CHEMICAL ENGINEERING Ph.D. PROGRAM INFORMATION

Educational Objectives:

The educational objectives of this program are to educate graduates to have careers in research and development departments of national and international companies requiring expertise in special fields and in academic institutes and can make constant progress in their profession.

Goals:

The goals of the Chemical Engineering Department of Yeditepe University is to educate students to become chemical engineers with a doctorate degree who help develop novel Chemical Engineering Technologies, use advanced Chemical Engineering knowledge in behalf of human necessities, make the research information to be used for the society from ethical and social point of view.

PROGRAM LEARNING OUTCOMES

- Understand and apply fundamental sciences, mathematics and engineering sciences at high level.

- Have a wide and deep knowledge in his/her field including the latest progresses.

- Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.

- Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.

- Understand a genuine research process independently, design, apply and carry through; manage this process.

- Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.

- Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.

- Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.

- Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.

- Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.

Teaching Methods

Teaching-learning methods and strategies are selected in the way to enhance the abilities of the students in working individually, recognition of the need for lifelong learning, observing, teaching others, presentation, critical thinking, working in a team, employing information technologies effectively.

Moreover, it is respected that the teaching methods support the students with different types of talents. The teaching methods used in the program are listed below*:

(*) According To the properties of the lecture, one or more methods specified below may be applied.

Teaching Methods*	**Essential Learning Facilities**	**Tools used**
Lecture	Listening and understanding	Standard class technologies, multimedia tools, projector, computer, overhead projector
Lecture with discussion	Listening and understanding, observation/circumstances processing, critical thinking, problem formulation	Standard class technologies, multimedia tools, projector, computer, overhead projector
Problem Solving	Special skills planned in advance	
Case study	Special skills planned in advance	
Brain Storming	Listening and understanding, observation/circumstances processing, critical thinking, problem formulation, group study	Standard class technologies, multimedia tools, projector, computer, overhead projector
Discussion in a small group	Listening and understanding, observation/circumstances processing, critical thinking, problem formulation	Standard class technologies, multimedia tools, projector, computer, overhead projector
Seminar	Research – Life-long learning, writing, listening, informatics, listening and understanding, administrative skills	Standard class technologies, multimedia tools, projector, computer, overhead projector, special facilities
Group Study	Research – Life-long learning, writing, listening, informatics, listening and understanding, administrative skills, group study	Internet databases, library databases, e-mail, online discussion, web-based discussion forums
Laboratory	observation/circumstances processing, informatics administrative skills, group study	Special facilities
Homework	Research – Life-long learning, writing, listening, informatics	Internet databases, library databases, e-mail
Investigation / Sample Survey Study	Research – Life-long learning, writing, reading	
Panel	Listening and understanding, observation/circumstances processing	Standard class technologies, multimedia tools, projector, computer, overhead projector, special facilities
Guest Speaker	Listening and understanding, observation/circumstances processing	Standard class technologies, multimedia tools, projector, computer, overhead projector, special facilities
Student Ensembles Facilities / Projects	observation/circumstances processing critical thinking, problem formulation, group study, research-long-life learning, reading, writing, administrative skills, special skills plnned beforehand.	

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
MODELING AND ANALYSIS OF CHEMICAL ENGINEERING SYSTEMS	**CHBE 512**	**1-2**	**2 + 2**	**3**	**10**

Prerequisites	NONE

Language of Instruction	English
Course Level	Ph. D. Degree (Third Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	Assist. Prof. Betül Ünlüsü
Assistants	
Goals	The aim of this course is to provide students with the ability to model chemical engineering systems and solve model equations using analytical and numerical techniques.
Content	Modeling and mathematical formulation of lumped-parameter and distributed-parameter systems encountered in chemical engineering. Analytical and numerical methods used in the solution of ordinary and partial differential equations.

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Gains the ability to derive models for chemical engineering systems in a hierarchy of levels from the simplest to the most complex using the fundamental laws of physics	1	1,2	A,C
2) Acquires the ability to solve ordinary and partial differential model equations using analytical and numerical techniques	1	1,2	A,C
3) Gains the ability to communicate effectively in English	8	1,2	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	MODELING OF CHEMICAL ENGINEERING SYSTEMS (MASS, MOMENTUM AND ENERGY CONSERVATION EQUATIONS)	Textbook
2	MODELING OF CHEMICAL ENGINEERING SYSTEMS (MASS, MOMENTUM AND ENERGY CONSERVATION EQUATIONS)	Textbook
3	ANALYTICAL SOLUTION METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS (FIRST ORDER LINEAR AND NONLINEAR EQUATIONS)	Textbook
4	ANALYTICAL SOLUTION METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS (SECOND ORDER LINEAR AND NONLINEAR EQUATIONS)	Textbook
5	ANALYTICAL SOLUTION METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS (METHOD OF FROBENIUS)	Textbook
6	ANALYTICAL SOLUTION METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS (BESSEL'S EQUATION)	Textbook
7	MIDTERM EXAM I	Textbook
8	ANALYTICAL SOLUTION METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (METHOD OF COMBINATION OF VARIABLES)	Textbook
9	ANALYTICAL SOLUTION METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (METHOD OF SEPARATION OF VARIABLES)	Textbook
10	ANALYTICAL SOLUTION METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (METHOD OF LAPLACE TRANSFORMATION)	Textbook
11	ANALYTICAL SOLUTION METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (METHOD OF LAPLACE TRANSFORMATION)	Textbook

12	NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS	Textbook
13	NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS	Textbook
14	MIDTERM EXAM II	Textbook

RECOMMENDED SOURCES	
Textbook	RICE, R. G., DO, D. D., APPLIED MATHEMATICS AND MODELING FOR CHEMICAL ENGINEERS, 2nd ED., WILEY, 2012
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	63
Assignment	6	37
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.					+
2	Have a wide and deep knowledge in his/her field including the latest progresses.					
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.					
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					
5	Understand a genuine research process independently, design, apply and carry through; manage this process.					
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.			+		
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.					
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 16x Total course hours)	14	3	42

Hours for off-the-classroom study (Pre-study, practice)	14	10	140
Mid-terms	2	4	8
Ödev	6	8	48
Final examination	1	5	5
Total Work Load			243
Total Work Load / 25 (h)			9.72
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ADVANCED ENGINEERING THERMODYNAMICS	ChBE 514	1 or 2	3 + 0	3	10

Prerequisites	-

Language of Instruction	English
Course Level	PhD
Course Type	Compulsory
Course Coordinator	-
Instructors	Assist. Prof. Levent Organ
Assistants	-
Goals	The aim of this course in general is to present thermodynamics and its applications in the context of available energy (exergy). Following a detailed classification of thermodynamics, fundamental concepts and derivations of thermodynamics are presented and discussed along the lines of relevant energy and available energy (exergy) applications.
Content	The course comprises the subtitles of classification, basic concepts, definitions and interpretations of thermodynamics; introduction to available energy analysis: goal and definitions; 1. Law of thermodynamics and energy; energy analysis in a control volume; 2.Law of thermodynamics and entropy; entropy generation rate in a control volume; thermodynamic analysis of steady state flow systems; fundamentals of available energy; available energy expression and entropy analysis; available energy analysis in flow systems; available energy (2.Law) efficiency or effectiveness; chemical availability; total (thermomechanical and chemical) available energy and thermoeconomy.

Learning Outcomes	Program Learning Outcomes	Teaching Methods	Assessment Methods
1) Acquires the knowledge in mathematics, science and engineering subjects in the context of energy and available energy under thermodynamics at Master's level; ability to use theoretical and applied information in these areas to solve engineering problems.	1,2,3	1	A,C
2) Gains the ability to identify, formulate, and solve complicated engineering problems related to energy and available energy at Master's level; ability to select and apply proper analysis methods for this purpose.	1,2,3	1	A,C
3) Gains the ability to communicate effectively in writing and orally in the English language	8	1	A,C

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

COURSE CONTENT

Week	Topics	Study Materials
1	Thermodynamics: classification, basic concepts, definitions and interpretations	Resources listed, course notes
2	Introduction to available energy analysis: goal and definitions	"
3	1. Law of thermodynamics and energy	"
4	Energy analysis in a control volume	"
5	2.Law of thermodynamics and entropy	"
6	Entropy generation rate in a control volume	"
7	Thermodynamic analysis of steady state flow systems	"
8	Midterm exam	"
9	Fundamentals of available energy; available energy expression and entropy analysis	"
10	Available energy analysis in flow systems; efficiency or effectiveness	"
11	Chemical availability	"
12	Total (thermomechanical and chemical) available energy	"
13	Thermoeconomy	"

14	Project presentation	"

RECOMMENDED SOURCES	
Textbook	Moran, M.J., Shapiro, H.N.,"Fundamentals of Engineering Thermodynamics", 4 ed. John Wiley&Sons, Inc., New York, 2000. [MS]
Course Notes	Course notes prepared from various references, mainly Moran, are distributed to the students (unpubl).
Additional Resources	1.Smith,J.M., Van Ness,H.C., Abbott,M.M.,"Introduction to Chemical Engineering Thermodynamics", 7.ed., McGraw-Hill, 2005. [SVN7] 2.Prausnitz,J.M., Lichtenthaler,R.N.,"Molecular Thermodynamics of Fluid-Phase-Equilibria", 3.ed., Prentice Hall, 1999; 1.ed. 1969; 2.ed.1986. [P3] 3.a) Reid,R.C., Prausnitz,J.M., Sherwood,T.K., 3.ed., 1977; b) Reid, R.C., Prausnitz,J.M., Poling,B.E.,4.ed.,1987; c) Poling,B.E., Prausnitz,J.M., O'Connell,J.P., 5.ed.,2001, "The Properties of Gases and Liquids", McGraw-Hill. [PROP] 4.Dinçer, S., "Denge Süreçlerinin Termodinamiği", Boğaziçi Üniversitesi Yayınları, 1984. [D]

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-term	1	41.65
Project	1	41.65
Homework	8	(bonus: add 5% of HW's to the overall grade)
Attendance		16.7
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60 (add 5% bonus points for HW's to the overall grade)
Total		**100 (**add 5% bonus points for

		HW's to the overall grade)

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.				X		
2	Have a wide and deep knowledge in his/her field including the latest progresses.				X		
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.				X		
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.						
5	Understand a genuine research process independently, design, apply and carry through; manage this process.						
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.						
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.						
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.				X		
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.						
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.						

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	8	112
Mid-term	1	3	3
Project	1	40	40
HW	8	6	48
Final examination	1	4	4
Total Work Load			249

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

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
TRANSPORT PHENOMENA	ChBE 534	1 or 2	3 + 0	3	10

Prerequisites	-

Language of Instruction	English
Course Level	PhD
Course Type	Compulsory
Course Coordinator	-
Instructors	Prof.Dr. Salih Dinçer
Assistants	-
Goals	The aim of this course is to teach the formulation and application of momentum, energy and mass transport concepts using shell balances and derived transport equations in vector-tensor notation, together with the approaches used for the relevant analytical solutions.
Content	The course comprises an introduction to vector-tensor notation and relevant vector-tensor operations useful in transport phenomena, and the presentation of the concepts, formulations, analogies, analytical approaches and applications used for each of momentum, energy and mass transport.

Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Acquires the knowledge of mathematics, science and engineering subjects pertaining to momentum, energy and mass transfer at Master's level; ability to	1,2,3	1	A,C

use theoretical and applied information in these areas to solve relevant engineering problems.			
2) Gains the ability to identify, formulate, and solve complicated science and engineering problems related to momentum, energy and mass transfer at Master's level; ability to select and apply proper analysis methods for this purpose.	1,2,3	1	A,C
3) Gains the ability to communicate effectively in writing and orally in the English language	8	1	A,C

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

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction to vector-tensor notations and relevant vector-tensor operations useful in transport phenomena	Textbook, library, Sci Direct
2	The mechanism of momentum transport and viscosity; shell momentum balances and velocity distributions in laminar flow	"
3	The equations of change (conservation) for isothermal systems	"
4	Velocity distributions with more than one independent variable; velocity distributions in turbulent flow	"
5	Interphase momentum transport in isothermal systems	"
6	Macroscopic balances for isothermal flow systems	"
7	The mechanism of energy transport and thermal conductivity; shell energy balances and temperature distributions in solids and laminar flow	"
8	Midterm exam 1	"
9	The equations of change (conservation) for nonisothermal systems; introduction to temperature distributions with more than one independent variable	"
10	Interphase energy transport in nonisothermal systems; macroscopic balances for nonisothermal systems	"
11	The mechanisms of mass transport and the diffusivity; concentration distributions in solids and laminar flow	"
12	Equations of change (conservation) for multicomponent systems; interphase mass transport in nonisothermal systems	"
13	Interphase mass transport in nonisothermal systems (contd); macroscopic balances for multicomponent systems	"
14	Midterm exam 2	"

RECOMMENDED SOURCES	
Textbook	Bird, R.B., Stewart,W.E., Lightfoot, "Transport Phenomena", John Wiley & Sons, Inc., New York, revised 2.ed., 2007. [BSL]
Additional Resources	Library and Sci Direct

MATERIAL SHARING	
Documents	-
Assignments	-
Exams	-

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-term	2	83.3
Homework	12	(Bonus: 5% of HW's added to the total points)
Attendance		16.7
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60 (5% of HW's added as bonus to the total points)
Total		**100** (5% of HW's added as bonus to the total points)

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.				X		

2	Have a wide and deep knowledge in his/her field including the latest progresses.			X		
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.			X		
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					
5	Understand a genuine research process independently, design, apply and carry through; manage this process.					
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.			X		
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.					
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.					

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	10	140
Mid-terms	2	3	6
HW's	12	5	60
Final examination	1	4	4
Total Work Load			252
Total Work Load / 25 (h)			10
ECTS Credit of the Course			10

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ADVANCED CHEMICAL AND BIOLOGICAL REACTION ENGINEERING	CHBE 562	1	3 + 0	3	8

Prerequisites	-

Language of Instruction	English
Course Level	MS Degree (Second Cycle Programmes)
Course Type	Compulsory
Course Coordinator	Prof. Dr. Mustafa Özilgen
Instructors	
Assistants	
Goals	Enabling graduate engineering students carry out modeling studies by employing advanced chemical engineering kinetics knowledge to biological and chemical data
Content	Mathematical modeling (transport phenomena, analogy and empirical models, 80 % -20 % rule), review of priciples of mathematical modeling as applied to kinetics of biological and chemical systems and reactor design. Biological reactor design , product formation, growth and sterilization models. Affect of axially dispersed plug flow analysis in biological and chemical reactor efficiency

Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**

1) Learns mathematical modeling		1,2, 3, 9, 12	A,C
2) Learns why the chemicals react: theoretical aspects, data analysis, reliability of data		1,2, 3, 9, 12	A,C
3) Gains knowledge on microbial kinetics: Metabolic engineering, growth product formation, sterilization models		1,2, 3, 9, 12	A,C
4) Gains the ability to design ideal reactors		1,2, 3, 9, 12	A,C
5) Analyzes real reactors in terms of series and parallel reactor systems with chemical and biological applications		1,2, 3, 9, 12	A,C
6) Designs non ideal reactors with emphasis on axially dispersed flow		1,2, 3, 9, 12	A,C

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Discussion, 9: Simulation, 12: Case Study + simulation of the literature data from refereed articles
Assessment Methods:	A: Testing, C: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1-2	Mathematical modeling	Textbook + Articles + library + computer program packages
3-6	Why do the chemicals react: theoretical aspects, data analysis, reliability of data	Textbook + Articles + library + computer program packages
7-8	Microbial kinetics: Growth product formation, sterilization models	Textbook + Articles + library + computer program packages
9-10	Overview of ideal reactor design	Textbook + Articles + library + computer program packages
11-12	Real reactor analysis in terms of series and parallel reactor systems with chemical and biological applications	Textbook + Articles + library + computer program packages
11-12	Real reactor analysis in terms of series and parallel reactor systems with chemical and biological applications	Textbook + Articles + library + computer program packages
13	Discussion and presentation of the student projects	Textbook + Articles + library + computer program packages
14	Non-ideal reactor design with emphasis on axially dispersed flow	Textbook + Articles + library + computer program packages
15-16	General Revision and discussion, case studies, crititisim of	Textbook + Articles +

	literature	library + computer program packages

RECOMMENDED SOURCES	
Textbook	Özilgen M. Handbook of food process modeling and statistical quality control, 2nd ed. Taylor & Francis, USA, 2011
Additional Resources	Instructors refereed publications and presentations in international symposia

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	10 x 2
Homeworks	2	5 x2
Term project	1	70
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION (turned in as a project) TO OVERALL GRADE		70
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		20
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM		
No	Program Learning Outcomes	Contribution

		1	2	3	4	5
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.					X
2	Have a wide and deep knowledge in his/her field including the latest progresses.					X
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.					X
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					X
5	Understand a genuine research process independently, design, apply and carry through; manage this process.					X
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.			x		
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					x
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.			x		
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.			x		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 16x Total course hours)	16	3	48
Hours for off-the-classroom study (Project)	16	8	128
Mid-terms	2	10	20
Final examination	1	10	10
Total Work Load			206
Total Work Load / 25 (h)			8.24
ECTS Credit of the Course			8

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Instrumental Analysis	**CHBE 525**	**1**	**3+1**	**3**	**7**

Prerequisites	---

Language of Instruction	English
Course Level	Graduate (Second/Third Cycle Programme)
Course Type	Elective
Course Coordinator	
Instructors	Assist. Prof. Semin Funda Oğuz
Assistants	
Goals	Understanding the principles and components of analytical instruments and their applications in science, Experiencing how to prepare samples for analysis and how to design experiment, Developing capability to resolve analytical problems in science.
Content	This course is advanced instrumental analysis course which emphasizes principles and applications of selected analytical instruments in different fields. The focus will be more on characterization and separation techniques. Lecture topics cover mainly molecular spectroscopy (UV-VIS, IR, NMR, and mass spectrometry), separation methods (GC, LC, and HPLC), atomic spectroscopy (AAS, AES, and ICP-MS), electroanalytical methods (potentiometry, voltammetry, impedance spectrometry) and thermal analysis methods (DSC, TGA, DMA). In the laboratory, students gain hands-on experience by performing special experiments, the results of which will be discussed in the class.

Course Learning Outcomes	Program Learning Outcomes	Teaching Methods	Assessment Methods
1) Ability to understand the working principles of modern instrumentations	1	1,2,3	A,B,C
2) Ability to define application areas of instrumentation techniques	1,2	1,3	A, B, C
3) Ability to apply the instrumentation techniques for specific problems	5	3,4	B, C, D
4) Ability to interpret the instrumental analyses results	1, 5, 8	1, 3, 4	A,B,C
5) Ability to follow the improvements in instrumentation techniques	3, 8	1, 4	C, D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction to Molecular Spectroscopy	Textbook
2	UV/VIS Spectroscopy	Textbook
3	IR Spectroscopy	Textbook
4	Mass Spectrometry/ UV/VIS Experiment	Textbook/Web sources
5	NMR Spectroscopy/ IR Spectroscopy Experiment	Textbook/Web sources
6	NMR Spectroscopy/ Mass Spectrometry Experiment	Textbook/Web sources
7	Separation Techniques and Liquid Chromatography	Textbook
8	Liquid Chromatography	Textbook
9	Gas Chromatography	Textbook
10	HPLC and GC Experiments	Web sources
11	Atomic Spectroscopy/ Atomic Spectroscopy Experiment	Textbook
12	Electroanalytical Methods/ Electroanalytical Experiment	Textbook
13	Thermal Analysis Methods/ Thermal Analysis Experiment	Web sources
14	Presentations	Textbook/Web sources

RECOMMENDED SOURCES

Textbook	Skoog, Holler and Niemann, ”Principles of Instrumental Analysis”, 5th Edition, Brooks/Cole
Additional Resources	Rouessac F. and Rouessac A., “Chemical Analysis, Modern Instrumentation Methods and Techniques”, 2nd Edition, Wiley

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-term	1	40
Assignment	2	20
Lab Report	1	20
Term Project Presentation	1	20
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70
Total		**100**

COURSE CATEGORY	Field Course

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Acquire expanded and in-depth information via performing scientific research in the field of Chemical Engineering, evaluate, interpret and implement knowledge.				X		
2	Be knowledgable in the contemporary techniques and methods applied in Chemical Engineering and their respective constraints.				X		
3	Be cognizant of the novel and developing applications of his/her profession, study and learn them as required.				X		
4	Formulate Chemical Engineering problems, develop methods to solve them and implement innovative techniques in solutions						

5	Design and conduct analytical modeling and experimental research, analyze and interpret complex problems encountered in this process.					X
6	Develop novel and/or original ideas and methods; conceive innovative solutions in systems, component and process design					
7	Complete information via processing limited or incomplete data by the use of scientific methods and implement it; integrate knowledge from different disciplines					
8	Communicate in at least one foreign language at the level of European Language Portfolio B2 orally and in writing.					X
9	Communicate stages and results of his/her studies in a systematic and clear manner orally or in writing in intra or interdisciplinary national and international settings.					
10	Defines societal and environmental aspects of Chemical Engineering applications					
11	Observe social, scientific and ethical values during collection, interpretation, and dissemination of data and in all professional activities.					
12	Lead multidisciplinary teams, develop solution methodologies for complex problems and take responsibility					

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterm examination	1	2	2
Homework	2	10	20
Laboratory Reports	1	15	15
Project	1	15	15
Final examination	1	3	3
Total Work Load			181
Total Work Load / 25 (h)			
ECTS Credit of the Course			7

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Fundamentals of Colloid and Surface Chemistry	**CHBE 565**		**3+1**	**3**	**7**

Prerequisites	

Language of Instruction	English
Course Level	PhD
Course Type	Elective
Course Coordinator	Assoc. Prof. Seyda Malta
Instructors	Assoc. Prof. Seyda Malta
Assistants	
Goals	The aim of this course is to give the fundementals of colloid and surface chemistry and give the students the ability to apply this knowledge to nanotechnology. The course is supplemented with experiments to solidify the theoretical knowledge.
Content	Fundamentals of colloid and surface chemistry with theoretical and laboratory work. Topics include: self assembly of amphiphiles, Brownian motion, surface chemistry and monolayers, surface tension and contact angle, electrostatic interactions in colloidal systems, structure and properties of micelles in industrial and biological processes, bilayer systems, membranes in biological systems and transport, micro-and macro emulsions. Lab work includes: surface tension and conductimetric determination of CMC, preparation and characterization of different colloidal structures using UV-Vis Spectrophotometer and microscopy techniques, preparation of microemulsions, and reactions in microemulsion droplets.

Course Learning Outcomes	Program Learning Outcomes	Teaching Methods	Assessment Methods
1) Acquires adequate knowledge in science and technology in colloid and surface chemistry; ability to use theoretical and applied information in these areas to solve relevant problems.	1	1	A
2) Gains the ability to devise, select, and use modern techniques such as conductivity meter, spectrophotmeter, tensiometer, zeta-potential, viscosity meter, etc needed for engineering practice; ability to employ Excel to plot data and make calculations and Word to write reports effectively.	4	1, 3	A, B
3) Gains the ability to conduct experiments, gather data for investigating problems on colloid and surface chemistry such as sedimetation, adsorption, self-assembly and analyze and interpret results from these experiments and also data from other techniques such XRD, microscopy and light scattering.	3	1, 3	B
4) Gains the ability to work efficiently in intra-disciplinary teams by performing experiments as a pair in the lab and ability to work individually by writing reports on these experiments and taking exams.	6	3	B
5) Gains the ability to communicate effectively both orally and in writing by following the text book, lab manual and teaching and writing reports and exams in English.	7	1, 2, 3	A, B
6) Recognizes the need for lifelong learning; ability to access information, to follow developments in science and nanotechnology, and to continue to educate him/herself on these topics.	8	1, 2	A, B
7) Gains knowledge about nanotechnology and the global and societal effects of nanotechnology on health, environment, and safety.	11	1, 2	A, B

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT

Week	Topics	Study Materials
1	INTRODUCTIONS, COLLOID AND SURFACE CHEMISTRY	Textbook
2	MOLECULAR INTERACTIONS, SELF-ASSEMBLY, BROWNIAN MOTION, SEDIMENTATION	Textbook & Lab Manual
3	SURFACE CHEMISTRY. SURFACE TENSION, CAPILLARY ACTION, CONTACT ANGLE, METHODS OF SURFACE TENSION MEASUREMENT	Textbook
4	SURFACTANTS, MICELLES, PACKING PARAMETER, CMC, ETC	Textbook & Lab Manual

5	ELECTROSTATICS	Textbook & Lab Manual
6	COLLOIDAL STABILITY	Textbook & Lab Manual
7	PHASE DIAGRAMS. VESICLES, MICROEMULSİONS, EMULSIONS, ETC	Textbook & Lab Manual
8	REVIEW AND MIDTERM 1	Textbook
9	POLYMERS IN SOLUTION	Textbook & Lab Manual
10	NANOPARTICLES AND METHODS OF SYNTHESIS	Textbook & Lab Manual
11	TECHNIQUES USED IN SIZE DETERMINATION	Textbook
12	TECHNIQUES USED FOR CRYSTAL STRUCTURE (XRD) AND EVALUATION OF DATA	Textbook
13	POPULAR TOPICS BY STUDENTS	Textbook
14	REVIEW AND MIDTERM 2	Textbook

RECOMMENDED SOURCES	
Textbook	Introduction to Modern Colloid Science, R. Hunter, Oxford Press
Additional Resources	Laboratory Experiments Manual

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	62
Lab Reports + Lab Performance	7	38
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		35
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		65
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.		**x**			
2	Have a wide and deep knowledge in his/her field including the latest progresses.					**x**
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.			**x**		
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					
5	Understand a genuine research process independently, design, apply and carry through; manage this process.					
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					**x**
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writttten.					
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.	**x**				

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding two midterms: 13x Total course hours)	13	4	52
Hours for off-the-classroom study (Pre-study, practice)	13	7	91
Midterm examination	2	2	4
Reports	7	3	21
Final examination	1	3	3
Total Work Load			171
Total Work Load / 25 (h)			6.84
ECTS Credit of the Course			7

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Advanced Biotechnology	ChBE 573	1	3 + 0	3	7

Prerequisites	-

Language of Instruction	English
Course Level	Ph.D. (third cycle program)
Course Type	Elective
Course Coordinator	
Instructors	
Assistants	
Goals	The aim of this course is to teach the basic concepts of chemical engineering applied for biotechnology
Content	Advanced unit operations, transport phenomena and thermodynamics as applied to biological systems with extensive computer applications and analytical mathematical analysis through selected examples about industrial and metabolic processes

Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Learns the Basic Principles of Biotechnology		1	C
2) Acquires knowledge about enzyme techniques and the biocatalysis		1,2	C
3) Acquires knowledge about living organism applied in biotechnology		1,2,3	,C
4) Gains the ability to design of the Bioreactors and Fermentors		1,2,3	A,C
5) Acquires knowledge about unit operations and transport phenomena in Biotechnology.		1, 9,12	A,C
6) Analyzes Industrial applications of Biotechnology.		1,3	A,C

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

Methods:	

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction	
2	Basic Principles of Biotechnology	Text Book
3	Proteins and their synthesis	Additional Resources
4	Proteins and enzymes	Additional Resources
5	Basics of enzyme kinetics	Additional Resources
6	Fundamentals of designing bioreactors	Text Book
7	Midterm Exam	
8	A little Microbiology	Text Book
9	Kinetcis of substrate Utilization and biomass production	Text Book
10	Transport Phenomena in Bioprocess Systems	Text Book
11	Industrial Applications of Biotechnology	Text Book
12	Project respresentation	oral
13	General Revision	
14	Midterm Exam II	

RECOMMENDED SOURCES	
Textbook	Bailey, James E., and David F. Ollis. " Biochemical Engineering Fundamentals. " New York, NY: McGraw-Hill Education, 1986
Additional Resources	Alan Wiseman, " Principles of Biotechnology", Surrey Uni. Press. David L. Nelson, Michael M. Cox, " Lehninger – Principles of Biochemistry ",W. H. Freeman; 5th ed. Ghasem D. Najafpour, " Biochemical Engineering and Biotechnology ", Elsevier

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	20
Term Paper Project	1	20
Homeworks	1	15
seminar (oral representation)	1	25
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.					X	
2	Have a wide and deep knowledge in his/her field including the latest progresses.				X		
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.				X		
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					X	
5	Understand a genuine research process independently, design, apply and carry through; manage this process.				X		
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					X	
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.				X		

8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.			X		
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.				X	
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.			X		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	9	126
Midterm examination	2	3	6
Final examination	1	3	3
Total Work Load			177
Total Work Load / 25 (h)			
ECTS Credit of the Course			7.08

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
ADVANCED POLYMER CHEMISTRY	CHBE 581	1	3 + 0	3	7

Prerequisites	-

Language of Instruction	English
Course Level	Graduate Degree
Course Type	Technical Elective
Course Coordinator	Assist. Prof. Dr. Erde Can
Instructors	Assist. Prof. Dr. Erde Can
Assistants	-
Goals	The aim of this course is to provide students with an advanced knowledge of polymer chemistry, polymerization reactions, polymer types, polymer structure - property relationships, polymerization and polymer characterization techniques and polymer applications
Content	Basic principles of polymer chemistry, polymer classifications, the chemical structures of a variety of polymers, polymerization reactions, mechanisms and kinetics, polymer structure - property relationships, polymerization techniques, techniques for molecular and morphological and physical property characterization, applications of polymers. Term project.

Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Acquires expanded and in-depth information of the basic principles of polymer chemistry, polymer classifications, the chemical structures of a variety of polymers, polymerization reactions, mechanisms and kinetics, polymer structure - property relationships and ability to use theoretical and applied information in these areas to solve polymer engineering problems	1	1,2	A
2) Acquires expanded knowledge of the various applications of polymers	2	1,12	A,D
3) Acquires expanded knowledge of advanced polymeric materials used in current applications (polymer nano-composites, fire-resistant polymers, liquid crystalline polymers, conductive polymers, biodegradable polymers, biocompatible polymers for	2,3	12	D

medical applications..) and ability to access information and to follow developments in these areas.			
4) Learns polymerization techniques, techniques for polymer molecular, morphological and physical property characterization and their respective constraints.	1,2	1,2	A
5) Acquires knowledge about the global and societal effects of polymer engineering practices on health (eg.biomedical applications of polymers) and environment and contemporary issues (eg. plastic wastes, recyclable and biodegradable polymers..)	2,3	1,12	D
6) Gains the ability to work efficiently in intra-disciplinary teams in project assignments and ability to communicate effectively both orally and in writing in English (and ability to communicate stages and results of his/her studies in a systematic and clear manner orally and in writing in intradisciplinary national and international settings) via preparation of project reports and presentations on novel and developing applications of polymeric materials	2,3,8	2,12	D

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

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to Polymer Science *(Basic concepts, classification of polymers,* natural and synthetic polymers..)	Textbook-Lecture Notes
2	Polymer structure, molecular weight and molecular weight distributions	Textbook-Lecture Notes
3	Step-Reaction Polymerization – Condensation Polymerization *(Mechanisms and kinetics)*	Textbook-Lecture Notes
4	Addition Polymerization - Radical Chain Polymerization *(Mechanisms and kinetics)*	Textbook-Lecture Notes
5	Ionic and Coordination Polymerizations *(Mechanisms and kinetics)*	Textbook-Lecture Notes
6	Copolymerization	Textbook-Lecture Notes
7	MIDTERM EXAM I	Textbook-Lecture Notes

8	Polymerization Techniques *(Bulk, solution, suspension, emulsion polymerization and polymerization in supercritical fluids)*	Textbook-Lecture Notes
9	Polymer structure and physical properties I *(Morphology and Order in Crystalline Polymers, Rheology and the Mechanical Properties of Polymers, viscous flow, rubber elasticity, viscoelasticity, glassy state and the glass transition)*	Textbook-Lecture Notes
10	Polymer structure and physical properties II *(Mechanical properties of crystalline polymers, and the crystalline melting point)*	Textbook-Lecture Notes
11	Polymer conformation, solutions and Chain Dimensions	Textbook-Lecture Notes
12	Polymer characterization techniques *(*Methods for polymer molecular, morphological and physical property characterization*)*	Textbook-Lecture Notes
13	Industrially Important Polymers and Applications *(Commodity thermoplastics, elastomers, thermosets and engineering and specialty polymers)*	Textbook-Lecture Notes
14	Project presentataions	-

RECOMMENDED SOURCES	
Textbook	"Principles of Polymerization", G. Odian,3rd Edition, John Wiley&Sons Inc, New York, 1991 "Polymer Science and Technology", J.R. Fried, 2nd Edition, Prentice Hall, NJ, 2008
Additional Resources	"Principles of Polymer Engineering", N.G.McCrum, C.P.Buckley, C.B.Bucknall, 2nd Edition, Oxford University Press, New York

MATERIAL SHARING	
Documents	
Assignments	
Exams	

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

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.					X	
2	Have a wide and deep knowledge in his/her field including the latest progresses.					X	
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.					X	
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.						
5	Understand a genuine research process independently, design, apply and carry through; manage this process.						
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.						
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.						
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					X	
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.						
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.						

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 13x Total course hours)	13	3	39
Hours for off-the-classroom study (Pre-study, practice)	14	4	56
Midterm examination	1	(10+2)	12
Project	1	40	40
Final examination	1	(15+3)	18
Total Work Load			165
Total Work Load / 25 (h)			6.6
ECTS Credit of the Course			7

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
SPECIAL TOPICS II in CHBE: Green Engineering and Sustainability	CHBE585	2	3 + 0	3	7

Prerequisites	Master's Degree in Chemical Engineering

Language of Instruction	English
Course Level	PhD (8th Cycle)
Course Type	Elective
Course Coordinator	
Instructors	Prof Dr Sevil Ünal
Assistants	
Goals	The aim of this course is i) to aid postgraduate students in becoming environmentally knowledgeable and skilled and dedicated chemical engineers who are willing to work toward achieving and maintaining a sustainability in their chemical engineering practices, both economically and environmentally ii) to acquaint them with "green engineering" principles and practices; iii)to develop their skills for conducting Life Cycle Assesment (LCA) in chemical engineering processes.
Content	Sustainability and sustainable development; Formation of the Earth, evolution of life; The biosphere, the Earth and its environment; Resources of the Earth and their utilization, pollution; Green engineering and the responsibilities of chemical engineers; Industrial ecology, Life Cycle Assessment (LCA).

Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Understands the uniqueness of the biosphere and the role of the engineer in upsetting the delicate balances required;	2	1,2	A
2) Gains practice of the profession with awareness and respect for the environment;	2,4	1,2,4	A,D
3) Understands the requirements for sustainable development;	2	1,2	A
4) Gains the ability and skill in applying green engineering principles when and where needed;	2,4,5	1,2,4	A,D

5) Gains the ability and skill to conduct LCA and to research/find/adapt the necessary data for the analysis;	2,4,5	1,2,4	A,D
6) Gains the ability for presentation of the term project and communication in English of the methodology and findings.	8,9	1,2,4	D

Teaching Methods:	1: Lecture, 2: Question-Answer, 4: Case-study
Assessment Methods:	A: Testing, D: Project

COURSE CONTENT

Week	Topics	Study Materials
1	Current environmental issiues and sustainability	(RS)
2	Sustainable development	(RS)
3	Formation of the Earth, evolution of life	(RS)
4	The Biosphere and its workings	(RS)
5	The Earth, its resources and environment	(RS)
6	Pollution	(RS)
7	Midterm Exam	
8	Green Engineering	(RS)
9	Industrial ecology, "zero waste" concept	(RS)
10	Introduction to Life Cycle Assesment (LCA)	(RS)
11	LCA: case studies/practices	Student research
12	LCA: case studies/practices	""
13	LCA Project presentations/discussions	""
14	LCA Project presentations/discussions	""

RECOMMENDED SOURCES (RS)

ENERGY: Principles, problems, alternatives, J. Priest
Pollution Prevention: Fundamentals and Practice, Paul L. Bishop, McGraw-Hill International Editions
Introduction to Engineering and the Environment, Edward S. Rubin, McGraw-Hill International Editions

Environmental Science, K. Arms, Saunders College Publishing
Environment, P.H.Rawen, L.R. Berg, G.B. Johnson, Saunders College Publishing
ÇEVRE:Bilinci, Bilgisi ve Eğitimi, S. Ünal, E.Mançuhan ve A.A. Sayar, Marmara Üniversitesi Yayınları

MATERIAL SHARING	
Documents	
Assignments	
Exams	

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

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.						
2	Have a wide and deep knowledge in his/her field including the latest progresses.					**X**	
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.						
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					**X**	

5	Understand a genuine research process independently, design, apply and carry through; manage this process.				**X**	
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					**X**
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.				**X**	
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam days: 13x Total course hours)	13	3	39
Hours for off-the-classroom study (Pre-study, practice)	14	6	84
Midterm examination	1	2	2
LCA (practice) Project / Presentation	1	12	12
LCA term Project / Presentation	1	24	24
Final examination	1	3	3
Total Work Load			164
Total Work Load / 25 (h)			6.6
ECTS Credit of the Course			7

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
SEMINAR	CHBE 690	1	0+0	0	2

Prerequisites	None

Language of Instruction	English
Course Level	Ph.D. Degree (Third Cycle Programmes)
Course Type	Compulsory
Course Coordinator	
Instructors	
Assistants	
Goals	The aim of this course is, to broaden the student's mind in recent topics with the seminars given by guest speakers, academicians and graduate students from Chemistry, Chemical Engineering and Bioengineering disciplines.
Content	Seminer presentation about the research topics in Chemistry, Chemical Engineering and Bioengineering and learn the presented topics.

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) He/She gathers together the basic information on which the research topic is based on.	2,3	1, 4	
2) He/She analyzes the research data and presents them in a report.	7	1,3,4	
3) He/She prepares a presentation and gives this presentation in which the gathered information and discussed results are introduced.	8,9,10	1,2,4	
4) He/She analyzes the presentation, considers the results from different point of view and asks questions.	7	2	

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	SEMINAR	
2	SEMINAR	
3	SEMINAR	
4	SEMINAR	
5	SEMINAR	
6	SEMINAR	
7	SEMINAR	
8	SEMINAR	
9	SEMINAR	
10	SEMINAR	
11	SEMINAR	
12	SEMINAR	
13	SEMINAR	
14	SEMINAR	

RECOMMENDED SOURCES	
Textbook	
Additional Resources	Academic publications

MATERIAL SHARING	
Documents	
Assignments	
Exams	

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

COURSE CATEGORY	Expertise Course

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.					
2	Have a wide and deep knowledge in his/her field including the latest progresses.					X
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.					X
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					
5	Understand a genuine research process independently, design, apply and carry through; manage this process.					
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					X
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					X
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.					X
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.				X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 14x Total course hours)	14	2	28
Hours for off-the-classroom study (Pre-study, practice)	1	20	20
Total Work Load			48
Total Work Load / 25 (h)			1.92
ECTS Credit of the Course			2

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Qualifying Exam Preparation	**CHBE 691**			**NC**	**30**

Prerequisites	

Language of Instruction	English
Course Level	Ph.D.
Course Type	Compulsory
Course Coordinator	Süheyla Uzman
Instructors	
Assistants	
Goals	This course is designed to prepare the Ph.D. students for the qualifying exam.
Content	In this course, the student carries out an independent study to prepare for the qualifying exam. At the end of the course, the student takes a written and oral qualifying exam to demonstrate that he/she has sufficient knowledge about the fundamental subjects in his/her field and that he/she is capable of conducting scientific reseach towards writing a Ph.D. thesis.

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
Possess adequte knowledge of fundamental subjects within the field of study	1,2	1	A
Ability to conduct research in the area of concentration	3,4,5	1	A
Ability to contribute to the existing scientific knowledge in the area of concentration	4,6,7	1	A
Ability to communicate technical content in writing and orally	6,8,9	1	A

Teaching Methods:	1: Independent study
Assessment Methods:	A: Qualifying Exam (written and oral)

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1-14	Independent study in preparation for the qualifying exam	Variety of textbooks in the field of Chemical Engineering, Books and articles related to the thesis topic.

RECOMMENDED SOURCES	
Textbook	
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Qualifying exam (written)	1	50
Qualifying exam (oral)	1	50
Total		**100**
Contribution of Final Examination to Overall Grade		100
Contribution of In-Term Studies to Overall Grade		0
Total		**100**

COURSE CATEGORY	Expertise

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply natural sciences, mathematics and engineering sciences in advanced level.					X	
2	Have a wide and deep knowledge in his/her field including the latest progresses.					X	
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.					X	
4	Ability to do an extensive study which brings in novelty to science and technology, develop a new scientific method or technological product/process, or apply a know method to a new field.					X	
5	Understand a genuine research process independently, design, apply and carry through; manage the process					X	
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					X	
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					X	
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio C1 orally and written.					X	
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and written.					X	
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.						

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Independent study	1	750	750
Qualifying exam (written)	1	4	6
Qualifying exam (oral)	1	2	2
Total Work Load			752
Total Work Load / 25(h)			30.32
ECTS Credit of the Course			30

COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
PhD Thesis	**ChBE 700**	**5,6,7,8**			**30**

Prerequisites	Compulsory and Elective Courses, Proficiency Examination

Language of Instruction	English
Course Level	Doctorate (Third Cycle Programme)
Course Type	Compulsory
Course Coordinator	
Instructors	Chem. Eng. Dept. Faculty
Assistants	
Goals	The aim of this course is the preparation and Defense of an original Thesis in the field of Chemical Engineering
Content	Fundamental and advanced principles of Chemical Engineering, Applications and theses

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Gains ability to work on an original scientific Thesis.	2,3,4,5	4,5	D
2) Acquires extensive and original knowledge about the thesis topic	6,7,8,	4,5	D
3)Gains ability to complete an original scientific Thesis. Ability to defend the thesis	6,7,8,9	4,5	D
4) Gains ability to publish scientific results	6,8,9,10	5	D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study 5.Discussion
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D**: Thesis Defense**

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

1	Thesis	Relevant scientific Publications
2	Thesis	Relevant scientific Publications
3	Thesis	Relevant scientific Publications
4	Thesis	Relevant scientific Publications
5	Thesis	Relevant scientific Publications
6	Thesis	Relevant scientific Publications
7	Thesis	Relevant scientific Publications
8	Thesis	Relevant scientific Publications
9	Thesis	Relevant scientific Publications
10	Thesis	Relevant scientific Publications
11	Thesis	Relevant scientific Publications
12	Thesis	Relevant scientific Publications
13	Thesis	Relevant scientific Publications
14	Thesis	Relevant scientific Publications

RECOMMENDED SOURCES	
Textbook	Relevant scientific Publications
Additional Resources	

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Thesis Defence		**100**
Total		**100**

COURSE CATEGORY	Expertise/

COURSE'S CONTRIBUTION TO PROGRAM							
No	Program Learning Outcomes	Contribution					
		1	2	3	4	5	
1	Understand and apply fundamental sciences, mathematics and engineering sciences at high level.						
2	Have a wide and deep knowledge in his/her field including the latest progresses.					X	
3	Reach the latest knowledge in the field and through its comprehension possess high level competence in required methods and skills for doing research.					X	
4	Ability to do an extensive study which brings novelty to science and technology, develop a new scientific method or technological product/process, or apply a known method to a new field.					X	
5	Understand a genuine research process independently, design, apply and carry through; manage this process.					X	
6	Contribute to science and technology literature by publishing the outcomes of his/her academic studies in prestigious media.					X	
7	Able to do critical analysis, synthesis and evaluation of ideas and progresses in his/her specialization.					X	
8	Able to communicate and discuss at high level orally, written and visually by using a language at least at the level of European Language Portfolio B2 orally and written.					X	
9	Able to communicate with persons in his/her career and widely with scientific and social ensemble orally and writtten.					X	
10	Able to evaluate scientific, technological, social and cultural developments and transfer them to society with senses of scientific disinterest and ethical responsibility.					X	

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 14x Total course hours)	14	40	560
Hours for off-the-classroom study (Pre-study, practice)	14	12	168
Total Work Load			728
Total Work Load / 25 (h)			29,12
ECTS Credit of the Course			30

Program Learning Outcomes vs. Courses										
Course	*PLO1*	*PLO2*	*PLO3*	*PLO4*	*PLO5*	*PLO6*	*PLO7*	*PLO8*	*PLO9*	*PLO10*
CHBE 512 Modeling and Analysis of Chemical Engineering Systems	5	0	0	0	0	0	0	3	0	0
CHBE 514 Advanced Engineering Thermodynamics	4	4	4	0	0	0	0	4	0	0
CHBE 534 Transport Phenomena	4	4	4	0	0	0	0	4	0	0
CHBE 562 Advanced Chemical and Biological Engineering	5	5	5	5	5	3	5	0	3	3
CHBE 565 Fundamentals of Colloid and Surface Chemistry	2	5	3	0	0	0	0	5	0	1
CHBE 573 Advanced Biotechnology	5	4	4	5	4	5	4	3	4	3
CHBE 581 Advanced Polymer Chemistry	5	5	5	0	0	0	0	5	0	0
CHBE 585 Special Topics II in CHBE: Green Engineering and Sustainability	0	5	0	5	4	0	0	5	4	0
CHBE 690 Seminar	0	5	5	0	0	0	5	5	5	4
CHBE 700 Ph.D. Thesis	0	5	5	5	5	5	5	5	5	5

Course Category List	ECTS
Field Courses	
CHBE 512 Modeling and Analysis of Chemical Engineering Systems	10
CHBE 514 Advanced Engineering Thermodynamics	10
CHBE 534 Transport Phenomena	10
CHBE 562 Advanced Chemical and Biological Reaction Engineering	7
CHBE 690 Seminar	2
CHBE 692 Qualifying Exam Preparation	30
Total	**70**
Expertise Courses	
CHBE 525 Advanced Instrumental Anlaysis	7
CHBE 581 Advanced Polymer Chemistry	7
CHBE 585 Special Topics II in CHBE: Green Engineering and Sustainability	7
Total	**21**
CHBE 700 Ph.D. Thesis (4 semesters)	**120**
Total ECTS of all courses	**211**

Level of Qualification:

This Graduate Programme is subjected to third cycle program with 211 ECTS credits for the doctorate degree in the field of Chemical Engineering.
Students who complete the program successfully with all the program requirements receive a doctorate (Ph.D.) degree in Chemical Engineering

Admission Requirements:

To apply for a doctorate program**,** an Master'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 score of 55 from ALES or 149 from GRE (Quantitative Reasoning).

- A minimum of 55 from YDS or 66 from TOEFL IBT. 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.

Or the students who have the BSc degree whofullfil the following requirements may apply for the degree:

- A minimum B.Sc. cumulative grade point average (CGPA) of 3.00 out of 4.00.

- A minimum score of 80 from ALES or 156 from GRE (Quantitative Reasoning).

- A minimum of 55 from YDS or 66 from TOEFL IBT. 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.

Employment Opportunities and Promotion

Our graduates may be in research activities in many national or international research instititues and universities as well as working in many national and international companies in chemical industry as engineers and managing directors.

Graduation Requirements

To earn Doctorate degree in Chemical Engineering, students who have a B.S. degree must complete 4 compulsory, 10 elective courses and a non-credit seminar course (42 credits, 259 ECTS) with a minimum CGPA of 3.0 (out of 4.0), be successful in the

Qualifying Examination, must prepare a Ph.D. Thesis and be succesful in the Dissertation Defense.

To earn Doctorate degree in Chemical Engineering, students who have a M.Sc. degree must complete 5 compulsory and 3 elective courses and a non-credit seminar course (21 credits, 211 ECTS), be successful in the Qualifying Examination, must prepare a Ph.D. Thesis and be succesful in the Dissertation Defense.

Contact Details:

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