient, T and F tests.

**IST 536 Statistical Softwares 3+0 7,5**

Software for Data Analysis; Introduction; Statistical software; Introduction to Minitab; Running Minitab; Minitab Menus; Data input; Data Copy; Data Import and Export; Ordering of Data; Calculator; Data Simulation; Matrix; Calculation of Descriptive Statistics; Graphs; Time

Series Graphics; Probability Plots; Commands in Minitab; Saving to Output File; Introduction to SPSS; SPSS Menus; Data Input; Data Copy; Determination of Variables; Add New Variable; Remove Variable; Calculate; Cross Tabulation.

**İST 537 Actuarial Models 3+0 7,5**

Calculation of Premiums: Individual and pooled risk models; Measuring Risk: Coherent risk measures; Dependence Between Risks: Sklars representation theorem; Premiums for Deductibles and Maximum Limits; Calculation of Bühlmann Premiums; Extreme Value Analysis; Generalized Additive Loss Models; Testing Fit of Loss Models by Kolmogorov-Smirnov Test; Measuring Risk with MCMC Methods; Analyzing Loss Tables; SAS Applications.

**İST 539 Statistical Simulation 3+0 7,5**

Concepts of System, Model and Simulation; Random Number Generators: Linear congruential generators; Examination of Some Properties of the Generated Numbers: Run and Gap tests; Generation of Random Numbers from Probability Distribution: Inverse transformation, acceptance-rejection and decomposition methods; Simulation of Some Discrete and Continuous Distributions and Matlab Applications: Binom, Poisson, Gamma; Univariate and Multivariate Normal Distribution; Simulation for Statistical Inference and Matlab Applications: Parameter estimation, Hypothesis test and some applications; Bootstrap and Jackknife Methods and Matlab Applications; Monte Carlo Integration.

**İST 541 Time Series Analysis with Application 3+0 7,5**

Fundamental Concepts of Time Series; Time series components/trend, Seasonality, ACF-PACF/autocorrelation tests Bartlett, Box-Pierce Q, Ljung-Box Q, AR-MA-ARMA models and Box-Jenkins methodology; Stationarity and Unit Root Tests; Applications with E-views; Structural Break and Structural Break Tests; Applications with E-views; Co-integration and Co-integration Tests; Applications with E-views; Error Correction Models; Causality in Time Series; Granger Causality; VAR Models, Choice of Degree in a VAR Model; Control of Sufficiency; VAR Impact-Response Function; Vector Error Correction Models.

**İST 592 Seminar 3+0 7,5**

**İST 604 Econometric Models 3+0 7,5**

Traditional Econometric Methodology; The Traditional View of Econometric Modeling; Under fitting a Model; Over fitting a Model; Tests of Specification Errors. Alternative Econometric Methodologies; Learner's Approach to Model Selection; Hendry's Approach to Model Selection. Selected Diagnostic Tests; The Discrimination Approach; The Discerning Approach. Logit; Probit and Tobit Models.

**İST 608 Mathematical Methods of Statistics 3+0 7,5**

Line Integrals; Functions of Complex Variables; Derivative and Integral; Power Series; Characteristic Functions of Distributions; Inverse Transformations for Characteristic Functions; Uniqueness Theorem for Characteristic Functions; Continuity Theorem for Characteristic Function in  $R^1$  and  $R^n$ ; Some Convergence Theorems; The Normal Distribution in  $R^n$  and Some Distributions Connected with Them; Tests of Goodness of Fit; Pearson Theorem.

**İST 610 Conjoint Analysis 3+0 7,5**

Some Concept Related to Conjoint Analysis: Factor (Attribute), Interattribute correlation, Level, Orthogonality, Trade-off method; Comparing Conjoint Analysis with Other Multivariate Methods; Stages of Conjoint Analysis: Research question and objectives, Designing a conjoint analysis experiment, Assumptions of conjoint analysis, Estimating the conjoint model and assessing overall fit, Interpreting the results, Validation of the conjoint results; Conjoint Analysis with a Large Number of Factor.

**İST 611 Pearson System I 3+0 7,5**

Statistics and Decision Making Theory; Explaining the Decision Problem; Solution Stages in the Decision Problem; Univariate Frequency Distributions; Frequency Distributions; Moments; Density Functions; Pearson System in Frequency Distributions; Obtaining the Common Equation of the Pearson System; Obtaining the Basic Types of the System By the Common Equation; Type I (First Main Type); Type IV (Second Main Type); Type VI (Third Main Type); Proofs of the Main Types; Applications.

**İST 612 Pearson System II 3+0 7,5**

Obtaining the Transition Types in Pearson System; Transition Types Which is Produced From the First Main Type Type II; Type VIII; Type IX; Type XII; Transition Function Related to the Second Main Type; Type VII; Transition Function Related to the Third Main Type; Type XI; Special Case of the Type II (Normal Curve); Transition Types Between Main Functions; Type III; Special Case of the Type III; Type X; Type V; Moments of the Overall Types and Obtaining Pearson Criteria; Applications About Transition Types.

**İST 613 Artificial Neural Networks and Statistical Models I 3+0 7,5**

Single-Layer Neural Networks, Perceptron; Multi-Layer Feed-Forward Neural Networks: Back-Propagation Algorithms and Statistical Pattern Recognition; Recurrent Neural Networks and Training Algorithms for Pattern Association: Heteroassociative Memory Neural Network; Autoassociative Net; Elman and Hopfield's Net, Bidirectional Associative Memory (BAM).

**İST 614 Artificial Neural Networks and Statistical Models II 3+0 7,5**

Radial-Basis Function Networks: Exact Interpolation, Regularization Theory, Relation to Kernel Regression, Comparison with MLP; NN Based on Competition, Fixed-Weight Competitive Nets; Kohonen Self-Organizing Maps; Learning Vector Quantization; Counterpropagation; Adaptive Resonance Theory: ART I, ART II.

**IST 615 Mathematics Foundation in Regression****Analysis I****3+0 7,5**

Elements of Matrix Analysis: Generalized Inverse matrices; Idempotent Matrices; Vector, Matrix Norms. General Linear Systems: Gauss Transformation; LU Factorization, Pivoting, Permutations Matrices. Special Linear Systems: LDMT and LDLT Factorization; Banded, Block Systems. Orthogonalization: Householder and Givens Matrices; QR Factorization; The Full Rank and the Rank Deficient LS Problems. The Symmetric and Unsymmetric Eigenvalue Problems; Properties and Decompositions; The Jacobi Methods; Computing the SVD; The Hessenberg and Real Schur Forms; The Practical QR Algorithm.

**IST 616 Mathematics Foundation in Regression****Analysis II****3+0 7,5**

Matrix Computations in Linear Regression: Kronecker Products and the Vec and Vech Operators; Generalized QR factorization; Applications for Ordinary and Generalized Least Squares and SUR models. Mathematics Foundation in Nonparametric Regression: A Roughness Penalty Approach; Smoothing and Regression Splines, Kernel Regression and Corresponding Mathematics Concept and Operations; Choosing the Smoothing Parameter. Additive and Generalized Additive Regression's Models (GAM): Estimating Equations for Additive Models and its Numerical Solutions.; Fisher Scoring for GAM; Local-Scoring Procedure; A Roughness Penalty Approach; Choosing the Smoothing Parameters.

**IST 617 Modern Regression Techniques****3+0 7,5**

Linear Regression Analysis; History; Estimation of Coefficients; Model and Model Checking; Least Squares Minimization; Least Absolute Deviations (L<sub>1</sub>) Regression; Introduction; Algorithms for Line Fitting; Problems in Algorithms; Estimation of Coefficients; M-Regression: a Regression Sample; Lagrange Multiplier for Minimization; Line Fitting; Tests for Coefficients; Nonparametric Regression; Line Fitting; Tests for Coefficients; Bayesian Regression; Bayes Approach; Line Fitting; Tests for Coefficients; Ridge Regression; Line Fitting; Standardization; Multi Collinearity; Comparison of Techniques; Comparison Properties; Samples.

**IST 618 Information Theory and Statistics****3+0 7,5**

The Method of Types; The Law of Large Numbers; Universal Source Coding; Large Deviation Theory; Examples of Sanov's Theorem; The Conditional Limit Theorem; Hypothesis Testing; Stein's Lemma; Chernoff Bound; Lempel-Ziv Coding; Fisher Information and the Cramer-Rao Inequality.

**IST 621 Advanced Circular Data Analysis****3+0 7,5**

Nonparametric Testing Procedures: Single Sample Tests, Two Sample Tests; Distributions on Spheres: Spherical Data, Descriptive Measures, Distributions for Spherical Data; Some Inferences for Spherical Data; Circular Correlation and Regression: Measures of Correlation, Regression Models, Bivariate Distributions, Circular Time Series; Modern Methodology in Circular Data Analysis:

Outliers, Robust Methods, Bootstrap Methods; General Sample Spaces; Shape Analysis.

**IST 622 Fuzzy Neural Integrated Systems****3+0 7,5**

Basic Operations in Fuzzy Sets; Expansion of Fuzzy Set Concept; Fuzzy Relation; Fuzzy Arithmetic; Fundamentals of Fuzzy Logic; Fundamentals of Fuzzy Logic Control Systems; Projection Methodology; Integrated Fuzzy Systems and Artificial Neural Networks: Basic Concepts; Reasons for Integrating; The Equivalence of Fuzzy Inference Systems and Artificial Neural Networks; Neural-Network-Based Fuzzy Systems: Neural Realization of Basic Fuzzy Logic Operations; Neural-Network-Based Fuzzy Logic Inference; Neural-Network-Based Fuzzy Modeling; Neural Fuzzy Controllers: Types of Neural Fuzzy Controllers; Structure Learning for Neural Fuzzy Controllers.

**IST 623 Fuzzy Artificial Neural Networks****3+0 7,5**

Types of Fuzzy Neurons; Fuzzification of Neural Network Models; Fuzzy Perception; Fuzzy Classification with the Back Propagation Network; Fuzzy Associative Memories; Fuzzy Kohonen Networks; Neural Networks with Fuzzy Training; Neural Networks with Fuzzy Teaching Input; Neural Networks with Fuzzy Parameters; Fuzzy Control for Learning Parameter Adaptation; Fuzzy Neural Classification; Fuzzy Neural Clustering.

**IST 625 Entropy Optimization Methods With****Applications****3+0 7,5**

Entropy and Information for Discrete Systems; Conditional Entropy and Mutual Information; Entropy and Information for Continuous Systems; The Method of Variations in Problems with Fixed Boundaries; Variation and its Properties; Euler Equations; Variational Problems Involving a Conditional Extremum; Contraction Mappings; Newton's Method for Lagrange Multipliers; Jaynes' Maximum Entropy Principle with Statistical Applications; Kullback's Minimum Cross-Entropy Principle with Applications.

**IST 626 Numerical Methods in Modeling with****Entropy Optimization Distributions****3+0 7,5**

Introduction To Numerical Methods; Linear Equations and Solution Methods for Linear Equations; Nonlinear Equations; Solution Methods for Nonlinear Equations; Numerical Integration Methods; Maximum Entropy Methods for Discrete and Continuous Random Variables; Estimation of Parameters of Statistical Distribution Based on Maximum Entropy Methods; Minimum Cross Entropy Methods for Discrete and Continuous Random Variables; Estimation of Parameters of Statistical Distribution Based on Minimum Cross Entropy Methods.

**IST 627 Fundamentals of Stochastic****Differential Equations****3+0 7,5**

A Hilbert Space of Random Variables; Convergence of Sequences of Random Variables, Exercises; Discrete stochastic processes; Continuous Stochastic Processes; A Hilbert space of stochastic processes, Exercises; Stochastic Integrals of the form  $\int_0^t \sigma(s) dB(s)$ , Definition of Brownian motion and

its properties, Winner integral, Conditional expectation, Martingales, Ito stochastic integrals, Approximation of stochastic integrals, Stochastic differential and Ito's formula, Ito's formula for martingales, Applications of Ito formula, Stratonovich stochastic integrals; Multidimensional Ito's formula, Exercises.

**IST 628 Stochastic Differential Equations and Applications 3+0 7,5**

Properties of Solutions to SDE, Some Examples, Bellman-Gronwall Inequality, Existence and Uniqueness Theorem, Ito's Formula and Exact Solutions; Approximating SDE, Systems of SDE; Markov Property, Solutions of SDE, Diffusion Processes, Kolmogorov (Fokker-Planck) Equations, Stability; Parameter Estimation for SDE, Linear SDE, Feynman-Kac Formula, SDE Models in Physical Systems, in Finance and in Biology.

**IST 629 Stochastic Modeling and Analysis 3+0 7,5**

Stochastic Processes: Probability, Distribution And Distribution Function; Expectation, Variance and Covariance; Independence and Dependence; Expectation And Covariance Function for Stochastic Processes; Dependence for Stochastic Processes: Stationary Increments, Independent Increments; Brownian Motion: Defining Properties; Processes Derived from Brownian Motion; Simulation of Brownian Sample Paths; Systems with Stochastic Inputs and the Power Spectrum; Continuity for Stochastic Processes; Differentiation for Stochastic Processes; Integration for Stochastic Processes; Applications.

**IST 631 Robust Statistical Methods 3+0 7,5**

Comparison of Classical and Robust Approaches; Robust Estimates of Location and Scale; Measuring Robustness: Influence function, Breakdown point; Balancing Robustness and Efficiency; Some Robust Estimation Methods: Trimmed least squares, M-estimation, Least absolute deviations (LAD), Least median squares (LTS), Weighted least squares; Partially Adaptive Estimation; Robust Estimation for Regression Model and Parameters of Distributions; Applications in Matlab Program.

**IST 790 Thesis 0+1 30,0**

**IST 890 Thesis 0+1 30,0**

**ITB 501 Biotechnology 3+0 7,5**

History of Biotechnology; Recombinant DNA Technology, Manipulation of Prokaryotic Gene Expression, Production of Protein in Eukaryotic Cells, Development and Use of Genetically Modified Plants and Animals, High Protein Production in Recombinant Microorganisms; Fermentation Technology and Regulation, Isolation and Protection of Metabolism in Microorganisms, Preferable Commercial Features of Microorganisms, Coulter Collection; Enzyme

Technology; DNA Sensors, Molecular Diagnosis, Gene Therapy in Human Somatic Cells, Genetic Practices in Food Technologies; Gene Engineering, Genetic Transformation Systems, Bioinsecticides; Social Dimension of Biotechnology; Patents and Brands.

**ITB 503 Biotechnology Laboratory Techniques I 3+0 7,5**

Biosafety; Basic Principles of Spectroscopy, UV and Visible Molecular Absorption Spectroscopy, Basic Procedures of Mass Spectroscopy, IR Spectroscopy, Nuclear Magnetic Resonance Spectroscopy (NMR), Chromatographic Analysis Techniques and Separation Procedures, GC, GC-MS, Thermal Analysis Techniques (TG, DTA, DSC), Preparation of Natural Compounds for Structural Analysis, Scanning Electron Microscopy and Microanalysis.

**ITB 504 Biotechnology Laboratory Techniques II 3+0 7,5**

Bacterial Evaluation Techniques, Biomonitoring, Cell Culture Techniques, Purification of Proteins and Analysis Methods, ELISA, DNA and RNA Isolation and Analysis Methods, Principles of PCR, DNA Fingerprints, In Vitro Transcription, In Vitro Mutation, Recombinant DNA Techniques.

**ITB 505 Biomaterials 3+0 7,5**

Introduction, Use of Alumina and Zirconia in Implants, Introduction to Bio-active Glasses; Production, Composition, Properties, Reaction Kinetics and Clinical Applications, A/W Glass-Ceramics; Processes, Properties and Clinical Applications, Ceramital Bio-Active Glass-Ceramics, Machinable Phosphate Based Glass-Ceramics, Dense Hydroxyapatite, Porous Hydroxyapatite, Surface Coatings, Bioceramic Composites, Biomaterials, Characterisation of Biomaterials

**ITB 506 Drug Design and Application 3+0 7,5**

Planning Drug Development, Chemical Development, Formulation Development, Characteristics of Drug Development: Electronic Properties, Ionization Constants, Hydrophobic Interactions, Steric Parameters, Hydrophobic Interactions and Lipophilicity, Partition Constants as Lipophilicity Index, Effects of Ionization on Partition Constant, Suggestion of Lipophilicity, Suggestion of Ionization, Suggestion of Steric Parameters. Prediction of Drug Receptor Relationship, Prediction of Mutagenesis, Ligand Bonding Studies, Biological Evaluation: Ligand Bonding, Secondary Messenger Measurements, Measurement of Functional Activity, Quantification of Agonist Activity, Quantification of Antagonist Activity, in Vivo Tests, SAR and QSAR Linear Regression and Multiple Linear Regression.

**ITB 507 Biometer 3+0 7,5**

Data Understanding in Biological Research. Calculation of Descriptive Statistics, Introduction to Probability Distribution; Binomial and Poisson Distribution, Normal Distribution and Its Application. Sampling Techniques,



Estimation, Tests for Statistical Hypotheses, ANOVA, Regression Analysis, Spatial Analysis, Allometry

**İTB 508 Applications of High Performance Liquid Chromatography in Biotechnology** **3+0 7,5**

Important Parameters for Application of HPLC in Biotechnology; Sample Collection and Preparation; Characteristics of Sample and Standards; Selection of Column, Detector, Mobile Phase and Other Important Subjects; Position of HPLC in Purification of Enzymes; Importance of HPLC in Waste Water; Analysis of Protein and Peptide in HPLC and Applications; Applications of HPLC for Terpenoids.

**İTB 509 Biotechnological Production of Medicine Raw Materials** **3+0 7,5**

Presences of Secondary Metabolites and Biotechnological Examples; Biotechnological Utilization of Plant Genetic Resources for the Production of Phytopharmaceuticals; Methods for the Biotechnological Pathway for the Active Natural or Semi-Synthetic Derivatives; Analytical and Preparative Methods by Structural Elucidation and Characterization After Biotechnological Production of Important Commercial Secondary Metabolites; Magnetic Force Microscopy (MFM), Scanning hall aygıtı microscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM)

**İTB 511 DNA Vaccines and Viral Vector** **3+0 7,5**

Nucleic Acid Vaccines: DNA vaccines, RNA vaccines; Biological, Chemical and Physical Methods of DNA Vaccination; Viral Vectors: Poxviruses, Adenoviruses, Herpesviruses, Adeno-Associated viruses; Viral Vector Systems: Manufacture and stability, Safety, Effect of immunity, Therapeutic payload; Mechanism of DNA Vaccines in Cells; Routes of Immunization; Limitations of Plasmid DNA Immunogens.

**İTB 513 Antisense Technology and its Applications** **3+0 7,5**

Antisense Technology and Its Applications: Antisense oligonucleotides, RNA interference, Gene silencing mechanisms; miRNA and Production; Areas of Use of miRNA; siRNA and Production; Areas of Use of siRNA; In Vitro and In Vivo Stability of siRNA; Encapsulation of siRNA with Drug Delivery Systems; RNA Vaccines; Using of Antisense Technology in Cancer Therapy; Assessment of Antisense Technology.

**İTB 592 Seminar** **3+0 7,5**

**İTB 790 Thesis** **0+1 30,0**

**İTN 501 Atom and Molecular Structure** **3+0 7,5**

Structure of Atoms, Periodic Properties of Elements, Electronic Structure of Elements, Chemical Bonds, Interactions Between Particles, Geometry of Molecules,

Attraction Forces Between Molecules, Description of Molecules, Doped Structures and k.p. Calculations of These Structures, Diffusion Equations, Solutions of Boltzman Equations, Basics of Quantum Physics, Photoelectricity, Matter and Wave, Principles of Uncertainty, Schrödinger Equation, Angular Momentum and Spin, Perturbation Theory, Variation Method, Symmetry and Transformations.

**İTN 502 Nanotechnology** **3+0 7,5**

Introduction to Nanotechnology, Nanobiology, Nanochemistry, Nanotechnology and Nanomedicine, Nanomaterials, Synthesis of Nanomaterials, Characterisation of Nanomaterials, Nanodevices, NEMS based Nanotechnology, Nanostorage, Nanorecognition

**İTN 503 Applications of Nanotechnology** **3+0 7,5**

Electronics; Nanotubes for Nanoelectronics, Vacuum Nanoelectronics, DNA Electronics, Nanoelectromechanical Systems, Molecular Electronic Devices; Health, Nanotechnology and Nanomedicine, Medical Nanomaterials, Biotechnology Devices, Medical Nanorobotics, Polymeric Nanoparticles for Drug and Gene Delivery, Pharmaceutical Nanotechnology, Biocompatible Core-Shell Nanoparticles, Nanocrystals of Poorly Soluble Drugs, Nanoparticles as Drug Delivery Systems, Nanomagnetism for Biomedical Applications ; Physics; Chemistry; Nanochemistry, Sol-Gel Chemistry, Techniques in Electrochemical Nanotechnology, Polymer Nanostructures, Nanostructured Bipolar Organic Polymers; Engineering; Electronic, Computer, Construction, Material, Chemistry, Genetic and Gene Engineering

**İTN 505 Nanocharacterisation I** **3+0 7,5**

Structural Characterization of Nanomaterials, Thermal Conductivity of Semiconductor Nanostructures, Characterization of Magnetic and Electronic Properties, Characterization of Nanostructured Materials by X-Ray Photoelectron Spectroscopy, X-Ray Microscopy and Nanodiffraction, X-Ray Characterization of Nanomaterials, Raman Spectroscopy

**İTN 506 Nanocharacterisation II** **3+0 7,5**

Crystallography and Shape of Nanoparticles; Microscopic Techniques; Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM), Scanning Probe Microscopy, Magnetic Force Microscopy (MFM), Scanning Hall Aygıtı Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM)

**İTN 507 Nanomaterials** **3+0 7,5**

Metal, Ceramic, Organic Molecular Group, Polymeric or Composite Materials, Nanoparticles, Nanotubes, Nanoporous Materials, Nanoporous Carbons, Nanomembranes, Nanofluids, Nanocontainers, Nanocapsules, Nanocables and Nanojunctions, Ferroelectric Nanomaterials, Nanowires, Nanoceramics (Ceramic Nanopowders), Nanobiomaterials, Nanotransistors, Nanofibers, Nanocrystals, Nanostructured Metals and Alloys, Magnetic Nanomaterials (Soft and Hard), Bismuth Nanostructured Materials, Superhard Nanocomposites, Polymeric Nanomaterials, Protein-Doped Nanoporous

Silica Gels, C60-Based Materials, Colloidal Gold, Dye/Inorganic Nanocomposites, Metal Nano-Optics, Multifunctional Nanocomposites, Nanostructured Thin Films, Quantum Dots, Nanolayers, Nanocomposites

**İTN 508 Synthesis of Nanomaterials 3+0 7,5**

Chemical Synthesis of Nanoparticles; Synthesis of Nanomaterials Using Microemulsion Process; Sol-Gel Method; Liposomes; Nanostructures Created by Lasers; Solid-State Synthesis of Carbon Nanotubes; Carbon Nanotube Synthesis by Arc Discharge Technique; Catalytic Synthesis of Carbon Nanotubes and Nanofibers; Synthesis of Inorganic Nanowires and Nanotubes; Synthetic Nanoinorganics by Biomolecular Templating; UHV-SPM Nanofabrication; Electrochemical Synthesis of Semiconductor and Metal Nanowires; Nanopowders Produced Using Microreactors; Nanocrystalline Ceramics by Mechanical Activation; Formation of Nanostructured Polymers.

**İTN 509 Nano-Biotechnology 3+0 7,5**

Bionanodevices; Bionanomotors; Biological Nanomaterials; Biological Molecules in Nanodevices; Biogenic Nanoparticles; Bioelectronics; Nanobiosensors; Nanoanalysis of Biomaterials,

**İTN 510 Structure Property Relationship in Nanomaterials 3+0 7,5**

Photochemistry; Photoconductivity; Photodynamic; Electrochemistry of Nanomaterials; Dynamic Processes in Magnetic Nanostructures; Diffusion in Nanomaterials; Nanoscale Heat Transfer; Catalysis by Gold Nanoparticles; Transport in Semiconductor Nanostructures; Transition Metal Atoms on Nanocarbon Surfaces; Nanomechanics of Nanoscale Materials; Nanodeposition of Soft Materials; Nanocatalysis; Electronic Structure of Semiconductor Nanoparticles; Kinetics in Nanostructured Materials; Mechanical Behavior of Nanomaterials

**İTN 511 Properties of Nanomaterials 3+0 7,5**

Dielectric Properties of Nanomaterials, Characterization of Magnetic and Electronic Properties, Optical Properties of Nanomaterials, Thermodynamics Properties of Nanomaterials, Superplasticity of Nanoceramics

**İTN 512 Nanodevices and Design 3+0 7,5**

Semiconductor Nanodevice Modeling; Single-Electron Devices; Single-Electron Transistors; Single-Electron Dynamics; Nanorobotics and Nanomanipulation; Mechanical Molecular Nanodevices; Nanocomputers: Theoretical Models; Optical Fibers for Nanodevices; Photochemical Molecular Devices; DNA-Based Nanodevices; Gas-Based Nanodevices; Micro and Nanomechanics

**İTN 513 Nanotechnology Applications in Textiles 3+0 7,5**

Classification of Textile Materials; Textile Fibers and Properties; Type of Yarns and Spinning Systems; Nanotechnology Applications in Fibers and Yarns Production: Nanofibres; Electro spinning and

Nanoadditives Used in Fiber Production; Textile Fabrics and Production Methods; Textile Finishing; Fabric Dying and Printing Technologies; Nanotechnology Applications in Textile Finishing: Water and oil repellency; Soil Release; Antimicrobial and Flame Retardant Finishes; Physical and Chemical Testing of Textiles; Characterization of Nanomaterials Applied on Textile Materials; Analyzing Textiles By SEM; Some Commercial Textile Products Based on Nanotechnology.

**İTN 514 Nanomagnetism and Applications 3+0 7,5**

Introduction to magnetism; Magnetostatics; Micro-magnetism, domains and hysteresis; Nanoscale-magnetism; Experimental methods in nanoscale; Micro- and Nanoscale Magnetic materials; Application of soft magnets; Application of hard magnets; Application of magnetic nanoparticles; Application of magnetic nanoscale thin films; Spin Electronics, magnetic recording and memory; Special topics; Samples of industrial devices.

**İTN 592 Seminar 3+0 7,5**

**İTN 790 Thesis 0+1 30,0**

**KİM 501 Selected Topics in Organic Chemistry I 3+0 7,5**

General Principles of Kinetics and Thermodynamics and Chemical Reactivity; Aromaticity; Antiaromaticity; Hyperconjugation; Tautomerism; Hydrogen Bonding; EDA Complexes; Complexes of Crown Ethers and Related Compounds; Phase Transfer Catalysis; Classification of Reaction Mechanisms and Fundamental Reaction Mechanism Types; Basic Factors Influencing Acidity and Basicity.

**KİM 502 Selected Topics in Organic Chemistry II 3+0 7,5**

Methods for Identification of Organic Reaction Mechanisms; Primary and Secondary Kinetic Isotope Effects; Stereochemical Proofs; Isolation of Reaction Intermediates; Substituent Effects; Chemistry of Organic Compounds Containing Boron; Phosphorus and Sulphur; Pericyclic Reactions; Radical Reactions; Photochemistry; Molecular Rearrangements; Oxidation Reduction Reactions.

**KİM 504 Chemical Kinetics 3+0 7,5**

Reactions Rate and Order; Zero, First-, Second-, Third Order Rate Equations; Kinetics of Complex Reactions; Kinetics of Chain Reactions, Molecular Reaction Dynamics; Collision Theory, Activated Complex Theory; Molecular Activation and Types; Intermolecular Energy Transfer; Catalysis; Heterogeneous Catalysis; Homogeneous Catalysis; Fundamentals of Enzyme Kinetics.

**KİM 506 Polymer Chemistry 3+0 7,5**

Concepts and Definitions; Classification of Polymers; Polymer Molecular Weights and Their Determination;

Polymer Isomerism; Thermal Transitions and Mechanical Behavior; Step-Growth Polymerization; Chain- Growth Polymerization; Ionic and Coordinated Polymerization; Copolymers.

**KİM 509 Carbon-Carbon Bond Formation 3+0 7,5**  
Carbonion Alkylation; Enolate Alkylation; Asetilide-Cyanide Alkylation; Organometallic Alkylation; Addition to Carbonyl; Replacement Reactions; Aldol and Related Reactions; Claisen and Related Reactions; Organometallic Reactions; Wittig Type Reactions; Asetilide-Cyanide Reactions; Conjugate Addition Reactions; Reactions of Alkenes; Alkenes; Alkynes; and Some Aromatic Compounds; Pericyclic Reactions; and Friedel-Crafts and Related Reactions.

**KİM 510 Advanced NMR Techniques 3+0 7,5**  
Introduction to NMR theory; FT-NMR; Pulse NMR; Dynamic NMR; High Field NMR; One Dimensional NMR: Dept45, Dept90, Dept145, Inept, NOESY; Two Dimensional NMR: COSY, HETCOR, HMBC, HMQC, INADEQUATE.

**KİM 511 Electrochemistry 3+0 7,5**  
Electrochemistry; Ionic Interactions; The Conducting Properties of Electrolytes; Potentiometric Measurements, Electrode Systems; Electro-analytical Techniques; Conductometric Titrations; Potentiometric Titrations; Ultramicroelectrodes; Electrochemical Sensors; Ion-Selective Electrodes; Chemically Modified Electrodes; Enzyme Electrodes; Electrochemistry in Industry; Water Purification; Inorganic Electrolytic Processes; Organic Electrosynthesis; Fuel Cells; Electrolysis; Corrosion; Types of Corrosion; Electrochemical Methods of Avoiding Corrosion.

**KİM 513 Chemical Thermodynamics 3+0 7,5**  
The First Law of Thermodynamics; Work; Heat; Internal Energy; Enthalpy; Changes of State; The Second Law of Thermodynamics; Carnot Cycle; Heat Engine; Entropy; Criterion for the Direction of Spontaneous Change; Clausius Inequality; Thermo chemistry; Free Energy and Equilibria; Standard Molar Free Energy; Chemical Potential; Pressure and Temperature Dependence of Free Energy; Fugacity; Thermodynamics of Multi component Systems; Ideal Solution; Real Solutions; Partial Molar Quantities; Colligate Properties; Phase Equilibria; Phase Rule; Phase Diagrams; Thermodynamics of Non-Ideal Systems; The Third Law of Thermodynamics.

**KİM 515 Complexes Chemistry 3+0 7,5**  
Coordination Compounds: Overview of nomenclatures, Formation and stability of complexes in solution; Bonding in Coordination Compounds: Valence band theory, Crystal field theory, Ligand field theory, Molecular orbital theory, comparisons of the theories, Coordination number in complexes and effect on stability; Importance of Coordination Compounds and Application Areas; Electronic Spectra of Transition Metal Complexes: Ligand spectra, Counter-ion spectra, Charge-transfer spectra, Ligand field spectra, Synthesis of Coordination

Compounds: Sigma-bonded coordination compounds, Substitution reactions in aqueous solution, Direct synthesis of the complexes, Oxidation-reduction reactions; Pi-Acid Ligand Complexes.

**KİM 516 Physical Organic Chemistry 3+0 7,5**  
Models of Chemical Bonding; Kinetics and Thermodynamics; Acids and Bases; Electrophiles and Nucleophiles; Correlation of structure with Reactivity; Hammett and Taft Equations; LFER; Solvent Effects, Kinetic Isotope Effects; Steric and Conformational Properties; Homogeneous Catalysis; Acid and Base Catalysis; Specific and General Catalysis; Proton Transfers; Bronsted Catalysis Law; Discussion of Reactions in Terms of Mechanistic Properties.

**KİM 517 Selected Topics in Inorganic Chemistry I 3+0 7,5**  
Atomic Structure: Atomic orbital, Schrödinger Equation, Many-electron atoms; Molecular Orbital: Formation of molecular orbital from s, p and d orbital, Heteronuclear and diatomic molecules; Molecular Symmetry: Symmetry operations and symmetry elements, Point Groups, Application of symmetry; Acids, bases and ions in aqueous solution: Definitions of acids and bases, Hard-soft acids and bases, strength of acids and basis.

**KİM 518 Selected Topics in Inorganic Chemistry II 3+0 7,5**  
Crystal Structure; Lattice energy, Thermodynamics of the formation of ionic solids, band structure, conductivity; Chemistry of Main Group Elements: General physical and chemical properties and reactivity; d-block chemistry; physical and chemical properties, reactivity of metals; Redox Reactions in Inorganic Compound; Nuclear Properties: Nuclear bonding energy, Applications of isotopes.

**KİM 519 Heterocyclic Chemistry I 3+0 7,5**  
Heterocyclic Systems Similar to Cyclopropane: Azirine, Aziridine, Oxirane (ethylene Oxide), Thirane, Diazirine, Diaziridine, Oxaziridine; Heterocyclic Systems Similar to Cyclobutane: Azetidine, Azitidinone, Oxetene, Oxetane, Oxetanone, Thietene, Thietane; Four Membered Rings with Two Heteroatoms.

**KİM 520 Heterocyclic Chemistry II 3+0 7,5**  
One-Heteroatom Rings similar to Cyclopentadiene: Pyrrole, Furan, Thiophen, Comparison of Aromatic Properties of Furan and Thiophen; Other Heteroatom Containing Heterocyclic; Pyrrole, Furan and Thiophen Containing Fused Heterocyclics; Other Fused Heterocyclics.

**KİM 521 Adsorption 3+0 7,5**  
Adsorption and Surface Phenomenon; Adsorption; Adsorption of Gases on Solids; Heat of Adsorption; Physical Adsorption; Chemical Adsorption; Monolayer Adsorption; Multilayer Adsorption; Adsorption Isotherms; Langmuir Adsorption Isotherm; The BET and Other Isotherms; Surface Area Determination; The Solid-Liquid Interface-Adsorption from Solution; Interactions at Solid-

Solution Interface; Capillarity: Surface Tension and Surface Free Energy; Surface Films; Wetting and Detergency.

**KİM 523 Complex Equilibria in Analytical Chemistry** **3+0 7,5**

Mathematical Methods Used in Equilibrium Calculations; Mass and Charge Balances, Proton Condition; Strong and Weak Acids-Bases; Buffer Solutions and Logarithmic Concentration Diagrams; Hydrolysis of Salts of Weak Acids and Bases; Polyprotic Acids and Bases: Logarithmic concentration diagrams of solutions of polyprotic salts; Mixture of Two Weak Monoprotic Acids and Multiple Buffer Systems; Solubility of Polyprotic Acid Salts; Precipitation and Solubility: Separation with precipitation, Precipitation titrations; Solubility of Weak Monoprotic Acid Salts.

**KİM 524 Bioinorganic Chemistry** **3+0 7,5**

Biological Functions of Inorganic Elements; Biological Ligands for Metal Ions; Metals at the Center of Photosynthesis; Catalyses through Hemoproteins; Iron-Containing Biological Proteins; Nickel-Containing Enzymes; Copper-containing Protein; Biological Functions of Transition Metals; Zinc and Enzymatic Catalysis; Biomimic Chemistry; Biominerals; Bioinorganic Chemistry of the Toxic Metals; Chemotherapy, Imaging and Other Applications of the Nonessential Elements.

**KİM 525 Quantum Chemistry** **3+0 7,5**

Introduction to Quantum Chemistry; Traveling Waves and Equations; Electromagnetic Theory; Quantum Mechanics of Some Simple Systems; The One-Dimensional Harmonic Oscillator; The Quantum Mechanics Applications of Atoms; The Particle in a One-Dimensional Box; The Particle in a One-Dimensional Box for Wave Functionals and Momentum; The Hydrogen Atoms for Quantum Chemistry; Introduction to Some Concepts of Quantum Mechanics and the Theoretical Basis of the Chemical Bonds; Introduction to Some Chemical Bonds of Molecular Orbitals as Linear Combinations of Atomic Orbitals (LCAO) and Basics Procedure for Quantum Mechanical Mixing of a Atomic Orbitals Solution for Molecular Orbital Functions; Determination of the Molecular Orbitals Wave Functions; Approach LCAO Methods for the P-Bond Systems; Electron Density; Charge Density; Bond Order.

**KİM 526 Microwave Organic Synthesis** **3+0 7,5**

Microwave Assisted Organic Chemistry (MAOS) A Brief History; Microwave Theory; Microwave Equipments; Microwave Processing Techniques; Designing Reaction using Microwave; Comparison of Microwave Synthesis and Conventional Synthesis; Practical Applications of CEM Discover Microwave Equipment.

**KİM 529 Catalytic Chemistry** **3+0 7,5**

Catalysis in Solutions; Acid-base Catalysis; Catalysis By Electron Transfer; Organometallic Catalysis; Catalysis By Macromolecules; Phase Transfer Catalysis; Catalysis By Enzymes; Structure of Enzymes; Reactions Catalyzed By Enzymes; Catalysis By Polymers; Structures of Polymers; Other Polymer Catalysis; Catalysis on Surfaces; Surface

Structures; Adsorption, Surface Catalysis; Catalysis on Metal Surfaces; Other Metal Catalysis.

**KİM 531 Modern Analysis Methods I** **3+0 7,5**

Introduction to Molecular Spectroscopy and Differences With Atomic Spectroscopy; Infrared (IR) Spectroscopy and Applications; Microwave Spectroscopy; Raman Spectroscopy and CARS Applications; Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique; NO Technique; NMR With Solid Samples; <sup>13</sup>C-NMR; <sup>19</sup>F-NMR And <sup>31</sup>P-NMR Spectroscopy; Thermal Analysis Methods; Thermogravimetry; Differential Thermal Analysis.

**KİM 532 Modern Analysis Methods II** **3+0 7,5**

Theory of Atomic Spectroscopy; Atomic Absorption Spectrometry and Applications; Atomic Emission Spectroscopy and Applications; Atomic Fluorescence Spectrometry and Applications; Laser Source Atomic Spectroscopy and Applications, X-Ray Spectrometry; Mössbauer Spectroscopy, ESCA Spectroscopy and Applications; Radiochemical Methods; Spectroscopy, Neutron Activation Analysis and Other Nuclear Techniques.

**KİM 533 Electroanalytical Chemistry** **3+0 7,5**

Principles of Electroanalytical Methods; Electrochemical Cells; Cell and Electrode Potentials; Electrode Types; Potentiometric Methods; Potentiometric Titrations; Voltammetric Methods; Linear-Sweep Voltammetry; Cyclic Voltammetry; Polarographic Methods; Puls Polarography; Alternative Current Polarography; Stripping Methods; Analytical Applications; Amperometric and Coulometric Methods; Amperometric and Coulometric Titrations; Conductometric Methods; Measurement of Conductance; Conductometric Titrations; Spectroelectrochemistry.

**KİM 534 Organometallic Chemistry** **3+0 7,5**

Overview of Organometallic Chemistry; Fundamentals of Structure and Bonding; Electron Rule; Carbonyl Ligands; Pi Ligands; Other Important Ligands; Organometallic Reactions I; Organometallic Reactions II; Homogeneous Catalysis; Transitions Metal-Carbene and Transitions-Metal Carbyne Complexes; Applications of Organometallic Chemistry to Organic Synthesis; Other Applications of Organometallic Chemistry.

**KİM 535 Data Analysis in Chemistry** **3+0 7,5**

Basic Statistics: a Review; Errors; Accuracy; Precision; Reducing Systematic Errors; Mean and Standard Deviation; Distribution of Random Errors; Reliability of Results; Confidence Interval; Comparison of Results; The T-Test; Analysis of Variance; Signal Detection and Manipulation; Signal Detection; Point Estimation of the Detection Limit; The Wilcoxon Test; Signal Manipulation; Curve Fitting; Smoothing of Data; Least-Squares Polynomial Smoothing; Differentiation of the Signal; Calibration and Chemical Analysis; Comparison With Standards; Constructing a

Calibration Curve; Utilizing the Calibration Curve for Chemical Analysis; Resolution of Analytical Signals; Exploratory Data Analysis: Processing Techniques; Graphical Methods; Partial Least Squares Path Modelling; Control and Optimization.

#### **KİM 536 Chromatographic Techniques 3+0 7,5**

Introduction to Chromatographic Techniques; Classification of Chromatographic Techniques; Planar Chromatographic Techniques and Applications; Gas Chromatography and Hybrid Systems; Supercritical Fluid Chromatography; Gel Permeation Chromatography and Applications; Electrochromatographic Methods; Gel Electrophoresis; Capillary Electrophoresis and Applications

#### **KİM 537 Organic Macro Molecules 3+0 7,5**

Enzymes, Non-enzyme Soluble Proteins; Calcium Binding Proteins; Integral Membrane Proteins; DNA, RNA, Protein Complex to Nucleic Acid; Virus Components, Immune System, Toxins, Carbohydrates; Unusual Tertiary and Quaternary Structures; Protein Crystals; History of Earliest Crystallographic Structures.

#### **KİM 539 Quantitative Structure Property Relationship 3+0 7,5**

Molecular mechanics, ab initio, and semi-empirical calculations.

#### **KİM 550 Reagents In Organic Synthesis 3+0 7,5**

Oxidizing and Reducing Reagents; Oxidizing and Reducing Reagents; Classification and Reactions; Activating Agents and Protecting Groups; Reagents and protecting groups for elimination reactions, Acylation, Ether formation, Protection of diols, Amines, Carbonyl groups and reagents, Sulfonylation reagents; Reagents and Catalysts for C-C Bond Formation: Acetylenes and allenes, Aluminum, Boron, Copper, Cyano, Isocyanato, Diazo, Azido, Dienes, Dienophiles, Enolates, Epoxides, Halo compounds, Imines, Ketenes, Lithium, Magnesium, Phosphorus, Sulfur, Zinc, Nickel; Acidic and Basic Reagents; Acidic and Basic Catalysts; Using Lewis Acid; Hydrolyses and Enzymatic Reagents.

#### **KİM 551 Sensors and Their Applications 3+0 7,5**

Sensor Technology; Introduction to Chemical Sensors; Optical Methods and Sensors: Sensor techniques in optics, evanescent waves, spectroscopy, surface plasmon resonance, Fiber Optics; Mass Sensitive Sensors: piezoelectric sensors, quartz crystal microbalance, Surface Acoustic Waves; Biosensors: Biomaterials for biosensors, enzymes, enzyme structure, antibodies, antibody structure, production of antibodies, detection of antibody-antigen binding, immobilization techniques of biomolecules, Preparation Techniques of Chemical Sensors, Evaluation of Sensor Signal, General Analytical Applications.

#### **KİM 558 Biochromatography 3+0 7,5**

Theory of Biochromatography; Gel Filtration; Ion Exchange Interaction Biochromatography; Hydrophobic Interaction Chromatography Of Proteins; Affinity Chromatography; Dye Ligand Affinity Chromatography;

Immobilized Synthetic Dyes in Affinity Chromatography; Immobilized Pseudospecific Ligands In Affinity Chromatography; Immobilized Metal-Ion Affinity Chromatography; Intelligent Polymers, Imprinted Polymers; Biomedical Applications of Biochromatography.

#### **KİM 560 Alternative Reaction Systems 3+0 7,5**

Ionic Liquids; Physical properties of ionic liquids, synthesis of ionic liquids, Multiphasic Solvent Systems; Aqueous biphasic systems, Fluorous biphasic systems, Properties of perfluorinated solvents, Triphasic systems, Supercritical Fluids; Physical properties of supercritical fluids, Chemical reactions in supercritical media, Catalytic Reactions In Alternative Reaction Systems; Hydrogenation, Hydroformylation, Diels-Alder, Oxidation, Carbon-Carbon Bond Formation, Metathesis, Polymerization

#### **KİM 561 Novel Tendencies in Liquid Chromatography 3+0 7,5**

Introduction to High Performance Liquid Chromatography (HPLC); Development of Method in Liquid Chromatography (LC); Qualitative and Quantative Analysis; Column Preparation Techniques in LC; Micro-Nano LC; Fast Protein Liquid Chromatography (FPLC) and Ultra Fast Liquid Chromatography (UFLC) Systems; Researching of Other Novel LC Techniques; Evaluation of Analysis in LC; Applications of LC.

#### **KİM 562 Inorganic Polymers 3+0 7,5**

Definition and classification of inorganic polymers; Polymeric sulfur, selenium, tellurium; Linear polyphosphates, polyphosphazenes, polycarboranes, poly(sulfur nitride); Chalcogen glasses Borate, borophosphate and borosilicate glasses; Boron-nitride and phosphor-oxy nitride polymers; Crystalline silicates and aluminum phosphates; Synthetic inorganic fibers; Technological applications of inorganic polymers.

#### **KİM 563 Natural Product Synthesis I 3+0 7,5**

Total Synthesis of Carbohydrates; Total Synthesis of Prostaglandins; Total Synthesis of Pyrrole Pigments; Total Synthesis of Nucleic Acids; Total Synthesis of Antibiotics; Synthesis of Monoterpenes; Total Synthesis of Sesquiterpenes; Synthesis of Triterpenes; Naturally Occurring Aromatic Steroids; Total Syntheses of Isoquinoline Alkaloids; Synthesis of Indole Alkaloids; Alkaloid Synthesis; Synthesis of Insect Pheromones; Total Synthesis of Cannabinoids; Total Synthesis of Ionophores; Synthesis of Prostaglandins; Synthesis of Monoterpene.

#### **KİM 564 Natural Product Synthesis II 3+0 7,5**

Total Synthesis of Macrocyclic Lactones; Synthesis of the Leukotrienes; Synthesis of Monoterpenes; Total Synthesis of Aromatic Steroids; Gene Synthesis; Total Synthesis of Triterpenes; Total Synthesis of Carbohydrates; Total Synthesis of Pyrrole Pigments; Total Synthesis of Tri- and Tetracyclic Diterpenes; Synthesis of Polysaccharides; Total Synthesis of Naturally Occurring Quinones; Total Synthesis of Spiroketal-Containing Natural Products; Synthesis of

Insect Pheromones; Acyclic Sesquiterpenes; Monocyclic Sesquiterpenes; Bicyclic Sesquiterpenes; Tricyclic Sesquiterpenes.

#### **KİM 565 Literature Search in Chemistry 3+0 7,5**

Search for Authors by Using SciFinder Program; Search for Patents by Using SciFinder Program; Search for Journals by Using SciFinder Program; Search by Topics by Using SciFinder Program; Search for Chemical Substances by Using SciFinder Program; Search for Reactions by Using SciFinder Program; Chemical Abstract Search in Library; Search for Topics Using Web of Science; Search for Authors by Using Web of Science; Search for Citations by Using Web of Science; Getting Data from Council of Higher Education and The Scientific and Technological Research Council of Turkey; Using other Search Engines.

#### **KİM 566 Stereo Selective Reactions and Practical Approach 3+0 7,5**

General Concepts of Stereoselective Synthesis; Characterization of Stereoisomers; Analysis of Conformation and Configuration; Stereoselective Catalytic Reductions; Stereoselective Non-Catalytic Reductions; Stereoselective Oxidations; Stereoselective Carbon-Carbon Bond Forming Reactions by Nucleophilic Addition to Carbonyl Groups; Stereoselective Carbon-Carbon Bond Forming Reactions; Stereoselective Carbon-Carbon Bond Formation by Pericyclic Reactions; Stereoselective Formation of Carbon-Heteroatom Bonds; Stereoselective Formation of Carbon-Nitrogen Carbon-Phosphorus; Carbon-Oxygen; Carbon-Sulfur and Carbon-Halogen Bonds.

#### **KİM 567 Applications of Computational Chemistry 3+0 7,5**

ChemOffice Package Program: Molecule drawing with ChemDraw programme; Molecule drawing and the data preparation with chem3D programme; Mopac Package Program: Calculations with mopac programme in chem3D; Calculations with mopac2009 programme; Cache Package Program: Semi-empirical and ab initio; Spartan Package Program: Semi-empirical and ab initio; Gabedit Program: Mopac and gaussian; Gaussian Package Program; GaussView Package Program; Other Computing Programs.

#### **KİM 568 Solvent-free Organic Synthesis 3+0 7,5**

Solvent-Free Reduction; Solvent-Free Oxidation; Solvent-Free Carbon-Carbon Bond Formation; Solvent-Free Carbon-Nitrogen Bond Formation; Solvent-Free Carbon-Oxygen Bond Formation; Solvent-Free Carbon-Sulphur Bond Formation; Solvent-Free Carbon-Phosphorus Bond Formation; Solvent-Free Carbon-Halogen Bond Formation; Solvent-Free Nitrogen-Nitrogen Bond Formation; Solvent-Free Rearrangement; Solvent-Free Elimination; Solvent-Free Hydrolysis; Solvent-Free Protection; Solvent-Free Deprotection; Solvent-Free Reactions under Microwave Irradiation.

#### **KİM 569 Structure Determination of Organic Chemistry 3+0 7,5**

Separation and purification of organic compounds; Determination of physical characteristics; Elemental analysis of organic compounds; The general principle of Ultraviolet (UV), Infrared (IR), nuclear magnetic resonance (NMR) and mass spectroscopy methods; Importance of structural analysis of organic compounds; Interpretation of NMR; IR and UV spectra together; Structure determination applications of selected specific examples using NMR, IR, UV, and mass spectroscopy.

#### **KİM 571 Molecular and Cellular Biochemistry 3+0 7,5**

Foundations of Biochemistry; Principles of Bioenergetics; Glycolysis, Gluconeogenesis; Principles of Metabolic Regulation: Regulation of metabolic pathways, Coordinated regulation of glycolysis and gluconeogenesis, Analysis of metabolic control; The Citric Acid Cycle; Fatty Acid Catabolism: Digestion, mobilization and transport of fats, Oxidation of fatty acids, Ketone bodies; Amino Acid Oxidation and Production of Urea; Carbohydrate Synthesis in Plants and Bacteria; Lipid Biosynthesis; Biosynthesis of Amino Acids, Nucleotides; DNA Metabolism; RNA Metabolism; Protein Metabolism; Regulation of Gene Expression.

#### **KİM 592 Seminar 3+0 7,5**

#### **KİM 599 Term Project 3+0 15,0**

#### **KİM 601 Investigations of Mechanisms in Organic Chemistry I 3+0 7,5**

Kinds of Organic Reactions; How Organic Reactions Occur; Aliphatic Nucleophilic Substitution: General features of Aliphatic Nucleophilic Substitution; Ion Pairs as Intermediate in Nucleophilic Substitution; Influence of Solvent; Nucleophile; Leaving Group; Intramolecular Cationic Rearrangements; 1, 2-Shifts in Carbenium Ions; Carbonium Ions; Migrations to Carbonyl Group; Rearrangements to Electron-Deficient Nitrogen and Oxygen; Carbanion; Carbens and Electrophilic Aliphatic Substitution.

#### **KİM 602 Investigations of Mechanisms in Organic Chemistry II 3+0 7,5**

Addition and Elimination Reactions; Electrophilic Addition to Double and Triple Bonds; 1, 2-Elimination Reactions; Nucleophilic Addition to Multiple Bonds; Electrophilic Aromatic Substitution; Nucleophilic Aromatic Substitution; Reactions of Carbonyl Compounds; Hydration and Acid-Base Catalysis; Other Simple Additions; Addition Followed By Elimination; Addition of Nitrogen Nucleophiles; Carboxylic Acid Derivatives; Enols; Enolates, And Addition of Carbon Nucleophiles to C=O Bond; Cycloaddition Reactions; Electrocyclic Reactions; Sigmatropic Reactions.

#### **KİM 603 Organic Synthesis 3+0 7,5**

Designing Organic Syntheses and the Disconnection approach; The Order of Even Chemoselectivity; Stereoselectivity; Regioselectivity; Protecting Groups; One-

Group C-C Disconnections and Carbonyl Compounds; Two-Group Disconnections; 1, 2-; 1, 3-; 1, 4-; 1, 5-; 1, 6-Difunctionalised Compounds; Use of Acetylenes.

**KİM 606 Molecular Symmetry and Spectroscopy** **3+0 7,5**

Symmetry Elements; Symmetry Point Groups; Matrix Representations; Reducible and Irreducible Representations; Character Tables; Representations and Quantum Mechanics; Molecular Vibrations; Molecular Orbital Theory and Symmetry; Hybrid Orbitals; Transition Metal Complexes.

**KİM 609 Advanced Polymer Chemistry** **3+0 7,5**

Thermal, Mechanical, Chemical, Electrical and Optical Properties of Polymers; Polymer Mixtures; Solubility Parameters, Flory-Huggins theory; Polymer Characterization; Miscellaneous Polymerisations; Polymer Modification; Polymeric Reagents and Catalysts; Commercial Polymerisations.

**KİM 612 Pericyclic Chemistry** **3+0 7,5**

Fundamentals of Pericyclic Reactions; Electrocyclic Reactions; Cycloaddition Reactions; [2+2] Reactions; [4+2] Cycloaddition Reactions; Intra and Intermolecular Diels-Alder Reactions; 1, 3-Dipolar Reactions; Chelotropic Reactions; Ene and Related Reactions.

**KİM 614 Conducting Polymers** **3+0 7,5**

Basics of Conducting Polymers; Doping and Conductivity Properties; Synthesis of Conducting Polymers; Semiconductor Models for Conducting Polymers; Electrochromic Properties; Electrochemistry of Conducting Polymers; Solubility and Processing of Conducting Polymers; Characterization Methods; Application Fields of Conducting Polymers.

**KİM 615 Chemistry of Drugs I** **3+0 7,5**

Mechanisms of Drugs Effect on Biological Systems; Relationships Between the Chemical Structures of Drugs and their Biological Effects; Receptor Concept and Structure Specific Drugs; Structure Non-Specific Drugs; Solubility-Ionization Property of Drugs in Biological Systems and Its Relationship With Biological Activity; Steric Properties of Drug Molecules and its Relationship With Biological Activity; Isosterism and its Application on Biological Systems.

**KİM 616 Chemistry of Drugs II** **3+0 7,5**

General Reactions Used in Drug Syntheses; Phenylalkylamines; Phenylethylamines; Phenylpropylamines; Allgesics; Arylalkanoic Acid Derivatives; Chemotherapeutics; Sulphonamides; Sulphonamide Diuretics; Pyrazole Analgesics; Azole Antifungals; Symptomimetics Containing Imidazoline Residue; Benzimidazoles; Pyridine Derivatives; Dihydropyridine Antihypertensives; Drugs Containing Quinoline Residue; Pyrimidine Anticancer Agents; Barbiturates; Quinolone Hypnotics; Antihistaminic and Neuroleptics Containing Phenothiazine; Dibenazepine Antidepressants; Cyclopentanoperhydro-Phenanthrene Hormones.

**KİM 617 Statistical Thermodynamics** **3+0 7,5**

Permutations; Thermodynamic Probability; Distribution To Energy Levels of Molecules; Statistic Weight; Most Probable Distribution; Partition Functions; Statistical Correlation To Partition of Thermodynamic Functions; Work And Heat; Enthalpy And Heat Capacity; Entropy And Free Enthalpy; Mixing Entropy; Heat Capacity of Gases; Heat Capacity of Liquids; Statistical Interpretation of Equilibrium Constant; Statistical Approach For Transition State Theory.

**KİM 618 Molecular Imprinted Polymers and Applications** **3+0 7,5**

The Purpose And Basic Principles of Molecular Imprinting: Covalent bonding imprinting, Non-covalent bonding imprinting, Metal-coordination imprinting; Synthesis and Characterization of Molecular Imprinted Polymers; Application of Molecular Imprinted Polymers: Separation and preconcentration processes by solid-phase extraction, Application of molecular imprinted polymers on high performance liquid chromatography, Application of capillary electro chromatography, Application of biosensors, Application of Pharmacologic Technology: Separation and purification of chiral compounds, Improving of releasing systems; Bioimprinting: Separation and purification of biomolecules, Improving of mimic enzyme and catalytic applications; Environment Technology Applications; Recovering Valuable Chemicals

**KİM 619 Organic Electrochemistry** **3+0 7,5**

Principles and Methods of Organic Electrochemistry; Synthetic and Mechanistic Aspects of Cathode and Anode Reactions of Organic Compounds Classified by Electrophoresis; Electrochemical Classification of Heterocyclic Compounds; Natural Products; Pharmaceuticals and Coordination Compounds; Classification of Electrode Reactions by Reaction Type; Electro synthesis of Amalgams; Reagents; Acids and Bases by Indirect Methods, Present and Future of Electro synthetic Methods.

**KİM 620 Surface Chemistry** **3+0 7,5**

Colloidal Systems; Classification of Colloidal Systems; Preparation and Purification of Colloidal Systems; Kinetic Properties; The Motion of Particles in Liquid Media; Osmotic Pressure; Liquid-Gas and Liquid-Liquid Interfaces; Surface and Interfacial Tensions; Adsorption and Orientation at Interfaces; Association Colloids and Micelle Formation; The Solid-Gas Interface; Adsorption of Gases and Vapours on Solids; The Solid-Liquid Interface; Adsorption From Solution; Charged Interface; Colloid Stability; Emulsions and Foams.

**KİM 621 Supercritical Fluids** **3+0 7,5**

Definition of Supercritical Fluids; Physical Properties of Supercritical Fluids; Properties at or Near the Critical Point; Properties of the Supercritical Region; Density; Diffusivity; Viscosity; Dielectric Constant; Polarity; Physico-Chemical Properties of Pure Supercritical Solvents; Binary Systems;

Reactions in Supercritical Fluids; Influence of Pressure on the Reaction Rate; Catalytic Effects; Solid-Supercritical Fluid Phase Diagrams; Thermodynamic Modeling of Supercritical Fluid-Solute Phase Behavior; Applications of Supercritical Fluids.

**KİM 622 Ion Selective Electrodes 3+0 7,5**

Ions; Formation of Ions, Conduction of Electricity; Strong and Weak Electrolytes; Polyelectrolytes; Electrodes, Oxidation and Reduction; Electrode Potentials; Electrochemical Cells; Electrode Reactions; Electrode Types; Ion Selective Electrodes; Crystalline (Single and Polycrystal) and Noncrystalline (Glass, Liquid Etc.) Electrodes, Molecular Selective Electrodes; Gas Sensors; Enzyme Substrate Electrodes (Biosensors and Modified Electrodes), Application of Ion and Molecular Selective Electrodes.

**KİM 623 Affinity Chromatography 3+0 7,5**

Principles for the Affinity Chromatography; Choice of the Ligand; Utility and Choice of a Spacer Arm; Choice of the Matrix; Principal Methods of Immobilization; Direct Immobilization; Indirect Immobilization; Evaluation of Reactive Groups Anchored to the Matrix; Methods for Determining the Amount of Immobilized Ligand; Experimental Procedures; Separation on Column, Separation in Suspension; Application Fields of Affinity Chromatography; Protein Separation and Purification; Nucleic Acid Separation; Cell Separation; Large Scale Application; Particular Aspects of Affinity Chromatography; Charge Transfer Chromatography; Metal Chelate Chromatography; Covalent Chromatography; Hydrophobic Chromatography; Affinity Electrophoresis.

**KİM 624 Solvent Extraction Chemistry 3+0 7,5**

Aqueous Solutions, Organic Solutions and Liquid-Liquid Systems; Statistical Treatment of Liquid-Liquid Distribution Equilibria; Solvent Extraction Systems; Solvent Extraction of Nonelectrolyte Molecules; Weak Acid and Bases and Ionic Salts; Solvent Extraction with Acidic, Basic and Neutral Extractants; Application of Solvent Extraction in Solution Chemistry; Determination of Thermodynamic Activity of Chemical Species in Solutions; Determination of Association and Dissociation Equilibria in Solutions; Applications of Solvent Extraction in Analytical Chemistry.

**KİM 642 Photochemistry 3+0 7,5**

Organic Photochemistry; Electronic Orbital; Configurations and State; Transitions Between States-Chemical Dynamics; Potential Energy Surfaces; Radiative Transitions; The Absorption and Emission of Light; Photo-physical Radiation Transitions; Theoretical Organic Photochemistry; Mechanistic Organic Photochemistry; Energy Transfer; Photoaddition and Photosubstitution Reactions; Cycloaddition Reactions; Isomerizations and Rearrangements; Photofragmentation Reactions.

**KİM 643 Named Reactions in Heterocyclic Chemistry 3+0 7,5**

Three and Four Membered Heterocyclics: Corey-Chaykovsky reaction, Jacobsen-Katsuki epoxidation, Paterno-Buchi reaction; Five Membered Heterocyclics: Barton-Zard reaction, Knorr and Paal-Knorr pyrrole synthesis, Hofmann-Löffler-Freytag reaction; Fischer indole synthesis, Graebe-Ullman carbazole synthesis, Madelung indole synthesis, Reissert indole synthesis, Paal-Knorr furan synthesis, Feist-Benary furan synthesis, Fiessellmann thiophen synthesis, Paal thiophen synthesis, Fischer oxazole synthesis, Knorr pyrazole synthesis; Six Membered Heterocyclics: Krönke pyridine synthesis, Chichibabin pyridine synthesis, Camps quinoline synthesis, Doebner quinoline synthesis, Pictet-Hubert reaction, Beirut reaction, Biginelli reaction.

**KİM 644 Stereochemistry 3+0 7,5**

Simple Molecules; Hybridization, conformation and configuration, Chirality and stereogenic centers; Chiral Molecules; One stereogenic center, Molecules with two (or more) stereogenic centers Isomerism in carbon compounds; Stereochemistry of carbon-carbon and carbon-nitrogen bonds, Stereoisomerism in cyclic structures, Substitution reactions at saturated carbon: Fischer projections, Absolute stereochemistry: the *r/s* rules, Optical activity, Recognizing symmetry, Identifying chiral centers, Chirality without stereogenic carbon, Prochirality, enantiotopic and diastereotopic groups and faces: use of nmr spectroscopy in stereochemistry.

**KİM 645 Bioorganic Chemistry 3+0 7,5**

Natural Products and Drug Research; Enzymatic Synthesis and Biotransformation; Carbohydrate Chemistry and Glycobiology; Peptide Chemistry and Applications; Biosynthetic Pathways and Biochemistry; Physical and Analytical Methods.

**KİM 646 Nanochemistry 3+0 7,5**

Introduction: Inorganic Material Chemistry and Properties of Nanostructures; Nanomaterial Synthesis Methods: Bottom-up vs. Top-down Methods; Characterization of Nanomaterials; Nanomaterials: Inorganic Nanoclusters, Quantum-dots and Nanowires; Metal, Metal Oxide and Carbon Nanotubes; Inorganic-Organic and Inorganic-Polymer Nanocomposite Materials; Applications of Nanomaterials.

**KİM 647 Molecular Structure Calculations and Theories 3+0 7,5**

Molecular mechanics, Hydrogen molecule ion, Potential energy surfaces, Born-Oppenheimer approximation, Linear combination of atomic orbitals, Hydrogen molecule, Valence bond theory, Electron density, Self consistent field theory, Koopman's theorem, Open shell calculations, Unrestricted Hartree-Fock theory, Differential overlap models, Atomic orbitals and choice of atomic orbitals, Ab-initio quantum mechanical calculations, Semi-empirical quantum mechanical calculations, Electron correlation, Application to real chemical problems.

**KİM 648 Named Reactions in Organic Chemistry 3+0 7,5**



Named Reactions of Rearrangement: Chan, Demjanov, Ferrier, Payne, Ramberg-Backlund, Stevens, Tiffeneau-Demjanov; Named Reactions of Addition: Heck, Henry; Named Reactions of Coupling: McMurry, Roush, Sonogashira, Stille, Suzuki; Named Reactions of Olefination: Horner-Wadsworth-Emmons, Nysted, Pearlman, Peterson; Named Reactions of Aldehydes and Ketones: Barbier, Luche, Parkih-Doering, Garner, Seyferth-Gilbert; Named Reactions of Condensation, Stobbe, Ugi, Pechmann, Darzens; Named Reactions of Cyclization: Bergman, Birch, Danishefsky, Glase, Majetich, Paterno-Buchi, Nazarov, Pictet-Spengler; Named Reactions of Oxidation- Reduction: Swern, Julia, Jones, Fleming-tamao, Dess Martin; Named Reactions of Amines: Neber, Shapiro.

**KİM 649 Organic Functional Group Preparations I 3+0 7,5**

Alkanes, Alkenes, Alkynes, Alcohols, Amines, Nitroso Compounds, Nitro Compounds, Nitriles, Isonitriles (Isocyanides), Cyanates, Isocyanates, Carbonyl Compounds, Thiocyanates, Isothiocyanates, Carbonyl Compounds.

**KİM 650 Organic Functional Group Preparations II 3+0 7,5**

Azides, Azo Compounds; Boranes, Borates, Peroxides, Thiols, Sulfides, Disulfides, Sulfoxides, Sulfones, Sulfonik Acids, Sulfonates, Organophosphorus Compounds, Phosphonic Acids, Phosphinic Acids, Phosphines, Phosphates, Phosphites.

**KİM 651 Biosensors 3+0 7,5**

Biosensors and Their Fundamental Properties: Ideal biosensor characteristics and measurement systems, enzyme kinetics; Basic Electrochemical Principles: Cells, electrodes, current-potential curves; Transducers: pH, O<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O<sub>2</sub>, ion measurements; Amperometric Biosensors: Mesarument systems and applications; Potentiometric Biosensors: Types of indicator electrodes and applications; Immunosenors: Basic principles and applications; Microbial Biosensors: BOD, gas, hybrid sensors and applications; Thermal Biosensors: Enzyme activity determination, environmental applications.

**KİM 654 Proteomics and Genomics 3+0 7,5**

The Molecular Basis of Heredity: DNA; RNA; Gene; Chromosome; Protein and Heredity; Gene Cloning; Applications of Recombinant DNA Technology; Human Genome Project and Genetic Engineering; Protein Structure; Function and Purification; Affinity Chromatography and Application of Affinity Chromatography; Gel Based Proteomics; Electrophoresis and Principles and Applications of Proteomics; Molecular Analysis and Bioinformatics.

**KİM 657 Asymmetric Organic Synthesis I 3+0 7,5**

Stereo chemical terms; Purpose and importance of asymmetric synthesis; Analytical methods; Resolution; Asymmetric synthesis and rules; General methods used in asymmetric synthesis; Use of natural chiral compounds in asymmetric synthesis; Asymmetric synthesis using chiral

auxiliary component; Chiral catalysts and use of chiral catalysts in asymmetric synthesis; Chiral compounds; Bioorganic asymmetric synthesis and use of other methods in asymmetric synthesis.

**KİM 658 Asymmetric Organic Synthesis II 3+0 7,5**

Overview of asymmetric organic reactions; Carbon-carbon bond formation; Asymmetric carbon-heteroatom bond formation; Addition reactions to multiple bonds; Hydrogenation; Cyclization reactions; Reduction and oxidation reactions; Rearrangement reactions; Isomerization; Applications and industrial importance of asymmetric synthesis; Selected sample reactions in the literature for asymmetric synthesis.

**KİM 659 Synthesis of Amino Acids and Peptides 3+0 7,5**

Sources and Roles of Amino Acids and Peptides; Nomenclature for ?The Protein Amino Acids?; Alias ?The Coded Amino Acids ; Abbreviations for Names of Amino Acids; Conformations of Amino Acids and Peptides; Physicochemical Properties of Amino Acids and Peptides; Examples of Assignments of Structures to Peptides from NMR Spectra and Other Data; Reactions and Analytical Methods for Amino Acids and Peptides; Determination of The Primary Structure of Peptides and Proteins; Synthesis of Amino Acids; Methods for The Synthesis of Peptides; Biological Roles of Amino Acids and Peptides; Some Aspects of Amino-Acid and Peptide Drug Design.

**KİM 665 Bioorganometallic Chemistry 3+0 7,5**

Relationship Between Inorganic and Organic Chemistry; Metals and Chemistry of Metals in Biological Systems: Mn, Fe, Co and Cu, Ni metal identification techniques; Bonding Theories in Organometallic Chemistry: Valance bond, Molecular orbital and ligand field theory, Chemistry of M-C, M-N, M-S and M-O bonding; Supramolecular Ligands and Metal Complexes: Synthesis, Properties, Characterization; Biological Ligands: Metalloproteins, Carbohydrates, Sugars, Lipids; Biocatalysts and Biocatalytic Reactions; Chemistry of Enzyme: Catalase, Peroxidase, Nitrogenase enzymes; Metals in Medicine.

**KİM 667 Metals in Catalytic Reactions I 3+0 7,5**

Concept of Catalysis: Catalysis, Catalyst, Selectivity, Activity; Catalytic Reaction Types: Homogeneous catalysis, Heterogeneous catalysis; Catalytic Reaction Mechanisms: Oxidative addition, Reductive elimination, Insertion, Elimination; Some Catalytic Reaction Types: Hydrogenation, Hydroformylation, Oxidation, Coupling; Catalytic Properties of Main Group Metals: Metal halides, Metal oxides, Phase transfer catalysts; Catalytic Properties of Transition Metals: Iron group metals, Copper group metals, Platinum group metals; Catalytic Applications of Transition Metals.

**KİM 669 Analytical Method Development and Validation 3+0 7,5**

Statistical Evaluation of Analytical Data; Analytical Method Selection; Analytical Method Development and Validation: Introduction: Validation process, Qualification,

Method development, Optimization and validation approaches: Method development, Optimization, Method validation approaches; Method Validation: Terminology and Definitions: Accuracy, Precision, Specificity, Limit of detection, Limit of quantification, Linearity and range, Ruggedness, Robustness, Data elements required for assay validation; System Suitability; Method Validation Protocol; Method Transfer and Revalidation.

**KIM 790 Thesis** **0+1 30,0**

**KIM 890 Thesis** **0+1 30,0**

**KMH 501 Advanced Chemical Engineering Thermodynamics** **3+0 7,5**

Basic Concepts of Thermodynamics; Properties of Pure Substances; The First Law of Thermodynamics; The Second Law of Thermodynamics; Entropy; Second-Law Analysis of Engineering Systems; Thermodynamics Relations; Gas Mixtures; Chemical Reactions; Chemical and Phase Equilibrium.

**KMH 505 Advanced Mass Transfer** **3+0 7,5**

Principles of Diffusion and Mass Transfer Between Phases; Theory of Diffusion; Mass Transfer Coefficients; Diffusion in Solids; Inter phase Mass Transfer; Gas-Liquid Operations; Gas Absorption; Distillation; Equipment for Gas-Liquid Operations; Humidification Operations; Liquid Extraction; Solid-Fluid Operations; Adsorption and Ion Exchange; Drying; Solid-Liquid Extraction.

**KMH 506 Advanced Process Control** **3+0 7,5**

Theoretical Analysis of Complex Process; Stability; Root Locus; Frequency Response Methods; Control System Design by Frequency Response; Bode and Nyquist Diagrams; Advanced Control Techniques; Cascade Control; Feed forward Control; Internal Model Control; Adaptive Control; Predictive Control; Controller Design and Tuning; State-Space Methods; Nonlinear Control; Digital Computer Simulation of Control Systems; Process Control Strategies.

**KMH 507 Advanced Heat Transfer** **3+0 7,5**

Process Heat Transfer; Conduction; Convection; Radiation; Temperature; Counter flow; Double-Pipe Exchangers; 1-2 Parallel-Counter flow; Shell-and-Tube Exchangers; Flow Arrangements for Increased Heat Recovery; Streamline Flow and Free Convection; Calculations for Process Conditions; Condensations of Single Vapors; Condensation of Mixed Vapors; Evaporation; Vaporizes; Evaporators and Reboilers; Extended Surfaces; Direct-Contact Transfer; Cooling Towers; Batch and Unsteady State Processes; Furnace Calculations; The Control of Temperature and Related Process Variables.

**KMH 509 Fuel and Energy** **3+0 7,5**

Energy; Forms of Energy; Energy Conversion; Energy Sources and Resources; Solid Fuels; The Formation of Coal; The Structure and Petrography of Coal; Sampling and

Analysis of Solid Fuels; Liquid and Gaseous Fuels; Crude Petroleum; Physical Processing of Crude Petroleum; Natural Gas; Liquefied Petroleum Gases; Conversion Processes; Cracking Processes; Reforming Processes; Carbonization and Gasification Processes; Carbonization of Coal; The Gasification of Solid Fuels; Fuel Testing; Calorific Value; Tests on Liquid Fuels; Fuel and Flue Gas Analysis; Calculations in Fuel and Energy; Estimation of Fuel Properties from Experimental Data; Mass and Energy Balances; Stoichiometry; Application to Combustion Plant.

**KMH 510 Advanced Reactor Design** **3+0 7,5**

Multiple Reactions; Design for Parallel Reactions; Successive Irreversible Reactions of Different Orders; Irreversible Series-Parallel Reactions; Flow Patterns; Contacting, and Non-Ideal Flow; Basics of Non-Ideal Flow; Compartment Models; The Dispersion Model; The Tanks-In-Series Model; The Convection Model for Laminar Flow; Earliness of Mixing; Segregation and RTD; Self-Mixing of a Single Fluid; Mixing of Two Miscible Fluids.

**KMH 511 Advanced Instrumental Analysis** **3+0 7,5**

Basic Principles of Spectroscopy; UV and Visible Section Molecular Adsorption Spectroscopy; IR Spectroscopy; Nuclear Magnetic Resonance Spectroscopy; <sup>1</sup>H-NMR, <sup>13</sup>C-NMR; Chromatographic Analysis Methods; GC; GC-MS; Thermal Analysis Methods; TG; DTA; Application of Thermal Analysis by Spectroscopic and Chromatographic Methods in Chemical Engineering.

**KMH 513 Advanced Transport Phenomena** **3+0 7,5**

Conservation Principles; The Control Volume; Principle of Conservation of Mass; The Momentum Theorem; Principle of Conservation of Energy; The Differential Equations of the Boundary Layer; The Integral Equations of the Boundary Layer; Momentum Transfer; Heat transfer; Convective Heat Transfer at High Velocities; Mass Transfer; Formulation of a Simplified Theory; Some Solutions to the Conserved Property Equation; Some Examples of Evaluation of the Driving Force.

**KMH 516 Physical Operations in Food Technologies** **3+0 7,5**

Cleaning of Raw Materials; Dehulling; Peeling; Techniques and Equipment of Drying; Particle Size; Size Reduction; Particle Size Distribution; Particle Density; Techniques and Equipment of Classifying; Distillation; Rectification and Extraction; Filtration: Ultra Filtration; Micro Filtration; Supercritical Fluid Extraction; Principles; Applications in Food Industry; Recovering Valuable Components From By-Products.

**KMH 517 Advanced Stoichiometry** **3+0 7,5**

Definition of Selected Production Processes; Assessment of Required Physical and Chemical Data and Formula; Determinations of Mass and Energy Balances in the Process Units and their Solutions; Some Examples on Mass and Energy Balances; Balances on Transient Processes; Production of Soda Ash from Brine; The Use of Limestone Slurry Scrubbing to Remove Sulphur Dioxide from Power Plant Flue Gases.

**KMH 518 New and Renewable Energy Sources 3+0 7,5**

Solar Energy; Hydropower; Hydrogen Energy; Geothermal Energy; Wind Energy; Biomass Energy; Biomass Formation; Biomass Characteristics; Biomass Advantages; Biomass Components; Environmental Effects of Biomass; Biomass Sources; Fuel and Chemicals Production From Biomass; Biochemical Converting Processes; Thermo Chemical Converting Processes; Application Areas of These.

**KMH 519 Advanced Fluid Mechanics 3+0 7,5**

Viscosity and the Mechanism of Momentum Transport: Newton's law of viscosity, Pressure and temperature dependence of viscosity, Theory of viscosity of gases, Theory of viscosity of liquids; Velocity Distributions in Laminar Flow: Shell momentum balances, Flow of a falling film, Flow through a circular pipe, Flow through an annulus, Adjacent flow of two immiscible fluids; Transportation and Metering of fluids: Pipes, Fittings, Valves; Pumps: Positive-displacement pumps, Centrifugal pumps, Fans, Blowers, Compressors; Measurement of Flowing Fluids: Area meters, Turbine meters, Magnetic meters, Thermal meters, Elbow meters, Weirs.

**KMH 520 Chromatographic Separation Processes 3+0 7,5**

Separation Principles; Dynamics of Zone Migration; Diffusion and Kinetics; Modern Analytical and Preparative Bio separation Techniques of Liquid Chromatography; Elution and Separation Techniques in Liquid Chromatography; Gradient Elution; Adsorption; Partition; Size Exclusion; Ion Chromatography and Ion Exchange; Detectors Used in Liquid Chromatography; UV-Vis; Fluorescent; Refractive Index; Conductivity and Mass Detectors; Column Packing Materials in Analytical and Preparative Scale Liquid Chromatography; Method Development and Validation in Liquid Chromatography; Applications to Food and Bioprocesses; Quantification.

**KMH 521 Mathematical Methods in Chemical Engineering I 3+0 7,5**

Ordinary Differential Equations; Solutions by the Laplace Transform, Solutions by Series; Simultaneous Differential Equations; Functions and Definite Integrals; The Error Function; The Gamma Function; Other Tabulated Functions Defined by Integrals; Evaluation of Definite Integrals; Treatment of Experimental Results; Theoretical Properties; Curve Fitting; Propagation of Errors.

**KMH 523 Advanced Separations Processes 3+0 7,5**

Thermodynamics of Separation Operations; Energy; Entropy; Phase Equilibria; Ideal Liquid Solution Model; Nonideal Thermodynamic Property Models; Derived Thermodynamic Properties From P-V-T Models; Liquid-Liquid; Liquid-Solid Equilibria; Solvent Extraction of Organic and Inorganic Solids; Principles; Equipment; Design Calculation Methods; Algebraic and Graphical Methods; Ideal Stage and Equilibrium; Fluid/Particle Separations; Theory and Practices; Motion of Particles in Fluids; Properties of Fine Particles; Interfacial Phenomena and Rate Equations; Membrane Processes; Supercritical

Fluid Extraction; Supercritical Fluid; Principles; Phase Equilibrium; Operation; Effect of Co solvent; Applications.

**KMH 524 Materials' Synthesis, Characterization and Applications 3+0 7,5**

Synthesis and Characterization Methods (Methods Such As XRD, AAS, SEM, AFM, EDS and XPS) and Applications of Micro-, Meso- and Macro-Porous Materials; Nano-Porous Materials and Their Industrial Applications.

**KMH 525 Supercritical Fluid Extraction 3+0 7,5**

Fundamentals of Processing With Supercritical Fluids; Phase Equilibria; Thermodynamics; Equations of State; Critical Behavior; Crossover Effects; Properties of Supercritical Fluids; Viscosity; Thermal Conductivity; Diffusion Coefficient; Solubility in Supercritical Solvent; Extraction of Substances With Supercritical Fluids From Solid Substrates; Extraction Process; Extraction Rate; Influence of Process Parameters and the Conditions of the Solid Substrate on the Extracting Process; The Effect of Modifier on Solvent Power; Selectivity and their Pressure and Temperature Dependence; Supercritical CO<sub>2</sub>; Mass Transfer Phenomena in Supercritical CO<sub>2</sub> for Production of Natural Substances; Industrial Applications to Food; Pharmaceuticals; Natural Materials; Supercritical CO<sub>2</sub> Extraction of Vegetable Oils; Process Scale-Up and Economy.

**KMH 526 Membrane Separation Processes 3+0 7,5**

Membrane Materials; Transport in Membrane: Liquid Diffusion, Gas Diffusion, Cascades; Dialysis and Electrodialysis; Membrane Structure: Reverse Osmosis Membranes, Microfiltration Membranes, Ultra Filtration Membranes; Pervaporation; Gas Permeation.

**KMH 527 Electrochemical Engineering 3+0 7,5**

Vector Calculus; Dilute Solution Theory; Cell Potential; Effect of Convection in Mass Transfer; Estimation of Mass Transfer Rates from Nu Correlations; Potential and Current Distribution Problems; Secondary Distribution Problems; Numerical Calculation of Potential Distribution; Reactor Design in Electrochemistry; Differential Mass Balance; Convective Diffusion Problems; Concentrated Solution Theory; Electrode Kinetics: Measurement and Interpretation; Solid State Membrane Reactors; Measurement of Diffusion Coefficient; Impedance Modeling and Data Interpretation; Modeling and Design of Polymer Electrolyte Membrane Fuel Cell.

**KMH 528 Fuel Cells 3+0 7,5**

Principles of Fuel Cells; Efficiency and Open Circuit Voltage; Operational Fuel Cell Voltages; Polymer Electrolyte Membrane Fuel Cells; Alkaline Electrolyte Fuel Cells; Medium and High Temperature Fuel Cells; Fuelling Fuel Cells; Auxiliary Units with Fuel Cells; Delivery of Fuel Cell Power.

**KMH 529 Numerical Methods in Chemical Engineering I** **3+0 7,5**

Thermodynamics; Establishment of Non-linear Equation and Equation Systems Frequently Encountered in Thermodynamics; Unit Operations and Chemical Kinetics; Numerical Methods for Solving These Equations; Numerical integration; Simpson Rule; Method of Successive Substitutions; Newton Method; Jacobi Method; Gauss-Jordan Method; Development of Computer Models.

**KMH 530 Design of Experiments in Chemical Engineering** **3+0 7,5**

Design of Experiments and the Taguchi Approach; Definition and Measurement of Quality; Common Experiments and Methods of Analysis; Experimental Design Using Orthogonal Arrays; Experimental Design with Two-Level Factors; Experimental Design with Three- and Four-Level Factors; Analysis of Variance; Experimental Design for Studying Factor Interaction; Experimental Design with Mixed-Level Factors; Combination Designs; Strategies for Robust Design; Analysis Using Signal-to-Noise Ratios; Result Comprising Multiple Criteria of Evaluations; Quantification of Variation Reduction and Performance Improvement; Effective Experiment Preparation and Planning.

**KMH 531 Bioseparation Engineering** **3+0 7,5**

Introduction to Bioproducts: Primary and secondary metabolites; Proteins: Structure and stability; Biosystems: Eukaryotic and prokaryotic cell structure and cultivation; Cell Disruption Methods and Flocculation; Crystallization and Precipitation; Membrane Filtration; Extraction: Organic aqueous, Aqua two-phase, Reverse micelles, Supercritical fluids; Chromatography; Electrophoresis; Solvent Removal and Drying; Bioprocess Design.

**KMH 532 Biochemical Engineering** **3+0 7,5**

Bioprocessing; Enzyme Kinetics: Simple enzyme kinetics, Enzyme reactors, Enzyme inhibition; Cell Cultivations: Microbial, animal and plant cell cultivations; Cell Kinetics and Fermenter Design: Batch and continuous fermentation processes, Plug flow, Continuous stirred-tank fermenter, Multiple fermenters in series, Kinetic models; Sterilization; Agitation and Aeration: Basic mass transfer concepts; Measurements of Interfacial Area, Oxygen absorption rate, Scale-up; Downstream Processing: Solid-liquid separation, Recovery and purification processes.

**KMH 533 Polymer Synthesis** **3+0 7,5**

Concept of Polymer; Structure and Nomenclature of Polymers; Types of Molecular Weight in Polymers and Molecular Weight Determination Methods; Synthesis of Polymers: Step-growth polymerization, Condensation polymerization, Cationic polymerization, Anionic polymerization; Polymerization Techniques: Bulk polymerization, Solution polymerization, Suspension polymerization, Emulsion polymerization, Interfacial polymerization.

**KMH 535 Porous Materials** **3+0 7,5**

Definition and Classification of Porous Materials; Natural and synthetic porous materials, Synthesis methods for synthetic porous materials, Characterization methods; Using Porous Materials in Catalysis: As supporting materials and as catalysts; Determination of Internal and External Mass Transfer Mechanisms and Transport Parameters in Porous Materials; Internal and External Mass Transfer Effects on Selectivity in Reactions.

**KMH 592 Seminar** **3+0 7,5**

**KMH 601 Stage Separation Processes I** **3+0 7,5**

The Staged Process; The Ideal stage; The Staged Separation; Batch and Continuous Processes; Steady-State and Unsteady-State Operation; Equilibrium and Non equilibrium Separations; Distillation; Liquid-Liquid Extraction; The Overall Material Balance; Flow Variables; Phase Flows, Recycle Matrices; Calculation of Flows; The Component Material Balance; Definitions of Phase Compositions; The Sum of Compositions Restrictions; Phase Equilibrium; The Equilibrium Ratio; Equilibrium Equations; Equilibrium Ratio Equations for Some Simple Cases; Computer Programs for Equilibrium Ratios.

**KMH 602 Stage Separation Processes II** **3+0 7,5**

Constant Equilibrium Ratio Extraction; The Equilibrium Ratio in Liquid Extraction; Equations for Constant Equilibrium Ratio Extractions; Basic Program for Constant Equilibrium Ratio Extractions; Iterative Methods for Simultaneous Vector Equations; Constant Flow Rate Distillation: a Fixed Flow Model; Distillation Terminology; Bubble and Dew Point Calculation; Bubble Point Correction Method for Constant Flow Distillation; Constant Flow Distillation With Nonideal Liquid Phases; The Fugacity Ratio; Isotropic and Extractive Distillation; Energy Balance Equations; Derivation of the Energy Balance Equations; Calculation of Enthalpy for Vapor and Liquid Mixtures; A Computer Program for Calculation of Enthalpy.

**KMH 604 Petroleum Refinery Engineering** **3+0 7,5**

History and Development of Refining; Composition of Petroleum; Refinery Products and Test Methods; Evaluation of Oil Stocks; Physical Properties of Petroleum Oil; Introduction to Processing; Refinery and Distillation Processes; Refinery Corrosion and Metals; Chemical Treatments; Solvent Treating or Extraction Processes; Fluid Mechanics; Vaporization and Condensation; Fractionation and Towers; Heat Transfer and Exchangers; Tubestill Heaters; Thermal Cracking and Decomposition Processes; Rebuilding Hydrocarbons; Catalytic Cracking and Reforming; Natural and Refinery Gases; Economics of Design; Typical Design Calculation.

**KMH 605 Heterogeneous Reaction Kinetics and Reactor Design** **3+0 7,5**

Global Rates of Reactions in Heterogeneous Processes; Fluid-Particle Reaction Kinetics; Fluid-Particle Reactor Design; Fluid-Fluid Reactions Kinetics; Fluid-Fluid Reactor Design; Solid Catalyzed Reactions; Rates of Adsorption;

Desorption and Surface Reaction; Rate Equations in Terms of Fluid Phase Concentrations; Kinetics of Catalyst Deactivation.

**KMH 606 Advanced Mathematical Modeling in Chemical Engineering** **3+0 7,5**

Energy and Mass Balances in Steady-State Systems; Modeling in Unsteady-State Systems with a Single Variable; Modeling in Unsteady-State Systems with Multiple Variables; Modeling of Systems Involving Chemical Reactions; Solution of Finite Difference Equations.

**KMH 609 Synthetic Fuel Production By Thermochemical Methods** **3+0 7,5**

Fossil Fuels; Synthetic Fuels; Chemistry of Synthetic Fuels; Thermodynamics of Synthetic Fuels; Reaction Kinetics and Catalysis; Biomass; Biomass Sources, Thermochemical Methods; Pyrolysis: Mass and Energy Balances; Reactor Description; Effective Factors; Liquefaction: Indirect and Direct Liquefaction; Gasification; Oxygen Production; Hydrogen Production; Combustion.

**KMH 613 Coal Technology** **3+0 7,5**

Coal Beneficiation-History, Current Options And Effectiveness; Physical Coal Cleaning Systems; Coal Pre-Treatment-Size Reduction and Screening Techniques; Dry Mechanical Separation Processes; Wet Mechanical Separation Processes; Chemical Coal Cleaning; Coal Combustion; Fluidized Bed Combustion; Coal Briquette; Coal Pyrolysis; Coal Gasification; Coal Liquefaction.

**KMH 622 Mathematical Methods in Chemical Engineering II** **3+0 7,5**

Partial Differential Equations; Boundary Conditions; Particular Solution of Partial Differential Equations; Method of Separation of Variables; One- and Two-Dimensional Heat Equations; Finite Differences; The Difference Operators  $\nabla$  and  $\nabla^2$ ; Linear Finite Difference Equations; Non-Linear Finite Difference Equations; Graphical Solutions.

**KMH 630 Numerical Methods in Chemical Engineering II** **3+0 7,5**

Numerical Methods; Gauss Seidel Method; Solving Nonlinear Equations; Iterations of Newton-Raphson Model; Solving Ordinary Differential Equations; Euler's Method; Runge-Kutta Method; Solving These Equations With Computer Programs.

**KMH 790 Thesis** **0+1 30,0**

**KMH 890 Thesis** **0+1 30,0**

**KOR 501 Preservation Studio I** **2+4 10,0**

Determination of Historical, Architectural and Structural Properties of Buildings that are Examples of Civil Architecture Survived throughout the Different Historical

Periods; Definition of Conservation Principles that Lead the Practice; Formation of Conservation Decisions; Identification of Conservation Methods and Techniques; Proposal for the Conservation Practice.

**KOR 502 Preservation Studio II** **2+4 10,0**

Determination of Historical, Architectural and Structural Properties of A Monumental Building that Survived Throughout the Different Historical Periods; Analysis of the Building Within the Urban Context; Definition of Conservation Value; Formation of Conservation Decisions; Identification of Conservation Methods and Techniques; Proposal for the Conservation Practice.

**KOR 503 Conservation History and Theories** **3+0 7,5**

Historical Development of Conservation Problem; Relationship between Modernism and Conservation; Conflict between Universality and Local Values; Postmodernism and Cultural Identity; Concept of Conservation in the Contemporary World; Conservation History and Theory in Turkey.

**KOR 504 Architectural History and Concepts** **3+0 7,5**

Architecture and culture; Architecture and society; Architecture and city; Architecture and art; Architecture and form; Architecture and technology.

**KOR 505 Special Topics in Preservation** **2+0 5,0**

Contemporary Approaches to Conservation; International Trends in Conservation; National Trends in Conservation; Criteria for the World Heritage List; Reasons for Conservation of Cultural Heritage; Affects of Environment on the Historic Buildings; Sustainable Conservation.

**KOR 506 Technics of Documentation** **3+0 7,5**

Traditional Techniques of Architectural Documentation; Latest Techniques of Documentation; Use of Information Technology for Documentation; Formation of Archives.

**KOR 507 Cultural Heritage Management** **3+0 7,5**

Definition of Cultural Heritage; Principles of International Conservation Laws; Formation of Flow Charts for Continuity of Cultural Heritage; Principles for the Project Management; Risk Factors in the Conservation Process.

**KOR 508 Preservation Management** **2+0 5,0**

National Regulations for Conservation; International and National Principles and Instructions; Conservation Organizations in Turkey; Conservation Laws and Legacy in Turkey; Risk Factors in the Conservation Process.

**KOR 517 History of Modern Turkish Architecture** **3+0 7,5**

Turkish Architecture in the Pre-Republic Period under the Effect of Western Architecture; the First Nationalistic Architecture Period; the First Period of Modern Architecture I; Period of Foreign Architects; the First Period of Modern Architecture II; Period of Turkish Architects; the Second Nationalistic Architecture Period; Architecture of Sedad Hakkı Eldem; The Period between

1950 and 1980 I; the Second Period of Modern Architecture; The Period between 1950 and 1980 II; Importance of 1960s and its Reflections on Architecture; The Period between 1950 and 1980 III; Architecture of 1970s; Architecture after 1980 I; Architecture after 1980 II; Architecture of Today.

**KOR 518 History of Anatolian Architecture 3+0 7,5**

Historical Continuity and Interaction in Anatolia; Anatolian Civilizations: Prehistoric Period; Anatolian Civilizations I; Anatolian Civilizations 2; Greek Architecture in Anatolia; Roman Architecture in Anatolia; Byzantine Period and Architecture; Seljuk Period and Architecture; Architecture of Principalities Period; Early Ottoman Architecture, Classical Period Ottoman Architecture and Late Ottoman Architecture.

**MAT 502 Analysis 3+0 7,5**

Tensor Algebra; Differential Forms; Exterior Derivative and Its Properties; Fields; Orientation; Volume Element; Poincare Lemma; Singular Cubes; Stokes Theorems on Open Sets; Manifolds; Manifolds With Boundary; Differentiable Mappings; Tangent and Cotangent Spaces; Differential Forms and Fields on Manifolds; Stokes Theorem on Manifolds; Classical Theorems of Green; Gauss and Stokes.

**MAT 503 Topology 3+0 7,5**

Topological Spaces; Basic Concepts; Neighborhoods; Base and Sub base; Continuous Functions; Product Spaces; Quotient Spaces; Convergence; Nets and Filters; Separation and Countability; Separation Axioms; Countability Properties; Compact Spaces; Local Compact Spaces and Compactness; Metrizable; Complete Metric Spaces and Baire's Theorems; Connected Spaces; Local-Connectedness and Path-Connectedness.

**MAT 504 Differential Equations 3+0 7,5**

Differential Equation; Classical Solution and Solution Concepts; Isoclines; Phase Space; System of the Linear Differential Equations; Wronskian, Gronwall Inequality; Nonlinear Differential Equations; Existence; Uniqueness and Extendibility of Cauchy Problem Solution; Dependence of Solutions on Initial Condition and Parameters; Numerical Solution Methods; Stability of Solutions; Lyapunov Theorems; Linear First Order Partial Differential Equations; Existence and Uniqueness of Cauchy Problem Solution; Characteristics Method.

**MAT 506 Reel Analysis 3+0 7,5**

Measure Theory; Measure in the Plane; Lebesgue Measure and Its Properties; Measurable Functions; Convergence; Lebesgue Integral and Its properties; Lebesgue; Fatou and Levi Theorems; Differentiation of an Lebesgue Integral With Respect to its Upper Limit; Monotone Functions; Differentiation of Monotone Functions; Differentiation of An Integral With Respect to Its Upper Limit; Functions of Bounded Variation; Differentiation of the Indefinite Lebesgue Integral; Absolutely Continuous Functions; L Spaces.

**MAT 507 Applied Mathematics I 3+0 7,5**

Rectangular Coordinates; Coordinate Transformations: Polar, Cylindrical and Spherical Coordinates; Scalar and Vector Fields; Gradient, Divergence and Curl; Volume Integrals; Line Integrals and Surface Integrals; Gauss's Theorem; Stoke's Theorem; Linear Spaces; Subspaces .Linear Combinations and Linear Dependence; Hilbert Space; Orthogonal Complements; The Gram-Schmidt Procedure; Complete Orthonormal Sequences; Fourier Series; Fourier Series of a Periodic Functions; Approximations.

**MAT 507 Applied Mathematics I 3+0 7,5**

Rectangular Coordinates; Coordinate Transformations: Polar, Cylindrical and Spherical Coordinates; Scalar and Vector Fields; Gradient, Divergence and Curl; Volume Integrals; Line Integrals and Surface Integrals; Gauss's Theorem; Stoke's Theorem; Linear Spaces; Subspaces .Linear Combinations and Linear Dependence; Hilbert Space; Orthogonal Complements; The Gram-Schmidt Procedure; Complete Orthonormal Sequences; Fourier Series; Fourier Series of a Periodic Functions; Approximations.

**MAT 508 Applied Mathematics II 3+0 7,5**

Linear Transformations; Inverse Transformation; Laplace transformation; Laplace Transformation and Differential Equations; Fourier Transformation; Partial Differential Equations; The Classical Partial Differential Equations; The One-Dimensional and Two-Dimensional Wave Equations; The One-Dimensional and Two-Dimensional Heat Equations; Separation of Variables; Laplace's Equation in a Circular Region; Laplace's Equation in a Sphere; Laplace Transformation and Fourier Transformation Applied to Partial Differential Equations.

**MAT 508 Applied Mathematics II 3+0 7,5**

Linear Transformations; Inverse Transformation; Laplace transformation; Laplace Transformation and Differential Equations; Fourier Transformation; Partial Differential Equations; The Classical Partial Differential Equations; The One-Dimensional and Two-Dimensional Wave Equations; The One-Dimensional and Two-Dimensional Heat Equations; Separation of Variables; Laplace's Equation in a Circular Region; Laplace's Equation in a Sphere; Laplace Transformation and Fourier Transformation Applied to Partial Differential Equations.

**MAT 509 Algebraic Topology I 3+0 7,5**

Categories; Functors; Homotopy Category; Fundamental Group; Simply Connected Spaces; Contractible Spaces; Covering Projections; Deck-Transformations; Classification of Covering Spaces; Topological Groups; Group Actions; Computation Methods for the Fundamental Group; Higher Homotopy Groups; Wedge and Suspension; Fiber Bundles; Exact Sequences; Exact Homotopy Sequence of Fiber Bundles.

**MAT 510 Algebraic Topology II 3+0 7,5**

Axiomatic Homology and Cohomology Theories; Eilenberg-Steenrod Axioms; Elementary Homological

Algebra; Singular Homology and Cohomology Theory as Model of Eilenberg-Steenrod Axioms; Method of Acyclic Models; Computation of Homology and Cohomology Groups of Spheres; Brouwer Fixed-Point Theorem and Other Geometric Applications; Products in Cohomology and Cohomology Ring; Eilenberg-Zilber Theorem.

**MAT 511 Dynamical Systems I 3+0 7,5**

Linear Systems; Diagonalization; Exponentials of Operators; The Fundamental Theorem for Linear Systems; Linear Systems in  $\mathbb{R}^2$ ; Complex Eigenvalues; Multiple Eigenvalues; Jordan Forms; Stability Theory; Non homogeneous Linear Systems; Nonlinear Systems; Local Theory; The Fundamental Existence-Uniqueness Theorem; Dependence on Initial Conditions and Parameters; Maximal Interval of Existence.

**MAT 512 Dynamical Systems II 3+0 7,5**

The Flow Defined by a Differential Equation; Linearization; The Stable Manifold Theorem; Hartman-Grobman Theorem; Stability and Liapunov Functions. Nonlinear Systems; Global Theory; Dynamical Systems and Global Existence Theorems; Limit Sets and Attractors; Periodic Orbits; Poincare Map; Stable Manifold Theorem for Periodic Orbits; Poincare-Bendixson Theory in  $\mathbb{R}^2$ .

**MAT 513 Axiomatic Sets Theory 3+0 7,5**

Mathematical logic; Formal systems; Basic proof methods; The work of Cantor; Paradoxes; Discussions about the basic of mathematics; Ways of solution; ZF and ZFC axioms; NGB set theory; Ordinal numbers; Transitive models; Consistency discussions.

**MAT 515 Engineering Mathematics 3+0 9,0**

Approximation Theory: Discrete least squares approximation, Orthogonal polynomials and least square approximations, Chebyshev polynomials and economization of power series, Rational function approximation, Padé rational approximation, Chebyshev rational approximation, Trigonometric polynomial approximation; Gamma and Beta Functions: Taylor series expansion of Gamma function, Stirling's approximation for  $\Gamma(N)$  for large  $N$ ; Error Functions; Finite Differences; Linear Difference Equations: First degree difference equations, Second degree difference equations, High degree difference equations, Difference equations systems.

**MAT 517 Applied Mathematics 3+0 7,5**

Vector Spaces; Subspaces; Linear Dependence And Linear Independence; Basis; Linear Mappings; Matrices; Matrix Representation of A Linear Mappings; System of Linear Equations; Eigenvalues And Eigenvectors; Inner Product Spaces; Differential Equations And Their Solutions; First Order Ordinary Differential Equations And Their Applications; Higher Order Linear Differential Equations And Their Applications; Systems of Linear Differential Equations.

**MAT 519 Algebra 3+0 7,5**

Rings; Ideals; Quotient Rings; Integral Domains; Principal Ideal Rings; Euclidean Rings; Polynomial Rings; Vector

Spaces; Linear Transformations; Matrix Representation of Linear Transformations; Dual Spaces; Modules; Algebra of Linear Transformations; Eigenvalues; Eigenvectors; Minimal Polynomials; Canonical Forms; Triangular Forms; Jordan Forms; Rational Canonical Forms; Hermitian, Unitary and Normal Transformations; Real Quadratic Forms.

**MAT 520 Lie Algebras 3+0 7,5**

Simple and Semi Simple Algebras; Killing Form; Cartan's Criteria; Structure Theorems; Representations; Relations with Lie Groups; Cartan Sub-Algebras; Root Systems; Coxeter-Dynkin Diagrams; Classification of Complex Semi Simple Lie Algebras.

**MAT 521 Geometric Topology 3+0 7,5**

Surfaces and Cell-Decomposition; Surgery; Fundamental Groups and Methods of Calculation; Van Kampen's Theorem; Edge Group of a Complex and its Relation with the Fundamental Group.

**MAT 523 Introduction to Riemann Geometry 3+0 7,5**

Differentiable Manifolds; Tangent Spaces; Tangent Bundles; Riemannian Manifolds; Levi-Civita Connections; Geodesics; Curvature Tensors; Curvature and Local Geometry.

**MAT 524 Geometry of Differential Forms 3+0 7,5**

Manifolds, Lie groups, Vector fields, Differential forms, Exterior algebra, Lie derivative, Frobenius theorem, Vector-valued differential forms, Maurer-Cartan form, Homology of manifolds, Stokes theorem, de Rham theorem, Hopf invariant, Massey product, Cohomology of compact Lie groups, Mapping degree.

**MAT 525 Equations of Mathematical Physics I 3+0 7,5**

Boundary-Value Problems of Mathematical Physics: Some concepts from the theory of functions and operator theory, Fundamental equations of mathematical physics, Classification of quasi-linear differential equations of the second order, Setting basic boundary-value problems for second-order linear differential equations; Generalized Functions: Basic and generalized functions, Differentiation of generalized functions, Convolution of generalized functions, Generalized functions of slow increase, Fourier transform of the generalized functions of slow increase; Fundamental Solutions and The Cauchy Problem: Fundamental solutions of linear differential operators, Wave potential, Cauchy problem for wave equation, Propagation of waves, Cauchy problem for the equation of thermal conductivity.

**MAT 526 Equations of Mathematical Physics II 3+0 7,5**

Integral Equations: Method of sequential approximations, Fredholm's theorems, Integral equations with the Hermitian kernel, Hilbert-Schmidt theorem and its consequences; Boundary-Value Problems for the Equations of Elliptical Type: Eigenvalue problems, Sturm-Liouville problem, Harmonic functions, Fourier's method for eigenvalue problems, Newton potential, Boundary-value problems for the equations of Laplace and Poisson in the space, Green's

function, Dirichlet problem, Boundary-value problems from Laplace's equation on the plane; The Mixed Problem: Fourier's method, Mixed problem for the hyperbolic equation, Mixed problem for the parabolic equation.

**MAT 527 Numerical Solutions of Partial Differential Equations** **3+0 7,5**

Basic Concepts of Finite Difference Method; Finite Difference Methods for Parabolic Partial Differential Equations; Convergence, Stability and Consistency; Finite Difference Methods for Elliptic Partial Differential Equations; Finite Difference Methods for Hyperbolic Partial Differential Equations.

**MAT 528 Optimization Methods I** **3+0 7,5**

Unconstrained Optimization: Functions of One Variable, Functions of Several Variables, Positive and Negative Definite Matrices and Optimization, Coercive Functions and Global Minimizers, Eigenvalues and Positive Definite Matrices; Convex Sets and Convex Functions: Convex Sets, Convex Functions, Convexity and the Arithmetic-Geometric Mean Inequality, Unconstrained Geometric Programming, Convexity and Other Inequalities; Iterative Methods for Unconstrained Optimization: Newton's Method, Gradient Method, Broyden's Method, Secant Methods for Minimization; Convex Programming and the Karush-Kuhn -Tucker Conditions: Separation and Support Theorems for Convex Sets, Convex Programming and the Karush-Kuhn -Tucker Theorem, Karush-Kuhn -Tucker Theorem and Constrained Geometric Programming, Dual Convex Programming.

**MAT 529 Optimization Methods II** **3+0 7,5**

Convex Programming and the Karush-Kuhn-Tucker Conditions; Separation and Support Theorems for Convex Sets, Convex Programming: Karush-Kuhn-Tucker Theorem, Karush-Kuhn-Tucker Theorem and Constrained Geometric Programming, Dual Convex Programming, Lagrangian Duality and Saddle Point Optimality Conditions; The Lagrangian Dual Problem, Duality Theorems and Saddle Point optimality Conditions, Properties of the Dual Functions, Formulating and the Solving of the Dual Problem, Getting the Primal Solution, Linear and Quadratic Programs, Least Squares Optimization; Least Squares Fit, Subspaces and Projections, Minimum Norm Solutions of Undetermined Linear Systems; Generalized Inner Products and Norms: The Portfolio Problem, Penalty Methods; Penalty Functions, The Penalty Method, Applications of the Penalty Function Method to Convex Programs.

**MAT 530 Introduction to the Theory of Nonlinear Optimization** **3+0 7,5**

Existence Theorems for Minimal Points; Problem Formulation, Existence Theorems, Set of Minimal Points, Generalized Derivatives; Directional Derivative, Gateaux and Frechet Derivatives, Subdifferential, Quasidifferential, Clarke Derivative, Tangent Cones; Definition and Properties, Optimality Conditions, A Lyusternik Theorem, Generalized Lagrange Multiplier Rule; Problem Formulation, Necessary Optimality Conditions, Sufficient Optimality Conditions.

**MAT 531 Tensor Analysis** **3+0 7,5**

Tensor fields, tensor product, some specific tensor fields, Tensor at a point, Components of tensor, Contraction, Tensor derivation, Metric tensor, Levi-Civita connection, Curvature tensor, Ricci curvature, Bianchi identities, Some basic differential operators.

**MAT 532 Functional Analysis** **3+0 7,5**

Normed Vector Spaces; Examples of Normed Spaces; Product of Normed Spaces; Continuous Functions Between Normed Spaces; Sequences and Completeness ; Finite Dimensional Vector Spaces; Banach Spaces; Contraction Mapping Theorem; Integral and Differential Equations; Linear Mappings; Bounded Operators; The Space of Bounded Linear Transformations; Open Mapping Theorem; Closed Graph Theorem; Hahn-Banach Theorem; Inner Product Spaces; Hilbert Spaces; Self-Adjoint Bounded Linear Operators; Compact Operators; Self-Adjoint Compact Operators; Orthonormal Sets; Gram-Schmidt Orthogonalization Process.

**MAT 533 Differentiable Manifolds** **3+0 7,5**

Definition of Manifolds and Examples: Atlas; Smooth Structure; Manifolds As Subsets of  $\mathbb{R}^n$ ; Grassmannian Manifolds and Projective Spaces; Topological Properties of Manifolds. Smooth Mappings: Smooth Mapping between Manifolds; Diffeomorphisms; Partition of Unity. Tangent Vectors: Tangent Vectors on a Manifold; Differential of Maps between Manifolds; Expressing Tangent Vectors in Local Coordinates; Tangent Vectors of Curves. Vector Fields: Vector Bundles; Vector Fields. 1-Forms: Cotangent Bundles; 1-Forms; Push-Forward and Pull-Back of Vector Fields and 1-Forms.

**MAT 534 Selected Topics in Algebra** **3+0 7,5**

The Algebra Concept: Definitions and Examples; Structure Constants; Division Algebras; Normed Algebras: Cayley-Dickson Process; Associator; Alternativity; Hurwitz Theorem; Artin Theorem; Quaternion: Geometric interpretations and applications; Octonions: Moufang identities; Double; Triple and Quadruple Vector Cross Products; Characterization of Double Vector Cross Products and Determination of the Dimension in Which They Exist.

**MAT 535 Hyperbolic Geometry** **3+0 7,5**

Axioms of Hyperbolic Geometry; Upper Half Plane Model for Hyperbolic Plane; General Möbius Group: Cross Ratio; Classifications of Möbius Transformations; Reflections; Length and Distance in Upper Half Plane Model: Arc-Length Element; Hyperbolic Metric and Isometries; Other Models for Hyperbolic Plane: Poincaré Disk Model; Projective Disk Model; Hyperbolic Area and Gauss-Bonnet Formula Hyperbolic Trigonometry; Higher Dimensional Hyperbolic Spaces.

**MAT 536 Applications of Integration and Differential Equations** **3+0 7,5**



Applications of Integration: Volumes by slicing; Cylindrical Shells; Mass; Centre of Mass; Energy; Force and Work; Arc Length and Surface Area; Differential Equations: Separable equations, Exact equations; Linear first order equations; Second Order and High Order Linear Differential Equations; Partial Differential Equations; Applications of Differential Equations: Oscillation; Growth and Decay; Electrical Circuits; Wave and Heat Equations.

**MAT 537 General Topology 3+0 7,5**

Topological Spaces: Basic Concepts; Construction of Topology by using Neighborhoods and Operators; Continuous Functions: Open and closed maps; Homeomorphisms; Construction of New Topologies from the Old: Subspaces; Initial Topology; Final Topology; Product Space; Quotient Space; Convergence: Sequences; Nets; Filters; Separation Axioms and Countability: Separation axioms; Countability Properties; Uryhson's Theorem; Tietze's Extension Theorem; Compactness: Compact spaces; Locally Compact Spaces; Compactifications; Connectedness: Connected spaces; Path and Local Connectedness; Completeness; Completion of Metric Spaces; Baire's Theorem; Function Spaces.

**MAT 538 Axiomatic Geometry 3+0 7,5**

Axiomatic Systems: Historical background; Axiomatic Method; Properties of Axiomatic Systems; Finite Geometries; Axiom Sets of Euclidean Geometry: Euclid's Geometry And Euclid's Elements; Hilbert's Axioms; Birkhoff's Axioms; SMSG Axioms; Neutral Geometry: The Pasch axiom; The Saccheri-Legendre Theorem; The Parallel Postulate and Implications; Non-Euclidean Geometries: History of the Parallel Postulate; Hyperbolic Geometry; Elliptic Geometry; Euclidean Plane Geometry; Congruence; Similarity; Some Euclidean Results Concerning Circles; Some Euclidean Results Concerning Triangles; Analytical Geometry and Transformations; Isometries and Applications of Isometries.

**MAT 539 Fractal Geometry 3+0 7,5**

Fractal Examples: Contour Set; Koch Curve; Sierpinski Triangle; Menger Spongene; Examples From Nature; Iterated Function Systems: Metric spaces and Banach fixed point theorem; Hausdorff Metric; Iterated Function Systems; Collage Theorem; Dimension: Space-Filling Curves; Topology Dimension; Hausdorff Dimension; Fractal Dimension and Application; Iteration of Complex Functions: Julia sets; Mandelbrot set.

**MAT 540 Introduction to Convex Analysis 3+0 7,5**

Convex and Affine sets; Convex functions from  $\mathbb{R}$  to  $\mathbb{R}$ : Continuity; Differentiability and Convex Functions; Characterizations of Convex Functions; Convex Functions from  $\mathbb{R}^n$  to  $\mathbb{R}$ : Continuity; Differentiability and Convex Functions; Characterizations of Convex Functions; Sub differentiability of Convex Functions; Separation Theorems; Convex Functions and Optimization; Convex Programming Problem; Primal Problem; Dual Problem; Kuhn-Tucker Duality Theorem; Arithmetic-Geometric Mean Inequalities and Geometric Programming.

**MAT 541 Selective Topics from Theory of Functions of a Complex Variable 3+0 7,5**

Special Functions: Gamma function; Definition and Elementary Properties; Examples; Beta Function; System of Orthogonal Functions; Orthogonal Polynomials; Generating Functions Represented by Weight Functions; Examples and Applications; Cylindrical Functions; Cylindrical Functions of the First Kind; Other Cylindrical Functions; Asymptotic Relations for Cylindrical Functions; Graphics of Cylindrical Functions; Distribution of Zeros; Examples and Applications; Elliptic Functions; Periodic Functions; General Properties of Elliptic Functions; Elliptic Integrals and Jacobi Function; Weierstrass Function; Theta-Function; Examples and Applications.

**MAT 542 Game Theory 3+0 7,5**

Two-Person Zero-Sum Game; Maxmin Criterion; Von Neumann Theorem; Solution Concept; Domination; Worthwhile Strategies; Methods of Solution to the Matrix Game; Two-Person Non-Zero-Sum Finite Game; Maxmin Strategies And Equilibrium Pairs; Nash's Theorem; Swastika Method; Cooperative Games; Jointly Randomized Strategies; Bargaining Set and Bargaining Procedure; Two-Person Zero-Sum Non-Matrix Game; Existence of The Solution; Ky Fan Inequality; Two-Person Non-Zero-Sum and Non-Matrix Game; Existence of The Equilibrium Pairs; Nikaido-Isoda Theorem; Differential Game; Positional Strategy; Existence of Value; Approach-Evasion Problem; Extremal Aiming Method; Existence of Alternative.

**MAT 543 Introduction to Optimization Theory 3+0 7,5**

Unconstraint Optimization: One dimensional problems and method of solutions; Gradient Method; Newton Method; Optimal Solutions For A System of Linear Equations; Linear Programming: Convex Sets and Convex Functions; Canonical Form of a Linear Programming Problem; Simplex Method; Dual Problem; Equality-Constrained Optimization Problems: Lagrange Condition; Inequality-Constrained Optimization Problems: Karush-Kuhn-Tucker Condition.

**MAT 544 Combinatorial Knot Theory 3+0 7,5**

Fundamental Group: Construction; Methods of Calculation; Seifert-Van Kampen Theorem; Fundamental Group of Adjunction Spaces and Compact-Closed Surfaces; Equivalence of Topological Space Pairs in Particular Equivalences of  $\pi_1$  in  $X$ ; Isotopy; Ambient Isotopy and the Equivalence of Equivalence of Knots to the Redeimeister Moves; The Knot Group; Definition and Method of Calculation; Broad Introduction to Skein Theory and a Numerical Knot Invariant: Chromatic Number of a Knot; Its Invariance and its Adequacy: Alexander-Conway Polynomial: Definition; Invariance; Calculation for Rational Knots and its Adequacy; Jones Polynomial: Definition; Invariance; Calculation for Rational Knots and its Adequacy.

**MAT 545 Integral Equations I 3+0 7,5**

Introduction and Basic Concepts: Classification of integral equations, Problems reduced integral equations; Fredholm Theory: Fredholm's formulas, Integral equations with

degenerate kernels, Fredholm's theorems; The Contraction Operator Principle: The contraction operator principle, Applications of contraction operator to integral equations; Linear Integral Equations: Application of linear operator to integral equations, The Fredholm theorems for general Fredholm integral equation, Kernels with weak singularities, Character of solution of integral equation; Integral Transforms: Fourier transform, Laplace transform, Mellin transform, Wiener-Hopf's method.

**MAT 546 Integral Equations II 3+0 7,5**

Symmetric integral equations, Symmetric operators, Hilbert-Schmidt theorem, Solutions of operator equations, Integral equations with symmetric kernels, Hilbert-Schmidt theorem for integral equations, Characteristic values and extremal properties of characteristic functions, Equations that can be reduced to symmetric equations, Classification of symmetric kernels, Green's function, Reduction of boundary value problems to integral equations; Integral Equations of the First Kind, Volterra equations of the first kind, Fredholm equations of the first kind, Operator equation of the first kind; Singular Integral Equations, NonFredholm integral equations, Hilbert transform.

**MAT 547 Asymptotic Methods in Analysis 3+0 7,5**

Introduction: Order symbols; Asymptotic equivalence; Asymptotic series; Operations on asymptotic series; Implicit Functions: Lagrange inversion formula; Applications; Iteration methods; Roots of equations; Asymptotic iteration; Sum: Euler-Maclaurin summation formula; Stirling formula for the Gamma function; Alternating sums; Poisson summation formula; Laplace Method for Integrals: General case; Asymptotic expansion; asymptotic behavior of the Gamma; Multiple integrals; Saddle Point Method: Steepest descent method; Small perturbations; Applications of saddle point method; Indirect Asymptotics; Iterated Functions.

**MAT 548 Numerical Solutions of Ordinary Differential Equations 3+0 7,5**

Basic Concepts: Definition of ordinary differential equations, Definition and basic concepts of initial value problems of ordinary differential equations, Difference equations; Single-step Methods: Taylor series method, Euler method, Runge Kutta methods, Convergence analysis, Stability analysis, Implicit Runge Kutta methods, Obrechhoff methods; Multistep Methods: Explicit multistep methods, Implicit multistep methods, General linear multistep methods, Stability analysis, Convergence analysis.

**MAT 549 Introduction to Graph Theory 3+0 7,5**

Definitions and Examples: Graph, Vertex, Edge, Degree; Paths and Cycles: Connectivity, Eulerian graphs, Hamiltonian graphs; Trees: Properties of trees, Counting trees, Applications; Planarity: Planar graphs, Kuratowski's theorem, Eulers formula, Dual graphs; Colouring Graphs: Colouring vertices, Colouring maps, The four-color theorem, Colouring edges; Matching: Halls marriage theorem.

**MAT 552 Introduction to Mathematical Elasticity 3+0 7,5**

Introduction: Mathematical Preliminaries, Cartesian tensors, Operational tensors; Stress and Equilibrium: State of Stress, Equations of equilibrium, Principal stress, Properties and special states of stress; Deformations: Strain, Physical interpretation of strain tensor, Principal strains, Volume and shape changes, Compatibility; Material Behaviour; Formulation, Uniqueness, Solution strategies; Extension, Bending, Torsion; Two-dimensional Elasticity: Plane Stress Equations, Plain strain equations.

**MAT 592 Seminar 3+0 7,5**

**MAT 599 Term Project 3+0 15,0**

**MAT 601 Stability of Linear Systems 3+0 7,5**

Linear Systems; Stability of Matrices and Polynomials; Uncertain Systems; Robust Stability; The Value Set Approach; Zero Exclusion Principle; Kharitonov's Theory; Stability Bounds; Stability of Polytopes of Polynomials; Polytopes of Polynomials; Stability of Convex Combinations; Edge Theorems; Convex Directions: Definitions; Rantzer's Growth Condition; Schur Stability; Schur Stability of Interval Polynomials and Matrices; Weak and Strong Kharitonov Regions; Multi linear Structures and Mapping Theorem; Spherical Polynomial Families.

**MAT 602 Stability of Nonlinear Dynamical Systems 3+0 7,5**

Nonlinear Differential Equations; Definitions; Existence and Uniqueness; Geometric Interpretation; Stability: Critical Points and Attractors; Stability and Asymptotic Stability; Linearization and Lyapunov Theory; Stability of Periodic Solutions; Stability of Two-Dimensional Autonomous Systems; Applications; Stability Analysis by the Direct Methods; Lyapunov Functions; Rantzer's Theorem; Bifurcation and Chaos; Hopf Bifurcation; Lorentz Equation; Chaos and Chaotic Maps.

**MAT 603 Convex Analysis 3+0 7,5**

Lower and Upper Semi Continuous Functions; Ekeland's Variational Principle; Convex Sets and Functions; Continuity of Convex Functions; Yosida-Moreau's Approximation; Separation Theorems; Conjugate of the Convex Functions; Properties; Young-Fenchel's Inequality; Dual Problem; Fenchel's Theorem. Directional Derivability of Convex Functions; The Sub differential Concept; Subdifferentiability of Convex Functions; Sub differential Calculus; Tangent and Normal Cones of Convex Sets; Minimization of Convex Functions; Properties of Convex Set-Valued Maps.

**MAT 604 Topological Vector Spaces 3+0 7,5**

Topological Vector Spaces; Convex; Balanced; Absorbing Sets; Neighborhoods of the Zero Vector; Subspaces;

Quotient Spaces; Continuous Linear Mappings; Finite Dimensional Topological Vector Spaces; Normability of a Topological Vector Spaces; Locally Convex Topological Vector Spaces; Semi Norms; Locally Convex Topological Vector Spaces Generated by Semi Norms; Barrel Spaces; Convex; Compact Spaces.

**MAT 605 Differential Inclusions Theory** 3+0 7,5  
Set-Valued Maps; Differential Inclusion Concept; Existence of Cauchy Problem Solutions of Differential Inclusion With Convex Valued Right Hand Side Set-Valued Map; Closedness and Initial Condition Dependence of Solutions Set; Local Properties of Solutions; Reachable Sets and Integral Funnel of Differential Inclusions; Filippov's Theorem. Existence of Cauchy Problem Solutions of Differential Inclusion With Nonconvex Valued Right Hand Side Set-Valued Map, Relaxation Theorem; R-Solution Concept; Approximate Computation of Reachable Sets; Weakly and Strongly Invariant Sets With Respect to Differential Inclusions.

**MAT 606 Riemannian Geometry** 3+0 7,5  
Differentiable manifolds; Differentiable manifold, Differentiable functions, Tangent space, Immersions and Imbeddings, Vector fields, Brackets, Tensors, Orientation; Riemannian Manifolds: Riemannian metric, Riemannian manifold, Affine connection, Riemannian connection, Geodesics, Convex neighborhoods; Curvature: Curvature, Sectional curvature, Ricci curvature, Scalar curvature, Tensors on Riemannian manifolds, Jacobi fields, Hopf-Rinow Theorem; Spaces of constant curvature.

**MAT 607 Topological Groups** 3+0 7,5  
Topological Groups; Neighborhoods Systems of a Point in a Topological Groups; Isomorphism and Local Isomorphism; Subgroups; Quotient Groups; Products of Topological Groups; Continuous Homeomorphisms; Direct Product of Topological Groups; Connected and Disconnected Groups; Uniform Structures on Topological Groups; Complete Groups; Completions of a Topological Group; Compactness in Topological Groups; Locally Compact Groups; Topological Transformations Groups.

**MAT 608 Analysis on Fractals** 3+0 7,5  
Geometry of Self-Similar Sets; Constructions of Self-Similar Sets; Shift Space and Self-Similar Sets; Self-Similar Structure; Self-Similar Measure; Dimension of Self-Similar Sets; Laplacians on Fractal Sets; Dirichlet Forms and Laplacians on a Finite Sets; Sequence of Discrete Laplacians; Constructions of Laplacians on P.C.F. Self-Similar Structures; Harmonic Structures; Harmonic Functions; Dirichlet Forms on P.C.F. Self-Similar Sets; Green's Function; Green's Operator.

**MAT 609 Knot Theory** 3+0 7,5  
Basic Definitions and Notations; Knot in the Plane; Jordan Curve Theorem and Jordan Theorem; Torus Knots; Solid Torus; Connected Sums and the Knot Group; Seifert Surfaces; Cyclic Coverings and Torsion Invariants; Knots and Surgery in; S<sup>3</sup> Infinite Cyclic Coverings and the Alexander Invariants; Otomorphisms Sets and Quandle,

Invariants Obtained From Quandle; Conway and Jones Polynomials; Knots With 2-Bridges and Insufficiency of Jones Polynomials; Mutants; Generalized Polynomials; Coefficients of Conway Polynomials and Its Relation With Alexander Polynomial.

**MAT 610 Basic Topics of the Set Valued Analysis** 3+0 7,5  
Set-Valued Map Concept; Upper and Lower Semi continuity of Set-Valued Maps; Selectors of Set-Valued Maps; Michael's Theorem; Steiner Point; Lipschitz Selectors; Marginal Functions and Properties; Parameterization of Set-Valued Maps; Caratheodory Parameterization; Contingent Cones; Derivative Sets of Set-Valued Maps; Fixed and Equilibrium Points of Set-Valued Maps; Kakutani Theorem; Integral of Set-Valued Maps; Bang-Bang Principle.

**MAT 611 Introduction to Gauge Theory** 3+0 7,5  
Principal Bundles; Transition Functions; Bundle Maps and Equivalence; Principal G-Bundles Over Spheres; Hopf Bundle; Vector Valued 1-Forms; Connections Over Vector Bundle; Connections Over Principal Bundles and Equivalence; Curvature and Gauge Fields; The Yang-Mills Functional; Hodge Dual For 2-Forms In Dimension Four; The Modular Space; Matter Fields; Associated Fiber Bundles; Matter Fields and their C Variant Derivatives; Seiberg-Witten Equations.

**MAT 612 Fractals and Chaos** 3+0 7,5  
Iterated Function Systems; Fractal Dimension; Hausdorff Dimension; The Notion of Chaos; Chaos on Fractals; Symbolic Dynamics; Logistic Chaos And Bifurcation; Henon - Lorenz Examples; Lyapunov Exponentials.

**MAT 613 Clifford Algebras** 3+0 7,5  
Symmetric Bi-Linear Forms; Quadratic Forms; Tensor Product of Vector Spaces; Tensor Algebra; Tensor Product of Algebras; Definitions of The Clifford Algebra And Its Universal Property; Other Properties of Clifford Algebras; The Involution And The Anti-Involution of Clifford Algebra; Odd And Even Parts of Clifford Algebra; Non-Degenerate Real Clifford Algebras And Their Classifications; Degenerate Real Clifford Algebras; Representations of Real Clifford Algebras; Complex Clifford Algebras And Their Representations; Pin And Spin Groups; Spinors; Triality.

**MAT 614 Continuous Modules** 3+0 7,5  
Injectivity and Related Concepts: A-injective Modules; Quasi-injective Modules, Exchange and Cancellation Properties, Decomposition Theorems, Quasi-Continuous Modules: Basic Properties, Direct Sums of Quasi-Continuous Modules, Decompositions of Quasi-Continuous Modules; Internal Cancellation Property, Quasi-Continuity Versus Quasi-injectivity; Continuous Modules: Endomorphism Modules; Endomorphism Rings, Continuous Modules, The Exchange Property.

**MAT 615 Compact Operators** 3+0 7,5

Compact Operators and their General Properties; The Theory of Riesz-Schauder for Compact Operators; Spectral Properties of Compact Operators; Compact Self-Adjoin Operators; Fredholm Andvolterna Integral Equations; Differential Equations; Eigen Value Problems and Green's Functions.

**MAT 616 Fiber Bundles 3+0 7,5**

Manifolds; Local Triviality; Vector Bundles; Transition Maps; Operations On Vector Bundles; Sub Bundles; Sections of Vector Bundles; Maps Between Vector Bundles; Metric Structures on Vector Bundles; Frame Bundles; Normal Bundles; Covariant Derivative; Curvature Tensor; Lie Groups; Principal Fiber Bundles; Structure Groups; Grassman Bundles; Universal Bundle; Associated Vector Bundles; Vector Valued Forms; Connection; Connection Forms on a Principal Bundle; Curvature Form; Spinor Bundles.

**MAT 619 Vector Optimization I 3+0 7,5**

Convex Analysis: Linear spaces, partially order linear spaces, topological linear spaces and convex sets, Convex maps and differentiability, Some fundamental theorems: Zorn's Lemma, Hahn Banach theorem, separation theorems, Contingent cones and Lyusternik theorem; Theory of Vector Optimization: Optimality notions, Scalarization, Existence theorems, Generalized Lagrange multiplier rule.

**MAT 620 Vector Optimization II 3+0 7,5**

Duality: A general duality principle, Duality theorems for abstract optimization problems, Specialization to abstract linear optimization problems; Vector Approximation: Simultaneous approximation, Generalized Kolmogorov condition, Nonlinear Chebyshev vector approximation, Linear Chebyshev vector approximation, Duality results; Cotingent Epiderivatives: Cotingent derivatives and cotingent epiderivatives, Properties of cotingent epiderivatives, Cotingent epiderivatives of real valued functions, Generalized cotingent epiderivatives; Subdifferentials: Concept of subdifferentials, Properties of subdifferentials, Weak subdifferentials; Optimality Conditions: Optimality conditions with cotingent epiderivatives, Optimality conditions with subgradients, Generalized Lagrange multiplier rule.

**MAT 621 Metric Geometry 3+0 7,5**

Metric Spaces, Length Spaces, Spaces of Bounded Curvature, Smooth Length Structures, Curvature of Riemannian Metrics, Spaces of Metric Spaces.

**MAT 622 Characteristic Classes 3+0 7,5**

Vector Bundles; Stiefel-Whitney Classes; Stiefel-Whitney Numbers; Grassman Manifolds and Universal Bundles; Cohomology Ring of Grassman Manifolds; Construction of Stiefel-Whitney Classes; Oriented Bundles and the Guler Class; Thom Isomorphism Theorem; Complex Vector Buudles; Chern Classes; Pontrjagin Classes; Chern Numbers; Pontrjagin Numbers.

**MAT 623 Bochner Technique on Riemannian Manifolds 3+0 7,5**

Gradient of a Function; Divergence of a Vector Field and of a  $(1, s)$ - Tensor Field; Hessian and Laplacian Operators; Killing Vector Fields; Conformal Killing Vector Fields; Harmonic Vector Fields; Bochner Formula for Any Vector Field; Weitzenböck Formula for Amy Function and its Applications to Eigenfunctions of Laplace Operator.

**MAT 624 Stability of Switched Linear Systems 3+0 7,5**

Switched Dynamical Systems: Switching signals, Switching sequences, Solutions of switched linear systems; Stability, Asymptotic stability, Exponential stability, Lyapunov theorems; Common Lyapunov Functions: Common quadratic lyapunov functions, Switched quadratic lyapunov functions, Piecewise quadratic lyapunov functions, Multiple lyapunov functions; Stabilization of Switched Systems: Quadratic stabilization of switched systems, Piecewise quadratic stabilization of switched systems.

**MAT 625 Generalized Functions 3+0 7,5**

Test and Generalized Functions : Introduction; Space of test functions; Space of generalized functions; Support of generalized functions; Regular and singular generalized functions; Sohotskii formula; Change of variables; Product of generalized functions; Derivative of Generalized Functions: Properties of generalized derivatives; The antiderivative of generalized functions; Convolution of Generalized Functions : Direct product of generalized functions; Definition of convolution; Regularization of generalized functions; Newton potential and examples of convolution; Slows Growing Generalized Functions: Space of functions  $S$ ; Space  $S'$ ; Examples of slowly growing generalized functions; Fourier Transform : Fourier transform of functions from  $S$ ; Fourier transform of functions from  $S'$ ; Properties of the Fourier transform of generalized functions; Examples; Fundamental Solutions : Fundamental solutions of linear differential operators; Notion of fundamental solution; Fundamental solutions of heat operator; Wave operator; Laplace operator and Helmholtz operator; Wave potential; Propagation of waves; Cauchy problem for the heat equation.

**MAT 626 Boundary Value Problems 3+0 7,5**

Boundary Value Problems for Elliptic Equations: Eigenvalue problems; Sturm-Liouville problem; Harmonic functions and their properties; Fourier's method for eigenvalue problems; Newtonian potential; Boundary value problems for Laplace and Poisson equations in space; Green's function for Dirichlet problem; Boundary value problem for Laplace equation in the plane; Mixed problems: Fourier's method; Mixed problems for hyperbolic equations; Mixed problems for hyperbolic equations; Mixed problems for parabolic equations.

**MAT 627 Antagonistic Differential Games 3+0 7,5**

Minimax Control Problems; Positional Strategy; Motion of the system; Quality criterion; Two person differential game; Game problem of Approach and Evasion; Local Estimation; Extremal positional strategy; Existence of the alternative; Existence of the value of the positional differential games;

Bellman-Isaacs equation; Viscosity solution of the Hamilton-Jacobi equation and value function of the differential game; Unification of differential.

#### **MAT 628 Rings and Radicals 3+0 7,5**

General Theory of Radicals; Rings with Descending Chain Condition: Nil and nilpotent; Descending chain condition; Ideals in nil semi-simple rings with D.C.C.; Central idempotent elements; First structure theorem; Second structure theorem; Simple rings; Radical properties; Rings with the Ascending Chain Condition: Relationship between A.C.C. and D.C.C.; Nil and nilpotent; Baer lower radical; Prime rings; Zorn's lemma; Prime ideals; Subdirect sums; Semi-prime rings; Semi-prime rings with A.C.C.; The Jacobson Radical: Quasi-regularity; Semi-simple rings; Right primitive rings; Jacobson radical and general radical theory; Brown-McCoy Radical: G-regularity; G-semi-simple rings; Brown-McCoy radical and the general theory; Levitzki Radical: Local nilpotitic; Eight radicals and results.

#### **MAT 629 Complex Analysis 3+0 7,5**

Review of Cauchy Formula and Some Results; Entire Functions: Zeros of Entire Functions; Infinite Products; Weierstrass Formula; Order of an Entire Function; Analytic Continuation: Notion of Analytic Continuation; Analytic Continuation on a Chain of Domains; Analytic Continuation on a Curve Segment; Continuation of Functional Equations; Weierstrass Method; Riemann Method and Schwarz Reflection Principle; Singular Points; Functions Defined in Terms of a Cauchy Kernel: Hölder Condition.

#### **MAT 630 Hardy-Hilbert Space and its Operators 3+0 7,5**

Hardy-Hilbert space; Shift operator, invariant subspaces, Beurling's theorem, Inner and outer functions, Blaschke products, Singular inner functions, Structure of outer functions; Toeplitz operators, Basic properties of Toeplitz operators, Spectral structure of Toeplitz operators; Hankel operators, Bounded Hankel operators, Compact Hankel operators, Relation between Hankel and Toeplitz operators; Composition operators, Littlewood subordination theorem, Eigenvalues and eigenvectors of composition operators, Compact composition operators.

#### **MAT 631 Mathematics for Operations Research 3+0 7,5**

Introduction to Convex Analysis; Vector Spaces; Basis, Matrices; Linear Transformations; Systems of Linear Equation; Eigenvalue and Eigenvectors; Positive Certainty; Convex Sets and Their Topological Characteristics; Hyper Planes; Polyhedron Sets; Cones; Separating and Supportive Hyperplanes; Extreme Points and Directions; Convex Functions; Continuity and Differentiability of Convex Functions.

#### **MAT 632 Complex Geometry 3+0 7,5**

Complex Structures and Holomorphic Maps; Almost Complex Manifolds: Integrability, Nijenhuis tensor field; Complex Manifolds: Complex vector fields, Differential forms; Connection in Almost Complex Manifolds; Hermitian Manifolds; Hermitian metrics, Kaehler

Manifolds; Kaehler metrics, Kaehler form, Curvature tensor, Ricci tensor, Ricci form, Kaehler Metrics in Local Coordinate Systems; Examples of Kaehler Manifolds.

#### **MAT 633 Measure Theory and Integral 3+0 7,5**

Measurable Space and Measure Space; Borel Measurable Sets; Regular and Radon Measure; The Jordan and Hahn Decompositions of Measure; The Saks, Alexandrov and Caratheodory Theorems; Measurable Functions; Egorov and Luzin Theorems; Integral of Simple Functions and Integral of Measurable Non-Negative Valued Functions; Bochner Integral; The Lebesgue and Radon ? Nikodym Theorems; The Banach space ; Riesz representation of continuous functionals defined on the space of continuous functions; Topological conjugate of the space of continuous functions.

#### **MAT 634 Compactness Theorems on Riemannian Manifolds 3+0 7,5**

Metric Structure on Riemannian Manifolds; Riemannian Metric Tensor; Length of a Curve; Distance between Two Points; Geodesics; Completeness of a Riemannian Manifold with Respect to a Metric; Definition of the Segment Between Two Points; Calculus of Variations and Compactness Theorems on Riemannian Manifolds; Laplace Comparison Theorems and Compactness Theorems on Riemannian Manifolds.

#### **MAT 635 Graph Theory 3+0 7,5**

Graphs: Basic definitions, Trees, Counting trees and Cayley's Theorem; Planarity: Planar graphs, Euler Formula, Kuratowski Theorem, Graphs and planarity; Colouring Graphs: Colouring vertices, Brooks Theorem, Chromatic polynomials, The four-colour theorem, Colouring edges; Digraphs: Orientations, Directed Euler trails; Ramsey Theory: The graphical case of Ramsey's Theorem, Bounds on Classical Ramsey numbers, The general case of Ramsey's Theorem; Flows in Networks: Transportation networks and flows, Maximal flows, The max flow min cut theorem and algorithm, Supply and demand problems; Some Graph Algorithms: Data structures, Some graph algorithms.

#### **MAT 637 Fuchsian Groups 3+0 7,5**

Hyperbolic Geometry: Hyperbolic metric, Geodesics, Isometries, Hyperbolic area and The Gauss-Bonnet Formula; Fuchsian Groups: The  $PSL(2, \mathbb{R})$  group, Discrete groups, Algebraic properties of Fuchsian groups; Fundamental Regions: The Dirichlet region, Isometric circles and Ford fundamental region; Geometry of Fuchsian Groups: Geometrically finite Fuchsian groups, Co-compact Fuchsian groups.

#### **MAT 639 Differential Topology 3+0 7,5**

Topological Manifolds, Differentiable Manifolds, Manifolds with boundary, Vector bundles, Fibre bundles, Sard's Theorem, Imbedding theorems, Homotopy and Stability, Dynamical systems, Isotopies, Transversality, Tubular Neighborhoods, Degree of a map, Euler Characteristic, Intersection number, Winding number, Lefschetz fixed point theorem, Poincare-hopf Theorem, Morse

functions, Regular levels, Connected sum of manifolds, Classification of surfaces.

**MAT 790 Thesis** **0+1 30,0**

**MAT 890 Thesis** **0+1 30,0**

**MEK 501 Advanced Soil Mechanics** **3+0 7,5**

Soil Structure; Hydraulic Conductivity: Permeability and seepage; Stresses in Soil Mass: Two-dimensional problems and three-dimensional problems; Consolidation Theory: Settlement analysis; Theory of Shear Strength; Bearing Capacity of Shallow Foundations; Stability of Slopes; Theory of Lateral Earth Pressure; Soil Improvement: Grouting, Jet grouting.

**MİM 501 Analysis in Architecture** **3+0 7,5**

The Concept of Place and Space in Architectural Design; The Special Form of House; Perception; Definition of the Visual and Special Elements; In Connection With Cultural and Environmental Characteristics; Meaningful in the Architecture; Agenda of the Concept Studies; Scientific Researches and Reflection to Architectural Design; The Scaling Problem in Architecture; Components of Space and Place; Conceptual, Graphical, Typological and Algorithmic Techniques.

**MİM 502 Criticism in Architecture** **3+0 7,5**

Criticism in Architectural Design; Descriptions and Methods; Relationships of the Criticism/ Evaluation; Architectural Design; Criticism and Structure of the Criticism; The Criteria Developing in Architectural Design; Selection and Hierarchy of Criteria; Formation of Conceptual and Instructive Criteria and Criticism in Architectural Education.

**MİM 503 Housing Problems and Policies** **3+0 7,5**

Historical Development of Housing Problem; Housing Problem of Developed Countries; Housing Problem of Developing Countries; Housing Problem of Turkey; Housing Demand and Factors Affecting the Demand; Housing Policies of Developed and Developing Countries; Basic Principles of Housing Policy in Turkey and Results of Implementation of Them.

**MİM 504 Qualitative Values of Housing Areas** **3+0 7,5**

Concept of Quality in Housing Areas; Basic Determinants of Forming a Dynamic Environment in Mass Housing Areas by Considering Social Aspects; Comfort Conditions Depending on Variables of Physical Environment; Physical; Aesthetics; Visual and Social Parameters Which Form Quality Concept; Analysis of Housing Environment in Terms of Social and Technical Infrastructure; User Demands; Problems Related to Quality of Housing Environment.

**MİM 505 Ecological Planning and Design** **3+0 7,5**

Fundamental Ecologic Principles and Terms; Hybrid and Active Energy Design; Production and Protection of the Energy Planning of the Electric Production; Manipulation and Protection for the Sun; Heat and Wind; Protection for the Water Resources; Ecological Infrastructure of Some Countries; Pollution and Environmental Health; Protection of Fauna and Flora; The Difference Between Natural and Artificial Planning; Plants for Determining Environmental Quality; The Methods for Plants Protection.

**MİM 509 Legal Aspects of Urban Planning** **3+0 7,5**

Design and Realization Processes of Urban Plans; Laws and Regulations Concerned in the Process of Urban Design; Critical Review of Laws and Regulations in Effect; New Approaches to Urban Design Process; Environment Responsive Urban Design.

**MİM 511 Building Material Failures** **3+0 7,5**

Definition of Material Damage; Main Causes of Building Material Damage; External Causes of Damage (Climatic, Biological, Causes And Natural Disasters); Internal Causes of Damage And Man-Made Causes of Damage; Building Material Damages And Classification; Corrosion of Metals And Alloys Such As Iron, Copper And Lead; Degradation of Organic And Polymeric Materials Such As Wood, Paper, Leather, Wool, Cotton And Synthetics; Degradation of Inorganic Materials Such As Natural Stone, Brick, Glass, Concrete, Reinforced Concrete And Plaster.

**MİM 512 Administrative and Legal Aspects of Planning** **3+0 7,5**

Centralization and Decentralization : Definitions; Advantages and Disadvantages; Comparison; Local Governments in Turkey; Municipalities and its Administrative Units , Tasks, Problems and its Reorganization; Administrative and Implementation problems; Regulations and Problems of Urban Planning.

**MİM 513 Computer Programming and Introduction to Architectural Practices** **3+0 7,5**

Computer Graphics Design and Its Terms; Operating Systems; Modeling; Animation; Different Techniques of Virtual Realty; Artificial Intelligent- Expert Systems; Multimedia; Analysis of Different Computer Program; PASCAL Programming Language and Architectural Practices.

**MİM 514 User Interface Design** **3+0 7,5**

Introduction to GUI, History of Human- Computer Interaction; Interface Design and Methodologies; Computer Practices; The Principles of Interactive Communications Deal With Computer Technology and Interface Design; Techniques and Program.

**MİM 515 Solar Energy in Architecture** **3+0 7,5**

Historical Development of the Relation Between Solar Energy and Building Design; Why Solar Architecture?; The Role of Sun; In the Space Comfort; The Possible Active and Passive Uses of Solar Energy; The Basic Elements and the History of Passive Use; Solar Windows; Solar Walls; Green Houses; The Active Use of Solar Energy; Solar Collectors; Photovoltaic Modules; The History; Development; Construction; Specialties of Pvs and their Use in Architecture and Examples.

**MİM 516 Building Shell Design in Energy Efficient Buildings 3+0 7,5**

The Reasons of Energy Efficiency; Why Renewable Energy Sources; The Energy Efficiency Period; The Design Parameters of Artificial Environment; Place; Orientation; Form; Thermo-Physical Properties; Wall Constructions in the Aspect of Energy Efficiency and Climatic Comfort: Heat Isolation; Storing Heat; Heat Transfer on the Wall Construction; Convection; Conduction; Radiation; Passive Buildings; Low-Energy Building; Zero-Energy Building; Plus-Energy Building Concepts; The Design Principles of Energy Efficient Buildings and the Trend in 21st Century.

**MİM 517 Architectural Precast 3+0 7,5**

Precast Concrete and Advantages of Precast Concrete; Design Concept in Terms of Economy and Usage; Design Evaluations; Product Development; Shape; Form and Dimensions; Color and Texture; Weathering; Structural Design; Hoisting and Transportation; Tolerance; Jointing; Detailing; Application Drawings; Surfaces; Weathering Details; Fixings; Jointing; Joints.

**MİM 518 Structure in Architecture 3+0 7,5**

Structure and Architecture; Structural Design in Architecture; Relationship Between Architectural and Structural Design; Steel Structures; Selection Criteria; Steel Components; Structural Forms; Reinforced Concrete Structures; Selection Criteria; Concrete Technology; Structural Forms; Masonry; Structures; Timber Structures; Selection Criteria; Timber Components; Structural Forms.

**MİM 519 Housing Architecture 3+0 7,5**

Type and Typology Concepts; Development of Housing Typology in Historical Perspective; Shelter and House Concept; Effects of the Industrial Revolution on Housing Planning; Housing Spaces in Utopias; Approaches to Housing in the Understanding of Modernism; Development of the House in Turkey and the World; The Role and the Needs of the Occupant in Housing Planning; Traditional House and the Turkish House; The Turkish House; Planning Principles; Rooms; Facade Elements; Styles; Interpretation of the Turkish House in Today's Conditions.

**MİM 520 Architectural Steel 3+0 7,5**

Structural Steel in Architecture; Steel Production and Steel Products; Development in Steel Structures; High-Rise Steel Structures; Design and Application Criteria for Steel Structures; Basic Planning Problems; Columns; Wind Bracings; Flooring Structures and Applications; Constructional Elements; External Walls; Roofs; Fire Prevention; Corrosion and Prevention.

**MİM 521 Environmental Design 3+0 7,5**

Environmental Design; Perceiving and Environmental Perception; Theories and Researches; Environmental Cognition and Perception; Theories; Researches; Design and Cognitive Studies; Environmental Behavior; Behavioral Settings; Patterns of Act; Fit and Fitness; Researches; Behavior and Design; Space; Personal Space; Proximity Theory; Researches; Space and Design; Proximity; Intimate; Theories; Territoriality; Defensible Space; Intimate and Design; Environmental Stress; Theoretical Approach; Ecological Fitness.

**MİM 523 Contemporary Interpretation of Traditional Turkish Houses 3+0 7,5**

Primitive Living Spaces, Sheltering Conception of Turkish Society, Differences Between Nomad Period and Settled Period, Rural and Urban Houses, Turkish House Space Configuration, Turkish House and Regional Diversity, Plan, Function, Elevation Formations, Material, and Decorate about Turkish House; Analysing a Turkish House in Contemporary Life.

**MİM 525 Culture, House and Identity 3+0 7,5**

Sheltering; Housing and Mass Housing Concept; Shaping Development from Utopia to Present; The Relationship between Culture; Identity Concept and Housing Space; Approaches for Environmental Behavior on House Based Studies; Cultural Factors Affecting the Process of Shaping Housing Environment in Different Levels; Culture; House and Identity Components in the Settlements in different Cultures.

**MİM 526 Computer Aided Architectural Analyses Techniques 3+0 7,5**

Information Systems; Spatial Information Techniques; Computer Aided Design Applications; 3D Modeling; Computer Aided Architectural Analyses Techniques; Preparation Base Maps with High Resolution Satellite Images; Visualization Techniques; Topographical Analyses; Overlay; Interpretation Techniques.

**MİM 528 Using of Space around House and House Environment 3+0 7,5**

The Relationship between Environment , House and Mass Housing; Shaping Housing Area; Design of Housing Indoor and Outdoor Space: Micro climatic components, Physiological Environment components, Indoor and Outdoor Landscape, Livable Housing Environment, User needs; Quality in Housing Environment, Usability of Housing Environment; Post Occupancy Evaluation; Studying and Evaluation of the Alternative Housing Layout according to Environment; House and User.

**MİM 529 Urban Space and Handicapped People 3+0 7,5**

Planning Approaches for Healthy Cities; Features of the City; Urban Rights and Dependency; Handicapped People in the City; Urban Environment and Handicapped People; Accessibility in Urban Space; Urban Design for Everyone; Applications, Problems and Solutions; Handicapped Persons and Laws.

**MİM 530 National and International Aspects of Urban Conservation and Renewal 3+0 7,5**

The Reasons for Conservation of Historical Environment and Renewal; Historical Development of Conservation and Renewal Awareness in National and International Levels; Context and Concept of Conservation of Historical Environment and Renewal in National and International Level; Actions and Fundamentals of Conservation of Historical Environment and Renewal; Legislative Aspects of Conservation of Historical Environment and Renewal; The Tasks and Authorizations of the Conservation and Renewal Agencies.

**MİM 531 Architectural Design Methods 3+0 7,5**

Architectural Design and Process: Creativity, Analysis, Concept, Definition of the problem; Logic of Design and Methods: The role of perception, The originality of design and expression; The Approaches in Architectural Design; Participatory and Sustainability Design: The problem of place in architectural design, Contemporary Concepts and Evaluation of Environmental Problems: Cultural and historical design.

**MİM 532 Urban Regeneration 3+0 7,5**

National and International Scope of Urban Regeneration; Urban Development Processes and Regeneration Practices; Historical Formation and Structure of Urban Space; Social and Demographic Development Processes in Urban Spaces; Economic Development Processes; Physical Development Processes in Urban Spaces; Formation of the Urban Culture and Its Effect on Urban Space

**MİM 533 Methodologies in Architectural Design Research 3+0 7,5**

Methodologies In Architectural Design Research, Description of the Concept of Research, Various Approaches, Researches and Techniques; Research Problems in Architectural Design: Description, Planning, Content and procedures, Stating hypothesis, Strategies, Methods and techniques of data gathering, Data analyzing, Hypothesis testing; Tools for Environment-Behaviour Research; Problems of Reliability and Validity in Research, Qualitative and Quantitative Methods; Communicating the Research for Scientific References: Techniques of writing scientific documents.

**MİM 534 Designing of Housing Areas 3+0 7,5**

Problems Related to Mass Housing Construction and Alternative Solutions for Design Principles; Housing Problem and Its Indicators; Housing Policy Indicators; Housing Policies and Housing Systems in Turkey; Physical, Natural and Social Environmental Factors Related to the Location and Site Planning of Residential Areas; Residential Densities; Housing Types Environmental Factors in Housing Design. Problems related to Design of Housing Areas in the Modern Age; Analysis and Evaluation of Mass Housing Applications in Turkey and the World.

**MİM 535 Urban Design Theory 3+0 7,5**

Space, Definition of Urban Space and its Content; Elements of the Urban Pattern: Theories, definitions, man and urban

space relations; Sensual Evaluation Systems; Visual perception Action Patterns; Urban Space and User Qualities, Characteristics of the Social, Economic and Cultural Structures, Theories of the Urban Space Design: Decision theory, Perception theory, Theories which bring formal approach and evaluation to the space; Sociological Theories and Ecological Design Theories.

**MİM 536 Rationalism in Architecture 3+0 7,5**

Concept of Rationalism; Rational Architecture in the Ancient Egypt, Ancient Greek and Ancient Rome; Rational Architecture in Renaissance; Rationalism and Rational Architecture in the Enlightenment Period; Structural and Functional Rationalism; Rational Architecture in the Early Modern Architecture; Bauhaus and its Rational Sources; Rational Architecture after the World War II; Rationalist Reactions to Rationalism; Alternative Meanings of Contemporary Rationalism: Neo-Rationalism (Post-modern rationalism), Surrealism; Rationalism in Turkish Architecture.

**MİM 541 Architectural Design Studio I 2+4 7,5**

Architectural Design Education: Architectural design processes, Architectural design methods; Current Aspects of Architectural Design: Research on global architecture and regional and local architecture, Data collection and analysis, Developing projects as a solution; Responsibility in Architecture; Key Points in Architectural Design: Function, Firmness and Aesthetics; Use of Technology in Architectural Design Process.

**MİM 542 Architectural Design Studio II 2+4 7,5**

Theory and Applications in Architectural Design; Architectural Experience in International and National Projects; Approaches to Architectural Design: Scientific research, Design methods; Interpretation in Architectural Design; Methods of Using Architectural Technologies; Current Architectural Issues Related to Economic and Environmental Responsibility in Design.

**MİM 543 Building Material Experiments 3+0 7,5**

Conventional and Composite Building Materials; Natural stone, Brick, Tile, Ceramic, Natural and artificial wood, Plaster, Mortar, Reinforced concrete, Metal, Rubber, Bitumen and polymers; Physical, Chemical and Mechanical Features of Materials; Effects of Atmospheric Factors on Building Materials, Effects of Various Chemicals and Internal and External Factors; Analogue and Digital Test Equipment Used in the Measurements of Damage, Deformation and Physical Changes of Materials; Measurements and Analyses of Changes on Physical, Chemical and Mechanical Features of Materials and Use of Analogue and Digital Test Equipment for the Measurement and Analyses of Apparent or Unapparent Damage and Deformation Mechanisms in Materials.

**MİM 545 Architecture Sociological Readings 3+0 7,5**

Sociological Understanding of Architecture; Sociological Research; Evaluation of the Society from a Historical Perspective; National and International Status of the Architectural Profession; Sociological Components:



Historical awareness, Anthropological and critical perspectives; Responsibility Towards Society and the Built Environment; Architecture and the Phenomenon of Society; Ideology and Power Theory; The French Revolution, the Industrial Revolution, Relationship of Capitalist Production with Modernity and Nation-States; Modernist and Postmodernist Sociological Approaches.

**MİM 547 Architecture Communication** 3+0 7,5  
Architectural and Interior Design in Organization of Enterprises; Thinking on Architecture, Communication and Organizations and Conceptual Frameworks; Power of Spatial Relationships; Decision Making by Administrators and Architects in Consideration of Strategic Spatial Planning and Business Needs; Field Studies and Examples; Message Given by Successful Spatial Design to Clients and Business Partners; Impact of Communication and Spatial Design on Business Efficiency and Effectiveness.

**MİM 592 Seminar** 3+0 7,5

**MİM 599 Term Project** 3+0 15,0

**MİM 601 Architectural Studio Research I** 3+0 7,5  
In architecture, to bring together different areas in the basic idea of the systematic design; To ensure the cooperation interdisciplinary with exchange and communication with other disciplines; To do research on and develop upon to produce and to win the community the best qualified information that can be transferred to practice.

**MİM 602 Architectural Studio Research II** 3+0 7,5  
In the field of architecture to search configuration of to create of global warming, climatic changes, technology and scientific approaches; Depending on the research the future of an experimental project preparation, to work and development of innovative works in theoretical and practical architectural design fields by coming together in the interdisciplinary and the experimental environment.

**MİM 603 Architectural Research Methods** 3+0 7,5  
Domain of Architectural Research: Systems of Inquiry and Standards of Research Quality, Literature Review, Theory in Relation To Method, Design in Relation To Research; Seven Research Strategies: Interpretive-Historical Research, Qualitative Research, Correlational Research, Experimental and Quasi-Experimental Research, Simulation and Modelling Research, Logical Argumentation, Case Studies and Combined Strategies.

**MİM 604 Architecture: Art, Science and Technology** 3+0 7,5  
Architecture: Art, Science and Technology, Design; Interdisciplinarity, Design Process, Built-in Environment, Construction, Anesthesiology, Esthesiology, Live Art Performance, Benefits Of Society/User/Architect, Theory and Applications, Case Study.

**MİM 605 Sustainable Architecture** 3+0 7,5  
Principles of Sustainability, Strategic Design, Ecology, Recycled Building Materials, Eco Building Materials, Lowtech Housing, Hightech Housing, Passive and Active Sustainable Design.

**MİM 606 Urban Space Design Quality** 3+0 7,5  
The definition of urban space, the analysis of urban space form, the determination of user- urban space relationship, the user needs and requirements for urban space, the definition of quality, relationship between architecture and quality, urban space quality indicators, the analysis of well-done examples urban space.

**MİM 607 The Tools and Quality Measurement Methods for Design** 3+0 7,5  
Definition of design, architecture and design, architectural space, theories of perception, spatial perception and comprehension, spatial quality theory, space is associated with quality measurement methods, quantitative and qualitative measurement techniques in architectural design classification, use of quality indicators measurement method, weighting (multiple criteria method) method of valuation, integrated method, examples of quality measuring tools.

**MİM 613 Civic Space and Buildings** 3+0 7,5  
Study on the terminology of "Civic space" and "civic buildings"; Case studies on public and civic spaces such as agora, forum, square, place, piazza, public parks, hippodromes or stadiums, and public parks; significant examples of bureaucracy and cultural institutions such as the parliament, justice buildings, university, theatre, opera, concert hall, academies and art buildings; emphasizing on the twentieth century buildings and capitals.

**MİM 614 Health Impact Assessment of Space** 3+0 7,5  
The definition of health and well-being, Physical health, Mental health and well-being, Social health and well-being for open space; The typology of open spaces, according to their function and strategic importance; local and neighbourhood differences; parks: private gardens; natural and semi-natural greenspaces; green corridors; play space for children and teenagers; amenity greenspace; and, other functional greenspaces.

**MİM 615 Spatial Relationships and Architecture** 3+0 7,5  
Evaluation Physical Environment and Place: Interdisciplinary different approaches and different readings, Historical and cultural continuity concepts and contributions of historical process to spatial reading, Requirements of multi-aspect readings of spatial relationship; Spatial Relationships and Spatial Continuity: Different dimensions of spatial relationships, Concepts of spatial continuity and interface on different scales, All interfaces from scale of the city to the interior spaces as a place; Importance of Spatial Continuity and Concept of Integrated Design: Use of visual materials, Case studies with students.

**MİM 616 Bounderies of the House and Modernity** **3+0 7,5**

Home, House, Housing and Dwelling: Forces determining the house form: Physical Forces, Social Forces; House and its environment; Boundary and the House, Inside- Outside, Inside-inside relationships; Conditions of Modernity and the Change: House and its changing boundaries in first half of the 20th century, Analysis of the houses from Turkey and abroad.

**MİM 617 Architecture and the Morphological Study** **3+0 7,5**

The three existential world centers: SUB, OBJ, SEM, A model of fundamental triads, The fundamental triad of SUB, OBJ, SEM, Whitehead's view of the world as system of societies, The structural principle of the Gestalt method, Morphology: a cognitive approach to the general study of pattern, Goethe's morphology, The Kulturmorphologie movement, Cultural pattern stability, transmission, synchrony and diachrony

**MİM 618 History and Criticism of Contemporary Architecture** **3+0 7,5**

Modern Architecture I; Modern Architecture II; Modern City I; Modern City II; Postmodern Culture and Architecture I; Postmodern Culture and Architecture II; Trends in Contemporary Architecture I; Trends in Contemporary Architecture II; Trends in Contemporary Architecture III; Trends in Contemporary Architecture and Criticism IV; Effects of Contemporary Architecture on Turkish Architecture I; Effects of Contemporary Architecture on Turkish Architecture II.

**MİM 620 Universal Design** **3+0 7,5**

Introduction to Universal Design; Design and Users; Universal Design/Design for All; Users of Universal Design: People with disabilities, People without disabilities, Elderly; Barriers and Universal Design; Principles of Universal Design; Accessibility as a Right; Accessibility to Products and Services; Accessibility to Built Environment: Indoor public facilities, Outdoor public facilities; Best Practices and Universal Design Guide; Policies Supporting Universal Design.

**MİM 790 Thesis** **0+1 30,0**

**MİM 890 Thesis** **0+1 30,0**

**MLZ 501 The Structure-Property Relationships in Materials** **3+0 7,5**

The Structure of Materials; Levels of Materials Structure; Introduction to Structure-Property Relationships in Materials; Pauling Principles in Ionically Bonded Systems; Crystal Chemistry; Symmetry Operations; Symmetry Components; Point Groups and Their Stereograms; Space Groups; Transformation of Space Groups to Point Groups; Transformation Components for Symmetry Components; Neumann Principle; Analytical Form of Neumann

Principle; Heckmann Diagram; Thermodynamic Relations; Specific Heat and Entropy; Pyro-electricity; Stress and Strain; Thermal Expansion; Piezoelectricity and Piezoresistance; Application Examples.

**MLZ 502 Thermodynamic Applications in Material Science** **3+0 7,5**

The Zerowth, First, second, and Third Laws of Thermodynamics; Ellingham Diagrams; One-component Phase Diagrams; The Behaviour of Raoultian, Henrian and Regular Solutions; Gibbs Free Energy-Composition and Phase Diagrams of Binary Systems; Statistical Interpretation of Entropy; Reactions Involving Gases: the effect of temperature and pressure on the equilibrium constant, reaction equilibrium as a compromise between enthalpy and entropy; Reaction Equilibria in Systems Containing Components in Condensed Solution: criteria for reaction equilibrium, alternative standard states, binary systems containing compounds, graphical representation of phase equilibria, the solubility of gases in metals, solutions containing several dilute solutes; Electrochemistry: the relationship between chemical and electrical driving forces, the effect of concentration on EMF, formation cells, concentration cells, Pourbaix diagrams.

**MLZ 503 Electrical Properties of Materials** **3+0 7,5**

Electrons in Crystal; Electrical Conduction in Metals and Alloys; Superconductivity; Thermoelectric Phenomena; Semiconductors and Semiconductor Devices; Electrical Properties of Polymers, Ceramics, Dielectrics, and Amorphous Materials; Optical Properties of Materials; Applications (Electro-Optical Waveguides, Optical Storage, Complementary Metal?Oxide?Semiconductors (CMOSs), Charge-Coupled Devices (CCDs), LEDs, LCDs, LASERS); Magnetic Properties of Materials; Applications (Permanent Magnets; Magnetic Memory and Recording, Magnetic Detection and Sensors); Thermal Properties of Materials; Thermal Conduction and Expansion in Metals and Alloys; Applications (Thermocouples, Thermal Camera and Detectors).

**MLZ 504 Fracture Mechanics of Materials** **3+0 7,5**

Introduction; Fundamentals of Fracture Mechanics; Dislocations, Plastic Flow and Stresses; The Fracture Strength; The Factors Affecting Elastic Modulus in Ceramics; Impact Resistance and Toughness of Ceramics; Critical Crack Size; Fracture Surface Energy; Work of Fracture; The Effects of Coefficients of Thermal Expansion Difference on Mechanical Properties; Thermal Stresses and Fracture; The Determination of Thermal Shock Parameters for the Industrial Applications; Thermal Shock Behaviour; Engineering Design Data.

**MLZ 505 Thermal Analysis of Polymeric Materials** **3+0 7,5**

Properties of Thermoplastics, Thermosets and Elastomers, Introduction to Polymer Thermal Analysis, Polymer Physics, Definition of Glass Transition, Melting and Crystallization for Different Polymer Types. Differential Scanning Calorimetry (DSC) and Its Working Principles, Real Life Examples to DSC Applications with Hands on

Experiments, Thermogravimetry (TG) Analysis and Its Working Principles, Real Life Examples to TGA Applications with Hands on Experiments, Thermo Mechanical Analysis (TMA) and Its Working Principles, Real Life Examples to TMA Applications with Hands on Experiments, Introduction to Dynamic Mechanical Analysis (DMA), DMA Applications with Hands on Experiments. Introduction Micro-Thermal Analysis.

**MLZ 506 Mathematical Methods in Polymer Science and Technology 3+0 7,5**

Molecular Weights and Numerical Average of Polydispersity Indices and Calculations of Weight Averages; Stoichiometry of Polymerization Reactions, Their Kinetics and Transformations; Crystallization, Polymer Solutions, Polymer Mixtures and Calculations of Miscibility Parameters; Calculations Based on Viscoelasticity; The Use of WLF Equation; Heat Transfer Calculations; Stress-Strain Calculations in Fiber Containing Composites; Calculations in Molding Presses; Extrusion Calculations; Heat Treatment Calculations; Other Calculations in Polymer Production.

**MLZ 507 Fundamentals of Polymer Engineering 3+0 7,5**

Introduction to Polymer Engineering, Engineering Plastics, Polymerization, Copolymers and Cross-Linked Polymers, Physical and Chemical Properties of Solid Polymers, Crystalline and Glassy Polymers, Creep and Stress Relaxation in Polymers, Time Dependent Analysis of Viscoelastic Polymers, Fracture Mechanics of Polymers, Extrusion, Injection Molding, Thermoforming, Blow Molding, Compression and Transfer Molding.

**MLZ 508 Mechanics of Polymer-Based Laminated Composites 3+0 7,5**

Introduction to Polymer Composites, Overview of Constituents Material Forms, Processing and Applications, Macro-mechanical Behavior of A Lamina, Orthotropic Material Properties, Transformation of Coordinates, Lamina Strength Criteria, Micromechanical Behavior of Lamina, Classical Laminate Theory, Thermal Effects, Laminate strength, Delamination, Matrix Cracking, and Durability, Inter-laminar Stresses, Edge Effects, Fatigue and Fracture, Analysis of Laminated Beams, Composite I Beams, Shear in Composite Beams Design Examples.

**MLZ 509 Advanced Composite Materials 3+0 7,5**

Introduction; Classification of Composites; Ceramic Matrix Composites; Nano-composites; Laminate Composites; Metal Matrix Composites; The Properties and Conditions Required for Matrix and Reinforcement Phases in Composite Materials; The Effects of Thermal Expansion Mismatch in Composite Materials; Fracture Strength of Composites; Mechanical Properties of Composites; Fracture Mechanisms of Composites; Toughening Mechanisms; Properties of Interfaces and Thermal Stresses; Thermal Shock Parameters; Stress-Strain Behaviour of Ceramics with the Addition of Reinforcement Phase.

**MLZ 510 Thin Film Production and Vacuum Technologies 3+0 7,5**

Review of Materials Science; Vacuum Science and Technology; Principles of High Vacuum; Thin Film Evaporation Process; Discharge, Plasmas, and Ion-Surface Interactions; Plasma and Ion Beam Processing of Thin Films; Chemical Vapor Deposition; Film Deposition; Substrate Surfaces and Thin Film Nucleation; Physical Vapor Deposition; Plasma Etching; Sputtering; Electron Beam Evaporation; Epitaxy; Film Structure; Electrical Properties; Characterization Techniques.

**MLZ 511 Dielectric Materials and Devices 3+0 7,5**

Transformations and Tensors; Crystals and Texture Symmetry; Curie Principle and Neumann's Law; Polar Tensors; Pyroelectricity; Permittivity; Piezoelectricity; Elasticity; Thermodynamics; Equilibrium Properties; Axial Tensors; Piezomagnetism; Magnetoelectricity; Pyromagnetism; Magnetic Symmetry-Time Reversal, Hysteretic Properties-Domains; Transport Properties; Thermal and Electrical Conductivity; Galvanomagnetic Phenomena; Thermoelectric Phenomena; Thermomagnetic Phenomena; Waves Acoustics and Optics; Optical Activity.

**MLZ 512 Applications of Crystallography 3+0 7,5**

Summary of Crystallography; Stereographic Projections and Their Applications; Slip in Single Crystals and Diehl's Rule, Diffraction, Reciprocal Space, Ewald Sphere, Polymorphism and Polytypes, Rutile and Anatase Crystal Structures and their Applications, Zinc Sulfide Crystal Structures and Piezo and Pyroelectricity, Relationship between Optical Anisotropy? Crystal Structure; Interaction Colours and Photoelasticity, Olivine-Spinel Phase Transitions, Perovskite Structure, Superconductivity, Phase Transformations, ccp?hcp Phase Transformations and Shape Memory Alloys, Silicon Dioxide, Zirconia, Silicon Nitride and Silicon Carbide Phase Transformations.

**MLZ 513 Raw Materials and Mineral Processing 3+0 7,5**

Introduction; Ceramic Raw Materials; Clays, Quartz, Feldspars, Limestone, Marble and Other Raw Materials; Mineral Processing: Crushing, Grinding, Screening, Classification; Sizing Classification and Handpicking Enrichment; Gravity Separation; Magnetic Separation; Electrostatic Separation; Flotation; Chemical Enrichment

**MLZ 514 The use of Glass Materials in Industry 3+0 7,5**

Introduction; Importance of Glass and Glassy Materials in Industry; Introduction to Glaze Science; Certain Raw Materials Used in Glaze Production; Frit Production; Glaze Preparation and Application; Glaze-Body Interactions; Characterisation of Glazed Products; Technologically Important Glazes; Enamel Production; Technologically Important Enamels; Enamel Defects and Their Corrections.

**MLZ 515 Refractory Technology 3+0 7,5**

Classification and Properties of Refractories; Production Process and Test Methods; Industrial Applications; Properties and Application of Basic Refractories; Properties and Application of Acidic Refractories, and Corrosion

Resistance; Fundamentals of Fracture Mechanics; Determination of Mechanical Properties; The Effects of Coefficients of Thermal Expansion Difference on Mechanical Properties of Refractories; The Determination of Thermal Stress and Shock Parameters for the Industrial Applications; Thermal Shock Behaviour of Refractories; Preparation of Refractory Samples; Mechanical Testing; Microstructural Examinations in Scanning Electron Microscopy.

#### **MLZ 516 Coating Techniques 3+0 7,5**

An Introduction to Thin Coating; Coating Types and Process Steps; Evaluation of the Parameters for the Best Coating for a Given Application; Thermal Spraying Methods (Plasma Spraying, Low Pressure Plasma Spraying; Flame Spraying, HVOF Spraying; Their Applications and Coating Properties; TBC Coatings; Chemical Vapour Deposition (CVD); Metal Organic Chemical Vapour Deposition (MOCVD); Plasma CVD; Process Parameters, Application Areas; Physical Vapour Deposition, Process Parameters and Application Areas; Coating Properties; Ion Implantation ; Hardness, Friction and Wear Principles and Mechanisms

#### **MLZ 517 X-Ray Diffraction Techniques in Materials Characterisation 3+0 7,5**

Importance of materials Characterization; Importance of XRD Techniques in Materials Characterization; Techniques Used in Materials Characterisation and their Difference; Electromagnetic Radiation; The Continuous Spectrum; The Characteristic Spectrum; Absorption; Filters; Production of X-rays; Detection of X-rays; Introduction of the XRD Device; Specimen Preparation Methods; Interpretation of XRD Spectra; Lattices; Crystal Systems; Symmetry; Primitive and Non-primitive Cells; The Stereographic Projection; The Stereographic Projection; Diffraction Theory I: Directions of Diffracted Beams; Diffraction; Bragg Law; X-ray Spectroscopy; Diffraction Directions; Diffraction Methods; Diffraction Under Non-ideal Conditions Diffraction Theory-II: Intensities of Diffracted Beams; Scattering by an Electron; Scattering by an Atom; Scattering by a Unit Cell; Structure Factor Calculations: Multiplicity Factor, Lorentz Factor; Absorption Factor; Temperature Factor; Intensities of Powder Pattern Lines; Application; Determination of Particle Size; Determination of X-ray Density; Depth of X-Ray Penetration; Determination of Crystal Structure; Indexing Patterns of Cubic Crystals; Indexing Patterns of Noncubic Crystals; Determination of the Number of Atoms in a Unit Cell; Determination of Atom Positions, Quantitative XRD; X-Ray Fluorescence (XRF); XRF Applications.

#### **MLZ 518 Strengthening Mechanisms in Materials 3+0 7,5**

Classification of Materials; In Materials: Mechanical Properties; Mechanical Behaviours; Thermal Properties and Behaviours; Imperfections in Solids; Dislocations and Plastic Deformation; Mechanisms of Strengthening in Metals; Recovery, Recrystallization and grain growth; Imperfections in Ceramics and Mechanisms of Plastic Deformation; Defects in Polymers; Mechanisms of

Deformation and for Strengthening of Polymers; Strengthening Mechanisms in Composites.

#### **MLZ 519 Atomic Force Microscopy and Applications 3+0 7,5**

Basics of Atomic Force Microscopy; Historical Background; Components of Microscope, scanning Modes, Calibration; Tip-Sample Interaction; Imaging and Compositional Analysis; Mechanical Property Analysis; Nano-Indentation and Scratch Resistance Measurements; Electrical Property Analysis; Magnetic Property Analysis; Nano-Production Techniques with AFM.

#### **MLZ 521 Fracture Mechanics of Materials 3+0 7,5**

Definition, Importance and History of Fracture Mechanics: Historical perspective, Fracture mechanics for design, Effect of materials' properties on fracture; Linear Elastic Fracture Mechanics: An atomic view of fracture, Effect of stress concentration on flaws: Griffith energy balance, Energy release rate, Instability and the R curve; Crack Tip Plasticity Zone; Plastic zone shape; Elastic Plastic Fracture Mechanics: Crack-tip opening displacement, The J integral, Relationships between J and CTOD; Fatigue Fracture Formation: Fatigue diagram, Fatigue plastic zone; Materials Behavior: Fracture mechanism in metals, Fracture mechanism in non-metals, Theoretical and practical research and discussion.

#### **MLZ 551 Mechanical Behavior of Materials 3+0 7,5**

Mechanical Fundamentals; Stress and Strain Relationships for Elastic Behavior; Theory of Plasticity; Metallurgical Fundamentals; Plastic Deformation of Single Crystals; Dislocation Theory; Strengthening Mechanisms; Fracture; Applications to Materials Testing; The Tension; Hardness and Torsion Tests; Fracture Mechanics; Fatigue; Creep; Brittle Fracture and Impact Testing; Plastic Forming of Metals; Forging, Rolling of Metals; Extrusion; Drawing of Wires; Sheet-Metal Forming.

#### **MLZ 552 Materials Selection For Aircraft Structure 3+0 7,5**

Significant Factors for Materials Selection; Restriction Factors for Materials Selection; Basic Stages for Materials Selection; Significance of Materials Tests for Materials Selection and Analysis of Test Data; Determination of Significance Range of Materials Characteristics and Comparison of Their Characteristics; Selection of Nominee Materials and their Comparison.

#### **MLZ 553 Mechanical Behavior of Composite Materials 3+0 7,5**

Introduction to Composite Materials; Macro mechanical Behavior of o Lamina; Stress-Strain Relations for Anisotropic Materials; Elastic Constants for Orthotropic Materials; Strength Theories for an Orthotropic Lamina; Maximum Stress Theory; Maximum Strain Theory; Tsai-Hill Theory; Micromechanical Behavior of a Macro mechanical Behavior and Laminate; Bending and Buckling Equations of Laminated Plates.

**MLZ 554 Structure and Properties of Aircraft****Materials 3+0 7,5**

Atomic Structure and Packing of Atoms In 3D; Atomic Bonding; Dislocations; Dislocations and Plastic Deformation; Relationship Between Atomic Structure and Mechanical Properties; Mechanical Properties and Measuring Methods; Tensile; Compression; Bending, Shear; Impact; Fatigue and Creep; Materials Selection for Different Mechanical Applications; Case Studies for Aircraft Materials Selection.

**MLZ 592 Seminar 3+0 7,5****MLZ 599 Term Project 3+0 15,0****MLZ 601 Scanning Electron Microscopy and Chemical Analysis Techniques 3+0 7,5**

Introduction; What is the Importance of Microstructural Investigations?; What are the Reasons for the Use of Electron Microscopes; Which Techniques are Used for the Characterisation of Microstructures; Specimen Preparation for Electron Microscopy; Interactions between Electrons and Specimen; Depth of Signals Produced as a Result of Interactions and their Use; Scanning Electron Microscopes (SEM) and its Parts; Chemical Analysis Techniques: Energy Dispersive X-ray Spectrometers (EDX) and Wavelength Dispersive X-ray Spectrometers (WDX); Parameters to be Known to Obtain Best Quality Images and Reliable Chemical Analysis; Comparison with Environmental Scanning Electron Microscopes (ESEM) and Other Techniques; Investigation of Different Materials in SEM.

**MLZ 602 Transmission Electron Microscope and Chemical Analysis Techniques 3+0 7,5**

Importance of Grain Boundaries; Classification of Grain Boundaries; Low-Angle Grain Boundaries and Their Properties; High-Angle Grain Boundaries and Their Properties; Grain Boundaries Made by Different Phase Grains; Ceramic-Metal Interface Surfaces; Techniques Used to Investigate Grain Boundaries; Transmission Electron Microscopes; Dark Field; Light Field; Fresnel Unfocused and High Resolution Power Image Techniques; Electron Diffraction; Analysis of Diffraction Patterns; Chemical Analysis Techniques; Energy Dispersive X-Ray Spectrometer; Parallel Electron Energy Losses Spectrometer.

**MLZ 603 Special X-Ray Techniques and Their Applications 3+0 7,5**

Reflectivity of X-Rays from Soft Matter Surfaces and Multiple Interfaces; Roughness and Density Profiles; Reflectivity Experiments and Experimental Consideration; High Resolution Diffractometers and Reflectometers; Grazing Incidence and Exidence Diffraction and in-Plane Diffraction Techniques; Reciprocal-Space Map and Q-Scan

Techniques; Limits on the Use of Powder Diffractometer; High Temperature Powder Diffractometer Techniques.

**MLZ 604 Inorganic Powder Synthesis Technologies 3+0 7,5**

Introduction to Ceramic and Metal Powder Synthesis Methods; Powder Synthesis by Atomization; Powder Synthesis via Precipitation from Homogeneous Solutions; Powder Synthesis in Molten Salt; Powder Synthesis by Sol-Gel Technique; Interpretation of Solubility-pH Diagrams; Nucleation and Growth Kinetics; Size and Shape Control in Powder Synthesis; Composite and Multi-Functional Powder Preparation Techniques.

**MLZ 605 Sintering of Particulate Materials 3+0 7,5**

Introduction to Sintering Terms; Processing of Ceramic and Metal Powders; Microstructure-Sintering Relations; Sintering Analysis Techniques; Solid State Sintering; Liquid Phase Sintering; Viscous Sintering; Herring's Scaling Law; Sintering Maps; Deformations Occurring during Sintering and Approaches to Prevent Them; Pressure Assisted Sintering Techniques (Sinter Forging; Hot Pressing etc.); Other Sintering Techniques (Transient Liquid Phase Sintering, Reactive Sintering; Microwave Sintering, etc.); Examples of Sintering Methods Applied to Ceramic and Metal Particulate Systems; Grain Growth (Normal Grain Growth; Exaggerated Grain Growth; Anisotropic Grain Growth, etc.)

**MLZ 606 Phase Transformation Reactions of Metals 3+0 7,5**

Free energy, interface energy and activation energy terms; Structure of liquids; Liquid-solid interface; Solidification models; Solidification microstructures; Solidification kinetics and industrial control; Chemical partitioning and diffusion direction; Interaction of free energy and phase diagrams; Examples of chemical partitioning reactions of alloy systems; Classification of solid-solid transformation reactions and interface types; Diffusional transformation reaction mechanisms, kinetics, crystallography and morphologies; Industrial examples of diffusional transformation reactions through alloy systems; Mechanism of martensitic transformation, kinetics, crystallography and morphology; Industrial examples of martensitic transformation through alloy systems; Mechanism of spinodal decomposition, kinetics, crystallography and morphology; Industrial examples of spinodal transformation reactions through alloy systems.

**MLZ 607 Alloy Development-Principles, New Horizons and Extreme Applications 3+0 7,5**

Alloy development principles; trends, causes and products at existing alloy systems for conventional applications; Alloy selection examinations at applications that need tough property combinations; Alloy development attempts and products for cutting-edge applications; Alloy theory and microstructures of alloys; Steel types: Complication and expansions at classification; New trends, causes and products at steels; High temperature alloys (superalloys): new trends, causes and products; Aluminium alloys: new trends, causes and products; Titanium alloys: new trends,

causes and products; Magnesium alloys: new trends, causes and products; Magnetism and magnetic alloys: new trends, causes and products; Alloys selection examples for extreme applications; Trends and products at alloy development for extreme applications.

#### **MLZ 608 Polymer Rheology 3+0 7,5**

Rheology in Engineering Applications, Rheology of Polymers, Review of Vector and Tensor Analysis Flow, Newtonian Fluid Mechanics, Isothermal Flow Problems for Generalized Newtonian Fluids, Non-isothermal Flow Problems for Generalized Newtonian Fluids, Shear and Shear-Free Flows, Steady Shear Flow Material Functions, Unsteady Shear Flow Material Functions, Shear Free Flow Material Functions, Linear Viscoelastic Measurements, Parallel-Disk Viscometer, Cone-And-Plate Parallel-Disk Capillary Rheometer Slit Rheometer Newtonian Fluid and Hookean Solid, Linear Viscoelastic Fluids, Linear Viscoelastic Rheological Properties, Experimental Rheological Characterization of Different Types of Polymers with Hands on Experiments.

#### **MLZ 609 Modeling of Polymer Composites Manufacturing Processes 3+0 7,5**

Introduction to Polymer Composites, Polymer Composite Fabrication Processes, Mass, Heat And Momentum Transfer Equations for Polymer Composite Manufacturing, Introduction to Polymer Composites Process Modeling, Introduction to MATLAB Programming Assisted Numerical Calculations, General Aspects of Advanced Thermoplastic and Thermoset-Matrix Fiber-Reinforced Composites, Introduction to Liquid Composite Molding Processes (Resin Transfer Molding and Vacuum Assisted Resin Transfer Molding), LIMS (Liquid Injection Molding Simulation) Coupled with Hands-on Manufacturing of Composite Parts.

#### **MLZ 610 Kinetics 3+0 7,5**

Kinetics of Diffusion: Ficks First Law and applications, Ficks Second Law and Semi-Infinite System Applications, Ficks Second Law and Finite System Applications, Ficks Second Law and Laplace Transformations, Multi ? Phase Diffusion; Chemical Diffusion: Boltzman-Matano Analysis, Atomistic Theory of Diffusion, Fast Diffusion Regions, Ionic Diffusion; Kinetics of Chemical Reactions: Introduction, Determination of Reaction Orders and Rate Constants, Reaction Mechanisms and Corresponding Rate Laws, Solid ? Gas Reactions in Materials Science: Kinetics of Metal Oxidation, Kinetics of PVD Process, Kinetics of CVD Process

#### **MLZ 611 Diffusion in Solids 3+0 7,5**

Introduction; Diffusion Equations; Diffusion in Alloys; The Effect of Concentration Gradient on Diffusion; Diffusion in Non-Metallic Materials; Suitable Environments for Diffusion and Diffusion Methods; Heat Diffusion in Solids and Electrolyze.

#### **MLZ 612 Ferroelectric Materials and Devices 3+0 7,5**

Crystal Structure and Ferroelectricity; Origin of Spontaneous Polarization; Origin of Field Induced Strain;

Electrooptic Effect; Applications of Ferroelectrics; High Permittivity Dielectric; Pyroelectric Devices; Piezoelectric Materials; Piezoelectric Resonance; Piezoelectric Transformers; Ultrasonic Transducers; Surface Acoustic Wave Devices; Piezoelectric Actuators; Ultrasonic Motors; Electrooptic Devices; Wave Guide Modulators; PTC Materials; PTC Phenomenon; PTC Thermistors; Grain Boundary Layer Capacitors; Composite Materials.

#### **MLZ 613 Crystal Anisotropy 3+0 7,5**

Introduction and Overview; Permittivity; Polarization Mechanism; Dispersion and equivalent circuits; High Voltage Insulators; Electric Breakdown Mechanisms; Substrates and Packaging; Thick and Thin Film Processing; Resistance; Electronic Conduction; Fixed Resistors, PTC and NTC Thermistors, Varistors and Barrier Layer Capacitors, Humidity and Chemical Sensors; Ceramic Electrodes and Superconductors; Ionic Conduction and Batteries; Capacitors; Disk, tubular, Multilayer; Low k Ceramics: Temperature coefficient, Microwave dielectric resonators.

#### **MLZ 614 Spintronic and Applications 3+0 7,5**

Introduction to Magnetism; Spin Dependent Transport; Magnetoresistive (MR) Effects (X-MR Effects: Anisotropy-MR; Giant-MR; Tunnel-MR and Cloasal-MR Effects); Electrical Transport in Nonmagnetic and Magnetic Metals; Spin Dependent Tunneling; Ferromagnetic-Isolator and Superconductor-Isolator Tunnel Contacts; Spin-Valves; XMR-Effects and Their Applications.

#### **MLZ 615 Material and Energy Balance in Production 3+0 7,5**

Fundamentals of energy balances, material balances for processes without reaction; recyle, bypass and industrial application; gaseous and liquid fuels, calculations of enthalpy changes; application of Energy balances to open and closed systems; Applications of energy balances in processes that include chemical reactions; Energy balances in lime and cement industries; Formulations of ceramic mixes; Phase diagrams in ceramics; The equilibrium relations between liquid and solid phases; Design of a kiln in ceramic industry.

#### **MLZ 616 Colloid Chemistry and Rheological Behaviour 3+0 7,5**

Introduction to Colloid Chemistry and Classification; Colloidal Systems and Importance of Interface; Kinetic Properties; Surface Tension and Surface Energy; Gibbs Adsorption Equation; Adhesion, Cohesion, and Diffusion; Physical Adsorption by Solids; Physical Adsorption by Solids; Langmuir Isotherms; Freundlich Adsorption Isotherm; BET Adsorption Theory; Electrical Phenomena at Interfaces; Electrical Double Layer and Zeta Potential, DLVO Theory; Colloid Stability; Flotation; Surfactants; Wetting; Rheological Behaviour; Pseudoplasticity; Dilatant Flow Behaviour; Thixotropy, Effective Parameters on Viscosity; Rheological Applications; Stability of Clay Based Mud; Slip Casting; Ceramic Glazes.

**MLZ 617 Inorganic Pigments and Pigments Interactions 3+0 7,5**

Light and Colour; Colour Measurement Methods; Inorganic Pigments; Definitions; Classification and Crystal Structures; Pigment Production Process; Traditional Method; Sol-gel Method; Inorganic Pigments Used in Ceramics Industry; Pigments for Glazes; Pigments for Bodies; Inorganic Pigments Used in Plastics and Automotive Industry; Glaze-pigment and Body-pigment Interactions.

**MLZ 618 The Relationship between Structure and Properties in Industrial Glazes 3+0 7,5**

Introduction; The Importance of Glassy Coating Materials in 21st Century's Industry and Life; Certain Glaze Systems of Fast Firing Technologies; Utilization Possibility of Alternative Raw Materials in Glaze Production; Raw Material Based Cost Analysis and Adaptation to New Production Processes; Synthesis of Fast Firing Frits and Their Use in Glazes; Technological Improvements in Raw Glazes; New Detailed Characterization Techniques Applied to the Developed Products in order to Establish Structure-Property Relationships; The Interaction between Industry and Environment in Terms of the Technological Development; Adaptation of New Product Achieved as a Result of Micro-Structural Control to the Present Standards.

**MLZ 619 Phase Transformation Mechanisms of Metals 3+0 7,5**

Concepts of Free Energy, Interface Energy and Activation Energy; Relationship between Free Energy and Phase Diagrams; Diffusion Mechanisms, Industrial Examples for Diffusion Mechanisms; Diffusion Controlled Transformation Mechanisms: Kinetics, Crystallography and morphology, Industrial examples for diffusion controlled transformation mechanisms; Homogeneous and Heterogeneous Nucleation Mechanisms: Kinetics and control parameters; Precipitation Mechanisms: Kinetics, Crystallography, Interphase Analysis; Mechanism of Precipitate Coarsening; Spinodal Transformations; Martensitic Transformations, Industrial Examples for Martensitic Transformations.

**MLZ 651 Materials Science and Advanced Materials Technology 3+0 7,5**

Materials Science; Atomic structure; Bonding Between Atoms; Chemical Reactions and Reactivity; The Crystalline State; Elastic and Plastic Behavior; Constitution; Electrical and Magnetic Properties; Materials Technology; The Shaping of Materials; Metals; Ceramics; Thermoplastics; Thermosetting Materials; Composite Materials; The Behavior of Materials in Service; Testing of Materials; Metal-Joining Processes; Macroscopic and Microscopic Examination of Materials.

**MLZ 652 Fatigue and Creep Behaviour of Aircraft Materials 3+0 7,5**

Fracture and Toughness in Aircraft Materials; Fatigue Failure; Mechanism of Fatigue; Fatigue Crack Growth Analysis; Load Interaction; Case Studies for Aircraft Fatigue Failure; Creep and Creep Related Failure in Aircraft

Engine; Kinetic Theory of Diffusion; Mechanism of Creep and Creep-Resistant Materials; The Turbine Blade-a Case Study in Creep Failure.

**MLZ 790 Thesis 0+1 30,0**

**MLZ 890 Thesis 0+1 30,0**

**MOD 501 Pattern Design in Textile 3+0 7,5**

Importance of Pattern in Fashion Textile; Designing Patterns in View of Current Fashion Trends; Development of Textile Patterns (Imprinted and Woven); Relationship Between Patterns and Motifs; Basic Principles in Pattern Design; Methods of Pattern Design and Multiplication; Industrial Applications.

**MOD 510 Fashion Concept in Design 3+0 7,5**

Definition and Development Process of Fashion Concept; Art and Fashion Relation; Development Process of Fashion Concept in Design; Accepting a New Design in Different Levels of Society; Interaction Between Society and Fashion; Applications of Creating a Style According to the Conceptual Recommendations.

**MOD 511 Intelligent Textiles and Clothing 3+0 7,5**

Basic Research and Design Procedure of Intelligent Textiles; Phase Change Materials: Phase change Technology, Thermo physiological comfort, PCMs in textile and clothing; Shape Memory Materials: Principles of shape memory materials, SMs for Textile Applications; Chromic and Conductive Materials: Photo chromic, Thermo chromic and Electrochromic materials, Conductive Fibers and Yarns, Polypro Applications; Solar Textiles: Solar Cells, Photovoltaic, Textile Applications; Electronic Textiles: Principles of Wearable Electronics and Computers, Medical and Monitoring Applications of Electronic Textiles; Nanotechnology for Intelligent Textile Clothing; Future Trends in Intelligent Textile and Garment Applications.

**MOD 512 Art and Design 2+2 7,5**

Creating and Improving Two and Three Dimensional Surface-Form Relations; Approaching Processes Like Subject, Object: Converting Concepts to Visual Language; Interpreted and Re-Commented; Improving Techniques and Abilities to Use Concepts Like Ratio-Proportion, Placement, Form and Volume by Using Study Methods Based on Observation; Forming Conceptual, Cultural and Functional Relations by the use of Separate Subjects Chosen by Individual Students.

**MOD 513 Advanced Projects in Fashion Design I 2+2 7,5**

Scale; Function; Aesthetic; General Design Methods; Project Planning; General Design Strategy of an Organization; Methods and Principles About Creation of a Collection; Project Applications; Analyze of the Design Language; Design Challenging Conditions; Interaction Analysis; Cultural Analysis.

**MOD 514 Advanced Projects in Fashion Design****II 2+2 7,5**

Rapid Prototyping Methods and Applications; Formal and Functional Analysis of Potential Trends; Development of Alternative Solutions and Evaluation of Methods Used in Testing Steps; Using High Technology for Product Development and Sample Analysis; Examining Design and Cost Relation.

**MOD 515 Fashion Design Presentation and Graphic Design Relation****3+0 7,5**

Importance of Fashion Design Presentation: Scrutinizing the Tools and Techniques Used in Graphic Design Presentation; Crucial Factors Influencing Fashion Design Marketing: Graphic presentation techniques and graphic design within the changing fashion periods, Marketing and promotion of fashion design; A Semiotic Approach to the Relationship Between Fashion Design and Graphic Design.

**MOD 517 Design, Art and Fashion Relationship****3+0 7,5**

Introduction to Design, Art and Fashion relations: Non-verbal communication between art and fashion, Relationship between artistic creation and design; Assessment of selected subjects by students in terms of design; Intellectual and Functional Relations on Fashion Design and Fashion Fact: Assessment of selected subjects; Student designs and assessment of selected student designs.

**MOD 519 New Approaches to Design of Fashion****Accessories 3+0 7,5**

Definition of Accessories Design: Place and importance of accessories in fashion design, Sources; Creating a Collection of Accessories; Preparing a Collection; Market analysis, Distribution research, Synthesis of trends, Main idea, Compliance with formal design in accessories, Knowledge of materials, Choosing the correct material for design, Design applications, Project implementation; Determination of Design Criteria; Criticism in a Studio Atmosphere; Seminars and Evaluation by Juries.

**MOD 521 Fiber Art I****3+0 7,5**

Introduction to the History of Contemporary Textile Arts; Mini Textile Applications with Plant Fiber: Producing three-dimensional fiber art works in free and modular forms; Examination of Contemporary Fiber Arts Works; Contemporary Interpretation of Traditional Techniques in Textile Arts; Relationship Between Space and Fiber Art; New Creative Quests in Fiber Arts.

**MOD 522 Fiber Art II****3+0 7,5**

Yarn and Fabric Applications in Textile Arts: Examination of contemporary art works by yarn and fabric specimens; Modern Textile Art Applications in Line with Design Principles; Investigation and Discussion of Modern Textile Art Samples; Three-dimensional Surface and Space Practices with the Use of Yarn and Fabric.

**MOD 523 Philosophy of Design****3+0 7,5**

Concepts of Philosophy and Aesthetics; Use of Design Theories and Principles in Fashion and Textile Design;

Relationship between Philosophy, and Industrial Textile Design and Fashion Design; Philosophical Analysis of the Reflection of Urban Culture in Public Sphere through Textile and Fashion Products; Critical Evaluation and Interpretation of Contemporary Design Products via Philosophical Methodology.

**PLT 501 Aircraft Performance and Operation****Analysis 3+0 7,5**

Basic Definitions: Standard atmosphere, General performance requirements, Forces acting on an aircraft and axis; Symmetrical Steady State Flight: Horizontal flight and cruise performance characteristics, Climb performance characteristics, Descend and glide performance; Take-off: Take-off distance and take-off performance characteristics; Landing: Landing distance and landing performance characteristics; Curvilinear Flight: Turn performance and characteristics, Climbing and descending turns, Helicoidal and spiral climb, Descend and spin, Spin recovery; Cruise Range and Endurance.

**PLT 503 Aviation Research****3+0 7,5**

History of Aviation Research: American aviation research, NASA and FAA, European aviation research and space strategy, Turkish aviation research; Needs for Aviation Research; Aviation Research and Development Vision; R&D Politics and Strategy; R&D Methodology; R&D Resources: Human resources, Finance, Technical infrastructure; Know-How, Regulations, etc.; Innovation and Entrepreneurship; Intellectual and Industrial Property Rights; R&D Culture and Education; R&D Organization and Cooperation; R&D Software; R&D Strategic Management; Relationship Between R&D and Economic Development; Innovations in Aviation Industry; Sample Research Studies.

**PLT 504 Aviation Safety Cases****3+0 7,5**

Classification of Factors Affecting Aviation Safety; Flight Operation-oriented Accidents: Flight crew, Communication and procedural errors; Aircraft-oriented Accidents: Design and material failures; Maintenance-oriented Accidents: Personnel and procedural errors; Airport/Air Traffic Control-oriented Accidents: Midair and runway collisions; Accidents due to Meteorological and Geographical Conditions; Security-oriented Accidents: Terrorist attacks and security errors.

**PLT 505 Statistical Methods in Aviation****3+0 7,5**

Using Statistical Analysis in Airline Operations; Data Collection and Analysis; Basic Statistical Concepts: Summary of numerical knowledge, Probability, Sampling, Point forecast, Period forecast, Hypothesis testing, Correlation and regression analysis, Variance analysis; Using Software in Analysis; Analysis of flight data, Data collection, Data categorization, Analysis, Reports.

**PLT 506 Airlines****3+0 7,5**

Concept of Airline Transportation; Economic Characteristics of Airlines; History of Air Transportation; Airline Deregulation; Airline Operation Costs; Airline Marketing; Product Planning and Pricing; Demand for Air



Transportation and Factors Affecting the Demand; Traditional Carriers, Charter Carriers, Regional Carriers, Low Cost Carriers, Air Cargo Carriers.

**PLT 508 Aircraft Performance Optimization 3+0 7,5**

Maximum and Minimum Theory, Maximums and Minimums of Multi-Variable Functions, Lagrange Multipliers; Optimization; Optimization Conditions of Performances in Steady State Flight; Turns in Level Flight; Maximum Rate of Climb in a Constant Radius Helicoidal Climb; Maximum Bank Angle in a Helicoidal Climb; Minimum Radius of Turn in a Helicoidal Climb; Maximum Angular Velocity in a Helicoidal Climb; Calculation of Flight Altitude for Maximum Level Flight Speed; Maximum Range for a Given Flight Altitude; Optimization of Rate of Descent in a Helicoidal Descent; Minimum Flight Path Angle in a Helicoidal Descent.

**PLT 509 Advanced Flight Mechanics 3+0 7,5**

Basic Definitions - Aircraft Control Surfaces and Characteristics; General Conditions of Equilibrium and Stability; Longitudinal Static Equilibrium and Stability; Symmetrical Maneuver Analysis; Aircraft Equations of Motion; Analysis of Symmetrical Maneuvers by Non-dimensional Equations; Longitudinal Static Stability Analysis; Longitudinal Dynamic Stability Analysis; Fixed Stick Stability Analysis; Free Stick Stability Analysis; Study of Longitudinal Behavior and Unsymmetrical Movements; Lateral Equilibrium and Stability; Equilibrium and Stability Analysis of Special Flight Maneuvers.

**PLT 511 Aircraft Icing 3+0 7,5**

Introduction; Meteorological Aspects; Icing Physics; Parameters Affecting Icing; Ice Accretion Prediction: Supercooled droplet trajectories, Droplet impact, Droplet collection efficiency, Thermodynamic analysis, Ice growth rates, Extended Messinger Model, Runback water 2-D and 3-D ice accretion simulation, Supercooled large droplets, Icing related to ice crystals, Icing certification (Federal Aviation Regulations, Part 25, Appendix C, O, P).

**PLT 592 Seminar 3+0 7,5**

**PLT 790 Thesis 0+1 30,0**

**PSI 606 Psychology in Architecture Design 3+0 7,5**

Psychology- Architecture and Space Relations; Territory, Personality- Identity, Personal distance, Social distance, Privacy; Psychology of the user: The effects of spaces on people, Examples on the topic, Private and unprivate spaces, Analysis of Different Spaces; Psychology of the architect: Studies on designers and their approach.

**SHA 511 Aircraft Performance And Operation Analysis I 3+0 7,5**

Fundamental Definitions-Standard Atmosphere; General Performance Conditions-The Forces Effecting Aircraft and Axis Sets; General Flight Motions and Equations;

Symmetric, Permanent; Rectiling Flight Motion-Flight Performance Characteristics Horigantal; The Cruising Flight Performance Characteristics; The Climbing Motion and Climbing Performance Characteristics; Descending Motion and Descending Performance Characteristics; Take-Off Motion-Take Off Length and Take Off Performance Characteristics; Landing Motion-Landing Length and Landing Performance Characteristics; Curved Path Flight Motion; The Bend Motion and Bend Performance Characteristics; Studies on the Curved Climbing and Descending Motions-Helisel and Spiral Climbing; Descending and Vrille; The Travel Length; The Travel Time.

**SHA 513 Oil Analysis Program in Aircraft Maintenance 3+0 7,5**

Introduction: Lubrication, Features of Lubrication Oil; Oil Contamination; Different Test Methods; Spectrometric Oil Analysis Program (SOAP); Spectrometric Oil Analysis Techniques; Detectable Failures By SOAP; Important Subject Related to Sample Analysis at Oil Analysis Laboratories; Ferro graph; Ferro graphic Analysis; The Use of SOAP Together With Ferro graph; Importance of Determining the Wear With Oil Analysis; Efficiency of Different Analysis Techniques in Determining the Wear.

**SHA 515 The Effects of Construction Techniques Aircraft on Performances of Light 3+0 7,5**

Introduction; Construction of Light Aircraft; Wing structure; Fuselage Structure; Power plant; Empennage; Landing Gear; Equipment; Typical Construction Materials Used in The Light Aircraft; Wood; Metals; Composite Materials; Basic Performances and Factors Affecting Basic Performances; Basic Performances; Effect of Changing Wing Structure; Effect of Changing Weight; Effect of Changing Engine Power; Examination of the Construction and Performance Features.

**SHA 524 Modern Control Systems 3+0 7,5**

State Variable Analysis of Control Systems: State Variables; State Concept; State Equations; Transfer Matrix; Solution of Time Invariant State Equations; Linear Time Varying Systems; Discrete Time Systems; Controllability and Observability; Controllability and Observability of Linear Dynamic Equations; Output Controllability; Obtaining State Equations in Canonical Forms; Design of Control Systems in State Space; Pole Placement; Observer Design; Optimal Control Problems; Performance Index; Selection of Performance Index.

**SHA 525 CNS-ATM Systems 3+0 7,5**

CNS-ATM Concept: CNS-ATM concepts and stages of development, Global and regional plannings, Communication Systems; Present and future communication systems, Data link communications, Aeronautical Telecommunication Network (ATN), Navigation Systems; Present and future navigation systems, Performance Based Navigation (PBN), Required Navigation Performance (RNP), Surveillance Systems; Present and future surveillance systems, Automatic

Dependent Surveillance (ADS), Air Traffic Management (ATM); Air Traffic Services (ATS), Air Traffic Flow Management (ATFM), Airspace Management (ASM), Human factors and ATM Automation, CNS-ATM Applications; FANS 1/A applications, Studies on capacity increasing, ADS and CPDLC applications.

#### **SHA 531 Industrial Aerodynamics 3+0 7,5**

Wind Energy Resources; History of Wind Energy Appliances; Types of Wind Turbines: Horizontal Axis Wind Turbines, Vertical Axis Wind Turbines, Aerodynamics of Horizontal-Axis Wind Turbines: Betz Limit, Rotor Disk Theory, Angular Momentum Theory, Maximum Power, Rotor Blade Theory, Blade Geometry; Wind Potential Determination; Wind-Turbine Performance and Availability; New Developments and Trends on Wind Turbine Energy.

#### **SHA 535 Helicopter Theory and Flight Principles 3+0 7,5**

Types of Aircraft; Basic Laws of Mechanics and Aerodynamics; Blade and Rotor; Lift and Drag of a Rotor Blade; Center of Pressure of a Rotor Blade; Forces Acting on a Rotating Blade; Total Rotor Lift (Thrust); Dissymmetry of Lift; Flapping Motion; Lift Control; Collective Pitch; Cyclic Pitch; Tail Rotor; Aerodynamic Behavior of a Rotor Blade; Vortex; Ground Effect; Autorotation; Limits of Rotation Speed; Helicopter Flight Principles; Hover; Forward Flight; Required Power; Flight Ceiling.

#### **SHA 536 Flight Control System Design 3+0 7,5**

Flight Control; Control Surfaces; Flight Control Systems; The Equations of Motion of an Aircraft; Axis Systems; Linearized Equations of Motion; State and Output Equations; Transfer Function; Aircraft Stability and Dynamics; Longitudinal Stability; Static and Dynamic Stability; Transfer Functions Related to Longitudinal Motion; Short Period and Phugoid Approximation; Lateral Stability; Transfer Functions Related to Lateral Motion; Control System Design; Generalized AFCS; Parameter Optimization; Stability Augmentation Systems; Actuator and Sensor Dynamics; Longitudinal and Lateral Control.

#### **SHA 537 Exergy Analysis 3+0 7,5**

1st Law of Thermodynamic: Closed systems; Control Volumes; Energy Balance; 2nd Law of Thermodynamic: Heat machine; Reversible and Irreversible States; 2nd Law Analysis For Control Volumes; Entropy: Entropy Change of Pure Substances; Entropy Change of Ideal Gas; Isentropic Efficiency; Entropy Balance; Exergy: Change of Exergy; Exergy Transfer; Exergy Balance; Chemical Reactions: Stoichiometric Combustion; Thermochemistry; Second Law; Exergy and Irreversibility; Work Production From Chemical Reactions; Chemical Exergy of Fuels; Energy Analysis; Exergy Analysis.

#### **SHA 538 Flight Procedures And Airspace Design 3+0 7,5**

Conventional Procedures; Area Navigation (RNAV) procedures; RNAV/ Barometric Vertical Navigation;

Departure and Approach Procedures for Required Navigation Performance (RNP) Approved Systems; RNP Holding Procedures; Airspace: Criteria for Airspace Sectorisation, Sector Capacity; Terminal Airspace Design: Terminal Airspace Configuration, The Function of Terminal Airspace, Sectorisation of Approach Control and Terminal Airspace, Traffic Flow, The Establishment of SIDs and STARs, Methodology for Terminal Airspace design.

#### **SHA 539 Advanced Aerodynamics 3+0 7,5**

Basic Relations: Continuity, Momentum and Bernoulli Equations; Potential Flow Theory: Ideal incompressible flow, Stream function, Basic types of flow; 2-D incompressible flow around cylinder: Circulation and lift, General thin airfoil theory, Symmetrical and cambered profiles; Incompressible Flow around Slender Wings: Vortex system, Effect of swept wing, Delta wings, Wing and fuselage configurations; Compressible Flow: Basic definitions, Energy equation, Adiabatic and isentropic flows, Shock waves; Transonic flow: 2-D transonic flow, Transonic flow around wings; Supersonic flow; Unsteady Aerodynamics.

#### **SHA 541 Current Issues in Gas Turbine Engines 3+0 7,5**

Basic Notions: Classification and structure of gas turbine engines, General definitions; Exergy Analysis: Calculations, Application for gas turbine engines; Methods For Improving Efficiency Of Gas Urbine Engines; Methods For Improving Thrust Of Gas Urbine Engines; Vibration: Basic notions, Devices and cursors used for analysis; Noise; Corrosion; Emission Analysis For Gas Turbine Engines; Gas Turbine Engines Of Unmanned Aerial Vehicles; Auxiliary Power Units (APUs).

#### **SHA 543 Parametric Cycle Analysis of Aircraft Propulsion System 3+0 7,5**

Introduction; Propulsion; Air-Breathing Engines; Thermodynamics Review; Compressible Flow; Classification of Aircraft Gas Turbines; Factors Effecting Thrust; Thrust Force; Engine Performance Parameters; Steps of Engine Parametric Cycle Analysis; Ideal Turbojet; Ideal Turbojet with Afterburner; Ideal Turbofan; Ideal Mixed Turbofan with Afterburner; Ideal Turboprop engine; Ideal Turboshift Engine; Component Performance; Variation in Gas Properties; Inlet and Diffuser Pressure Recovery; Compressor and Turbine Efficiencies; Burner Efficiency; Exit Nozzle Loss; Component Figures of Merit; Parametric Cycle Analyses of Real Engines; Real Turbojet; Real Turbojet with Afterburner; Real Turbofan with Separate Exhaust Stream; Real Turbofan with Afterburning-Mixed Exhaust Stream; Computer Programing for Cycle Analysis.

#### **SHA 545 Fuzzy Logic Applications in Aviation 3+0 7,5**

Introduction to Fuzzy Logic; History of Fuzzy Logic; Overview of Fuzzy Logic; Fuzzy Sets; Classical Control Systems; Fuzzy Systems; Fuzzification and Membership Functions; Rule-Base; Data Base; Defuzziciation; Middle of Maximum Method; Centroid Method; Fuzzy Control;

Examples of Fuzzy Control; Applications of Fuzzy Logic; Application of Air-Condition; Application of the Inverted Pendulum; Control of Final Approach of the Aircraft; Application of the Flight Controls; Application of The Longitudinal Control of the Aircraft; Application of the Longitudinal Controller; Application of the Flap.

#### **SHA 547 Flight Tests and Instrumentation 3+0 7,5**

Fundamentals; Phases of Flight Tests; Flight Performance Tests: Pitot static system performance; Stall speed determination; Level flight performance; Excess power characteristics; Turn performance and agility; Climb performance; Descent performance; Take-off and landing performance; Standard mission profiles; Design of Instrumentation: Factors influencing instrumentation system design; Basic elements of instrumentation; Flight Tests Applications.

#### **SHA 548 Experimental Aerodynamics Analysis for Incompressible Flow 3+0 7,5**

Introduction; Fundamental of Aerodynamics; Aerodynamics Forces and Moments; Dimensional Analysis; Flow Similarity; Types of Flow; Applied Aerodynamics; Models of Fluid: Control Volume and Fluid Elements; Continuity Equation; Momentum Equation; Energy Equation; Incompressible and Compressible Flows; Fundamentals of Incompressible Flow; Bernoulli's Equation; Incompressible in Duct: The Venturi and Low-Speed Wind Tunnel; Pitot-tube: Measurement of Airspeed; Measurement Equipment for Aerodynamics Experiments and Experimental Error; Flow Over a Circular Cylinder; Flow over Airfoils; Incompressible Flow over Finite Wings; Pressure Distribution and its Evaluation on the Aerodynamics Shapes; Boundary Layer Measurement; Velocity and Pressure Measurement over Finite Wings; Aerodynamic Analysis of Some Industrial Shapes

#### **SHA 549 Gas Turbine Combustion 3+0 7,5**

Introduction; Combustion and Thermochemistry; First Law of Thermodynamics; Ideal Gas Mixture; Adiabatic Flame Temperature; Second Law of Thermodynamics; Chemical Equilibrium; Introduction to Mass Transfer; Chemical Kinetics; Simplified Conservation Equations For Reacting Flows; Introduction to Turbulent Flows; Premixed Turbulent Flames; Turbulent Nonpremixed Flames; Fundamentals of Aircraft Gas Turbine Combustor Design; Combustors for Low Emissions; Heat Transfer Mechanism for Combustors.

#### **SHA 550 Preliminary Design of Unmanned Air Vehicle and Its Propulsion System 3+0 7,5**

Introduction; Unmanned Air Vehicles; Engine Types Used in Aeronautics; General Utilization Limits of Engines; Engine Selection by Mission Profile; Basic Parameters of Engine Design: Flight and aircraft system parameters, Design constraints, Design choices; Parametric Cycle Analysis of Engines: Component behaviour and efficiencies, General engine performance output parameters; Unmanned Air Vehicle Sizing; Performance Calculations for Unmanned Air Vehicle.

#### **SHA 551 Airline Operations and Scheduling 3+0 7,5**

Planning Optimization: Networks, Network flow models, Shortest path problem, Minimum cost flow problem, Maximum flow problem, Multi-commodity problem, Integer programming models, Set covering/partitioning problems; Flight Scheduling: Hub-and-spoke, Route development and flight-scheduling process, Load factor and frequency; Fleet Assignment: Indicator definitions, Mathematical model; Aircraft Routing: Maintenance requirements, Mathematical model; Crew Scheduling: Crew pairing, Crew pairing mathematical model, Crew rostering, Crew rostering mathematical model.

#### **SHA 552 Experimental Methods and Data Processing Techniques for Turbomachinery 3+0 7,5**

Introduction; Description of Measurement Chain and Its Components; Terminology Associated with Measurement Techniques; Pressure Measurement Techniques; Temperature Measurement Techniques; Velocity Measurement Techniques; Measurement of the Flow Angle; Optical Measurement Techniques; Classification of the turbine test rigs, Flow field measurements; Performance Measurement of Basic Engine Components; Fundamentals of Statistics; Frequency Analysis; Data Processing of Periodic Signals; Uncertainty analysis.

#### **SHA 553 Air-conditioning Systems for Aircraft 3+0 7,5**

Introduction; Air-conditioning and Ventilation; External and Environment Conditions; Effects of Cabin Internal Conditions on Staff, Device and Hardware; Thermodynamics Conditions, Temperature, Humidity, Pressure; Indoor Air Quality, Comfort Parameters, Psychometry; Heat Loads in Aircrafts, Heat Stress Indices, Thermal Comfort for Heat Balance; Thermal Loads on Aircraft Cabins; Heat Balance in Flight Cabin, Air Distribution and Velocity, Fog and Permeability; Air-conditioning Systems in Aircrafts; Air Flow Open Systems and Closed Systems; Vapor-compression Refrigeration Systems; Environmental Control Systems in Aircrafts.

#### **SHA 554 Aviation Lighting Technics 3+0 7,5**

Fundamentals of Photometric and Radiometric Quantities; Interior and Exterior Lighting; Lighting Calculations; Importance of Lighting in Aviation: Visual performance, Energy and cost effectiveness; Lighting Parameters: Lighting level, Uniformity, Luminance distribution, Glare, Colour temperature, Colour rendering; Lamps; Luminaires; Lighting Used in and on Aircraft; Airport Lighting: Public areas, Runways, Taxiways; Inspection and Maintenance of Lighting in Aircraft; Visual Illusion.

#### **SHA 601 Airline Management 3+0 7,5**

Fundamental Definitions and Rules; Classification and Organization Properties of Airlines Managements; Planning Activities; Techniques of Flight Programming; Administration Activities; Coordination and Communication; Administration Units; Affects of Administration Properties; Education Types and Properties; Aircraft Selection; Constitution of Fleet; Technical; Economical and Political Interaction; Rantability Areas of

Aircraft; Flight Planning; Selection of Flight Path; Forming New Path-Flight Profiles; Technical and Economical Operations Characteristics of Aircraft; Transportation and Personnel Price Policies; Revenues; Private Service air Transportation; Air-Taxi and Charter Companies; Airlines Transportation and Operations Rules; Authorities.

#### **SHA 602 Aircraft Dynamics 3+0 7,5**

Fundamental Definitions; Aircraft Handling Qualities; Control Surfaces and their Characteristics; General Equilibrium and Stability Definitions; Conditions and Features; Longitudinal Static Equilibrium and Stability Definitions and Features; Symmetrical Maneuver Analysis; General Equations of Motion of Aircraft; Analysis of Symmetrical Movements With Dimensionless Quantities; Longitudinal Static Stability Analysis; Longitudinal Dynamic Stability Analysis Stick-Fixed Stability Analysis; Stick-Free Stability Analysis; Study of Longitudinal Behavior and Unsymmetrical Movements; Study of Lateral Equilibrium and Stability; Analysis of Equilibrium and Stability of Special Flight Movements.

#### **SHA 604 Engineering Economic Analysis 3+0 7,5**

Cost Concepts; Time Value of Money Operations; Interest Calculations; Single Sums of Money; Series of Cash Flows; Multiple Compounding Periods in Year; Continuous Compounding; Equivalence; Variable Interest Rates; Consideration of Inflation; Principle Amount in Loan Payment; Measuring the Worth of Investments; Methods of Measuring Investment Worth; Capital Recovery Formula; Comparison of Alternatives; Defining Investment Alternatives; Defining the Planning Horizon

#### **SHA 608 Optimization Methods in Flight Mechanics 3+0 7,5**

Maximum and Minimum Theory, Maximums and Minimums of Multi Variable Functions, Lagrange Multipliers; Optimization; Optimization Conditions of Performances in Steady State Flight; Turns in Level Flight; Maximum Rate of Climb in a Constant Radius Helicoidal Climb; Maximum Bank Angle in a Helicoidal Climb; Minimum Radius of Turn in a Helicoidal Climb; Maximum Angular Velocity in a Helicoidal Climb; Calculation of Flight Altitude for Maximum Level Flight Speed; Maximum Range for a Given Flight Altitude; Optimization of Rate of Descent in a Helicoidal Descent; Minimum Flight Path Angle in a Helicoidal Descent.

#### **SHA 614 Airport Design 3+0 7,5**

Airport Planning; Airport System Planning Airport Master Planning; Airport Site Selection; Airport Characteristics Related to Airport Design; Airport Capacity; Forecasting in Aviation and Airport Planning; Airport Configuration; Geometric Design of the Airfield; Passenger Terminal Design; Air Cargo Terminal Design; Heliports; STOL Ports and Vertiports; Airport Lighting and Marking; Structural Design of Airport Pavements.

#### **SHA 615 Advanced Mechanical Vibrations 3+0 7,5**

Non-dispersive Behaviour of Uncoupled Vibrations; Pure Torsional Vibrations; Pure Shear Vibrations of Beams;

Dispersive Behavior of Uncoupled Vibrations; Transverse Vibrations of Euler-Bernoulli Beams; Transverse Vibrations of Timoshenko Beams; Dispersive Behaviour of Uncoupled Vibrations, Approximate Solutions; Transverse Vibrations of Euler-Bernoulli Beams; Free Wave Propagation in Uniform, Infinite and Periodic Structures.

#### **SHA 617 Sliding Mode Control Theory 3+0 7,5**

Switching Strategies for Linear Time-invariant (LTI) Systems; Driving LTI Systems Into the Sliding Mode and Making Them Track Desired Trajectory; Chattering and its Elimination; Relay Control; Robustness; Modeling Errors; Disturbances; Switching Hierarchy in MIMO Systems; Driving Nonlinear Systems Into the Sliding Mode and Making Them Track Desired Trajectory; Two-Link Robot Arm Example; MATLAB Implementation of Sliding Mode Control Techniques; Discrete Time Sliding Mode Control.

#### **SHA 618 Fault Tolerant Flight Control System Design 3+0 7,5**

Introduction; Some Aircraft Accidents and Importance of Fault Tolerant Control; Fault Tolerant Control; Definitions and Concepts; Fault Detection; Fault Isolation; Reconfiguration; Methods Used in Fault Detection and Isolation; Full-Order Observers; Reduced-Order Observers; Unknown Input Observers; Fault Detection Using Observers; Fault Isolation Using Observers; Fault Detection Using Unknown Input Observers; Fault Isolation Using Unknown Input Observers; Kalman Filter; Flight Control System; Equations of Motion And Pitot Static System; Sensor and Actuator Fault Detection; Isolation and System Reconfiguration in Flight Control System; State Estimation; Fault Detection; Isolation and System Reconfiguration In Flight Control System Using Unknown input Observers; Practical Applications

#### **SHA 619 Cogeneration -Combined Heat Power Systems 3+0 7,5**

Thermodynamic Principles of The Combined-Cycle Plant; Otto Cycle; Carnot Cycle; Diesel Cycle; Rankine Cycle; Brayton Cycle; Combined Cycle Concept; Single -Pressure Cycle; Preheating; Dual-Pressure Cycles; Triple-Pressure Cycle; Triple-Pressure Reheat Cycle; Application of Combined-Cycle; Combined Heat Power Systems's Components; Gas Turbine; Heat Recovery Steam Generator; Steam Turbine and Other Components; Comparison of Thermodynamic Performance of Combined Heat Power Systems; Economic Analysis of Cogeneration.

#### **SHA 620 Aircraft Performance and Operational Analysis II 3+0 7,5**

Fundamental Definitions, Limit Airspeeds; Limit Loads; Structural Maximum Weights; Flight Maneuvering Envelope; Engine Limitations; Take-off Performance And Limitations, Factors Effecting Take-off Performance; Cruise Performance, Cruising Speed, Range And Endurance, Factors Effecting Cruise Performance; Landing Performance And Limitations, Factors Effecting Landing Performance; Weigh And Balance, Determination of The Center of Gravity; Mission Profile; Operational Analysis of

The Mission Profile Phases; Flight Preparation; Fuel Calculations; Airworthiness Regulations.

**SHA 621 Advanced Gas Thermodynamics 3+0 7,5**

Basic Concepts: Maxwell correlations, Clapayron equation, Internal energy, Entropy, Enthalpy, Equations of state, Joule Thomson coefficient; Changes of Thermodynamic State in Gases, Enthalpy Change in Real Gases, Entropy Changes in Real Gases, Gas Behaviors, Formation Entropy in Gases; Combustion Analyses in Reactive Systems, First Law Analysis, Second Law Analysis; Phase and Chemical Balance in Combustion, Chemical Balance and Analyses in Gases, Phase Balance in Gases.

**SHA 625 Fatigue of Thermal Barrier Coating Systems 3+0 7,5**

Introduction to Gas Turbine Engines: Principles of Operation; Compressor; Combustion Chamber; Turbine; Thermal Efficiency; Introduction to Thermal Barrier Coating Systems: Substrate; Bond Coat; Thermally Grown Oxide; Top Coat; Materials Used in Thermal Barrier Coating Systems; Coating Techniques: Thermal spray; PVD; CVD; Gas Turbine Engine Applications; Microstructure of Thermal Barrier Coating Systems; Testing of Thermal Barrier Coating Systems: Isothermal ageing tests; Thermal Fatigue Tests; Thermal Mechanical Fatigue Tests; Isothermal Low Cycle Fatigue Tests; Hardness Tests; Creep Tests; Thermal Conductivity Tests.

**SHA 626 Genetic Algorithms and Applications of Control Systems 3+0 7,5**

Introduction to Genetic Algorithm; Traditional Optimization Techniques; The Goals of Optimization; Genetic Algorithms as a Optimization Process; How are Genetic Algorithms Different From Traditional Methods; A Simple Genetic Algorithm; Theoretical Basis of Genetic Algorithms; Basic Theorems; Computer Coding of Genetic Algorithms; Reproduction; Crossover; Mutation; Some Applications of Genetic Algorithms; Application Areas of Genetic Algorithms in Control Systems.

**SHA 627 Sizing of Propeller-Driven and Jet-Powered Aircraft 3+0 7,5**

Performance Objectives; Sizing Procedure; Speed Prediction; Airport Performance; Stall Speed; Landing/Take-Off Performance; Climb Performance; Cruising Performance; Aircraft Lift-Drag Characteristics; Engine Characteristics; Cruise Matching; Off-Design Cruise Operation; Aircraft Matching; Take-Off and Climb Calculation; Gross Weight Estimation; Weight Relationships; Useful Weight Fraction; Gross Weight Estimation; Range and Fuel Fraction; Aircraft Sizing.

**SHA 628 Airspace Management 3+0 7,5**

The Concept of the Flexible Use of Airspace; Flexible air Space Management and Civil/Military Coordination; Airspace Management Levels; Flexible Airspace Structures And Procedures; Strategic Level; Conditional Routes; Temporary Segregated Areas; Pretactical Level: Airspace Management Cell Authority; Airspace Allocation Process; Harmonization of Airspace Management/Air Traffic Flow

Management; Centralized Airspace Data Function; Tactical Level; Operational Requirements; Technical Support; Air Traffic Services Organization; Publication of Air Space Management Information; Airspace Use Plan; Updated Airspace use Plan; Conditional Route Availability Message.

**SHA 629 Non-Destructive Inspection Methods for Aircraft Maintenance 3+0 7,5**

Advantages of Non-Destructive Inspection in Aircraft Maintenance; Capacity of Non-Destructive Inspection Methods for Structural Defects; Special Non-Destructive Inspection Methods; Non-Destructive Inspection of Aircraft Elements; Fuselage; Wings; Tail Group; Landing Gear; Power plants; Inspection of Circular Holes With or Without Fasteners; Inspection of Bolts and Rivets; Inspection of Corrosion and Fatigue Defects; Inspection of Thermal and Impact Defects; Inspection of Composite Structures.

**SHA 630 Current Issues in Gas Turbine Engine Combustion Systems 3+0 7,5**

Basic Notions: Classification and structure of gas turbine engines, General definitions about fuel systems; Low NOx Combustion Systems; Knocking In Combustion Chambers; Catalytic Combustion Systems; Methods for Improving Efficiency In Combustion Chambers: Water injection, Vapour injection; Noise In Combustion Chambers And Methods For Preventing; Hydrogen Utilization In Aviation; Fuel-Cell Utilization In Aviation; Synthetic Gas Fuel (Syngas) Utilization In Aviation; Biofuel Utilization In Aviation.

**SHA 631 Aerothermodynamic Optimization of Aircraft Propulsion Systems 3+0 7,5**

Classification of aircraft gas turbines; Turbojet engines; Turboprop; Turboshaft engines; Propfan engines; Advance ducted engines; Factors effecting thrust; Introduction; Thrust force; Jet nozzle; Air speed; Air mass flow; Altitude; Ram Effect; Engine performance parameters; Propulsive efficiency; Thermal efficiency; Propeller efficiency; Overall efficiency; Take off thrust; Specific Fuel consumption; Aircraft range; Range factor; Specific thrust; Optimization of turbojet engine cycle; Thermodynamic analyse; Ideal cycle; Real cycle; Afterburner effect; Optimization analyses of turbojet cycle; Optimization of high bypass turbofan engine cycle; Thermodynamic analyse; Ideal cycle; Real cycle; Optimization of high bypass turbofan cycle; Optimization analyses of turbofan engine with afterburner cycle; Thermodynamic analyse; Ideal cycle; Real cycle; Optimization analyses of afterburner turbofan engine cycle; Optimization analyses of turboprop and turboshaft engine cycle; Thermodynamic analyse; Ideal cycle; Real cycle; Optimization analyses of turboprop and turboshaft engine cycles

**SHA 632 Free Flight Concept and Analysis 3+0 7,5**

Definition and Concept Description; Environment; Scheduling; Routing; RTCA Workshop Report; Free Flight with Airborne Separation Assurance (ASAS); User Preferred Separation Assurance; User Preferred Local

Traffic Flow Management Conformance; ASAS with Cockpit Display Traffic Information; Overview on Conflict Detection and Resolution Methods; State Estimation and Conflict Detection; Conflict Resolution Methods; Flight Rule Evolution and Optimization Process.

#### **SHA 890 Thesis**

**0+1 30,0**

#### **SHY 508 Air Traffic Management**

**3+0 6,0**

History of Air Traffic Control and International Authorities; Air Traffic Management Definitions and Components: CNS/ATM concept, Air traffic control services, Alerting services, Information services, Air traffic flow management, Airspace management; Elements of Air Traffic Control System: Airspace, Technique equipment, Staff, Aero plane; Operational Air Traffic Management: Air traffic management functions, Organization, Planning-control, Co-ordination; Capacity and Efficiency: Recent problems and solution techniques in air traffic management, Simulation models and SIMMOD; Free Flight Concept; EATCHIP Programme.

#### **SHY 517 Aviation Safety Management**

**3+0 6,0**

Safety Fundamentals; Factors Affecting Aviation Safety; Human Factors: SHEL model, Factors affecting human performance; Error Management Models: Reason model, Threat and error management model; Resource Management Programs: Communication, Leadership, Team work, Stress management, Conflict management, Situational awareness; Improving Safety Culture of Aviation Organizations; Safety Management System; Accident and Incident Investigation; Case Studies.

#### **SRM 501 Ceramic Forming Techniques**

**3+0 7,5**

Ceramic Powder Specifications and their Importance in Terms of Forming; Considerations for Selection of Suitable Forming Techniques; Forming Techniques; Dry Pressing; Isostatic and Semi-Isostatic Pressing; Slip Casting; Pressure Casting; Tape Casting; Extrusion; Injection Molding; Gel Casting; Forming and Densification Techniques; Hot Pressing; Hot Isostatic Pressing; Machining and Finishing Processes; Choosing the Right Equipment Depending on the Problem. Each Forming Technique is Explained as Follows; Advantages and Disadvantages; Selection of Suitable Processing Additives; Equipment; Product Properties; Cost; Possible Defects; Their Cause and Control.

#### **SRM 502 Rheological Behavior of Ceramics**

**3+0 7,5**

Definitions of Colloids; Colloidal Systems and Importance of Interfaces; Electric Double Layer; Electrophoretic Mobility and Zeta Potential DLVO Theory and Stabilisation of Slurries; Processing Additives; Water, Organics; Surfactants; Deflocculants; Stability of Clay Systems; Effect of Anions and Cations; Flow and Deformation; Rheologic Behaviours; Pseudoplasticity; Dilatency; Thixotropy; Yield Point; Factors Affecting Viscosity; Practical Usage of Rheological Properties.

#### **SRM 503 Dielectric Materials and Devices**

**3+0 7,5**

Transformations and Tensors; Crystals and Texture Symmetry; Curie Principle and Neumann's Law; Polar Tensors; Pyroelectricity; Permittivity; Piezoelectricity; Elasticity; Thermodynamics; Equilibrium Properties; Axial Tensors; Piezomagnetism; Magnetoelasticity; Pyromagnetism; Magnetic Symmetry-Time Reversal, Hysteretic Properties-Domains; Transport Properties; Thermal and Electrical Conductivity; Galvanomagnetic Phenomena; Thermoelectric Phenomena; Thermomagnetic Phenomena; Waves Acoustics and Optics; Optical Activity.

#### **SRM 506 Structure-Property Relationships in Ceramics**

**3+0 7,5**

Introduction to Crystal Structure of Ceramics; Packing of Atoms and Ions in the Crystal Structures (e.g., Fcc, Hcp, Perovskite, Spinel, etc.) and Variation of Physical Properties of Ceramics as a Function of Atom Positions (e.g., Anisotropic Properties, etc.); Point, Line and 3-D Defect Formation in Ceramic Crystals (Ionic and/or electronic Disorders, Defect Chemical Reactions, etc.) and Influences of Those Defects on Physical Properties of Ceramics (e.g., Color and Color Centers, Gas Sensing Ability of Some Ceramics, etc.); Review of Microstructure Development in Ceramics (i.e., Sintering, Capillary Forces, Grain Size and Morphology, Removal of Pores from the Microstructure, etc.) and Influence of the Microstructure on Properties (e.g., Effects of Pore Size, Grain Size, or Grain Boundary on Mechanical, Thermal and Electrical Properties of Ceramics, Secondary Phase Effects on Physical Properties of Ceramics, etc.); Ceramic Materials Selection Criteria for Specific Applications.

#### **SRM 510 High Temperature Properties of Ceramic Materials**

**3+0 7,5**

Basics; Chemical Bonds in Ceramic Materials and Their Effect on Mechanical Properties; The Parameters Effecting the High Temperature Properties of Ceramic Materials; High Temperature Properties of Ceramic Materials: Strength, Creep, Fatigue, Oxidation, Corrosion, Mechanical Wear; Application of Ceramic Materials for High Temperature; Improvement of High Temperature Properties of Ceramic Materials.

#### **SRM 513 Making of Heavy-Clay Products**

**3+0 7,5**

Introduction; Heavy Clay Product; Building Bricks; Face Bricks And Engineering Bricks; Roofing Tiles; Hollow Floor Blocks; The Raw Materials For Brick And Tile Making; Preparation of Raw Materials; Shaping; Surface Treatment; Cutters; Drying; Firing; Treatment of The Finished Product; Measurement And Control Technology; Quality Control of Products; Planning of Heavy-Clay Plants; Future of Brick as a Building Material.

#### **SRM 517 Ceramic Body and Glaze**

**3+0 7,5**

Classification and Production of Ceramics; Earthenware, Stoneware; Sanitary ware; Porcelain and Tiles; Body Composition; Methods of Body Preparation for Shaping in the Liquid; Plastic and Dry States; Glazing; Body-Glaze Relationship; Glaze Composition and Calculation; The

Properties of Glazes; Special Glazes; Opaque; Matt; Crackle; Salt; Luster; Crystalline; and Aventurine. Ceramic Colors; Preparation and Application Ceramic Stains and Engobes; Glaze Defect and their Control.

**SRM 520 Ceramic Tiles and Sanitary ware Production 3+0 7,5**

An Introduction to Ceramic Industry; Tiles: Wall Tiles, Floor Tiles, Porcelain Tiles; Raw Materials and Preparation, Milling and Granulation; Pressing, Glazing and Decoration; Sintering and Kilns; Frit Production and Glazes; Product Characterization, Standards and Testing; Sanitary Ware: Products, Raw Materials and Preparation; Production Methods: Slip Casting, Pressure Casting; Slip Preparation and Slip Casting; Drying; Sintering and Kilns.

**SRM 521 X-Ray Diffraction Techniques in Materials Characterization 3+0 7,5**

Importance of Materials Characterization; Importance of XRD Techniques in Materials Characterization; Techniques Used in Materials Characterization and their Difference; Electromagnetic Radiation; The Continuous Spectrum; The Characteristic Spectrum; Absorption; Filters; Production of X-rays; Detection of X-rays; Introduction of the XRD Device; Specimen Preparation Methods; Interpretation of XRD Spectra; Lattices; Crystal Systems; Symmetry; Primitive and Non-primitive Cells; The Stereographic Projection; The Stereographic Projection; Diffraction Theory I: Directions of Diffracted Beams; Diffraction; Bragg Law; X-ray Spectroscopy; Diffraction Directions; Diffraction Methods; Diffraction Under Non-ideal Conditions Diffraction Theory-II: Intensities of Diffracted Beams; Scattering by an Electron; Scattering by an Atom; Scattering by a Unit Cell; Structure Factor Calculations: Multiplicity Factor, Lorentz Factor; Absorption Factor; Temperature Factor; Intensities of Powder Pattern Lines;

**SRM 526 Ceramic-Metallic Thin Films and Coatings 3+0 7,5**

The Semi-Classical Theory of Conduction in Metals and Ceramics and the Electronic Band Structure of Selected Metals and Ceramics; Dielectric Properties of Insulators; Magnetic Ordering; Films-Coatings and Surface Effects; Growth Modes and Zone Models for Coatings and Films; Plasmas; Magneto-Electronic and Mechanical Properties of Selected Metal and Ceramic Films and Coatings.

**SRM 528 Advanced Composite Materials 3+0 7,5**

Introduction; Classification of Composites; Ceramic Matrix Composites; Nano-composites; Laminate Composites; Metal Matrix Composites; The Properties and Conditions Required for Matrix and Reinforcement Phases in Composite Materials; The Effects of Thermal Expansion Mismatch in Composite Materials; Fracture Strength of Composites; Mechanical Properties of Composites; Fracture Mechanisms of Composites; Toughening Mechanisms; Properties of Interfaces and Thermal Stresses; Thermal Shock Parameters; Stress-Strain Behavior of Ceramics with the Addition of Reinforcement Phase.

**SRM 592 Seminar 3+0 7,5**

**SRM 599 Term Project 3+0 15,0**

**SRM 602 Transmission Electron Microscopy and Interphase Boundaries 3+0 7,5**

Importance of Interphase Boundaries; Classification of Interphase Boundaries; Low Angle Boundaries and their Properties; High Angle Boundaries and their Properties; Interphase Boundaries between Different Crystals; Interphase Boundaries between Metal and Ceramics; Techniques to Characterize Interphase Boundaries; Transmission Electron Microscopy; Energy Dispersive X-ray Spectroscopy; Parallel Electron Energy Loss Spectroscopy; Dark Field; Bright Field; Fresnel Defocus and High Resolution Imaging Techniques; Diffraction of Electrons.

**SRM 604 Ceramic Sensors 3+0 7,5**

Physical-Chemical and Technological Principles of Ceramic Sensors; Physical and Chemical Bases of Ceramic Sensor Operation; Technological Principles of Ceramic Sensors; Ceramic Humidity Sensors; Semi Conductive Humidity Sensors; Pore Structure Control and Control of the Sensitivity of Ceramic Humidity Sensors; Testing and Stabilization of Ceramic Humidity Sensor Parameters; Ceramic Humidity Sensors Made of Solid Electrolytes; Ceramic Gas Sensors; Ceramic Alcohol Sensors; Ceramic Oxygen Sensors; Ceramic Sensors for Other Gases; Ceramic Temperature Sensors; NTC-Thermistors; PTC-Thermistors, CTR-Thermistors (Critical Temperature Resistors); Capacitive Ceramic Temperature Sensors; Ceramic Pressure Sensors; Multifunctional Ceramic Sensors; Application of Ceramic Sensors.

**SRM 606 Structural Advanced Ceramics 3+0 7,5**

Importance of Structural Advanced Ceramics; Classification of Structural Advanced Ceramics; General Properties; Processing Techniques and Applications of Non-oxide Structural Advanced Ceramics; Examples for Non-oxide Structural Advanced Ceramics; Silicon Carbide; Silicon Nitride; Sialons, Boron Nitride; Boron Carbide; Aluminum Nitride; General Properties; Processing Techniques and Applications of Oxide Structural Advanced Ceramics; Examples for Oxide Structural Advanced Ceramics; Alumina, Mullite; Zirconium.

**SRM 608 Ferroelectrics Materials and Devices 3+0 7,5**

Crystal Structure and Ferro Electricity; Origin of Spontaneous Polarization; Origin of Field Induced Strain; Electro Optic Effect; Applications of Ferroelectrics; High Permittivity Dielectric; Pyroelectric Devices; Piezoelectric Materials; Piezoelectric Resonance; Piezoelectric Transformers; Ultrasonic Transducers; Surface Acoustic Wave Devices; Piezoelectric Actuators; Ultrasonic Motors; Electrooptic Devices; Wave Guide Modulators; PTC Materials; PTC Phenomenon; PTC Thermistors; Grain Boundary Layer Capacitors; Composite Materials.

**SRM 609 Scanning Electron Microscopy and Chemical Analysis Techniques 3+0 7,5**

Introduction; What is the Importance of Microstructural Investigations?; What are the Reasons for the Use of Electron Microscopes; Which Techniques are Used for the Characterization of Microstructures; Specimen Preparation for Electron Microscopy; Interactions between Electrons and Specimen; Depth of Signals Produced as a Result of Interactions and their Use; Scanning Electron Microscopes (SEM) and its Parts; Chemical Analysis Techniques: Energy Dispersive X-ray Spectrometers (EDX) and Wavelength Dispersive X-ray Spectrometers (WDX); Parameters to be Known to Obtain Best Quality Images and Reliable Chemical Analysis; Comparison with Environmental Scanning Electron Microscopes (ESEM) and Other Techniques; Investigation of Different Materials in SEM.

**SRM 612 Crystal Anisotropy 3+0 7,5**

Introduction and Overview; Permittivity; Polarization Mechanism; Dispersion and equivalent circuits; High Voltage Insulators; Electric Breakdown Mechanisms; Substrates and Packaging; Thick and Thin Film Processing; Resistance; Electronic Conduction; Fixed Resistors, PTC and NTC Thermistors, Varistors and Barrier Layer Capacitors, Humidity and Chemical Sensors; Ceramic Electrodes and Superconductors; Ionic Conduction and Batteries; Capacitors; Disk, tubular, Multilayer; Low k Ceramics; Temperature coefficient, Microwave dielectric resonators.

**SRM 614 Colloid Chemistry and Rheological Behaviour 3+0 7,5**

Introduction to Colloid Chemistry and Classification; Colloidal Systems and Importance of Interface; Kinetic Properties; Surface Tension and Surface Energy; Gibbs Adsorption Equation; Adhesion, Cohesion, and Diffusion; Physical Adsorption by Solids; Physical Adsorption by Solids; Langmuir Isotherms; Freundlich Adsorption Isotherm; BET Adsorption Theory; Electrical Phenomena at Interfaces; Electrical Double Layer and Zeta Potential, DLVO Theory; Colloid Stability; Flotation; Surfactants; Wetting; Rheological Behaviour; Pseudo Plasticity; Dilatants Flow Behaviour; Thixotropy, Effective Parameters on Viscosity; Rheological Applications; Stability of Clay Based Mud; Slip Casting; Ceramic Glazes.

**SRM 790 Thesis 0+1 30,0**

**SRM 890 Thesis 0+1 30,0**

**TER 501 Advanced Thermodynamics 3+0 7,5**

Summary of Thermodynamics: First Law of Thermodynamics, Second Law of Thermodynamics, Entropy, Analysis of The Second Law of Thermodynamics, Gas Power Cycles: Brayton Cycle, The Brayton Cycle With Regeneration, The Ideal Jet-Propulsion Cycle; Thermodynamic Property Relations; Gas Mixtures: The Ratio of Mole and Mass of a Gas Mixture, P-V Behavior of Gas Mixtures, Properties of Gas Mixtures; Gas-Vapor Mixtures and Air Conditioning: Dry and Atmospheric Air,

Specific and Relative Humidity of Air; Chemical Reactions: Fuels and Combustion, Theoretical and Actual Combustion Processes.

**UBJ 701 Research in Area of Specialization 3+0 4,5**

**UBJ 702 Research in Area of Specialization 3+0 4,5**

**UBJ 901 Research in Area of Specialization 5+0 7,5**

**UBJ 902 Research in Area of Specialization 5+0 7,5**

**UBL 701 Research in Area of Specialization 3+0 4,5**

**UBL 702 Research in Area of Specialization 3+0 4,5**

**UBM 701 Research in Area of Specialization 3+0 4,5**

**UBM 702 Research in Area of Specialization 3+0 4,5**

**UBM 901 Research in Area of Specialization 5+0 7,5**

**UBM 902 Research in Area of Specialization 5+0 7,5**

**UCS 506 Methods of Numerical Analysis 3+0 7,5**

Linear Transformations: Approximation and matrices; Linear Geometry: Lines and Vectors; Linear Geometry in Space and Perspective; System of Linear Equations: Gauss and Gauss-Jordan Elimination Methods; The Rank of a Matrix and The Simplex Algorithm; Basic Matrix Algebra: Matrix multiplication and its properties; Determinants; LU Factorization; The Key Subjects of the Linear Algebra; Linear Composition and Subspaces; Linear Independence; Basis and Dimension; Vector Geometry: Scalar Product; Angles and Projections; Vector Product; Eigenvalues and Eigenvectors; Eigenspaces and Diagonalization; Symmetric Matrices and Probability Matrix; Matrices and Linear Transformations; Change of Basis, Orthogonalization and The Least Square Method; Orthogonality and the Gram- Schmidt Orthogonalization Method; Orthogonal Projections.

**UCS 508 Interpretation and Analysis Techniques on Geographic Information Systems 3+0 7,5**

The Quality of Graphic Data; Graphic Data Preparation for Analysis And Modeling Studies, Topological Analysis Applications: Neighborhood Relationship, Location Modeling Techniques; Raster and Vector Data Interactions with Database; Recoding Analysis on Raster and Vector Data; Physical Interactions Between Graphic Data: Union, Subtraction and Intersection and Neighborhood Relationship Between Vectorial Areas; Three-Dimensional Analysis and Modelling Techniques; Evaluation of the Data in Three-Dimensional Space; Data Interpolation Techniques In Two-dimensional (pixel) and Three-dimensional (voxel) Space Analysis and Modeling on Topographic Surfaces: Analysis of Slope, Aspect and Visibility, Evaluation of Elevation.



**UCS 511 Remote Sensing and Geographic Information Systems Techniques in Disaster Management 3+0 7,5**

What is Natural Disaster?; Types of Natural Disaster: Flood, Landslide; Earthquake; Remote Sensing Applications after Disaster; The Relationship between Emergency Management and GIS at Disaster; Using of Disaster Related Data in GIS; Use of RS and GIS for Geotechnical Research Regarding Earthquake; Use of GIS in Seismic Risk Analysis; Use of GIS for Regional and Local Analysis; Use of GIS Before and After Earthquakes.

**UCS 512 Special Topics in the Natural Resources Management with the Use of GIS 3+0 7,5**

Application of GIS for Different Natural Resources; Software and Hardwares Used for Natural Resources Management; Data Types for Geological and Mining Fields; Spatial Data Modelling: Raster Model, Vector Model; Attributes Used in Natural Resources; Spatial Data Structures in GIS; Use of Natural Resources Data in GIS; Using Different Formatted Data in the Same Project; Topology Concept; Map Analysis by Using GIS; Third Dimension in the Natural Resource Analysis; 3-Dimensional GIS; 3-D Modelling of Drilling Logs; 3-D Analyse and Interpretation.

**UCS 513 Special Topics on City Information Systems 3+0 7,5**

General Concepts for Planning and Design Terms; City Planning System; Planning Information Systems; Data Resources: Raster data, Vector data, Surveys; Base Map for City Information Systems: The layers for base map production according to the study coverage, Base map production techniques using GIS capabilities, Thematic maps as base maps for city information systems; GIS Aided Decision Making Mechanisms For City Information System; Inventory Preparation For City Planning System, Important Analyses Techniques Used For City Information Systems; Computer Support On Decision Making Progress.

**UCS 514 Environmental Management and Integration With Geographical Information Systems 3+0 7,5**

GIS Use for Air Quality Management: GIS Use for Air Pollution Inventory Studies; Preparation of Pollution Maps And The Clean Air Plans; GIS As A Tool For Water Quality Management; Water Quality Monitoring Studies On The Lake, River And Sea and Preparation of The Water Pollution Maps; GIS Use For Waste Management: Selection of the landfill area and monitoring of the pollution originating from the landfill area using GIS; Importance of the GIS applications for Solution of The Environmental Problems; GIS applications for Environmental Impact Assessment (EIA).

**UCS 519 Automated Mapping and Facility Management Systems 3+0 7,5**

Computer Aided Two Dimensional Drawing Applications; Proper CAD Drawing Preparations Techniques for Geographical Information Systems: Drawing cleanup,

Creating topology; Proper Geo-data Base Preparation for AM/FM Systems: Preparation of database, Linking the data; Surveying for mapping purposes; Application Development for AM/FM System: Application development for automated mapping, Application development for facility management; Examples for AM/FM System Studies.

**UCS 525 Digital Photogrammetry 3+0 7,5**

Principles of Photogrammetry; Optics on Photogrammetry; Stereoscopic Vision; Principles of Stereo Photogrammetry; Preparation of Flight Plan to Take Aerial Photographs; Photogrammetric Triangulation; Digital Photogrammetry and Digital Map; Orthophoto.

**UCS 527 Multicriteria Decision Making Methods 3+0 7,5**

Introduction to Multiple Criteria Decision Making Analysis; Components of MCDM Methods: Decision making concept and methodology, analytic hierarchy process and principles, analytic network process and principles; Combined Application of Geographic Information Systems (GIS) and Multiple Criteria Decision Making Methods; GIS and MCDM Applications on Environmental Decisions; Software Applications in AHP and ANP.

**UCS 533 Fundamentals of Mapping and Geographical Information Systems 3+0 7,5**

Essential Definitions for Mapping; Surveying; Measurement Units; Angle Units; Arc Units; Unit Conversion; Scale; Measurement Errors and Reason of Error Increase; Simple Measurement Instruments and their Use; Area Calculation; Volume Calculation; Vertical Coordinate System; Projection; Map Sheet Names; Basic Map Features; Topographic Maps; Photogrammetry; Photogrammetry Applications; GPS Usage; Definition of Geographical Information Systems; Planning; Spatial Data Processes; Map Data and Elements; Digital Map; Layer Sense; Graphical Data and Properties; Topology; Elements of Topology; General Topology Concept; Topology Data Model; Analysis Functions; Classification; Feature Class Definition and Database; Database Approaches and Designing of a Database; Database terminology; Database models.

**UCS 534 Geostatistics 3+0 7,5**

Probability; Normal Distribution Test; F Test; Variance Analysis; Chi-Square Test; Regression of Least Squares; Map Analysis; Geologic Maps; Distribution of the Points; Contouring; Trend Surfaces; 4 Dimensional Trend Surfaces; Moving Environments and Kriging; Comparison of the Maps; Data Analysis with Multiple Variables; Multiple Regression; Discriminant Analysis; Grouping Analysis; Factor Analysis.

**UCS 535 Integration of Geographic Information Systems and Global Positioning Systems 3+0 7,5**

Introduction to Global Positioning System (GPS); Principals of System Operation; GPS Segments: GPS space

segment, GPS control segment, GPS user segment; GPS Signal Structure; GPS Performance and Error Effects; Differential GPS; GNSS, GLONASS, GALILEO; Augmentation systems: WAAS, EGNOS, MSAS; GPS Navigation Applications: The utility of GPS on land, Navigation with GPS and a map, GPS navigation with or without a compass; Principals of Outdoor GPS Operation; The Use of Outdoor GPS and Applications; Evaluation of Received Data from GPS and Integration with GIS Graphical Database

#### **UCS 536 Remote Sensing 3+0 7,5**

History of Remote Sensing; Database Structure ; Spectral Resolution; Basic Image Processing Analysis; Remote Sensing Methods; Parameters in the Visual and Digital Image Analysis; Model Building for Remote Sensing Projects; Remote Sensing Satellites; Material and Electromagnetic Wave Interaction in Remote Sensing; Spectral Reflectance Properties of Objects; Evaluation of Softwares and Hardwares for Remote Sensing; Properties of obtaining color images; Obtaining of screen view; Statistical Analysis Techniques for Remote Sensing Studies; Geometric and Radiometric Correction of Remote Sensor Data; Image Enhancement; Classification Techniques in Remote Sensing.

#### **UCS 537 Geographic Information Systems in Social Sciences 3+0 7,5**

Thinking spatially in social sciences; Spatial analysis at individual and household levels: micro level spatial modeling; Neighborhood level analysis; Region level analysis; Spatial analysis of regional income inequality; The role of spatial analysis in demographic research; Geographical approaches in reconstructing past human behavior from prehistoric roadways.

#### **UCS 538 Geographic Information Systems and Health 3+0 7,5**

Introduction to GIS and health research; Spatial statistics and analysis of health data; Statistical methods and spatial epidemiology; Health research and geographical data base; Modeling spatial variations in air quality using GIS; time geography and health; GIS and public health; Improving health need assessment using patient register information in a GIS; Applications: Atlas of Turkey Mortality Maps.

#### **UCS 542 Raster and Grid Modeling on Remote Sensing 3+0 7,5**

Properties of Raster and Grid data. Data Sources and Techniques of Data Production. Point, Line, Polygon Projections on Data Formats. Geographic Sensitivity and Resolution. Change Detection Based on Time for Same Coordinate. Digital Elevation Model Practices. Algebraic Functions Used for Data Modelling. Grading and Recoding in Data Analysis; Multifactor Modelling Techniques.

#### **UCS 543 Applications of New Technologies in Geographic Information Systems 3+0 7,5**

What is geoinformatics? Geodatabase structures On-line data collection for GIS What is GPS? GIS and GPS integration Applications for GIS and GPS integration:

Mobile tracking What is wireless sensor networks (WSN)? Wireless sensor network applications: Pollution mapping, noise mapping

#### **UCS 544 Seismic Data Acquisition Techniques and Quality Control 3+0 7,5**

Seismic sources and receivers. Field configuration in seismic refraction and reflection methods. Acquiring land and marine seismic data. 3-D data acquisition techniques in seismic reflection. Seismic data quality control and criteria.

#### **UCS 545 Bore-Hole Seismic Methods and Professional Software 3+0 7,5**

Bore-hole seismic sources. Bore-hole three-component geophones and hydrophones. Sonic and density logs. Down-hole and up-hole shooting methods. Determination of seismic P and S wave velocities. Generating synthetic seismograms and correlation. Related professional software.

#### **UCS 546 Seismic Tomography and Professional Software 3+0 7,5**

Essentials of cross-hole tomography. Generation of coefficient matrices. Methods of matrix inversion: Singular-value-decomposition, Gauss-Newton method, damped least-squares and Lagrange coefficient, rank deficiency. Related professional software.

#### **UCS 547 Seismic Surface Waves 3+0 7,5**

Properties of body and surface waves. The concept of absorption and dispersion. Absorptive and dispersive properties of surface waves. Surface waves in earthquakes, structure ground interaction.

#### **UCS 548 Data-Processing in Seismic Refraction Methods and Professional Software 3+0 7,5**

Concept of critical angle and critical distance. Horizontal single-layer problem. Horizontal multi-layer problem. Dipping-layer problem. Blind-layer, hidden-layer problems. Intercept-time, cross-over distance, and time-distance equation solutions. Delay-time method. Related professional software.

#### **UCS 549 Data-Processing in Seismic Reflection Methods and Professional Software 3+0 7,5**

Concept of shot-gather and CDP-gather. Digital filters and gain. Data editing and muting. Geometry definition. Static and dynamic corrections. Velocity analysis and stacking. Deconvolution and migration processes. Time-to-depth conversion. Related professional software.

#### **UCS 550 Seismic Interpretation and Professional Software 3+0 7,5**

Factors affecting the seismic wavelet, Geometrical spreading, reflection and transmission coefficients, seismic absorption, interference; Pitfalls in seismic interpretation: Velocity pull-up, velocity pull-down Multiples. Definition of bright-spot, dim-spot, flat-spot. Related professional software.

#### **UCS 551 Seismic Stratigraphy and Tectonics 3+0 7,5**

Display of seismic sections. Concept of vertical and horizontal resolution. Incident-angle dependency of the reflection and transmission coefficients. Terms used in seismic stratigraphy: On-lap, top-lap, down-lap, truncation surfaces, etc. Determination of normal, reverse and strike-slip faults.

#### **UCS 552 Satellite Technologies and Communication 3+0 7,5**

Satellite Types and Orbits; General Principles of Satellite Telecommunication; Satellite Platforms; Introduction of Satellite Sub-Systems: Payload (Transmitter Sub-System); Electrical Power Sub-System; Impulse Sub-System; Avionics and Location Control Sub-System; Thermal and Structural Sub-System; Process and Tests of Satellite Production; Launching Services; Satellite Location Control Systems

#### **UCS 553 Satellite Managership 3+0 7,5**

Fundamental Principles of Satellite Managership; Individual and Institutional Services Presented via Satellites; Competition and Cooperations in Satellite Managership; Marketing Strategies in Satellite Managership; Contact Administration in Satellite Managership; Customer Relations Management in Satellite Managership; Satellite Managership in the World and Satellite Producers: Countries that have Satellite Managers and their Numbers; Leading satellite producers in the world; Firms that provide launching service; Satellite Purchasing and Ensuring

#### **UCS 555 Theoretical Basics of Remote Sensing 3+0 7,5**

Introduction to Remote Sensing; Remote Sensing System; Electromagnetic Energy and Electromagnetic Spectrum; Spectral Properties of Objects; Sensing Systems in Remote Sensing; Sensing Platforms in Remote Sensing; Optical Remote Sensing; Thermal Remote Sensing; Microwave Remote Sensing; Digital Image Processing; Classification; Supervised Classification; Unsupervised Classification.

#### **UCS 557 Microzoning 3+0 7,5**

Basic concepts of Micro-Zoning: Hazard, Risk, Scale; Natural and Technological Disasters: Definition of disaster, Types and causes of disaster, Disaster effects; Disaster Management: Phases of disaster management, Risk management, Crisis management; Micro-Zoning and Hazard Analysis: Fundamentals of micro-zoning, Phases of micro-zoning; Micro-Zoning and Geographic Information System: Data model design and geospatial data input, Spatial Prediction.

#### **UCS 592 Seminar 3+0 7,5**

#### **UCS 599 Term Project 3+0 15,0**

#### **UCS 601 Use of GIS in Earth Sciences 3+0 7,5**

Fundamentals of positional data models, Applications of positional data models, positional data structures, positional data input, display of positional data, inquiry of positional data, transformation of positional data, applications of positional data transformation, tools needed for single map

analysis, tools needed for map pairs analysis, tools needed for multi-maps analysis.

#### **UCS 602 Earth Systems 3+0 7,5**

Global changes, energy equilibrium and greenhouse effect, atmospheric circulation system, circulation in oceans, modeling of atmosphere-ocean systems, plate tectonics, carbon cycle, ecosystems and biodiversity, effect of life on atmosphere: increase in oxygen and ozone, long period climate changes, paleobiodiversity, glaciations in Pleistocene, short period climate changes, global warming, ozone layer, human effect on biodiversity, climatologic stability in Earth and Earthlike planets.

#### **UCS 603 Advanced Photogeology 3+0 7,5**

Stereoscopy, stereoscopic vision, stereoscopes, radial displacement concept, air photographs, types of air photographs, informations printed on aerial photographs, taking areal photographs, handling of areal photographs, photogeological symbols and abbreviation, photointerpretation in geology, fundamentals of photointerpretation, essential interpretation elements in photointerpretation, application of photointerpretation to geology, structural analysis, lithologic interpretation.

#### **UCS 604 Environmental Hydrogeology 3+0 7,5**

Introduction to water quality, characterization of water bodies, hydrodynamic features, physico-chemical properties, biological characteristics, definition of water quality, water uses and human impact on water quality, pollutant sources and pathways, temporal and spatial variations of water quality, hydrological characteristics, rivers, major water quality issues in rivers, waste storage, geological aspects for assessment, clean up and siting of waste disposal sites, sampling design, environmental impacts related to hydrogeological systems, environmental impacts on water resource systems..

#### **UCS 606 Hydraulics in Porous Media 3+0 7,5**

Properties of fluids, statics of fluid, dynamics of fluid, general properties of porous media, porous environments, determination of porosity, hydrostatics of porous media, hydrodynamics of porous media, Darcy's law, aquifer types, hydrogeologic units, hydrological properties of hydrogeological units, groundwater currents, groundwater current equations, solution to current equation.

#### **UCS 607 Advanced Technology Supported Archaeological and Architectural Documentation 3+0 7,5**

Concept of documentation, architectural documentation, archaeological documentation, advanced technology means, close picture photogrammetry, single picture evaluation, stereo photogrammetry, application of laser scanning, orthophoto production, evaluation.

#### **UCS 608 Multiple Criteria Stable Support System Applications in Disaster Management 3+0 7,5**

Geographic data, information and decision making, functions of geographic information systems, geographic

information systems and decision support, introduction to multi criteria decision support systems, producing criteria for disaster management, alternatives and restrictions, weighting of criteria, producing risk maps for disasters.

**UCS 609 Use of Geographic Information Systems in the Applications of Seismic Microzoning and Urban Transformation 3+0 7,5**

Inner earth and geophysics, natural hazards and risks, earthquakes and effect of earthquakes on settlement areas, earthquake magnitude, building and operating local earthquake observation networks, earthquake risks and seismic hazard size, fundamentals of seismic microzoning, seismic data acquisition and evaluation, disaster risks and urban transformation, application of geographic information systems to urban microzoning studies.

**UCS 610 Application of High Speed Ground Penetrating Radar to Ballast and Subsoil Inspections of Runways, Highways and Railways 3+0 7,5**

Recent advances in electronics and software development technologies provided high quality Ground Penetrating Radar (GPR) data with horizontal resolution of less than 5 centimeters and vertical resolution of less than 5 picoseconds at line speeds of more than 100 kilometers per hour. Contemporary increase in airline, highway and railway traffic imposes periodical ballast and subsoil inspections for local defects, deterioration, fouling and moisture accumulations. Modern GPR hardware (400 MHz and 1 GHz Horn Antennas, Doppler Radars, Digital Video Films, etc) and dedicated GPR processing, interpretation, visualization and analyzing software will be introduced.

**UCS 611 Use of Geographic Information Systems in the Planning of Earthquake Origin Risk/Damage Mitigation 3+0 7,5**

Earthquakes, earthquake effects in local soil conditions, fundamental principles of disaster management, damage mitigation essentials, hazard analysis, strategies of hazard minimization, application of geographic information systems in hazard mitigation planning.

**UCS 612 Modern Approaches to the City Planning 3+0 7,5**

The birth of the first civilizations and urbanism, as the Greek and Roman, medieval period, the understanding of cities and planning; medieval Islamic cities, the Renaissance understanding of the planning period, the industrial revolution, cities and other effects; ideal cities, working cities, planned industrial cities, urbanism and planning in the west of the modern and the development of post-modern era and the historical development of the conceptual roots in the process of urbanization today and the future by examining the effects of urbanization and the dynamics of the contemporary features of urbanization in different economic strings of urbanization and

**UCS 613 Urban Conservation-Restoration 3+0 7,5**

The protection of national and international scale in urban areas, renovation and restoration, basic concepts, scope and purpose; urban sustainability, urban conservation action, the principles of urban conservation, urban renewal, urban development and change in the tissues, the types of renovation, tissue renewal areas, the areas of urban renewal implementation issues, historical examples of application areas, urban renewal, historic environment restoration

**UCS 614 Urban Regeneration 3+0 7,5**

Urban life style, urban growth speed, urban social and physical infrastructure, urban change and regeneration process, social, economic and physical aspects of regeneration process, urban development process and regeneration of implementation examples in the external and internal scope of urban regeneration, historical formation and structure of urban space, social and demographic development change in urban space, urban economic development change, physical development change in urban space, formation of urban culture and effect of urban space, implementation examples in country and the world.

**UCS 615 Resource Inventory and Analysis 3+0 7,5**

Definitions of Basic Concepts: Resource, Inventory, Analysis, Resource inventory and analysis; Classification of Resources: Natural resources, Cultural resources; Importance and Basic Phases of Resource Inventory and Analysis; Equipment and Methods of Resource Inventory and Analysis; Simple and Detailed Survey Works for Natural and Cultural Resources: Topography, Hydrology, Geology, Climate, Soil, Flora, Fauna, Cultural values, Social values, Economical values; Capacity and Suitability Analysis.

**UCS 616 Physical Principles of Energy and Matter Interactions in Remote Sensing 3+0 7,5**

Structure of Atom and Molecules; Transfer of Energy Mechanisms: Ionization, Excitation, Bremsstrahlung; Direct Ionizing Radiation; Indirect Ionizing Radiation; Quantum Structure of Electromagnetic Energy, Gamma absorption, Photoelectric effect, Compton scattering, Pair production; Neutron Interactions: Neutron reactions, Elastic and inelastic scattering, Reactions in biological systems; Structure of Earth Atmosphere; Energy Interaction in the Atmosphere: Scattering, Absorption; Interaction of Energy with Components of Earth Surface: Spectral reflectance of vegetation, soil and water.

**UCS 617 Special Subject at Remote Sensing 3+0 7,5**

Introduction of Remote Sensing; Fundamentals of Remote Sensing; Sensing Systems and Platforms in Remote Sensing; Thermal Remote Sensing; Thermal Images and Their Interpretation; Thermal Remote Sensing Platforms and Their Application Areas; Thermal Remote Sensing Application Examples; Microwave Remote Sensing; Microwave Remote Sensing Systems; Radar Sensing Systems; Microwave Image Features and Their Interpretation; Microwave Remote Sensing Application Areas; Microwave Remote Sensing Application Areas.

**UCS 618 Network Analysis in Geographic Information Systems 3+0 7,5**

Definitions of Terms Used in Network Analysis; Similarities and Differences Between Geometric Network and Network Dataset; Network Dataset Features; Build Network; Make Route Layer; Make Service Area Layer; Directions in Network Dataset; Make Closest Facility Layer; Make Location and Allocation Layer; Make Origin-Destination Cost Matrix; Solving Network; Turn Features and Tables.

**UCS 620 Remote Sensing and Geographic Information Systems Applications for Mine Reclamation 3+0 7,5**

Definitions of Terms Used in Mine Reclamation; Time Span of Mine Closure; Mine Closure Plan; Mine Closure Procedures; Environmental and Social Impacts; Mine Reclamation Planning and Management; Laws and Regulations; Mine Reclamation Techniques; Geographic Information Techniques in Mine Closure; Cost of Mine Reclamation; Monitoring and Control of Nature Destruction in Mining with Remote Sensing and Geographic Information Systems.

**UCS 622 Basic Programming and Geometric Problems 3+0 7,5**

Introduction, Data structures, Geometric data structures and standards; Algorithms, Flow Diagrams; Operations; Comparison Operations; Loop Structures; Basic I/O Operations; Methods, Arrays, Solution of basic geometric problems: Field Calculation, Distance calculation, Distance between point and line, 2D linear coordinate systems, Calculating nearest point, Intersection.

**UCS 624 Airborne Laser Scanning (LIDAR) Systems 3+0 7,5**

Introduction; Airborne Laser Scanning Technology and Functions; Physical Basics of Laser Beams; Full Waveform Principles; LIDAR Data and Their Accuracy; Data Processing; Data Adjustment; Data Filtering and Point Classification; Commercial Software and Hardware Systems; Application Examples; Quality Control of Laser Data; Advantages and Disadvantages of LIDAR Systems; Project.

**UCS 626 Logistics Optimization 3+0 7,5**

Fundamental Definitions, Operations, Operations research; Modeling in Operations Research, Problems determining and problem solving, Logistics and logistics systems, Logistics operations, Logistics network design, Site selection, Route problems, Route optimization; Multi-Criteria Decision Making Systems; Demand Forecasting and Management, Information technologies in logistic management, Software solutions for logistics, Case studies for logistics optimization.

**UCS 628 National Standards, Legislations and Public Applications 3+0 7,5**

Basic Definitions and Concepts, European Union countries status, Inspire directives, Current institutional structure of geographic information systems in our country, Spatial data producing public institutions, National spatial data standards, TUCBS, National legislation in cadastral studies, Mapping, Cartography, Planning and geographical information technologies, Infrastructure facilities, National studies, public applications, Future sectoral approaches.

**UCS 630 Geographical Information Applications for Water Resources Planning 3+0 7,5**

Digital Elevation Model (TIN and GRID) Concepts; Drainage Basin Extraction and Determination of Properties; Various Spatial and Three-dimensional Analysis: Soil and Land Use Mapping, Point-to-area distribution (rain / snow / soil moisture / dirt etc.), Site selection and dimensioning for water structures; Disaster (flood, landslide, etc..) Risk Mapping; Geographic Information Systems Applications on the Field of Water Resources.

**UCS 632 Government Projects and Spatial Relations in Turkey 3+0 7,5**

E-Government Structure: E-government elements, The application purpose and the factors which the transformation, The benefits of the application, History, Spatial e-government practices in the world; E-Government and E-Transformation Process Adaptation Studies in Turkey: Information society strategy action plan, Integration standards, Data sharing standards, IT and security standards; Spatial Data Infrastructure and E-Government: TUCBS, Spatial e-government projects sample and applications.

**UCS 634 Property Law and Introduction to Land Survey Applications 3+0 7,5**

Introduction: The basic concepts of law, Real and personal rights, Property law and possession, The Turkish civil code, People law, Family law, Inheritance law, Real law, The right to property, Real property; Title Deeds and Land Registry: Land registry in Turkey, Principles and elements of the land registry, Transactions in the land registry, Land registry organization; Cadastre: Definitions and concepts, Definitions used in the cadastre, Land ownership relations, Cadastre types, Cadastral functions implemented in Turkey, Cadastral works in Turkey.

**UCS 636 Project Management in Geographic Information Systems 3+0 7,5**

Introduction: What is project, What is project management; Project Life Cycle and Organization: The features of the project life cycle, Project phases, Stakeholders; Project Management Processes in The GIS Project: Orientation process groups, Starting processes, Planning processes, Execution processes, Monitoring and control processes; Project Integration Management: The development of the project management plan, The realization of the integrated change control; The Project Scope Management; Project Time Management; Project Cost Management; Project

Quality Management; Managing The Project Team; Project Risk Management; Project Procurement Management.

<b>UCS 701 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UCS 702 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UCS 790 Thesis</b>	<b>0+1 30,0</b>
<b>UCS 890 Thesis</b>	<b>0+1 30,0</b>
<b>UCS 901 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UCS 902 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UÇV 701 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UÇV 702 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UÇV 901 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UÇV 902 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UEE 701 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UEE 702 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UEE 901 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UEE 902 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UEN 701 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UEN 702 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UEN 901 Research in Area of Specialization</b>	<b>5+0 7,5</b>
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<b>UFZ 701 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UFZ 702 Research in Area of Specialization</b>	<b>3+0 4,5</b>
<b>UFZ 901 Research in Area of Specialization</b>	<b>5+0 7,5</b>
<b>UFZ 902 Research in Area of Specialization</b>	<b>5+0 7,5</b>

**UGM 510 Failure Analysis of Aircraft Structures** **3+0 7,5**  
 Introduction; Definitions, Common causes of failures, Deficiency in design, Manufacturing defects, Deficiency in inspection and maintenance, Abnormal conditions, environmental effects, Failure analysis methodology and stages, Examination methods of failure analysis; Nondestructive

inspection, Destructive inspection, Characterization, Special techniques, Failure analysis of aircraft structures; Fatigue, Creep, Corrosion, Fracture, Fretting, Wear, Distortion failures, Case studies of failures.

**UGM 592 Seminar** **3+0 7,5**

**UGM 601 Environmental Impact of Commercial Aircraft** **3+0 7,5**

Fundamental Combustion Thermodynamics; Emission Types: NOX, HC and CO; Emission Mechanisms; Emission Regulations; Emission Inventory Investigations: ICAO, SAGE, AERO2K, DLR; Actual Emission Tests; Emission Abatement Techniques in Engines; Emission Analyses with Flight Data; Engine Power and Emissions; Effect of Flight Phase on Emissions: Cruise, Climb, Descent; Emission Estimations Based on Airport; Emissions and Air Traffic Management.

**UGM 603 Advanced Heat Transfer Calculations in Aviation** **3+0 7,5**

Basics of Heat Transfer; Heat Conduction: Steady-state heat conduction, Concept of heat resistance, Determination of temperature distribution, Unsteady heat transfer, Lumped system analysis, Infinite and semi-infinite matters, Fundamentals of heat convection, Dimensionless numbers, Energy equation, Momentum equation, Mass equation, Forced convection, Forced external convection, Forced internal convection, Natural convection; Heat Transfer Analyses for Aviation Applications.

**UGM 605 Advanced Exergy Analysis in Aviation** **3+0 7,5**

Basic Concepts; Conventional Exergy; Exergoeconomic and Exergoenvironmental Analyses and Exergy Destruction: Definitions of the theoretical system and the unavoidable thermodynamic irreversibility, Endogenous and exogenous exergy destructions, Unavoidable and avoidable exergy destructions, Avoidable endogenous, avoidable exogenous, Unavoidable exogenous, unavoidable endogenous exergy destructions, Exogenous exergy destructions, Application of advanced exergy analyses to exergoeconomic and exergoenvironmental methods in aviation.

**UGM 610 Thermoeconomic and Thermoenvironmental Optimization in Aviation** **3+0 7,5**

Thermal system design, Life-cycle design, Economic and environmental studies in aviation; Thermodynamic Analysis: Energy and exergy analysis, Heat transfer, modeling, and design analysis; Economic Analysis: Estimation of investment, Principles of economic evaluation; Environmental Analysis: Determination of environmental impacts and damages; Thermoeconomic Analysis and Evaluation; Thermoenvironmental Analysis and Evaluation; Aviation Application of Thermoeconomic and Thermoenvironmental

tal Analysis: Piston-prop engines, Gas turbine engines;  
Optimization: Determination of optimum points.

UGM 790 Thesis	0+1 30,0
UGM 890 Thesis	0+1 30,0
UHE 701 Research in Area of Specialization	3+0 4,5
UHE 702 Research in Area of Specialization	3+0 4,5
UHE 901 Research in Area of Specialization	5+0 7,5
UHE 902 Research in Area of Specialization	5+0 7,5
UHT 701 Research in Area of Specialization	3+0 4,5
UHT 702 Research in Area of Specialization	3+0 4,5
UHT 901 Research in Area of Specialization	5+0 7,5
UHT 902 Research in Area of Specialization	5+0 7,5
UIN 701 Research in Area of Specialization	3+0 4,5
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USM 702 Research in Area of Specialization	3+0 4,5
USM 901 Research in Area of Specialization	5+0 7,5
USM 902 Research in Area of Specialization	5+0 7,5
UUG 701 Research in Area of Specialization	3+0 4,5
UUG 702 Research in Area of Specialization	3+0 4,5
UUG 901 Research in Area of Specialization	5+0 7,5
UUG 902 Research in Area of Specialization	5+0 7,5
UYB 701 Research in Area of Specialization	3+0 4,5
UYB 702 Research in Area of Specialization	3+0 4,5
YBL 501 Earth Sciences	3+0 7,5
Introduction to Earth Sciences, Information about the earth, Earth's surface, Earth's internal structure, Atmosphere, Minerals and rocks, Volcanic rocks, Sedimentary rocks, Metamorphic rocks, The earth's general properties, Formation of the universe, Geologic date, Rock cycle, Motion of tectonic plates that make up the earth, Soil formation, Environmental geology.	

**YBL 502 Geotechnical Earthquake Engineering 3+0 7,5**

Earthquakes, Measurement and distribution of earthquakes, Characterization of seismicity, Engineering models of strong motion, Attenuation relations, Seismic risk and hazard, Response spectra, Stress-strain and shear strength characteristics of soils under earthquake excitations, Liquefaction and counter measures, Site amplification and microzonation, Earthquake codes related to geotechnical design.

**YBL 503 Geophysical Methods in Civil and Environmental Engineering 3+0 7,5**

Introduction to Geophysical Methods, Geophysical applications in civil engineering: Determination of Seismic P and S Wave Velocities, Seismic quality factor Q, Computation of static and dynamic soil parameters, Concept of bed-rock and seismic-basement, Geophysical applications in environmental engineering: Determination and Prospecting of Dump-sites, Implementation of seismic and ground penetrating radar techniques.

**YBL 504 Shallow Marine Geophysics 3+0 7,5**

Comparison of Land and Marine Geophysical Methods and Instrumentation; High-resolution Seismic, Multibeam-echosounder and side-scan-sonar techniques in shallow marine geophysics, Implementation of gravity and magnetic methods in marine environment, Seafloor classification, Geotechnical studies in marine environment: Docks, Bridges, Tunnels, Cables, Pipes, Offshore oil platforms, Dredging, Search for industrial materials and mines.

**YBL 505 In-situ Testing and Evaluation 3+0 7,5**

Borings and Soil Sampling; Standard Penetration Test (SPT); Cone Penetration Test (CPT); Plate Loading Test; In-situ Density Measurements; In-situ California Bearing Ratio Test (CBR); Pressuremeter; Dilatometer Tests; Field Shear Vane Test; In-situ Permeability Testing; Groundwater Pressure Measurements; Dynamic Soil Properties based on in-situ Measurements; Microtremor Measurements in Geotechnical Engineering; In-situ Stress and Deformation Measurements.

**YBL 506 Geosynthetics 3+0 7,5**

Introduction to Geosynthetics, The history and development of geosynthetics, Standards and selection of geosynthetics, Geosynthetics- soil interaction, Geometrical, Physico-mechanical chemical and hydraulic properties of geosynthetics, Production technology of geosynthetics, Project realization, Soil reinforcement, Drainage, Bank and bed protection, Roads and railways, Lining system.

**YBL 507 Experimental Soil Mechanics 3+0 7,5**

Introduction to Experimental Soil Mechanics, Information about soil samples, Contents of laboratory report, Determination of water content of soil, Atterberg limits of soils, Particle size analysis-mechanical method and hydrometer method, Specific gravity of soils, Relative density determination, compaction test, California bearing ratio (CBR) test, Coefficient of permeability, Consolidation test, Unconfined compression test, Triaxial test, Direct shear test.

**YBL 508 Theoretical Soil Mechanics and Soil****Models 3+0 7,5**

Rock Cycle and The Origin of Soil, Soil composition, Classification and identification of soil, flow of water in soil, Capillary rise in soils, Engineering properties of soil, Effective stress concept, Stress-strain behaviour of soils, Compressibility of soil, Yield criterion of soils, Some theories of failure, Classification.

**YBL 509 Engineering Properties of Soils 3+0 7,5**

Evaluation of Site Conditions, Sampling of soil, Classification of soil and index properties, Composition of soil, Consolidation, Theory of consolidation, Consolidation and settlements of soil, Flow of water in soils, Permeability concept, Compaction of soils, Stress and strain properties of soil stress and strain behavior of soils, Shear strength of soils, Shear strength properties of soils.

**YBL 510 Groundwater Hydraulics 3+0 7,5**

Definitions of Basic Concepts, Geological and hydrogeological classification of groundwater reservoirs; Aquifer Types, Unconfined, Confined, Leaky, Perched; Well Types, Small diameter, Large diameter, Deep, Shallow, Drilling, Completely and partially penetrations, Non-penetration; Groundwater Flow Types, Laminar, Turbulence, Steady, Unsteady, Compressible flows; Aquifer Parameters, Hydraulic conductivity, Specific yield, Specific retention, Storage coefficient, Transmissivity; Darcy Law, Hydraulic load, Piezometers, Well losses.

**YBL 511 Geological and Hydro-meteorological****Hazard Analysis 3+0 7,5**

Concepts Related to Natural Hazards; Fundamental Mechanism of Earthquakes; Seismic Hazard Analysis; Fundamental Mechanisms of Landslides and Erosion; Landslide Hazard Analysis; Erosion Hazard Analysis; Applications of Landslide Hazard Analysis and Erosion Hazard Analysis; Flood Hazard Analysis; Application of Flood Hazard Analysis; Multi-hazard Assessments.

**YBL 512 Earth Systems 3+0 7,5**

Global Changes, Energy equilibrium and greenhouse effect, Atmospheric circulation system, Circulation in oceans, Modeling of atmosphere-ocean systems, Plate tectonics, Carbon cycle, Ecosystems and biodiversity, Effect of life on atmosphere: Increase in Oxygen and Ozone, Long period climate changes, Paleobiodiversity, Glaciations in pleistocene, Short period climate changes, Global warming, Ozone layer, Human effect on biodiversity, Climatologic stability in earth and earthlike planets.

**YBL 513 Project Preparation and Management 3+0 7,5**

Project Cycle Management; Logical Framework; Needs Analysis; Problem Analysis and Strategic Planning Techniques: Stakeholder analysis, Problem analysis, Analysis of objectives, Analysis of Strategies, Communication strategies; Indicators of Success; Operational Planning; Quality Factors; Project Implementation; Project Monitoring and Evaluation; Designing a Monitoring System; Project Reporting.



**YBL 514 Sustainability of Cities 3+0 7,5**

City, Urban geography, origins of city, urban geographic views, urbanization, features and concepts; Physical environment and urban population; Spatial regulation patterns of city and urban land use models; regions depending on cities, cities domains; f classification of cities; Horizontal and vertical developments of city, geographical approach of urbanization problems: Squatters and earthquakes, etc.; Urban transportation, Management of urban resource, Urban renewal, Urban conservation; Urban tourism; Quality of urban life.

**YBL 516 Geomorphology 3+0 7,5**

Definition and relationship with other disciplines of geomorphology; Structural geomorphology; Fluvial geomorphology; Karst morphology; Coastal morphology; Geomorphology of arid and semi-arid regions Volcano morphology, Glacial morphology; Main geomorphological features of Turkey; Geomorphology applications: Paleogeographic evolution of the archaeological site, erosion detection, identifying landslide risk areas, identifying the flood areas, road constructions.

**YBL 518 Soft Computing and Data Mining in Earth Sciences 3+0 7,5**

Introduction; Soft Computing and Data Mining; Fuzzy Set Theory; Fuzzy Set Theory and Earth Sciences literature review; Application of Fuzzy Set in Hydrology and Hydrogeology; Application of Fuzzy Set in Landslides and Earthquakes; Artificial Neural Networks; Artificial Neural Networks and Earth Sciences literature review; Application of Artificial Neural Networks in Hydrology and Hydrogeology; Application of Artificial Neural Networks in Landslides and Earthquakes; Hybrid Systems; Hybrid Systems and Earth Sciences literature review.

**YBL 592 Seminar 3+0 7,5****YBL 599 Semester Project 3+0 15,0****YBL 790 Thesis 0+1 30,0**