(It will be applied from 2016-2017 Fall)

İZMİR INSTITUTE OF TECHNOLOGY
GRADUATE SCHOOL OF ENGINEERING AND SCIENCES
DEPARTMENT OF CHEMISTRY
CURRICULUM OF THE GRADUATE PROGRAMS

M.S. in CHEMISTRY

Core Courses		Credits
CHEM 500	M. S. Thesis	(0-1)NC
CHEM 501	M. S. Seminar in Chemistry*	(0-2)NC
CHEM 8XX	Special Studies	(8-0)NC
CHEM 599	Scientific Research Techniques and Ethics in Research and Academic Writing	(2-0)NC

***All M.S. students must register M.S. Seminar in Chemistry course in the term"M.S. Research Proposal Seminar" will be given. All M.S. students must register M.S. Seminar in Chemistry course until the beginning of their 4th semester.**

In addition, at least 2 of the following courses must be taken.

CHEM 502	Advanced Analytical Chemistry	(3-0)3
CHEM 503	Advanced Biochemistry	(3-0)3
CHEM 504	Advanced Inorganic Chemistry	(3-0)3
CHEM 505	Advanced Organic Chemistry	(3-0)3
CHEM 506	Advanced Physical Chemistry	(3-0)3

Total credit (min.) : 21
Number of courses with credit (min.) : 7

Ph.D. in CHEMISTRY

Core Courses

CHEM 600	Ph.D. Thesis	(0-1)NC
CHEM 601	Ph. D. Seminar in Chemistry*	(0-2)NC
CHEM 8XX	Special Studies	(8-0)NC
CHEM 599	Scientific Research Techniques and Ethics in Research and Academic Writing**	(2-0)NC

***All Ph. D. students must register Ph. D. Seminar in Chemistry course in the term "Ph. D. Research Proposal Seminar" will be given.**

** **Must be registered by the Ph.D. Students who have not taken this course during their M.S. Program.**

Total credit (min.) : 21 (for students with M.S. degree)
Number of courses with credit (min.) : 7 (for students with M.S. degree)
Total credit (min.) : 42 (for students with B.S. degree)
Number of courses with credit (min.) : 14 (for students with B.S. degree)

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Elective Courses

Code	Name	Credits	Prereq.
CHEM 510	Advances in Analytical Atomic Spectrometry	(3+0) 3	
CHEM 511	Analytical Applications of Nuclear and Radiochemical Methods	(3+0) 3	
CHEM 512	Analytical Separation Techniques	(3+0) 3	
CHEM 513	Chemometrics	(3+0) 3	
CHEM 514	Classification and Clustering Techniques in Analytical Chemistry	(3+0) 3	
CHEM 515	Environmental Chemistry	(3+0) 3	
CHEM 516	Experimental Design and Optimisation	(3+0) 3	
CHEM 517	Fundamentals and Applications of Laser Induced Plasma Spectroscopy	(3+0) 3	
CHEM 518	Glow Discharge Spectroscopies	(3+0) 3	
CHEM 519	Near-Infrared Spectroscopy and Raman Spectroscopy in Multivariate Analysis	(3+0) 3	
CHEM 520	Selected Topics in Analytical Chemistry	(3+0) 3	
CHEM 521	Spectrochemical Analysis	(3+0) 3	
CHEM 530	Experimental Biochemistry	(3+0) 3	
CHEM 531	Protein Chemistry	(3+0) 3	CHEM 411
CHEM 532	Special Topics in Biochemistry	(3+0) 3	
CHEM 539	Bioelectronics: Fundamentals of Bioelectrochemistry for Biomedical Sensors and Devices	(3+0) 3	
CHEM 540	Advanced Organometallic Chemistry	(3+0) 3	
CHEM 541	Advanced Solid State Chemistry	(3+0) 3	
CHEM 542	Analysis Techniques in Solid State Chemistry	(2+2) 3	
CHEM 543	Chemical Applications of Group Theory	(3+0) 3	
CHEM 544	Industrial and Biochemical Applications of Molybdenum Compounds	(3+0) 3	
CHEM 546	Introduction to Crystallography	(2+2) 3	
CHEM 547	Manipulation and Characterization Techniques for Air Sensitive Compounds	(2+2) 3	
CHEM 548	Selected Topics in Inorganic Chemistry	(3+0) 3	
CHEM 550	Synthetic Methods in Coordination Chemistry	(3+0) 3	
CHEM 555	Principles of Asymmetric Synthesis	(3+0) 3	
CHEM 556	Reactions and Synthesis in Organic Chemistry	(3+0) 3	
CHEM 557	Selected Topics in Bioorganic and Medicinal Chemistry	(3+0) 3	
CHEM 558	Special Topics in Organic Chemistry	(3+0) 3	
CHEM 559	Spectroscopic Methods in Organic Chemistry	(3+0) 3	
CHEM 560	Strategy and Control in Organic Synthesis	(3+0) 3	
CHEM 561	Structure Elucidation in Solution by NMR Spectroscopy	(3+0) 3	
CHEM 562	Supramolecular Chemistry	(3+0) 3	
CHEM563	Writing Organic Reaction Mechanisms	(3+0)3	
CHEM 570	Advanced Polymer Science	(3+0) 3	
CHEM 571	Applied Bioconjugate Chemistry	(3+0) 3	
CHEM 572	Bioconjugate Chemistry	(3+0) 3	
CHEM 573	Biophysical Chemistry	(3+0) 3	
CHEM 574	Chemical Thermodynamics	(3+0) 3	
CHEM 575	Colloid Chemistry and Surface Science	(3+0) 3	
CHEM 576	Experimental Proteomics	(3+0) 3	CHEM 585

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CHEM 577	Interfacial Phenomena	(3+0) 3
CHEM 579	Molecular Modelling	(3+0) 3
CHEM 580	Molecular Simulation	(3+0) 3
CHEM 581	Molecular Spectroscopy	(3+0) 3
CHEM 582	Nanobiotechnology	(3+0) 3
CHEM 583	Nanophotonics	(3+0) 3
CHEM 584	Nanoscience and Nanotechnology	(3+0) 3
CHEM 585	Selected Topics in Mass Spectrometry	(3+0) 3
CHEM 586	Selected Topics in Physical Chemistry	(3+0) 3
CHEM 587	Single Molecule Chemistry and Biophysics	(3+0) 3

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COURSE DESCRIPTIONS **Credits**

CHEM 500 M. S. Thesis (0+1) NC
Program of research leading to MS. degree arranged between student and a faculty member. Students register to this course in all semesters starting from the beginning of their second semesters.

CHEM 501 M. S. Seminar in Chemistry (0+2) NC
Seminars that are given by Faculty of Science must be participated by students and a seminar about specific subjects will be given by the student.

CHEM 502 Advanced Analytical Chemistry (3+0) 3
Graduate level review of modern analytical chemistry and the literature. The analytical process and quality assurance/quality control. Fundamentals of chemical analysis including, homogeneous and heterogeneous equilibria, complex formation and redox systems. The use of modern analytical methods. Chemical and biochemical sensors, Total analysis systems, hyphenated techniques and process analytical chemistry.

CHEM 503 Advanced Biochemistry (3+0) 3
Chemistry of metarials of biochemistry interest. Carbonhydrates, lipids, proteins, aminoacids, nucleic acids, porphynins. Biochemistry of blood. Enzymes, metobolism, protein and nucleic acid biosynthesis.

CHEM 504 Advanced Inorganic Chemistry (3+0) 3
Atomic structure. Ionic bonding and nature of solids. The covalent bond. Acid-base chemistry. Coordination chemistry. Theory and structure, reaction kinetics and mechanisms. Organometallic chemistry and catalysis.

CHEM 505 Advanced Organic Chemistry (3+0) 3
Basic and advanced topics of organic chemistry mainly related to structure and mechanisms and related advanced topics.

CHEM 506 Advanced Physical Chemistry (3+0) 3
Basic principles of statistical thermodynamics, moleculer spectroscopy and some other advanced topics of physical chemistry.

CHEM 510 Advances in Analytical Atomic Spectrometry (3+0) 3
Review of developments in analytical atomic spectrometry, advances in AAS, ICP-AES and ICP-MS systems.

CHEM 511 Analytical Applications of Nuclear and Radiochemical Methods (3+0) 3
Selected applications of radioisotopic tracers and nuclear radiation in chemistry and some of other scientific fields.

CHEM 512 Analytical Separation Techniques (3+0) 3
Fundamental concepts of separation and practical aspects of current separation techniques used in analytical chemistry. Solvent extraction, volatilization, ion exchange, solid phase micro-extraction, liquid, gas and supercritical fluid chromatography, electrophoresis, capillary electrophoresis and field-flow fractionation.

CHEM 513 Chemometrics (3+0) 3
A survey of chemometrics, providing sufficient statistical background for chemist. The topics covered include probability, statistics, sampling estimation, multivariate regression analysis, optimization and experimental design, data analysis and signal processing.

CHEM 514 Classification and Clustering Techniques in Analytical Chemistry (3+0) 3
This course will have general coverage of the subjet ranging from principles of classification and clutering techniques, Hierarchical and Non–hierarchical, pattern recognition, K–nearest neighbor, Principle Component Analysis (PCA) Factorial Discriminant Analysis and , Mahalanobis Distance Method.

CHEM 515 Environmental Chemistry (3+0) 3
Reaction thermodynamics, ionic and oxidation-reduction equilibria, and reaction kinetics as related to natural aquatic and pollution control processes.

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CHEM 516 Experimental Design and Optimisation (3+0) 3

This course will have general coverage of the subject ranging from basic principles of experimental design and optimization, randomized block and latin square designs, central composite design, response surface methods, and simplex optimization.

CHEM 517 Fundamentals and Applications of Laser Induced Plasma Spectroscopy (3+0) 3

Fundamental concepts in production, evolution and decay of the laser induced plasmas. Plasma characterization. Analytical applications of LIPS as an atomic emission spectroscopic technique. Optical and electronic instrumentation for LIPS.

CHEM 518 Glow Discharge Spectroscopies (3+0) 3

This course will cover the followıng subjects: fundamentals of glow discharge spectroscopies, glow discharge optical spectroscopy, glow discharge mass spectrometry, solids analysis, new developments, and comparison with other methods of analysis.

CHEM 519 Near-Infrared Spectroscopy and Raman Spectroscopy in Multivariate Analysis (3+0) 3

This course will have general coverage of the subjet ranging from principles of Near–Infrared spectroscopy, Raman spectroscopy, multivariate analysis techniques, and their applications.

CHEM 520 Selected Topics in Analytical Chemistry (3+0) 3

Topics of current interest in analytical chemistry including advanced electrochemistry, surface spectroscopy, separations, laboratory automation, and new spectroscopic techniques.

CHEM 521 Spectrochemical Analysis (3+0) 3

Fundamental aspects of optical spectrochemical methods including, nature of spectrochemical information and measurements, Methodology in spectrochemical analysis. Optical components and design of spectrometers. Theory and operation of instruments. Signal-to-Noise considerations. Atomic emission and absorption spectroscopy. Molecular spectroscopy including uv-visible and infrared and luminescence spectrometry. Molecular scattering methods. New developments in spectrochemical techniques.

CHEM 530 Experimental Biochemistry (3+0) 3

The course will provide not only important and new subjects in the area of biochemistry but also will let students do hand in biological experiments in the laboratory.

CHEM 531 Protein Chemistry (3+0) 3

This course provides information for the importance of proteins in life and the reason of the chemistry knowledge of that macromolecules with landmark examples in biology and chemistry.
Prereq. CHEM 411 Biochemistry.

CHEM 532 Special Topics in Biochemistry (3+0) 3

The course contents will cover the recent development in the area of biochemistry and provide better understanding of biology in chemistry.

CHEM 539 Bioelectronics: Fundamentals of Bioelectrochemistry for Biomedical Sensors and Devices (3+0) 3

This course discusses chemistry and methods for control of electroactivity of sensing biointerface utilized for biomedical devices and instruments. The course covers the basic working principles of biomedical sensors as well as fabrication methodologies of biocompatible conducting electrodes. Enzyme electrodes, DNA templated electronic circuits, nanoparticle modified electrodes and electrode miniturization methods are discussed.

CHEM 540 Advanced Organometallic Chemistry (3+0) 3

Synthesis, properties and reactivity of organometallic compounds; the methodologies of organometallic chemistry of particular emphasis will be techniques of preparing and handling air and moisture sensitive compounds and coumpound purification and crystallization.

CHEM 541 Advanced Solid State Chemistry (3+0) 3

This course will have general coverage of the subject ranging from synthesis, characterization and structural consideration to properties and applications.

CHEM 542 Analysis Techniques in Solid State Chemistry (2+2) 3

This course will have general coverage of the analysis techniques in solid state chemistry to identify structural and physical properties of the compounds.

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CHEM 543 Chemical Applications of Group Theory (3+0) 3
It covers principles, including definitions, molecular symmetry, representation of groups and quantum mechanic and their applications.

CHEM 544 Industrial and Biochemical Applications of Molybdenum Compounds (3+0) 3
Various oxidation states of molybdenum and its inorganic compounds, inorganic compounds of molybdenum, oxo and imido compounds of molybdenum, molybdenum compounds as heterogeneous catalysts, molybdenum oxo and imido compounds as catalysts, molybdenum containing enzymes, molybdenum compounds as biochemical catalysts.

CHEM 546 Introduction to Crystallography (2+2) 3
This class will include theory and applications of X-ray crystallography.

CHEM 547 Manipulation and Characterization Techniques for Air Sensitive Compounds (2+2) 3
Bench-top inert atmosphere techniques. Adaptations of standart glassware. Syringe and cannula techniques. Schlenk techniques. Hot tube and sealed tube techniques, inert atmosphere glove-box techniques

CHEM 548 Selected Topics in Inorganic Chemistry (3+0) 3
Contents vary according to students's interest including topies related to modern inorganic chemistry and organometallic chemistry. Chemistry of some inorganic materials; synthetic methods and caracterization techniques will also be discussed.

CHEM 550 Synthetic Methods in Coordination Chemistry (3+0) 3
Fundamental Concepts in Modern CoordinationChemistry, Ligands of Modern Coordination Chemistry, Main Methods of the Synthesis of Coordination Compounds,Synthetetic Methods for Coordination Compounds with unusual properties, Synthesis of selected groups of coordination compounds

CHEM 555 Principles of Asymmetric Synthesis (3+0) 3
Covers basic principles related to the asymmetric synthesis in organic chemistry, such as: the diastereoselectivity in reactions of enantiopure starting materials and asymmetric catalysis.

CHEM 556 Reactions and Synthesis in Organic Chemistry (3+0) 3
Reactions and synthesis: nucleophilic reactions, electrophilic additions, reduction of functional groups, cycloaddition, unimolecular rearrangements, organometallic compounds, aromatic substitution, oxidations, multistep synthesis.

CHEM 557 Selected Topics in Bioorganic and Medicinal Chemistry (3+0) 3
The course contents will vary according to the students' interests, including topics related to synthesis and biological-biochemical applications of organic molecules

CHEM 558 Special Topics in Organic Chemistry (3+0) 3
Contents vary according to interest of students and instructor in charge. Typical contents include contemporary developments in Organic Chemistry.

CHEM 559 Spectroscopic Methods in Organic Chemistry (3+0) 3
Spectroscopic methods that include infrared spectroscopy, ultraviolet spectroscopy, mass spectroscopy and nuclear magnetic resonance spectroscopy will be used to identify the structures of organic compounds.

CHEM 560 Strategy and Control in Organic Synthesis (3+0) 3
This course covers the development of alternative strategies for solving problems in organic synthesis.

CHEM 561 Structure Elucidation in Solution by NMR Spectroscopy (3+0) 3
Basics of NMR (stationary magnetic field, radio frequency magnetic field, nuclear spin, dipole moment, energy, resonance condition, free induction decay).

CHEM 562 Supramolecular Chemistry (3+0) 3
The course includes discussion of the design, synthesis and the applications of macromolecular compounds to areas such as molecular electronics, molecular recognition.

CHEM 563 Writing Organic Reaction Mechanisms (3+0) 3
Covers detailed investigation of electron movements during the formation of possible intermediates or final products in organic chemistry reactions.

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CHEM 570 Advanced Polymer Science (3+0) 3
Configuration of polymeric chains, statistical thermodynamics of polymeric solutions/materials, rubberlike elasticity, elastic equation of state, statistical theory for ideal and real networks, and swelling of networks.

CHEM 571 Applied Bioconjugate Chemistry (3+0) 3
This course discusses experimental procedures of bioconjugate techniques.

CHEM 572 Bioconjugate Chemistry (3+0) 3
This course covers fundamentals of target chemicals/reagents and the chemistry of reactive groups in bioconjugate techniques.

CHEM 573 Biophysical Chemistry (3+0) 3
This course will cover foundations and biological applications of thermodynamics, kinetics, quantum theory and molecular spectroscopy. This course is to provide foundations for students who wish to study single molecule chemistry, molecular biophysics, and nanobiotechnology.

CHEM 574 Chemical Thermodynamics (3+0) 3
Development of thermodynamic theory, with special reference to common physical changes and chemical reactions.

CHEM 575 Colloid Chemistry and Surface Science (3+0) 3
Two major components of particle-particle interaction, namely van der walls and electrical double layer forces, will be examined for a theoritical estimate of the colloidal behavior for varying conditions.Coagulation and stability phenomena will be discussed with special emphasis on brownian and shear coagulation.Effect of polymer addition on the stability of a particulate system will be presented.

CHEM 576 Experimental Proteomics (3+0) 3
Proteomic application of mass spectrometry will be discussed. Sample preparation and sample handling will also be discussed. Protein sequencing, electrophoresis and HPLC techniques will be discussed. Protein purification and new bio-analytical techniques will also be discussed.
Prereq. CHEM 585 Selected Topics in Mass Spectrometry.

CHEM 577 Interfacial Phenomena (3+0) 3
The course will start off with a concise mention of chemical thermodynamics to elucidate the basic terminology.A discussion on the thermodynamics of liquid system will be covered so as to include van der walls, electrostatic and steric forces.Surfaces at solids will be examined as a prelude to more detailed analysis of various processes taking place at solid-liquid, liquid-liquid, solid-gas and liquid-gas interfaces, wetting, flotation and detergency will be included to emphasize how the phenomena studied applies to practical systems.

CHEM 579 Molecular Modelling (3+0) 3
Potential energy surfaces. Molecular mechanics. Introduction to molecular orbitals. Semi-empirical molecular orbital methods. Geometry optimization. Vibrational frequencies. Thermochemistry. Electron correleation. Density functional theory. Excited states. Solvent effects

CHEM 580 Molecular Simulation (3+0) 3
Statistical Mechanics, statistical ensembles, intermolecular forces, an introduction to Monte Carlo and molecular dynamics simulation techniques, computing free energies and phase equilibria.

CHEM 581 Molecular Spectroscopy (3+0) 3
Applications of quantum mechanism and group theory to the interpretation of electronic, vibrational, rotational and magnetic spectroscopy.

CHEM 582 Nanobiotechnology (3+0) 3
This course covers basics of functional nanoparticles for biomedical technologies and the current state-of-the-art.

CHEM 583 Nanophotonics (3+0) 3
This course covers foundations of nanophotonics, theory and applications along with growth and characterization of nanoscale photonic materials

CHEM 584 Nanoscience and Nanotechnology (3+0) 3
This course will cover the fundamentals of nanoscience and nanotechnology providing exemplary nanoscale materials and applications.

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CHEM 585 Selected Topics in Mass Spectrometry (3+0) 3

The new ioznization (MALDI and ESI) techniques and biopolymers and polymers analysis with mass spectrometry will be discussed. The course will also be discussed about CID and MS/MS techniques for structural identification of biopllymers and polymers.

CHEM 586 Selected Topics in Physical Chemistry (3+0) 3

Contents vary according to student's interest covering general aspects of modern physical chemistry.

CHEM 587 Single Molecule Chemistry and Biophysics (3+0) 3

This course provides information for the need of single molecule detection and discussion of vast array of single-molecule techniques with landmark examples in molecular biology and chemistry.

CHEM 599 Scientific Research Techniques and Ethics in Research and Academic Writing (2+0)NC

Ethics, ethics in science, research methodology in Chemistry, research, innovation and ethics, academic integrity, academic dishonesty and plagiarism, the ways to avoid plagiarism, citation techniques (paraphrase and summary) citation styles, editing, academic writing studies.

CHEM 600 Ph.D. Thesis (0-1)NC

Program of research leading to Ph.D. degree arranged between student and a faculty member. Students register to this course in all semesters starting from the beginning of their second semesters.

CHEM 601 Ph. D. Seminar in Chemistry (0-2)NC

Seminars that are given by Faculty of Science must be participated by students and a seminar about specific subjects will be given by the student.

CHEM 8XX Special Studies (8-0)NC

Graduate students supervised by the same faculty member study advanced topics under the guidance of their advisor.