MECHANICAL ENGINEERING M.S. PROGRAMME INFORMATION PACKET

Goals:

-To provide engineering education at a deeper level
-To fulfill the need of qualified engineers by the research and development personnel in the national scale
-To find research personnel needed by the departmental faculty in their own research programmes

Objectives:

-To increase the research and development efforts within the university

-To serve the industry relations by specially tailoring the program towards their needs

-To yield graduates qualified for the doctoral program or scientific research studies

PROGRAM LEARNING OUTCOMES

Theoretical, Factual Knowledge

- Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.

- Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.

Cognitive, Practical Skills

- Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.

- Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.

- Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.

Ability to work independently and take responsibility

- Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.

Learning Competence

- Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.

Communication and Social Competence

- Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.

- Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.

- Ability to assess social and environmental aspects of engineering applications.

- Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.

Field-based Competence

- Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.

Teaching & Learning Methods

The teaching & learning methods used in the Mechanical Engineering Department are listed below:

Teaching & Learning Methods	Major Learning Activities	Tools
Lecture	Listening and interpretation, critical thinking	Classware, multimedia, data projector, computer, overhead projector
Problem session	Specific predetermined skill	Classware, multimedia, data projector, computer, overhead projector
Homework	Research skills, writing, reading, IT Skills	Databases, e-mail
Project	Observation/manipulation situations, IT Skills, organizational skills, creative teamwork, Research skills, reading	Classware, specific hardware
Lab	Observation/manipulation situations, IT Skills, organizational skills, creative teamwork	Specific hardware, databases
In-class practice	Listening and interpretation, writing, reading, IT Skills, critical thinking, question posing	Classware, multimedia, data projector, computer, overhead projector
Teamwork	Listening and interpretation, Observation/manipulation situations, critical thinking, question posing, creative teamwork	Classware, multimedia, data projector, computer, overhead projector
Summer practice	Observation/manipulation situations, Research skills, writing, reading	
Seminar	Listening and interpretation, Observation/manipulation situations	Classware, multimedia, data projector, computer, overhead projector, specific hardware
Guest lecturer	Listening and interpretation, Observation/manipulation situations	Classware, multimedia, data projector, computer, overhead projector, specific hardware
Demonstration	Listening and interpretation, Observation/manipulation situations	Tools that allow observation followed by virtual application
Case study	Specific predetermined skill	

Course	*LO1*	*LO2*	*LO3*	*LO4*	*LO5*	*LO6*	*LO7*	*LO8*	*LO9*	*LO10*	*LO11*	*LO12*
Engineering Analysis - I		●	●	●								
Advanced Thermodynamics		●					●					
Advanced Heat Transfer	●			●								●
Biothermodynamics		●	●			●	●	●				
Advanced Fluid Dynamics	●			●								●
Advanced Mechanics of Solids	●	●		●								
Theory of Elasticity	●	●										
Fracture Mechanics	●		●	●								
Mechanical Design of Turbomachinery		●	●	●								
Advanced Control Theory		●	●	●								
Finite Element Analysis	●	●			●		●					
Computational Fluid Dynamics		●					●	●				
Graduate Seminar		●						●	●		●	
Master’s Thesis	●	●	●	●	●		●	●	●	●	●	●

Level of Qualification:

This program is a second cycle (graduate) programme of 120 ECTS credits in the area of Mechanical Engineering.

Students who complete the program successfully and acquire the program competencies receive an Master of Science degree in the area of Mechanical Engineering.

Admission Requirements:

To apply for a master's program, a Bachelor's degree must be held or expected to be held by the end of the term of application and the requirements given below must be met.

- A minimum B.S. cumulative grade point average (CGPA) of 2.50 out of 4.00.

- A minimum score of 60 from ALES or 148 from GRE (Quantitative Reasoning).

- A minimum of 80 from KPDS or 213 (CBT)/550 (PBT) from TOEFL or 6.5 from IELTS. Canditates who don't have aforementioned scores are required to be successful in the Yeditepe University's proficiency exam.

- Candidates are required to be successful in the interview held by the department they are applying for.

Graduation Requirements:

- To complete at least 7 courses, which have a minimum total credit of 21, from the offered elective and compulsory graduate courses, and obtain a minimum grade of CC from each course and a minimum general point average of 3.00.
- To pass a non-credit seminar course
- To complete a Master's thesis on a subject determined by the student and the thesis advisor under the supervision of the advisor and to successfully defend the thesis in front of the thesis jury.
- If the Mechanical Engineering Department deems necessary, to register to the Academic Preparation Program and to complete the undergraduate courses approved by the Department within two semesters. The total credit of the undergraduate courses cannot exceed 24 credits and the student must obtain a minimum degree of CC from each course and a minimum general point average of 2.50.

Course Categories	ECTS
DEPARTMENTAL COURSES	
Engineering Analysis – I	10
Advanced Thermodynamics	8
Advanced Heat Transfer	8
Biothermodynamics	8
Advanced Fluid Dynamics	8
Advanced Mechanics of Solids	8
Theory of Elasticity	8
Fracture Mechanics	8
Mechanical Design of Turbomachinery	9
Advanced Control Theory	8
Finite Element Analysis	8
Graduate Seminar	2
Master's Thesis	30
Total	**123**
Total ECTS Credit	**123**

Job Opportunities and Promotions of Graduates:

Approximately 44% of graduates continue to study in Ph.D. programs both abroad and domestically. Some of graduates started their careers as engineers but have been promoted to management positions such as product manager and vice-general director. Most of graduates work as engineers. A significant number of them are employed at R&D departments of large companies. Only 10% of full-time workers is working in a public sector while the rest of them work in private sectors.

Job Profiles of Graduates:

As of May 2013, the Mechanical Engineering Department of Yeditepe University has produced 18 M.S. graduates since its inception. Eight of them are pursuing Ph.D. degrees; two are in U.S.A., two are in Europe, and four are in Turkey. On the other hand, 10 of 18 are working full-time. One works at Istanbul Chamber of Industry, and another works as a vice-general director at a mid-size company. The rest of them are working in various engineering companies such as Arçelik A.Ş., Ford Otosan, Alarko Holding, Robert Bosch GmbH and TAI.

Programme Director & ECTS Coordinator:

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COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ENGINEERING ANALYSIS - I	ME 501	Fall	3 + 1	3	10

Prerequisites	Undergraduate level linear algebra and differential equations.

Language of Instruction	English
Course Level	Master's Degree
Course Type	Compulsory
Course Coordinator	
Instructors	Koray K. Şafak
Assistants	
Goals	Aim of this course is to build a graduate level knowledge of mathematics that will serve as a foundation for a broad range of areas of expertise in mechanical engineering.
Content	Linear differential equations. Power series solutions. Vector space. Eigenvalue problem. Scalar and vector field theory. Fourier series, Fourier integral, Fourier transform. Partial differential equations. Diffusion equation, wave equation, Laplace equation.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. An ability to handle and solve commonly used types of ordinary differential equations.	2, 3, 4	1, 3	A, C
2. Notion of vector space, scalar and vector fields, eigenspace analysis as applied to problems in engineering.	2, 3, 4	1, 3	A, C
3. Ability of utilize spectral (Fourier) methods for the solution of partial differential equations.	2, 3, 4	1, 3	A, C

Teaching Methods:	1: Lecture, 3: Homework
Assessment Methods:	A: Exam, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Equations of First Order.	Textbook
2	Linear Differential Equations of Second Order and Higher.	Textbook
3	Power Series Solutions.	Textbook

4	Power Series Solutions.	Textbook
5	Vector Space.	Textbook
6	The Eigenvalue Problem.	Textbook
7	The Eigenvalue Problem.	Textbook
8	Scalar and Vector Field Theory.	Textbook
9	Scalar and Vector Field Theory.	Textbook
10	Fourier Series, Fourier Integral, Fourier Transform.	Textbook
11	Fourier Series, Fourier Integral, Fourier Transform.	Textbook
12	Diffusion Equation.	Textbook
13	Wave Equation.	Textbook
14	Laplace Equation.	Textbook

RECOMMENDED SOURCES	
Textbook	M.D. Greenberg, Advanced Engineering Mathematics, 2nd ed., Prentice Hall, 1998
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	2	67
Homeworks	6-8	33
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	X					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						X
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.						X
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.						X
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	X					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	X					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	X					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	X					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68

ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Thermodynamics	ME 521	Spring	3 + 0	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Esra Sorgüven Öner
Assistants	
Goals	Aim of this course is to deepen our understanding of the basic concepts that define thermodynamics and be able to apply mass, energy, entropy and exergy analysis for various engineering systems.
Content	Review of the first and second laws of thermodynamics, Concept of exergy, Exergy analysis of closed and open systems and cycles, Generalized exergy analysis of a HVAC system, Single phase systems, Ideal and real gases, Chemical reactions, Thermodynamic design

Learning Outcomes	Program Outcomes	Teaching Methods	Assessment Methods
1. Ability to analyze and evaluate engineering systems with the mass, energy, entropy and exergy balances	2,7	1,3,4	A,C,D
2. Ability to calculate thermodynamic properties of complex substances and mixtures	2,7	1,3,4	A,C,D

Teaching Methods:	1: Lecture, 3: Homework, 4: Project
Assessment Methods:	A: Midterm and final exam, C: Homework, D: Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction	Textbook
2	Review of the 1st Law	Textbook
3	Applications of 1st Law	Textbook
4	Review of the 2nd Law	Textbook
5	Exergy, 2nd Law efficiency	Textbook

6	Exergy analysis of closed and open systems	Textbook
7	Exergy analysis of cycles	Textbook
8	Midterm 1	Textbook
9	Thermodynamic property relations: fundamentals	Textbook
10	Thermodynamic property relations: derivatives	Textbook
11	Thermodynamic property relations: applications	Textbook
12	Midterm 2	Textbook
13	Ideal and real gas mixtures	Textbook
14	Exergy generalized	Textbook

RECOMMENDED SOURCES	
Textbook	Advanced Engineering Thermodynamics, A. Bejan, Wiley
Additional Resources	Advanced Thermodynamics Engineering, Annamalai, Puri, CRC Press Petela R. Engineering thermodynamics of thermal radiation for solar power. McGraw Hill, New York; 2010. J. Szargut, D.R. Morris, F.R. Steward, Exergy analysis of thermal, chemical, and metallurgical processes. Hemisphere, New York, 1988.

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	2	57
Homeworks and quizzes	2	14
Project	1	29
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	X					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						X
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	X					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.	X					
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	X					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	X					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.		X				
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	X					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242

Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Heat Transfer	ME 522	Spring	3 + 0	3	10

Prerequisites	ME 324 (Heat Transfer)

Language of Instruction	English
Course Level	Master's Degree
Course Type	Compulsory
Course Coordinator	
Instructors	Erdem An
Assistants	
Goals	The goal of this course is to introduce basic equations and basic concepts in rigorous manner.
Content	Conduction, Bessel function, forced convection, integral method, free convection, condensation, mass transfer

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Understanding basic equations in heat transfer and the methods of solving them	1,4,12	1,2,3	A,C,H
2. Understanding basic concepts in heat transfer	1,4,12	1,2,3	A,C,H
3.			

Teaching Methods:	1: Lecture, 2: Solving problems, 3: Homework
Assessment Methods:	A: Exam, C: Homework, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Conduction	Lecture note
2	Conduction	Lecture note
3	Conduction	Lecture note
4	Conduction	Lecture note

5	Conduction	Lecture note
6	Forced Convection	Lecture note
7	Midterm exam	Lecture note
8	Forced Convection	Lecture note
9	Forced Convection	Lecture note
10	Free Convection	Lecture note
11	Condensation	Lecture note
12	Mass Transfer	Lecture note
13	Mass Transfer	Lecture note
14	Mass Transfer	Lecture note

RECOMMENDED SOURCES	
Textbook	None
Additional Resources	E.R.G. Eckert and Robert M. Drake, Analysis of Heat and Mass Transfer, McGraw-Hill, 1972. Other heat and mass transfer books in undergraduate level such as Heat and Mass Transfer by Incropera and Heat Transfer by Holman

MATERIAL SHARING
Documents
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ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	50
Homework and Class Participation	5	50
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						**X**
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.	**X**					
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.				**X**		
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	**X**					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	**X**					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	**X**					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.					**X**	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30

Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Biothermodynamics	ME 523	Spring	3 + 0	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Esra Sorgüven Öner
Assistants	
Goals	Aim of the course is to demonstrate the use and importance of thermodynamics to gain insight of biological systems. The target group is graduate students of Chemical, Mechanical and Systems Engineering, Genetics and Bioengineering and Physics Departments.
Content	Fundamental concepts of biothermodynamics. Thermodynamic properties of biologically important fluids. Effect of temperature, ionic strength, pH and dilution on thermodynamic properties of biochemical species. Laws of thermodynamics and their application to biological processes like ATP production and photosynthesis. Life span entropy.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to calculate thermodynamical properties of biochemical species under physiological conditions	2,3	1,3,4	A,C,D
2. Ability to apply 1st and 2nd law analysis to biochemical reactions and processes	2,3,6,7,8	1,3,4	A,C,D

Teaching Methods:	1: Lecture, 3: Homework, 4: Project
Assessment Methods:	A: Midterm and final exam, C: Homework, D: Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Fundamental Concepts of Biothermodynamics: Energy, Heat and Work	Lecture Notes
2	Fundamental Concepts of Biothermodynamics: Energy, Heat and Work	Lecture Notes
3	Biologically important Fluids: Water, Ideal and Real Gasses	Lecture Notes
4	Biologically important Fluids: Mixtures; Air, Blood, Milk	Lecture Notes

5	Applying mass balance for biological systems: Photosynthesis, Energy metabolism, Unsteady mass balance for the heart	Lecture Notes
6	Applying 1st law for biological systems: Derivation of the transformed enthalpy of formation for biochemical reactions	Lecture Notes
7	Applying 1st law for biological systems: Analysis of the energy metabolism in a cell	Lecture Notes
8	Applying 1st law for biological systems	Lecture Notes
9	Applying 2nd law for biological systems: Derivation of the transformed Gibbs free energy of formation for biochemical reactions	Lecture Notes
10	Applying 2nd law for biological systems	Lecture Notes
11	Entropy and aging; Life Span Entropy	Lecture Notes
12	Exergy Definition and Derivation of the exergy equation	Lecture Notes
13	Exergy Balance for biological systems: Analysis of the energy metabolism in a cell	Lecture Notes
14	Exergy Balance for biological systems	Lecture Notes

RECOMMENDED SOURCES	
Textbook	Lecture Notes
Additional Resources	Petela R. Engineering thermodynamics of thermal radiation for solar power. McGraw Hill, New York; 2010. Alberty RA. Thermodynamics of biochemical reactions. John Wiley&Sons, Inc.; 2003. J. Szargut, D.R. Morris, F.R. Steward, Exergy analysis of thermal, chemical, and metallurgical processes. Hemisphere, New York, 1988.

MATERIAL SHARING	
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ASSESSMENT

IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	29
Homeworks and quizzes	2	14
Project	3	57
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL		70

GRADE	
Total	**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	X					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						X
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.			X			
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.	X					
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	X					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.		X				
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.						X
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.				X		
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Mid-terms	1	20	20
Homeworks	2	10	20

Projects	3	20	60
Final examination	1	20	20
Total Work Load			246
Total Work Load / 25 (h)			9.84
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Turbomachinery	ME531	Spring	3 + 0	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree and PhD Degree
Course Type	Elective
Course Coordinator	Assoc. Prof. Esra Sorgüven Öner
Instructors	Assoc. Prof. Esra Sorgüven Öner
Assistants	
Goals	Goal is that the students gain ability to apply the basic principles of thermodynamics and fluid mechanics to analyze and design fluid machinery such as pumps, fans, compressors and turbines.
Content	Basic theory of turbomachinery. Dimensionless parameters and similarity laws. Pumps, fans, compressors and turbines. Design of turbomachinery and their analysis via computational fluid dynamics methods. Analysis of engineering applications.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Adequate knowledge on turbomachinery (pump, fan, compressor, turbine)	2	1,3	A,B,C
2) Ability to formulate, and solve complex engineering problems involving turbomachinery; ability to select and apply proper analysis and modeling methods for this purpose.	2,4	1,3,10	A,B,C
3) Ability to design and analyze a turbomachinery	4,7	1,4,7	D,E
4) Ability to work in teams	7,8	7	E

Teaching Methods:	1: Lecture, 3: Homework, 4: Project, 7: Teamwork, 10: Guest lecturer
Assessment Methods:	A: Midterm and final exams, B: Quiz, C: Homework, D: Report, E: Presentation

COURSE CONTENT

Week	Topics	Study Materials
1	Basic concepts on turbomachinery	Textbook
2	Laws of thermodynamics, 2nd law of Newton, Dimensionless numbers related to turbomachinery and laws of similarity	Textbook
3	Introduction to hydraulic pumps	Textbook
4	Centrifugal hydraulic pumps	Textbook
5	Axial hydraulic pumps	Textbook
6	Pumping systems	Textbook
7	Design of centrifugal pumps	Lecture notes
8	Design of axial pumps	Lecture notes
9	Hydraulic turbines	Textbook
10	Centrifugal compressor and fans	Textbook
11	Axial compressors and fans	Textbook
12	Steam turbines	Textbook
13	Design of steam turbines	Lecture notes
14	Discussion on the results of the design projects	Lecture notes

RECOMMENDED SOURCES	
Textbook	Turbomachinery, Design and Theory; Gorla and Khan
Additional Resources	Introduction to Turbomachinery; Japikse Fluid Mechanics with Applications; A. Esposito Fluid dynamics and heat transfer of turbomachinery; B. Lakshminarayana Handbook of turbomachinery; Logan Fan handbook; Bleier Rotodynamic pump design;Turton Centrifugal pump design; Tuzson Pump handbook; Karassik

MATERIAL SHARING	
Documents	
Assignments	
Exams	

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

Midterms	1	30
Homeworks	2	10
Quizzes	3	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	**X**					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						**X**
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.			**X**			
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	**X**					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.						**X**
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.				**X**		
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Fluid Mechanics	ME 532	Fall	3 + 0	3	10

Prerequisites	ME 331 (Fluid Mechanics)

Language of Instruction	English
Course Level	Master's Degree
Course Type	Compulsory
Course Coordinator	
Instructors	Erdem An
Assistants	
Goals	The goal of this course is to introduce basic equations and basic concepts in rigorous manner.
Content	Fluid kinematics, basic equations such as continuity and Navier-Stokes equations, solving simple fluid flows, Bernoulli equation including unsteady Bernoulli equation, potential flows, introduction to turbulence, boundary layers.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Understanding basic equations in fluid mechanics	1,4,12	1,2,3	A,C,H
2. Understanding basic concepts in fluid mechanics	1,4,12	1,2,3	A,C,H
3.			

Teaching Methods:	1: Lecture, 2: Solving problems, 3: Homework
Assessment Methods:	A: Exam, C: Homework, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Fluid kinematics	Lecture note
2	Basic Equations	Lecture note
3	Basic Equations	Lecture note
4	Simple fluid flows	Lecture note

5	Simple fluid flows	Lecture note
6	Bernoulli equation	Lecture note
7	Bernoulli equation	Lecture note
8	Midterm exam	Lecture note
9	Potential flows	Lecture note
10	Potential flows	Lecture note
11	Introduction to Turbulence	Lecture note
12	Introduction to Turbulence	Lecture note
13	Boundary layer	Lecture note
14	Boundary layer	Lecture note

RECOMMENDED SOURCES	
Textbook	None
Additional Resources	Graduate level: Viscous Fluid Flow, by Frank White, McGraw-Hill Other fluid mechanics books in undergraduate level such as: Fluid Flow by Sabersky, Acosta, and Hauptmann, 3rd edition, Macmillan Fluid Mechanics: Fundamentals and Applications by Çengel and Cimbala, 1st ed. in SI unit, Mc Graw Hill, 2006

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	50
Homework and Class Participation	5	50
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						X
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.	X					
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	X					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.				X		
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	X					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	X					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	X					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	X					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.					X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20

Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Experimental Methods in Thermofluid Systems	ME 534	Fall	1 + 4	3	10

Prerequisites	ME 324 (heat transfer) and ME 331 (fluid mechanics) or their equivalents

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Erdem An
Assistants	
Goals	• Conduct data and uncertainty analyses • Use various equipments such as data acquisition systems, multimeters, pressure transducers, thermocouples, and a high speed camera • Understand deeper concepts on thermofluids
Content	Measurement techniques, data analysis and uncertainty analysis. Viscosity measurement for non-Newtonian fluids. Wind tunnel and drag measurement using momentum equations. Measurements of friction and acoustics in corrugated pipes. Measurements of convection heat transfer in a pipe flow.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Conduct data and uncertainty analyses	1,3	1,5	D,H
2. Use various equipments	1,2	1,5	D,H
3. Understand deeper concepts on thermofluids	1,2,3	1,5	D,H

Teaching Methods:	1: Lecture, 5: Lab
Assessment Methods:	D: Report, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction	Lecture note
2	Uncertainty analysis	Lecture note
3	Momentum equation in integral form, Drag calculation,	Lecture note

4	Drag measurements of objects in the wind tunnel using momentum equations	Lecture note
5	Flow over a cylinder	Lecture note
6	Non-Newtonian fluid	Lecture note
7	Capillary viscometer	Lecture note
8	Viscosity measurement of non-Newtonian fluids	Lecture note
9	Friction in a pipe flow	Lecture note
10	Acoustics in corrugated pipes	Lecture note
11	Measurement of friction and acoustics in corrugated pipes	Lecture note
12	Convection heat transfer in a pipe flow	Lecture note
13	Measurement of convection heat transfer in a pipe flow	Lecture note
14	Temperature measurement	Lecture note

RECOMMENDED SOURCES	
Textbook	None
Additional Resources	Figliola, R.S. and Beasley D.E., Theory and Design for Mechanical Measurements, 4th ed., Wiley, 2006

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Lab report	4	80
Class Participation	14	20
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		0
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		100
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access wide and deep information with scientific researches in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						X
2	Has comprehensive information on modern techniques, methods and their borders, which are being applied to engineering.				X		
3	Ability to complete and implement limited or incomplete data by using the scientific methods.				X		
4	Ability to consolidate engineering problems, develop proper method(s) to solve and apply the innovative solutions to them.	X					
5	Ability to design and apply analytical, modeling and experimental based research, analyze and interpret the faced complex issues during the design and apply process.	X					
6	Ability to work in multi-disciplinary teams and to take responsibility to define approaches for complex situations.	X					
7	Awareness of new and developing applications of his/her profession and ability to analyze and study on those applications.	X					
8	Ability to use a foreign language at minimum B2 General Level of the European Language Portfolio to communicate effectively in oral and written form regarding the subjects in his/her field.	X					
9	Systematic and clear verbal or written transfer of the process and results of studies at national and international environments.	X					
10	Ability to interpret social and environmental dimensions of engineering applications.	X					
11	Awareness of social, scientific and ethical values guarding adequacy at all professional activities and at the stage of data collection, interpretation, and announcement.	X					
12	Starting from scratch, handling a graduate level problem from industry, development of models and reaching an appropriate solution.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	1	14
Hours for off-the-classroom study (Pre-study, practice)	14	3	42
Lab hours	4	6	24
Data analysis	4	20	80
Lab report writing with discussion	4	20	80
Total Work Load			240
Total Work Load / 25 (h)			9.60
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Mechanics of Solids	ME 541	Fall	3 + 0	3	10

Prerequisites	ME 246

Language of Instruction	English
Course Level	Master's Degree
Course Type	Compulsory
Course Coordinator	Fethi Okyar
Instructors	Fethi Okyar
Assistants	
Goals	The goal of this course is to provide a deeper understanding of the mathematical theory of the mechanics of materials by relating it with the theory of elasticity to a certain extent.
Content	Introduction to the theory of elasticity; stress, strain, constitutive equations. Topics from advanced strength of materials: bending of unsymmetrical cross-sections, curved beams, shear center, thick-walled cylinders. Pressurized cylinders and spinning disks. Beams on elastic foundations. Plasticity in structural members and collapse analysis. Shells of revolution with axisymmetric loads.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. command advanced and applied knowledge in the area of material behavior and their mechanics.	1,2	1,3	A,C
2. learn the relaxing of traditional mechanics of materials assumptions so that solutions can be found for more complex load and geometry cases.	1,2	1,3	A,C
3. Demonstrate the application of the knowledge in fundamental mechanics of materials to practical engineering structures.	4	3	C

Teaching Methods:	1-Lecture, 3-Homework
Assessment Methods:	A-Written exam, C-Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Summary of topics from mechanics of materials	Textbook

2	Plane theory of elasticity; equilibrium, compatibility and constitutive equations.	Textbook
3	Stress function. Inverse method, polynomial solutions.	Textbook
4	Plane problem in polar coordinates. Thick-walled cylinders. Compound cylinders.	Textbook
5	Spinning disks of constant and variable thickness.	Textbook
6	Symmetric bending of circular plates.	Textbook
7	Beams on Elastic foundations.	Textbook
8	Semi-infinite beams and short beams.	Textbook
9	Thin shells of revolutions. Membrane and bending theory.	Textbook
10	MIDTERM EXAM	Textbook
11	Energy methods. Principle of stationery energy.	Textbook
12	Castigliano's first and second theorems.	Textbook
13	Torsion. Saint-Venant theory.	Textbook
14	Thin-walled hollow sections.	Textbook

RECOMMENDED SOURCES	
Textbook	Cook and Young, Advanced Mechanics of Materials, 2 ed, Prentice Hall, 1998
Additional Resources	N/A

MATERIAL SHARING	
Documents	Syllabus, gradesheet, additional links
Assignments	Weekly assignments and their solutions
Exams	Midterm exam and its solution

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	40
Homeworks	6	30
Extended Homework	1	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60

	Total	**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						**X**
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						**X**
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.					**X**	
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	**X**					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	**X**					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	**X**					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36

Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Theory of Elasticity	ME 542	Spring	3 + 0	3	10

Prerequisites	ME 246

Language of Instruction	English
Course Level	Master's Degree (Second cycle)
Course Type	Elective
Course Coordinator	Mehmet Akgun
Instructors	Mehmet Akgun, Fethi Okyar
Assistants	
Goals	Students will master concepts of stress and strain tensors, know how to formulate a well posed elasticity problem, and learn several methods for its solution.
Content	Notions of stress and strain, field equations of linearized elasticity. Plane problems in rectangular and polar coordinates. Problems without a characteristic length.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Become proficient with indicial notation and master manipulation of Cartesian vector and tensor equations.	1,2	1,3	A,C
2. Apply the fundamental concepts and mathematical foundations of linear elasticity to solve structural problems analytically.	1,2	1,3	A,C
3. Solve, utilizing stress function techniques, stress distribution/concentration problems in cartesian / polar co-ordinates.	1,2	1,3	A,C

Teaching Methods:	1-Lecture, 3-Homework
Assessment Methods:	A-Written exams, C-Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Mathematical Foundations	Textbook
2	Mathematical Foundations	Textbook

3	Displacements and Strains, Strain Transformations, Strain Compatibility	Textbook
4	Displacements and Strains, Strain Transformations, Strain Compatibility	Textbook
5	Traction Vector and Stress Tensor, Principal Stresses, Equilibrium Equations	Textbook
6	Elastic Moduli, Elastic Constants, Constitutive Relations, Field Equations	Textbook
7	Strain Energy, Principal of Virtual Work, Principal of Minimum Potential and Complementary Energy	Textbook
8	Airy Stress Function Approach in Cartesian Coordinate System.	Textbook
9	MIDTERM	Textbook
10	Inverse, Semi-Inverse, Combination of Polynomials of Various Order.	Textbook
11	Boundary Condition, Equilibrium and Compatibility Criteria Achievement for Cartesian Coordinate Applications.	Textbook
12	Equations of Equilibrium, Compatibility, Stress/Strain Relations, Biharmonic and Laplacian equations development in Polar Coordinates.	Textbook
13	Stress Function Solutions in Polar Coordinates.	Textbook
14	More solutions in Polar Coordinates	Textbook

RECOMMENDED SOURCES	
Textbook	Theory of Elasticity, S. Timoshenko, McGraw-Hill Book Co., Inc., First Edition, 1934.
Additional Resources	Theory of Elasticity, S. P. Timoshenko and J. N. Goodier, McGraw-Hill Book Co., Inc., Third Edition, 1970. Advanced Strength and Applied Elasticity, A. C. Ugural and S. K. Fenster, Elsevier, 1977. Foundations of Solid Mechanics, Y. C. Fung, Prentice-Hall, 1965.

MATERIAL SHARING	
Documents	Course Outline
Assignments	Homeworks and their solutions
Exams	Midterm exam and its solutions

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterm	1	40
Homeworks	6	30
Extended Homework	1	30
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30

CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
	Total	**100**

COURSE CATEGORY	Expertise/Field course

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						**X**
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						**X**
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.	**X**					
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	**X**					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	**X**					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	**X**					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30

Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Fracture Mechanics	ME 543	Fall	3 + 0	3	10

Prerequisites	ME 444

Language of Instruction	English
Course Level	Master's Degree (Second cycle)
Course Type	Elective
Course Coordinator	Mehmet Akgun
Instructors	Mehmet Akgun, Fethi Okyar
Assistants	
Goals	To provide the knowledge and understanding necessary for advanced methods of analysis and measurement in fracture mechanics and their application to practical problems.
Content	Non-linear and ductile fracture mechanics. Applications to structural integrity; R6, COD design curve etc. Crack initiation mechanics. Crack velocity and stability. The effects of rate, temperature and environment on fracture toughness.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. understand mechanics of fracture and stress-concentration concepts; apply Griffith's energy balance concepts to determine fracture energy for various crack geometry and loading conditions and relate the inherent toughness of materials to macroscopic toughness of the material.	1	1,3	A,C
2. utilize knowledge of stress state ahead of cracks and Irwin's definition of stress intensity factor to assess the severity of cracked structure with a thorough assessment of crack-tip plasticity conditions and applicability of LEFM for specific cases.	1, 3	1,3	A,C
3. be able to use nonlinear fracture parameters such as the J-integral to determine conditions for crack growth in ductile materials.	1, 3	1,3	A,C
4. be able to solve case studies in LEFM and NLFM in different material systems and understand the implication of crack growth assessment in a variety of engineering applications such as aerospace, industrial and automotive applications.	4	4	D,E

Teaching Methods:	1: Lecture, 3: Homework, 4:Project
Assessment	A: Written exams, C: Homework, D: Reports, E: Presentation

Methods:	

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Theory of Elasticity overview.	Textbook
2	Plane stress and Plane strain, LEFM overview.	Textbook
3	Mixed-mode fracture	Textbook
4	Crack tip plasticity: Irwin Approach and Strip Yield Model	Textbook
5	Plastic Zone Size	Textbook
6	Crack tip opening displacement, J-Integral and CTOD	Textbook
7	J-Integral calculation, Fracture Mechanics in Metals	Textbook
8	Instability & R-curve concept	Textbook
9	MIDTERM	Textbook
10	Applications to structural integrity; R6	Textbook
11	COD design curve etc.	Textbook
12	Crack initiation mechanics.	Textbook
13	Crack velocity and stability.	Textbook
14	The effects of rate, temperature and environment on fracture toughness.	Textbook

RECOMMENDED SOURCES	
Textbook	Principles of Fracture Mechanics, R. J. Sanford, Pearson (Prentice Hall), 1st Ed., 2003
Additional Resources	Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture and Fatigue, 3ed. Dowling NE, Pearson 2007. Deformation and Fracture Mechanics of Engineering Materials, 3ed. Hertzberg RW, Wiley, 1989.

MATERIAL SHARING	
Documents	Lecture notes, and project related documents
Assignments	Homeworks and their solutions
Exams	Midterm exam and its solutions

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterm	1	36

Homeworks	6	43
Project	1	21
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Expertise/Field course

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						X
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.	X					
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.						X
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.						X
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	X					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	X					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	X					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	X					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration	Total

		(Hour)	Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Mid-terms (including preparation)	2	15	30
Homework	6	6	36
Project	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Theory of Plasticity	ME 544	Spring	3 + 0	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Fethi Okyar, Mehmet Akgün
Assistants	
Goals	Develop an understanding of post-yield behavior and the ability to analyze simple structures undergoing plastic deformations.
Content	Phenomenological nature of metals, yield criteria for 3-D states of stress, geometric representation of the yield surface. Levy-Mises and Prandtl- Reuss equations, associated and nonassociated flow rules, Drucker's stability postulate and its consequences, consistency condition for nonhardening materials, strain hardening postulates. Elasticplastic boundary value problems. Computational techniques for treatment of small and finite plastic deformations.

Learning Outcomes	Program Outcomes	Teaching Methods	Assessment Methods
1. Explain the fundamental assumptions underlying several continuum plasticity theories (J2 deformation theory, yield surface, normality rule, J2 flow theory, etc.);			
2. Calculate, analytically, the evolution of stress and strain in plastically deforming members/structures under homogenous loading;			
3. Use a finite element code to simulate plastically deforming members/structures under homogenous loading based on existing input files that can be modified to test different conditions/parameters.			

Teaching Methods:	Lecture (1), homework (3), project work (4)
Assessment Methods:	Midterm and final (A), homework (C), report (D)

COURSE CONTENT		
Week	**Topics**	**Study Materials**

1	Overview and historical development of the theory of plasticity	Textbook
2	Yielding and slip in polycrystalline materials.	Textbook
3	The yielding criterion and a review of the concept of stress	Textbook
4	The tensorial notation. Stress invariants. Geometrical representation of the yield surface.	Textbook
5	Strain hardening postulates. Isotropic hardening. Incremental small-strain plasticity.	Textbook
6	The flow rule and its geometric interpretation. Levy-Mises equations.	Textbook
7	Solution of elastic-plastic problems. Hollow cylindrical tube under twisting and tension.	Textbook
8	Midterm	Textbook
9	Combined torsion and tension of a cylindrical bar.	Textbook
10	Expansion of a spherical shell and a cylindrical tube.	Textbook
11	Limit design and collapse of structural members. Elastic-plastic bending of a beam.	Textbook
12	Method of virtual work in collapse analysis.	Textbook
13	Formulation of small-strain plasticity in the finite element method.	Textbook
14	Small-strain plasticity in the finite element method.	Textbook

RECOMMENDED SOURCES	
Textbook	[1] Hill, R., Mathematical Theory of Plasticity, Oxford, London, 1971
Additional Resources	[2] Cook, R.D., Young, W.C.; Advanced Mechanics of Materials, 2ed, Prentice Hall, 1998. [3] Hertzberg, R.W, Vinci, R.P., Hertzberg, J.L.: Deformation and Fracture Mechanics of Engineering Materials, 5ed, Wiley, 2013. [4]

MATERIAL SHARING	
Documents	
Assignments	Five homework assignments, and a project.
Exams	One midterm and one final examination

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterm	1	40
Homework	4-5	30
Extended Homework	1	30

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

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access wide and deep information with scientific researches in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.					**X**	
2	Has comprehensive information on modern techniques, methods and their borders, which are being applied to engineering.						**X**
3	Ability to complete and implement limited or incomplete data by using the scientific methods.	**X**					
4	Ability to consolidate engineering problems, develop proper method(s) to solve and apply the innovative solutions to them.	**X**					
5	Ability to design and apply analytical, modeling and experimental based research, analyze and interpret the faced complex issues during the design and apply process.	**X**					
6	Ability to work in multi-disciplinary teams and to take responsibility to define approaches for complex situations.	**X**					
7	Awareness of new and developing applications of his/her profession and ability to analyze and study on those applications.				**X**		
8	Ability to use a foreign language at minimum B2 General Level of the European Language Portfolio to communicate effectively in oral and written form regarding the subjects in his/her field.	**X**					
9	Systematic and clear verbal or written transfer of the process and results of studies at national and international environments.	**X**					
10	Ability to interpret social and environmental dimensions of engineering applications.	**X**					
11	Awareness of social, scientific and ethical values guarding adequacy at all professional activities and at the stage of data collection, interpretation, and announcement.	**X**					
12	Starting from scratch, handling a graduate level problem from industry, development of models and reaching an appropriate solution.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84

Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
MECHANICAL DESIGN OF TURBOMACHINERY	ME 545	Fall/Spring	3 + 0	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Bahadir Olcay
Assistants	
Goals	The goal of this course is to provide the graduate students with necessary knowledge to be able to mechanically design and analyze turbomachinery and its major components
Content	Mechanical design of rotating machinery, steam and gas turbines, compressors, vanes, and blades. Analyses of structural dynamics, rotordynamics; determination of design life and durability of turbomachinery. Static and dynamic stress analyses required for safe and reliable operation of turbomachinery, low cycle fatigue, high cycle fatigue, Campbell, Goodman, and SAFE Diagrams for turbine blades.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to design rubomachinery and its components using basic engineering concept and computational models	2, 3, 4	1, 3, 4	A, C, D
2. Ability to make use of computational tools in design and analyses of turbomachinery and its components	2, 3, 4	1, 3, 4	C, D

Teaching Methods:	1: Course, 3: Homework, 4: Project
Assessment Methods:	A: Mid-term and final exam, C: Homework, D: Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Turbine design process, performance estimation, blade loads	Textbook
2	Turbine design process, performance estimation, blade loads	Textbook

3	Turbine blade construction, materials, and manufacture	Textbook
4	Turbine blade construction, materials, and manufacture	Textbook
5	System of stress and damage mechanisms	Textbook
6	System of stress and damage mechanisms	Textbook
7	Review of fundamentals of vibration	Textbook
8	Damping concepts	Textbook
9	Vibration behavior of bladed disk systems	Textbook
10	Vibration behavior of bladed disk systems	Textbook
11	Rotordynamics	Textbook
12	Life assessment aspects for blade	Textbook
13	Life assessment aspects for blade	Textbook
14	Estimation of risk	Textbook

RECOMMENDED SOURCES	
Textbook	*Blade Design & Analysis for Steam Turbines,* Murari Singh, Gorge Lucas, McGraw-Hill, 2011, ISBN 978-0-07-163574-5. *Steam Turbines: Design, Applications, and Rerating,* Heinz P. Bloch, Murari P. Singh, 2nd Ed., McGraw-Hill Prof Med/Tech, 2008, ISBN 9780071508216.
Additional Resources	*Fundamentals of Turbomachinery,* William W. Peng, John Wiley & Sons, Inc., 2008, ISBN 978-0-470-12422-2. *A Practical Guide to Steam Turbine Technology,* Heinz P. Bloch, McGraw Hill, 1996, ISBN 9780070059245.

MATERIAL SHARING	
Documents	Syllabus
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	29
Homeworks	5	29
Project	1	42
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL		30

GRADE		
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
	Total	**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	**X**					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						**X**
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.						**X**
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.						**X**
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	**X**					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.	**X**					
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	**X**					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

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

14x Total course hours)			
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ADVANCED DYNAMICS	ME 551	Fall/Spring	3 + 0	3	10

Prerequisites	Undergraduate level dynamics course.

Language of Instruction	English
Course Level	Master's Degree (Second Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Koray K. Şafak
Assistants	
Goals	This course aims at providing the graduate level students with principals of analytical mechanics (energy based methods) for analyzing 3D motion of rigid bodies. Undergraduate level notions such as relative motion, mass moment of inertia, kinematics and kinetics are extended to treat general 3D motion.
Content	Kinematics of rigid bodies. Rotating reference frames and coordinate transformations; Inertia dyadic. Newton-Euler equations of motion. Gyroscopic motion. Conservative forces and potential functions. Generalized coordinates and generalized forces. Lagrange’s equations. Holonomic and nonholonomic constraints. Lagrange multipliers. Kane’s equations. Elements of orbital and spacecraft dynamics.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to formulate and analyze 3D motion of rigid bodies using energy based methods.	2, 3, 4, 5	1, 3	A, C

Teaching Methods:	1: Lecture, 3: Homework
Assessment Methods:	A: Exam, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Review of vector analysis, Newtonian particle mechanics, impulse-momentum, work-energy. (1.3-7)	Textbook
2	Moving coordinate frames, transformation of coordinates, rate of change of a vector, Relative velocity and acceleration. (2.2-7)	Textbook
3	Generalized coordinates, holonomic and nonholonomic constraints, virtual displacements and virtual work	Textbook

4	Generalized forces, principle of virtual work for static equilibrium (4.3-6)	Textbook
5	D'Alembert's principle, Hamilton's principles	Textbook
6	Lagrange's equations, constrained systems (4:7-10)	Textbook
7	Moments of inertia, properties (Ch. 6)	Textbook
8	Rigid body kinematics, body and space cones, Euler angles (7.2-5)	Textbook
9	Constrained motion of rigid bodies, rolling (7.8-9)	Textbook
10	Rigid body dynamics, Newton-Euler equations, equations in state form (8.5-7)	Textbook
11	Lagrange's equations for rigid bodies (8.10)	Textbook
12	Torque-free motion, motion of a spinning top (10.3-5)	Textbook
13	Rolling disk (10.6)	Textbook
14	Gyroscopes (10.7)	Textbook

RECOMMENDED SOURCES	
Textbook	H. Baruh, *Analytical Dynamics*, McGraw-Hill, 1999.
Additional Resources	

MATERIAL SHARING	
Documents	Syllabus
Assignments	Homework assignments
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	2	45
Homeworks	6	20
Total		**65**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access wide and deep information with scientific researches in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	**X**					
2	Has comprehensive information on modern techniques, methods and their borders, which are being applied to engineering.				**X**		
3	Ability to complete and implement limited or incomplete data by using the scientific methods.				**X**		
4	Ability to consolidate engineering problems, develop proper method(s) to solve and apply the innovative solutions to them.						**X**
5	Ability to design and apply analytical, modeling and experimental based research, analyze and interpret the faced complex issues during the design and apply process.						**X**
6	Ability to work in multi-disciplinary teams and to take responsibility to define approaches for complex situations.	**X**					
7	Awareness of new and developing applications of his/her profession and ability to analyze and study on those applications.	**X**					
8	Ability to use a foreign language at minimum B2 General Level of the European Language Portfolio to communicate effectively in oral and written form regarding the subjects in his/her field.	**X**					
9	Systematic and clear verbal or written transfer of the process and results of studies at national and international environments.	**X**					
10	Ability to interpret social and environmental dimensions of engineering applications.	**X**					
11	Awareness of social, scientific and ethical values guarding adequacy at all professional activities and at the stage of data collection, interpretation, and announcement.	**X**					
12	Starting from scratch, handling a graduate level problem from industry, development of models and reaching an appropriate solution.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ADVANCED CONTROL THEORY	ME 553	Fall/Spring	3 + 0	3	10

Prerequisites	An undergraduate level control systems course.

Language of Instruction	English
Course Level	Master's Degree (Second Cycle Programmes)
Course Type	Core
Course Coordinator	
Instructors	Koray K. Şafak
Assistants	
Goals	This course aims at providing the graduate level students with classical and modern control methodologies for analysis and design of feedback control systems.
Content	State space representation of systems. Stability, controllability and observability. Canonical forms, control with state feedback. Pole placement. Observer-based controllers. Non-Linear Control Theories.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to design a control system using tools from both classical and modern control theory.	2, 3, 4	1, 3, 4	A, C, D
2. Use of computational tools in modeling, analysis, and design of control systems.	2, 3, 4	1, 3, 4	C, D

Teaching Methods:	1: Lecture, 3: Homework, 4: Project work
Assessment Methods:	A: Exam, C: Homework, D: Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Root-locus analysis	Textbook
2	Root-locus design method	Textbook
3	Root-locus design method	Textbook
4	Frequency response analysis	Textbook
5	Frequency response design method	Textbook

6	Frequency response design method	Textbook
7	PID control	Textbook
8	PID control	Textbook
9	State-space analysis	Textbook
10	State-space analysis	Textbook
11	State-space design	Textbook
12	State-space design	Textbook
13	Optimal control	Textbook
14	Optimal control	Textbook

RECOMMENDED SOURCES	
Textbook	K. Ogata, Modern Control Engineering, 5th ed., Prentice Hall, 2009.
Additional Resources	

MATERIAL SHARING	
Documents	Syllabus
Assignments	Homework assignments
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	20
Homeworks	6	20
Project	1	30
Total		**70**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution NA	1	2	3	4	5
1	Ability to access wide and deep information with scientific researches in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	X					
2	Has comprehensive information on modern techniques, methods and their borders, which are being applied to engineering.						X
3	Ability to complete and implement limited or incomplete data by using the scientific methods.						X
4	Ability to consolidate engineering problems, develop proper method(s) to solve and apply the innovative solutions to them.						X
5	Ability to design and apply analytical, modeling and experimental based research, analyze and interpret the faced complex issues during the design and apply process.	X					
6	Ability to work in multi-disciplinary teams and to take responsibility to define approaches for complex situations.	X					
7	Awareness of new and developing applications of his/her profession and ability to analyze and study on those applications.	X					
8	Ability to use a foreign language at minimum B2 General Level of the European Language Portfolio to communicate effectively in oral and written form regarding the subjects in his/her field.	X					
9	Systematic and clear verbal or written transfer of the process and results of studies at national and international environments.	X					
10	Ability to interpret social and environmental dimensions of engineering applications.	X					
11	Awareness of social, scientific and ethical values guarding adequacy at all professional activities and at the stage of data collection, interpretation, and announcement.	X					
12	Starting from scratch, handling a graduate level problem from industry, development of models and reaching an appropriate solution.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ROBOTICS	ME 554	Fall/Spring	3 + 0	3	10

Prerequisites	Undergraduate level control theory.

Language of Instruction	English
Course Level	Master's Degree (Second Cycle Programmes)
Course Type	Elective
Course Coordinator	
Instructors	Koray K. Şafak
Assistants	
Goals	This course aims at providing graduate level students with principles of mechanics for robot manipulators. Forward and inverse kinematics analysis methods are presented. Dynamics and control problems for manipulators are discussed.
Content	Fundamental aspects of robotics and type of robots. Rotation matrices. Homogeneous transformations. Direct kinematics. Inverse kinematics. Jacobian matrix. Newton-Euler formulation. Lagrangian formulation. Trajectory planning. Sensors and Actuators. Control methods of manipulators. Industrial automation. Autonomous vehicles, mobile robotics.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to use linear algebra for spatial descriptions and transformations.	2, 3, 4, 5	1, 3	A, C
2. Formulate kinematics of robot manipulators. Solve forward and inverse manipulator kinematics problems.	2, 3, 4, 5	1, 3	A, C
3. Gain an understanding of manipulator dynamics, control and path planning problems.	2, 3, 4, 5	1, 3	A, C

Teaching Methods:	1: Lecture, 3: Homework
Assessment Methods:	A: Exam, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to robot mechanics	Textbook
2	Rotation matrices	Textbook

3	Homogeneous transformations	Textbook
4	Manipulator kinematics	Textbook
5	Manipulator kinematics	Textbook
6	Inverse manipulator kinematics	Textbook
7	Inverse manipulator kinematics	Textbook
8	Jacobians, analysis of velocities and static forces	Textbook
9	Manipulator dynamics	Textbook
10	Manipulator dynamics	Textbook
11	Path and trajectory planning	Textbook
12	Linear control of manipulators	Textbook
13	Nonlinear control of manipulators	Textbook
14	Force control of manipulators	Textbook

RECOMMENDED SOURCES	
Textbook	J.J. Craig, Introduction to Robotics: Mechanics and Control, 3rd ed., Prentice Hall, 2004.
Additional Resources	M.W. Spong, S. Hutchinson, M. Vidyasagar, Robot Modeling and Control, Wiley, 2005.

MATERIAL SHARING	
Documents	Syllabus
Assignments	Homework assignments
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	2	45
Homeworks	6	20
Total		**65**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM								
No	Program Learning Outcomes	Contribution						
		NA	1	2	3	4	5
1	Ability to access wide and deep information with scientific researches in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	X					
2	Has comprehensive information on modern techniques, methods and their borders, which are being applied to engineering.				X		
3	Ability to complete and implement limited or incomplete data by using the scientific methods.				X		
4	Ability to consolidate engineering problems, develop proper method(s) to solve and apply the innovative solutions to them.						X
5	Ability to design and apply analytical, modeling and experimental based research, analyze and interpret the faced complex issues during the design and apply process.						X
6	Ability to work in multi-disciplinary teams and to take responsibility to define approaches for complex situations.	X					
7	Awareness of new and developing applications of his/her profession and ability to analyze and study on those applications.	X					
8	Ability to use a foreign language at minimum B2 General Level of the European Language Portfolio to communicate effectively in oral and written form regarding the subjects in his/her field.	X					
9	Systematic and clear verbal or written transfer of the process and results of studies at national and international environments.	X					
10	Ability to interpret social and environmental dimensions of engineering applications.	X					
11	Awareness of social, scientific and ethical values guarding adequacy at all professional activities and at the stage of data collection, interpretation, and announcement.	X					
12	Starting from scratch, handling a graduate level problem from industry, development of models and reaching an appropriate solution.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242

Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
DIGITAL CONTROL	ME 555	Fall/Spring	3 + 0	3	10

Prerequisites	An undergraduate level control systems course.

Language of Instruction	English
Course Level	Master's Degree (Second Cycle Programmes)
Course Type	Elective
Course Coordinator	
Instructors	Koray K. Şafak
Assistants	
Goals	This course aims at providing the graduate level students with classical and modern control methodologies for analysis and design of digital control systems.
Content	Linear discrete dynamic systems and Z-transform theory. Design of digital filters. Numerical methods. Design of digital control systems using transform techniques and state-space methods. Microprocessor implementation of controllers. Sample-data systems. Quantization effects. Multivariable and optimal control. System identification algorithms.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to design a digital control system using tools from both classical and modern control theory.	2, 3, 4	1, 3	A, C
2. Use of computational tools in modeling, analysis, and design of digital control systems.	2, 3, 4	1, 3	C

Teaching Methods:	1: Lecture, 3: Homework
Assessment Methods:	A: Exam, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to digital control systems, sampling, quantization, A/D and D/A conversion.	Textbook
2	z-transform, properties and theorems, inverse z-transform	Textbook
3	z-transform, properties and theorems, inverse z-transform	Textbook
4	Reconstruction of original signals from sampled signals, pulse transfer	Textbook

	function	
5	Realization of digital controllers and digital filters	Textbook
6	Mapping between s-plane and z-plane	Textbook
7	Stability analysis in the z-plane	Textbook
8	Transient and steady-state response analyses	Textbook
9	Design based on root-locus method	Textbook
10	Design based on frequency response method	Textbook
11	Analytical design method	Textbook
12	State-space representation of discrete-time systems	Textbook
13	Controllability, observability	Textbook
14	Design via pole placement	Textbook

RECOMMENDED SOURCES	
Textbook	K. Ogata, Discrete-Time Control Systems, 2nd ed., Prentice Hall, 1995.
Additional Resources	

MATERIAL SHARING	
Documents	Syllabus
Assignments	Homework assignments
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	2	40
Homeworks	6	20
Total		**60**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access wide and deep information with scientific researches in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	**X**					
2	Has comprehensive information on modern techniques, methods and their borders, which are being applied to engineering.				**X**		
3	Ability to complete and implement limited or incomplete data by using the scientific methods.				**X**		
4	Ability to consolidate engineering problems, develop proper method(s) to solve and apply the innovative solutions to them.						**X**
5	Ability to design and apply analytical, modeling and experimental based research, analyze and interpret the faced complex issues during the design and apply process.						**X**
6	Ability to work in multi-disciplinary teams and to take responsibility to define approaches for complex situations.	**X**					
7	Awareness of new and developing applications of his/her profession and ability to analyze and study on those applications.	**X**					
8	Ability to use a foreign language at minimum B2 General Level of the European Language Portfolio to communicate effectively in oral and written form regarding the subjects in his/her field.	**X**					
9	Systematic and clear verbal or written transfer of the process and results of studies at national and international environments.	**X**					
10	Ability to interpret social and environmental dimensions of engineering applications.	**X**					
11	Awareness of social, scientific and ethical values guarding adequacy at all professional activities and at the stage of data collection, interpretation, and announcement.	**X**					
12	Starting from scratch, handling a graduate level problem from industry, development of models and reaching an appropriate solution.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
SMART MATERIALS AND STRUCTURES	ME556	2	3 + 0	3	10

Prerequisites	-

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Assist. Prof. Nezih Topaloğlu
Assistants	
Goals	On successful completion of this course, students will be able to: • Understand the concept of smart materials and smart structures • Develop familiarity with piezoelectric materials and their use as sensors and actuators in various configurations • Develop familiarity with shape-memory alloys • Knowledge of various other smart materials/structures with application examples • Read and understand emerging technical literature about the subject
Content	• An overview of smart materials and structures • Review of basic mechanical and electrical concepts • Piezoelectric materials • Shape-memory alloys • Electroactive polymers • ER and MR fluids • Vibration control and damping • Case studies

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Ability to design sensors & actuators using piezoelectric materials	1	1, 3	A, C
2) Ability to design sensors & actuators using shape memory alloys	2, 5	1, 3	A, C
3) Ability to analyze vibration control and damping structures using piezoelectric materials and SMAs	1, 2	1, 3	A, C
4) Ability to interpret emerging technical literature related to smart materials and structures and demonstrate knowledge	5, 7, 8, 9, 10	3, 4	C, D, E

in a project.

Teaching Methods:	1: Lecture, 3: Homework, 4: Project
Assessment Methods:	A: Written exam, C: Homework, D: Report, E: Presentation

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	INTRODUCTION AND OVERVIEW	COURSE NOTES, TEXTBOOK
2	PIEZOELECTRIC MATERIALS	COURSE NOTES, TEXTBOOK
3	PIEZOELECTRIC MATERIALS	COURSE NOTES, TEXTBOOK
4	PIEZOELECTRIC MATERIALS	COURSE NOTES, TEXTBOOK
5	SHAPE MEMORY ALLOYS	COURSE NOTES, TEXTBOOK
6	SHAPE MEMORY ALLOYS	COURSE NOTES, TEXTBOOK
7	PASSIVE AND SEMIACTIVE DAMPING	COURSE NOTES, TEXTBOOK
8	PASSIVE AND SEMIACTIVE DAMPING	COURSE NOTES, TEXTBOOK
9	PASSIVE AND SEMIACTIVE DAMPING USING SMA	COURSE NOTES, TEXTBOOK
10	MOTION CONTROL, ACTIVE VIBRATION CONTROL	COURSE NOTES, TEXTBOOK
11	ER and MR FLUIDS	COURSE NOTES, TEXTBOOK
12	ER and MR FLUIDS	COURSE NOTES, TEXTBOOK
13	CASE STUDIES	COURSE NOTES, TEXTBOOK
14	CASE STUDIES	COURSE NOTES, TEXTBOOK

RECOMMENDED SOURCES	
Textbook	• *"Engineering Analysis of Smart Material Systems", Donald J. Leo, Wiley, 2007*
Additional Resources	• *Lecture slides on the course web page* • *"Smart Structures: Analysis and Design", A.V. Srinivasan, D. M. McFarland, Cambridge, 2001* • *"Dynamics of Smart Structures", Ranjan Vepa, Wiley, 2010.*

MATERIAL SHARING	
Documents	Lecture notes
Assignments	Homeworks, technical paper readings
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Homeworks	4	25
Technical paper reading assignments	5	30
Project	1	20
Total		**75**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		25
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		75
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.					**X**	
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.					**X**	
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.					**X**	
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.			**X**			
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.					**X**	
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.				**X**		
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level	**X**					

problem from industry, starting from scratch.

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Finite Element Analysis	ME 572	Spring	3 + 0	3	10

Prerequisites	ME 371

Language of Instruction	English
Course Level	Master's Degree (second cycle)
Course Type	Elective
Course Coordinator	Fethi Okyar
Instructors	Fethi Okyar
Assistants	
Goals	The aim of the course is that the student shall obtain a knowledge base in FE-simulations for manufacturing processes and computational thermo-mechanics phenomena.
Content	Isoparametric element formulation; error, error estimation and convergence, Transient problem formulations; implicit and explicit formulations and iteration procedures; plate and shell formulations; introduction to material and geometric nonlinearity.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. be able to describe a validation strategy and concepts about different accuracy levels	2,5	1,3	C
2. understand which physical phenomena causes nonlinear mechanical behaviour., and be able to describe the additional steps in a finite element analysis of nonlinear problems compared with linear problems	1,2	1,3	A,C
3. use modern finite element software to tackle manufacturing process and computational thermo-mechanics applications	7	4	D
4. know the requirements of a stress-strain algorithm in a finite element code and describe the steps in an algorithm for von Mises plasticity model	2	1,3	A,C

Teaching Methods:	1-Lecture, 3-Homework, 4-Project
Assessment Methods:	A-Written exam, C-Homework, D-Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**

1	Isoparametric element formulation	Textbook
2	Isoparametric element formulation	Textbook
3	Error, error estimation and convergence	Textbook
4	Error, error estimation and convergence	Textbook
5	Transient problem formulations	Textbook
6	Implicit and explicit formulations	Textbook
7	Iteration procedures	Textbook
8	MIDTERM	Textbook
9	Plate and shell formulations	Textbook
10	Plate and shell formulations	Textbook
11	Plate and shell formulations	Textbook
12	Introduction to material and geometric nonlinearity	Textbook
13	Introduction to material and geometric nonlinearity	Textbook
14	Introduction to material and geometric nonlinearity	Textbook

RECOMMENDED SOURCES	
Textbook	RD Cook, DS Malkus, ME Plesha and RJ Witt. (2002) Concepts and Applications of Finite Element Analysis, Wiley.
Additional Resources	Bathe, K.J.,"Finite Element Procedures", Prentice Hall, 2 ed., 1996. Heath, M., "Scientific Computing", McGraw-Hill, 2 ed., 2002.

MATERIAL SHARING	
Documents	Lecture notes, and project related documents
Assignments	Homeworks and their solutions
Exams	Midterm exam and its solutions

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	36
Homeworks	5	43
Project	1	21
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL		70

GRADE		
	Total	**100**

COURSE CATEGORY	Expertise/Field course

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.					X	
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						X
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	X					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.	X					
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.				X		
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	X					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.						X
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.	X					
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Mid-term	1	20	20
Homeworks	6	8	48

Project	1	24	24
Final examination	1	20	20
Total Work Load			238
Total Work Load / 25 (h)			9.52
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
DESIGN AND MODELING OF MEMS	ME573	1	3 + 0	3	10

Prerequisites	-

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Assist. Prof. Nezih Topaloğlu
Assistants	
Goals	On successful completion of this course, students will be able to: • Understand the approaches used in modeling of MEMS • Develop familiarity with common lumped modeling and macromodeling methods • Develop familiarity with the steps required for design and analysis of a MEMS device • Read and understand emerging technical literature about the subject
Content	• An overview of MEMS (materials, microfabrication methods and MEMS Foundry processes) • Lumped modeling of MEMS devices. • Electrostatic transducers • Modeling elastic structures • Thermal domain and lumped modeling of dissipative processes • Fluids and squeezed-film damping • Macromodeling and finite element modeling of MEMS

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Ability to explain and compare MEMS microfabrication methods.	1	1, 3	A, C
2) Ability to design fabrication masks for a MEMS foundry process.	2, 5	1, 3	A, C
3) Ability to apply principles lumped modeling and macromodeling techniques to MEMS structures.	1, 2	1, 3	A, C
4) Ability to interpret emerging technical literature related to MEMS and demonstrate knowledge in a project.	5, 7, 8, 9, 10	3, 4	C, D, E

Teaching Methods:	1: Lecture, 3: Homework, 4: Project
Assessment Methods:	A: Written exam, C: Homework, D: Report, E: Presentation

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	INTRODUCTION AND OVERVIEW OF MEMS	SLIDES, TEXTBOOK
2	INTRODUCTION TO MICROMACHINING	SLIDES, TEXTBOOK
3	INTRODUCTION TO MICROMACHINING	SLIDES, TEXTBOOK
4	FOUNDRY PROCESSES, LUMPED MODELING	SLIDES, TEXTBOOK
5	ELECTROSTATIC SENSING AND ACTUATION	SLIDES, TEXTBOOK
6	ELECTROSTATIC SENSING AND ACTUATION	SLIDES, TEXTBOOK
7	MODELING OF ELASTIC MEMS STRUCTURES	SLIDES, TEXTBOOK
8	MODELING OF ELASTIC MEMS STRUCTURES	SLIDES, TEXTBOOK
9	DISSIPATIVE SYSTEMS	SLIDES, TEXTBOOK
10	MICROFLUIDICS	SLIDES, TEXTBOOK
11	PIEZOELECTRIC AND PIEZORESISTIVE EFFECT	SLIDES, TEXTBOOK
12	PIEZOELECTRIC AND PIEZORESISTIVE EFFECT	SLIDES, TEXTBOOK
13	CASE STUDIES	SLIDES, TEXTBOOK
14	CASE STUDIES	SLIDES, TEXTBOOK

RECOMMENDED SOURCES	
Textbook	*"Foundations of MEMS: International Edition", Chang Liu, 2011, Prentice Hall*
Additional Resources	• *Lecture slides on the course web page* • *"Microsystem Design", Stephen D. Senturia, Kluwer Academic Publishers, 2003* • *"Fundamentals of Microfabrication", M. Madou, CRC Press, 1997.*

MATERIAL SHARING	
Documents	Lecture slides
Assignments	Homeworks, technical paper readings
Exams	

ASSESSMENT

IN-TERM STUDIES	NUMBER	PERCENTAGE
Homeworks	3	30
Technical paper reading assignments	5	20
Project	1	25
Total		**75**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		25
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		75
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.					**X**	
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.					**X**	
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.					**X**	
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.			**X**			
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.					**X**	
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.				**X**		
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	**X**					
10	Ability to assess social and environmental aspects of engineering applications.	**X**					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterms (including preparation)	2	15	30
Homeworks	6	6	36
Extended homework	1	30	30
Final examination (including preparation)	1	20	20
Total Work Load			242
Total Work Load / 25 (h)			9.68
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Computational Fluid Dynamics	ME 575	Spring	3 + 0	3	10

Prerequisites	ME532 Advanced Fluid Dynamics

Language of Instruction	English
Course Level	Master's Degree
Course Type	Elective
Course Coordinator	
Instructors	Esra Sorgüven Öner
Assistants	
Goals	Learning the modern techniques in computational fluid dynamics, and applying those techniques to simulate various flow problems
Content	Finite volume method; pressure-velocity coupling techniques; error estimation, grid dependency, artificial dissipation; multi-grid solvers; overview of the recent CFD methods; Lattice Boltzmann Automata, Discontinuous Galerkin Method, Finite Element Methods; introduction to turbulence modeling, flow visualization, mark-cell methods

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Learning computational fluid dynamics methods	2	1,3	A
2. Simulating different flow problems via computational fluid dynamics and interpreting the simulation results	7,8	1,3,4	C,D

Teaching Methods:	1: Lecture, 3: Homework, 4: Project
Assessment Methods:	A: Midterm and final exam, C: Homework, D: Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Computational Fluid Dynamics	Textbook
2	Mathematical Description of Flows	Textbook
3	Mathematical Description of Flows	Textbook
4	Mathematical Description of Flows	Textbook
5	Spatial Discretization	Textbook

6	Spatial Discretization	Textbook
7	Temporal Discretization	Textbook
8	Temporal Discretization	Textbook
9	Turbulence Modeling	Textbook
10	Turbulence Modeling	Textbook
11	Turbulence Modeling	Textbook
12	Turbulence Modeling	Textbook
13	Advanced Flow Simulation Examples	Textbook
14	Advanced Flow Simulation Examples	Textbook

RECOMMENDED SOURCES	
Textbook	Computational Fluid Dynamics. The basics with applications; Anderson, J. D.
Additional Resources	Computational Fluid Dynamics; Peric Computational Fluid Dynamics; Blazek Numerical Computation of Internal and External Flows; Hirsch

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	29
Homeworks and quizzes	1	7
Project	3	64
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	X					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.						X
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	X					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.	X					
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	X					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	X					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.						X
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.						X
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.	X					
10	Ability to assess social and environmental aspects of engineering applications.	X					
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	X					
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Mid-terms	1	15	15
Projects	3	25	75
Final examination	1	30	30
Total Work Load			246
Total Work Load / 25 (h)			9.84
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
RESEARCH SEMINAR	ME 590	Fall	-	-	2

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree
Course Type	Compulsory
Course Coordinator	
Instructors	
Assistants	
Goals	The primary aim of this seminar course is to gain the students awareness in various contemporary topics in engineering, science, technology as well as social skills. The secondary aim is to let the students to present their own research topic in front of an audience.
Content	Current topics in engineering, science and technology. Seminars on social skills, leaderships, teamwork, and corporate environment.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Awareness in contemporary topics in engineering, science and technology, and awareness in social skills.	2, 7	9	H
2. Successfully presents his/her progress in a topic being researched, to an academic audience.	8, 9, 11	9	E, H

Teaching Methods:	9: Seminar
Assessment Methods:	E: Presentation, H: attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1-14	Seminar	

RECOMMENDED SOURCES	
Textbook	

Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Attendance	14	100
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		0
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		100
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.	**X**					
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.			**X**			
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.	**X**					
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.	**X**					
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.	**X**					
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.				**X**		
8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.			**X**			
	Systematic and clear verbal or written reporting of the processes and results						

9	of his/her studies at national and international settings in written or verbal form.			**X**
10	Ability to assess social and environmental aspects of engineering applications.	**X**		
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.		**X**	
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.	**X**		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (14x Total course hours)	14	2	42
Total Work Load			42
Total Work Load / 25 (h)			1.6
ECTS Credit of the Course			2

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
MASTER'S THESIS	ME 600	-	-		60

Prerequisites	Theoretical and applied courses

Language of Instruction	English
Course Level	Master's Degree
Course Type	Compulsory
Course Coordinator	
Instructors	Advisor
Assistants	
Goals	The objective of Master's thesis is to enable the student to show that he/she can carry out an independent, ethical, detailed and scientifically correct research on a theme in Mechanical Engineering; and to help the student to communicate the achieved results in a systematic and neat way.
Content	Master's thesis is a report, as a result of an independent research carried out following the completion of theoretical and applied courses. The thesis advisor leads the student to a pre-defined research topic. The supervisor helps the student in litereture search, guides him/her during his/her research and supports him regarding the ethical guidelines. At the end of the research phase, the student prepares a written report (Master's thesis) and defends it in an oral exam, to the thesis jury.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Solve a scientific problem within a given period of time, applying the appropriate scientific methods.	1, 2, 4, 5, 7, 12	1	D, E
2. Knows how to deal with the information or data sets gathered to reach a solution to a scientific problem, and announces the findings considering societal, scientific and ethical values.	3, 8, 9, 10, 11	1	D, E

Teaching Methods:	1: Lecture (in mutual consultation between the thesis supervisor and student)
Assessment Methods:	D: Report (Master's thesis), E: Presentation (oral exam)

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1-14	Studies towards solving the problem being studied	Textbook

RECOMMENDED SOURCES	
Textbook	Technical literature related to the subject being studied
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

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

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Ability to access broad and in-depth information via scientific search and research in the field of engineering, evaluate, interpret and implement the knowledge gained in his/her field of study.						**X**
2	Has comprehensive knowledge on modern engineering methods, techniques, and their limitations.				**X**		
3	Ability to complete and implement limited or incomplete data by using scientific methods; ability to integrate knowledge from various disciplines.				**X**		
4	Ability to set up engineering problems and to develop new approach(es) in order to solve them; ability to come up with innovative solutions for design of a part, system or process.						**X**
5	Ability to set up and implement analytical, modeling-based and experimental research plans; ability to interpret and resolve complex issues faced during such a process.						**X**
6	Ability to work in and lead multi-disciplinary teams, to come up with solution strategies in complex situations and to take responsibility.	**X**					
7	Awareness of new and developing approaches and applications in his/her profession and ability to understand and assess those applications.				**X**		

8	Ability to use a foreign language at a minimum general level of B2 of the European Language Portfolio to communicate effectively in oral and written form.		**X**
9	Systematic and clear verbal or written reporting of the processes and results of his/her studies at national and international settings in written or verbal form.		**X**
10	Ability to assess social and environmental aspects of engineering applications.	**X**	
11	Behavior entailing social, scientific and ethical values at the stages of data collection, interpretation, and announcement and in all professional activities in general.	**X**	
12	Ability to set up, model and find an adequate solution to a graduate level problem from industry, starting from scratch.		**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Weekly meetings with advisor	14	2	28
Research and preparation of thesis	28	53	1484
Total Work Load			1512
Total Work Load / 25 (h)			60
ECTS Credit of the Course			60

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Conduction Heat Transfer	ME 623	Fall	3 + 0	3	10

Prerequisites	ME 522 (Advanced Heat Transfer)

Language of Instruction	English
Course Level	Ph.D. Degree
Course Type	Elective
Course Coordinator	
Instructors	Associate Prof. Erdem An
Assistants	
Goals	The goal of this course is to introduce advanced topics and methods in conduction heat trasnfer and to guide students to do an independent project.
Content	Simple Kinetic Theory of an Ideal Gas, Heat Conduction Fundamentals, Separation of Variables, Application to the Extended Surfaces, Principle of Superposition, Use of Duhamel’s Theorem, Approximate Analytic Methods, Numerical Analysis

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Understanding basic equations related to conduction in depth	1,4,10	1,2,3	A,C,H
2. Ability to formulate governing equations in many engineering problems and provide the methods of solving	1,4,10	1,2,3	A,C,H
3. Ability to do an independent project on the topic of convection	1,4,7,10	4	D

Teaching Methods:	1: Lecture, 2: Solving problems, 3: Homework, 4: Project
Assessment Methods:	A: Exam, C: Homework, D: Report, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Simple Kinetic Theory of an Ideal Gas	Textbook
2	Heat Conduction Fundamentals	Textbook
3	Heat Conduction Fundamentals	Textbook

4	Separation of Variables in the Rectangular Coordinate System	Textbook
5	Separation of Variables in the Rectangular Coordinate System	Textbook
6	Separation of Variables in the Cylindrical Coordinate System	Textbook
7	Separation of Variables in the Spherical Coordinate System	Textbook
8	Application to the Extended Surfaces	Textbook
9	Midterm Exam	Textbook
10	Principle of Superposition	Textbook
11	Use of Duhamel's Theorem	Textbook
12	Approximate Analytic Methods	Textbook
13	Numerical Analysis	Textbook
14	Numerical Analysis	Textbook

RECOMMENDED SOURCES	
Textbook	Heat Conduction by M. Necati Özışık, 2ed., Wiley, 1993
Additional Resources	E.R.G. Eckert and Robert M. Drake, Analysis of Heat and Mass Transfer, McGraw-Hill, 1972.

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	54
Class Participation	14	23
Homework	4	23
Total		**100**
CONTRIBUTION OF FINAL PROJECT TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.						X
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.	X					
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	X					
4	Comprehends, designs, implements and concludes an original research process independently.				X		
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	X					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	X					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio.					X	
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	X					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	X					
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.					X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Homework	5	10	50
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Mid-terms	1	25	25
Final Project	1	65	65
Total Work Load			238
Total Work Load / 25 (h)			9.52
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Turbulent Flow Theory	ME 632	Fall / Spring	3 + 0	3	10

Prerequisites	ME 532 or instructor’s consent

Language of Instruction	English
Course Level	Ph.D. Degree
Course Type	Elective
Course Coordinator	
Instructors	Assistant Prof. Bahadır Olcay
Assistants	
Goals	The goal of this course is identify and evaluate stability of shear flows, to realize turbulence in shear flows and to understand basic concepts of turbulence modelling approaches.
Content	Introduction, Stability of Shear Flows, Definition of Flow Stability and Critical Reynolds Number, Inviscid Shear Flows, Viscous Shear Flows, Transition to Turbulence, Coherent Structures, Turbulence in Shear Flows, Basic Description, Statistical Background, Reynolds Averaged Navier-Stokes Equations (RANS), Free Shear Flows, Wall-Bounded Flows, Theory and Modeling of Turbulent Flows, Homogeneous Isotropic Turbulence, the Kolmogorov Spectrum, Modeling Turbulence, k-ε model, Large-Eddy Simulation (LES), Special Topics

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Understand how to identify the stability of shear flows and develop an evaluation in depth	1,4,10	1,2,3	A,C,H
2. Ability to realize turbulence in shear flows and determine the methods of solving for variety of engineering problems involve turbulence	1,4,10	1,2,3	A,C,H
3. Ability to understand basic concepts of turbulence modelling approaches and apply these approaches into the problems he/she faces with	1,4,7,10	1,3,4	D

Teaching Methods:	1: Lecture, 2: Solving problems, 3: Homework, 4: Project
Assessment Methods:	A: Final exam, C: Homework, D: Report, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction, Stability of Shear Flows	Textbook
2	Definition of Flow Stability and Critical Reynolds Number	Textbook
3	Inviscid Shear Flows	Textbook
4	Viscous Shear Flows, Transition to Turbulence	Textbook
5	Coherent Structures, Turbulence in Shear Flows, Basic Description	Textbook
6	Statistical Background, Reynolds Averaged Navier-Stokes Equations (RANS)	Textbook
7	Free Shear Flows	Textbook
8	Wall-Bounded Flows	Textbook
9	Theory and Modeling of Turbulent Flows	Textbook
10	Homogeneous Isotropic Turbulence	Textbook
11	the Kolmogorov Spectrum	Textbook
12	Project presentations	Textbook
13	Modeling Turbulence, k-ε model, Large-Eddy Simulation	Textbook
14	Özel Konular	Textbook

RECOMMENDED SOURCES	
Textbook	Durbin, P. A. and Pettersson Reif, B. A., Statistical Theory and Modeling of Turbulent Flows, 2nd ed., Wiley, 2010
Additional Resources	Pope, S. B., Turbulent Flows, Cambridge University Press, 2000

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Project	1	46
Class Participation	14	14
Homework	4	40
	Total	**100**
CONTRIBUTION OF FINAL PROJECT TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
	Total	**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.						**X**
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.	**X**					
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	**X**					
4	Comprehends, designs, implements and concludes an original research process independently.				**X**		
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	**X**					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	**X**					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio.					**X**	
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	**X**					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	**X**					
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.					**X**	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Homework	4	12	48
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Project	1	60	60
Final Exam	1	40	40
Total Work Load			246
Total Work Load / 25 (h)			9.84
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Convection Heat Transfer	ME 624	Spring	3 + 0	3	10

Prerequisites	ME 522 (Advanced Heat Transfer)

Language of Instruction	English
Course Level	Ph.D. Degree
Course Type	Elective
Course Coordinator	
Instructors	Associate Prof. Erdem An
Assistants	
Goals	The goal of this course is to introduce advanced topics and methods in convection heat trasnfer and to guide students to do an independent project.
Content	Energy equation, laminar external boundary layer, laminar flow inside tubes, turbulent external boundary layer, turbulent flow inside tubes, free convection, convection in non-Newtonian fluids.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Understanding basic equations related to convection in depth	1,4,10	1,2,3	A,C,H
2. Ability to formulate governing equations in many engineering problems and provide the methods of solving	1,4,10	1,2,3	A,C,H
3. Ability to do an independent project on the topic of convection	1,4,7,10	4	D

Teaching Methods:	1: Lecture, 2: Solving problems, 3: Homework, 4: Project
Assessment Methods:	A: Exam, C: Homework, D: Report, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Energy Equation	Textbook
2	Energy Equation / Laminar External Boundary Layer	Textbook
3	Laminar External Boundary Layer	Textbook
4	Laminar External Boundary Layer	Textbook

5	Laminar Flow inside Tubes	Textbook
6	Laminar Flow inside Tubes	Textbook
7	Turbulent External Boundary Layer	Textbook
8	Turbulent External Boundary Layer	Textbook
9	Turbulent Flow inside Tubes	Textbook
10	Turbulent Flow inside Tubes	Textbook
11	Midterm Exam	Textbook
12	Free Convection	Textbook
13	Free Convection	Textbook
14	Convection in Non-Newtonian Fluids	Textbook

RECOMMENDED SOURCES	
Textbook	W. M. Kays and M. E. Crawford, Convective Heat and Mass Transfer, 2ed., McGraw-Hill, 1980
Additional Resources	E.R.G. Eckert and Robert M. Drake, Analysis of Heat and Mass Transfer, McGraw-Hill, 1972.

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	54
Class Participation	14	23
Homework	4	23
Total		**100**
CONTRIBUTION OF FINAL PROJECT TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.						X
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.	X					
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	X					
4	Comprehends, designs, implements and concludes an original research process independently.				X		
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	X					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	X					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio.					X	
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	X					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	X					
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.					X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Homework	5	10	50
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Mid-terms	1	25	25
Final Project	1	65	65
Total Work Load			238
Total Work Load / 25 (h)			9.52
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Viscous Flow and Boundary Layer Theory	ME 631	Fall / Spring	3 + 0	3	10

Prerequisites	Instructor's consent

Language of Instruction	English
Course Level	Ph.D. Degree
Course Type	Elective
Course Coordinator	
Instructors	Assistant Prof. Bahadır Olcay
Assistants	
Goals	The goal of this course is to be able to solve the Navier-Stokes equations in viscous flows, to identify and evaluate two and three dimensional boundary layer flows, to employ similar and approximate methods of solutions.
Content	Equation of motion for viscous flow; exact solutions of Navier-Stokes equations; boundary layer theory, similar solutions, approximate methods of solution; turbulent boundary layers; introduction to three-dimensional compressible boundary layer flows. Fundamental equations of compressible viscous flow, stability of laminar flows, Reynolds equations of turbulent flow.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Identify viscous flows and develop exact solutions of Navier-Stokes equations for these flows	1,4,10	1,2,3	A,C,H
2. Evaluate two and three dimensional boundary layer flows and understand the parameters used to identification of boundary layer	1,4,10	1,2,3	A,C,H
3. Ability to understand similar and approximate methods of solution and determine the method for variety of engineering problems involve viscous flows	1,4,7,10	1,3,4	A,C,D,H

Teaching Methods:	1: Lecture, 2: Solving problems, 3: Homework, 4: Project
Assessment Methods:	A: Final exam, C: Homework, D: Report, H: Attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction, Navier-Stokes equations, Determination of project topics	Textbook and Journal articles
2	Navier-Stokes Equations	Textbook
3	Equation of motion for viscous flow	Textbook
4	Exact solutions of Navier-Stokes equations	Textbook
5	Exact solutions of Navier-Stokes equations	Textbook
6	Boundary layer theory	Textbook
7	Similar solutions, approximate methods of solution	Textbook
8	Turbulent boundary layer	Textbook
9	Turbulent boundary layer	Textbook
10	Introduction to three-dimensional compressible boundary layer flows	Textbook
11	Fundamental equations of compressible viscous flow	Textbook
12	Stability of laminar flows	Textbook
13	Project presentations	Journal articles
14	Reynolds equations of turbulent flow	Textbook

RECOMMENDED SOURCES	
Textbook	White, F. Viscous Fluid Flow, 3rd edition, McGraw-Hill Education, 2005
Additional Resources	Schlichting, H. and Gersten, K., Boundary-Layer Theory, 8th edition, Springer, 2000

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Project	1	46
Class Participation	14	14
Homework	4	40
	Total	**100**
CONTRIBUTION OF FINAL PROJECT TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
	Total	**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.						X
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.	X					
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	X					
4	Comprehends, designs, implements and concludes an original research process independently.				X		
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	X					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	X					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio.					X	
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	X					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	X					
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.					X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Homework	4	10	40
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Project	1	60	60
Final Exam	1	40	40
Total Work Load			238
Total Work Load / 25 (h)			9.52
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Large Eddy Simulation	ME 634	Fall/Spring	3 + 0	3	10

Prerequisites	ME532 Advanced Fluid Dynamics

Language of Instruction	English
Course Level	PhD
Course Type	Elective
Course Coordinator	
Instructors	Esra Sorgüven Öner
Assistants	
Goals	Aim of this course is to gain knowledge about Large Eddy Simulation technique and apply this method in turbulent flow simulations.
Content	Review of turbulent flow theory; RANS and DNS models; discretization in time and space; derivation of the Large Eddy Simulation (LES) equations; filtering; sub-grid scale models; boundary conditions.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Ability to simulate engineeringly relevant turbulent flow problems with LES	2,6	1,4	A,D
2. Ability to evaluate the results of a LES and compare those with RANS and DNS results	2,6	1,4	A,D

Teaching Methods:	1: Lecture, 4: Project
Assessment Methods:	A: Midterm and final exam, D: Report

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Properties of turbulent flows	Textbook
2	Turbulence Modeling Techniques: RANS, LES, DNS	Textbook
3	Derivation of the LES equations	Textbook
4	LES filtering	Textbook
5	LES filtering	Textbook
6	Subgrid Scale Modeling	Textbook

7	Subgrid Scale Modeling	Textbook
8	Midterm 1	Textbook
9	Boundary Conditions	Textbook
10	Boundary Conditions	Textbook
11	Case Study: Problem Statement, flow domain	Lecture Notes
12	Case Study: Boundary Conditions, meshing	Lecture Notes
13	Case Study: Temporal discretisation	Lecture Notes
14	Case Study: Post-Processing	Lecture Notes

RECOMMENDED SOURCES	
Textbook	Large Eddy Simulation for Incompressible Flows, an introduction, P. Sagaut
Additional Resources	Large Eddy Simulation for Compressible Flows, P. Sagaut Mathematics of Large Eddy Simulation of Turbulent Flows, L.C. Berselli, T. Iliescu, W.J. Layton

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	1	36
Project	3	64
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.	X					
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.						X
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	X					
4	Comprehends, designs, implements and concludes an original research process independently.	X					
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	X					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.						X
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio.	X					
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	X					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	X					
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.	X					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	5	70
Mid-terms	1	30	30
Projects	3	25	75
Final examination	1	30	30
Total Work Load			247
Total Work Load / 25 (h)			9.88
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
VARIATIONAL PRINCIPLES IN SOLID MECHANICS	ME 641	Fall	3 + 0	3	9

Prerequisites	

Language of Instruction	English
Course Level	Doctorate
Course Type	Elective
Course Coordinator	
Instructors	Prof. Dr. Mehmet A. Akgün
Assistants	
Goals	To teach students variational methods which they can use to formulate engineering problems and find approximate solutions. To equip students with knowledge to use variational calculus for finding extrema of functionals.
Content	Variational calculus. First variation and Euler-Lagrange equations. Principles of virtual and complementary virtual work. Theorem of minimum potential energy, complementary energy theorem, Reissner's principle. Applications to various problems.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. A good understanding of variational calculus.	1,2	1,3	A, C
2. Ability to formulate a mechanics problem using variational principles.	1,2	1,3	A, C
3. Find approximate solutions to mechanics problem using variational principles.	1,2	1,3	A, C

Teaching Methods:	1-Lecture, 3-Homework,
Assessment Methods:	A-Written exam, C-Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Extremal problems and formulation.	Textbook
2	Minimum principles, relative minimum.	Textbook
3	Euler-Lagrange equation in single coordinate, forced and natural boundary conditions.	Textbook

4	Euler-Lagrange equation in several cordinates.	Textbook
5	Principles of virtual and complementary virtual work.	Textbook
6	Ritz method, Galerkin method.	Textbook
7	Kantorovich method; approximate solutions, finite difference method.	Textbook
8	The variational principle of Reissner, Castigliano's principle.	Textbook
9	Approximate solutions of equilibrium problems, simple deformable bodies, plates, etc.	Class notes
10	Approximate solutions of equilibrium problems.	Class notes
11	Hamilton's principle.	Textbook
12	Vibration of discrete systems.	Textbook
13	Vibration of continuous systems.	Textbook
14	Stability.	Textbook

RECOMMENDED SOURCES	
Textbook	Variational Calculus in Science and Engineering, Marvin J. Forray, McGraw-Hill, 1968.
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT

IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterms	2	70
Homeworks	5	20
Extended homework	1	10
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.						**X**
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.						**X**
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	**X**					
4	Comprehends, designs, implements and concludes an original research process independently.	**X**					
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	**X**					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	**X**					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio.	**X**					
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	**X**					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	**X**					
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.	**X**					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 14 x total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	5	70
Mid-terms	2	15	30
Homeworks	5	5	25
Extended homework	1	20	20
Final examination	1	25	25
Total Work Load			212
Total Work Load / 25 (h)			8.5
ECTS Credit of the Course			9

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
PhD SEMINAR	ME 690	-	-	-	2

Prerequisites	

Language of Instruction	English
Course Level	PhD
Course Type	Compulsory
Course Coordinator	
Instructors	
Assistants	
Goals	The primary aim of this seminar course is to gain the students awareness in various contemporary topics in engineering, science, technology as well as social skills. The secondary aim is to let the students to present their own research topic in front of an audience.
Content	Current topics in engineering, science and technology. Seminars on social skills, leaderships, teamwork, and corporate environment.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Awareness in contemporary topics in engineering, science and technology, and awareness in social skills.	2, 7	9	H
2. Successfully presents his/her progress in a topic being researched, to an academic audience.	8, 9, 11	9	E, H

Teaching Methods:	9: Seminar
Assessment Methods:	E: Presentation, H: attendance

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1-14	Seminar	

RECOMMENDED SOURCES	
Textbook	

Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Attendance	14	100
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		0
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		100
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.	**X**					
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.			**X**			
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	**X**					
4	Comprehends, designs, implements and concludes an original research process independently.	**X**					
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	**X**					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	**X**					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio .						**X**
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.					**X**	
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	**X**					

10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.	**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (14x Total course hours)	14	2	42
Total Work Load			42
Total Work Load / 25 (h)			1.6
ECTS Credit of the Course			2

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
INDEPENDENT STUDY FOR QUALIFYING EXAM	ME 691	-	-	-	30

Prerequisites	

Language of Instruction	English
Course Level	PhD
Course Type	Compulsory
Course Coordinator	
Instructors	
Assistants	
Goals	The objective of this component of the PhD program is to prepare for the PhD qualifying exam. The student studies the topics of undergraduate concepts independently, in order to refresh his/her undergraduate background on mathematics and mechanical engineering.
Content	Undergraduate mathematics (calculus, linear algebra, differential equations) and two the following major areas of mechanical engineering: - Solid mechanics - Thermo-fluids - Dynamics, Control Systems and Mechanical Vibrations

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Solve an undergraduate level problem in mathematics and mechanical engineering.	1	3	A

Teaching Methods:	3: Homework (not an actual homework is given, but the student is expected to study the exam topics independently)
Assessment Methods:	A: PhD Qualifying Exam

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1-14	Independent study	

RECOMMENDED SOURCES	
Textbook	

Additional Resources

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Independent study	14	100
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		0
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		100
Total		**100**

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.						**X**
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.	**X**					
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.	**X**					
4	Comprehends, designs, implements and concludes an original research process independently.	**X**					
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.	**X**					
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.	**X**					
7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio .	**X**					
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	**X**					
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.	**X**					

10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.	**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Independent study	28	26	728
Exam	1	10	10
Total Work Load			738
Total Work Load / 25 (h)			29.5
ECTS Credit of the Course			30

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
PHD THESIS	ME 700	-	-		150

Prerequisites	Theoretical and applied courses

Language of Instruction	English
Course Level	Doctorate
Course Type	Compulsory
Course Coordinator	
Instructors	Advisor
Assistants	
Goals	The objective of PhD thesis is to enable the student to show that he/she can carry out an independent, ethical, detailed and scientifically correct high-level research on a theme in Mechanical Engineering; and to help the student to communicate the achieved results in a systematic and neat way.
Content	PhD thesis is a report, as a result of an independent and high-level research carried out following the completion of theoretical and applied courses. The thesis advisor leads the student to a pre-defined research topic. The supervisor helps the student in litereture search, guides him/her during his/her research and supports him regarding the ethical guidelines. At the end of the research phase, the student prepares a written report (PhD thesis) and defends it in an oral exam, to the thesis jury.

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1. Solve a scientific problem within a given period of time, either by developing an original methodology, or by applying an existing one to a new problem in mechanical engineering.	1, 2, 3, 4, 5, 6, 10	1	D, E
2. Publish the outcomes of PhD research in respected academic media and contribute to scientific and technological literature, by considering societal, scientific and ethical values.	7, 8, 9	1	D, E

Teaching Methods:	1: Lecture (in mutual consultation between the thesis supervisor and student)
Assessment Methods:	D: Report (Master’s thesis), E: Presentation (oral exam)

COURSE CONTENT		
Week	**Topics**	**Study Materials**
	Studies towards solving the problem being studied	Textbook

1-14

RECOMMENDED SOURCES	
Textbook	Technical literature related to the subject being studied
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

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

COURSE CATEGORY	Departmental courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		NA	1	2	3	4	5
1	Comprehends and implements basic sciences, mathematics and engineering sciences at an advanced level.					**X**	
2	Possesses in-depth and broad knowledge including the latest developments in his/her field.						**X**
3	Performs critical analysis, synthesis and assessment of developments and ideas in his/her field of expertise.						**X**
4	Comprehends, designs, implements and concludes an original research process independently.						**X**
5	Can conduct an extensive study producing a scientific or technological innovation, developing a new scientific method or technological product/process, or applying an existing method to a new area.						**X**
6	Can reach the most recent information in an area and comprehend it; has a high level of proficiency in methods and skills for conducting research using such information.						**X**

7	Able to communicate and discuss effectively in oral, written and visual modes with peers and broad scientific and social groups by using a foreign language at least at the general level of C1 of European Language Portfolio .		**X**
8	Evaluates and communicates scientific, technological, social and cultural developments, maintaining scientific objectivity and ethical responsibility.	**X**	
9	Contributes to scientific and technological literature by publishing outcomes of his/her studies in respected academic media.		**X**
10	Develops an original method, or applies an existing one to a new problem in mechanical engineering.		**X**

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Weekly meetings with advisor	56	15	840
Research and preparation of thesis	56	50	2800
Preparation for the oral exam	4	30	120
Total Work Load			3760
Total Work Load / 25 (h)			150.4
ECTS Credit of the Course			150