Chemistry & Biochemistry (CHEM)

COURSES

CHEM 1181. GENERAL CHEMISTRY I LABORATORY FOR ADVANCED CHEMICAL TECHNOLOGIES. 1 Hour.
General, analytical, and synthetic chemistry concepts will be reinforced through problem- and inquiry-based laboratory activities. The Advanced Chemical Technologies track for majors will introduce research and scientific methods in the context of instructor and student-selected research problems. Hand-on experience in the laboratory will be supplemented with mini-lectures, modules, and web resources to increase student readiness for scientific discovery. Students will also learn about contemporary challenges and advances in chemistry and biochemistry. If a student withdraws from CHEM 1181, the student must also withdraw from CHEM 1341. Prerequisite: Concurrent enrollment in CHEM 1341.

CHEM 1182. GENERAL CHEMISTRY II LABORATORY FOR ADVANCED CHEMICAL TECHNOLOGIES. 1 Hour.
General, analytical, and synthetic chemistry concepts will be reinforced through problem- and inquiry-based laboratory activities. Research and scientific methods will be reinforced through the investigation of student-selected research problems and modules on scientific communication. Increased exposure to state-of-the-art analytical techniques and instruments, as well as synthetic methods will culminate in the preparation of a proposal related to the synthesis of new materials and the analysis of their structure and function. If a student withdraws from CHEM 1182, the student must also withdraw from CHEM 1342. Prerequisite: (CHEM 1341 with a grade of C or better) and (CHEM 1181 with a grade of C or better) and (concurrent enrollment in CHEM 1342).

CHEM 1185. CHEMISTRY FOR ENGINEERS LABORATORY. 1 Hour.
This course is intended to provide laboratory credit in chemistry for engineering-majors who transfer into UT-Arlington with credit in Chemistry for Engineers lecture only. Students may register for this course only with specific approval of a Chemistry advisor. Prerequisite: 3 hours of Chemistry for Engineers lecture. Credit cannot be earned for both CHEM 1465 and CHEM 1185.

CHEM 1188. GENERAL CHEMISTRY I LABORATORY. 1 Hour.
This course is intended to provide laboratory credit in freshman chemistry for students who transfer into UT-Arlington with credit in General Chemistry I lecture only. Experiments include: measurement and scientific equipment use, physical properties, separations, synthesis, qualitative analysis, spectroscopy. Students may register for this course only with specific approval of a Chemistry advisor. Prerequisite: 3 hours of General Chemistry I lecture. Credit cannot be earned for both CHEM 1441 and CHEM 1188.

CHEM 1189. GENERAL CHEMISTRY II LABORATORY. 1 Hour.
This course is intended to provide laboratory credit in freshman chemistry for students who transfer into UT-Arlington with credit for General Chemistry lecture only. Experiments include: thermodynamics, electrochemistry, synthesis, quantitative analysis, spectroscopy, stoichiometry, and acid-base chemistry. Students may register for this course only with specific approval of a Chemistry advisor. Prerequisite: CHEM 1188 and 6 hours of General Chemistry II lecture. Credit cannot be earned for both CHEM 1442 and CHEM 1189.

CHEM 1341. GENERAL CHEMISTRY I. 3 Hours.
This course covers the fundamentals of atomic structure, chemical bonding, the periodic table, nomenclature, kinetic theory, gas laws, chemical equations, and solutions. Only chemistry majors in the Advanced Chemical Technologies program may take this course. When combined with CHEM 1181, this course will satisfy completion of CHEM 1441 for Chemistry, Biochemistry, and Biological Chemistry majors. Prerequisite: (MATH 1302 or MATH 1303 or MATH 1322 or MATH 1323 or MATH 1402 or MATH 1421 or MATH 1426 or MPT Algebra score =/> 17) and (concurrent enrollment in CHEM 1181). ACT program only.

CHEM 1342. GENERAL CHEMISTRY II. 3 Hours.
This course covers study of advanced atomic structure and bonding concepts, acid-base theory, kinetics and equilibria, thermodynamics, electrochemistry, and the chemistry of some elements. Only chemistry majors in the Advanced Chemical Technologies program may take this course. When combined with CHEM 1182, this course will satisfy completion of CHEM 1442 for Chemistry, Biochemistry, and Biological Chemistry majors. Prerequisite: (CHEM 1341 or CHEM 1441 with a grade of C or better) and (CHEM 1181 with a grade of C or better) and (concurrent enrollment in CHEM 1182). ACT program only.

CHEM 1345. CHEMISTRY IN THE WORLD AROUND US. 3 Hours.
This course looks at current issues in society and uses chemical principles to understand them. Topics include sustainability, air pollution, the ozone layer, global climate change, fuels, and water. CHEM 1345/1346 cannot be used to fulfill the CHEM 1441/1442/1451/1465 requirement in any degree program.

CHEM 1346. CHEMISTRY IN THE WORLD AROUND US II. 3 Hours.
This course is a continuation of the study of current issues in society using chemical principles to understand them. Topics include polymers, drug design, nutrition, and genetic engineering. CHEM 1345/1346 cannot be used to fulfill the CHEM 1441/1442/1451/1465 requirement in any degree program. Prerequisite: CHEM 1345 or equivalent with a grade of C or better.

CHEM 1400. INTRODUCTORY CHEMICAL PRINCIPLES. 4 Hours.
Provides a background in fundamental chemical mathematics, in writing and understanding chemical formulas and equations, and in the application of scientific laws to the behavior of matter. Students will learn problem solving skills necessary in general chemistry I by hands-on and interactive approach. This course is designed for the student with little or no previous chemical training who intends to take the CHEM 1441/CHEM 1442 sequence or CHEM 1465 at a later date. CHEM 1400 cannot replace CHEM 1441/CHEM 1442/CHEM 1451/CHEM 1465. Prerequisite: MATH 1302 or equivalent or MPT Algebra score =/> 17.

CHEM 1441. GENERAL CHEMISTRY I. 4 Hours. (TCCN = CHEM 1411)
The lecture covers the fundamentals of atomic structure, chemical bonding, the periodic table, nomenclature, kinetic theory, gas laws, chemical equations, and solutions. The laboratory introduces the scientific method, experiment design, data collection and analysis, as well as illustrates fundamental principles presented in the lecture. Students who have not had high school chemistry are advised to take an introductory chemistry course first. Prerequisite: MATH 1302 or MATH 1303 or MATH 1322 or MATH 1323 or MATH 1402 or MATH 1421 or MATH 1426 or MPT Algebra score =/> 17 or ALEKS =/> 61 or Student Group CHEM 1441.

CHEM 1442. GENERAL CHEMISTRY II. 4 Hours. (TCCN = CHEM 1412)
Study of advanced atomic structure and bonding concepts, acid-base theory, kinetics and equilibria, thermodynamics, electrochemistry, the chemistry of some elements. The laboratory focuses on experimental design, data collection and analyses as well as chemical syntheses to illustrate fundamental principles presented in the lecture. Prerequisite: CHEM 1441 or equivalent with a grade of C or better or (CHEM 1341 with a grade C or better) or Student Group CHEM 1442.

CHEM 1445. CHEMISTRY FOR NON-SCIENCE MAJORS. 4 Hours. (TCCN = CHEM 1405)
Chemistry of things of everyday life: energy, radioactivity, petroleum products, pollution, the nature of matter, and the applications of chemistry to things we use. CHEM 1445, 1446 cannot be used to fulfill the 1441/1442 requirement in any degree program.

CHEM 1446. CHEMISTRY II FOR NON-SCIENCE MAJORS. 4 Hours. (TCCN = CHEM 1407)
Continuation of the chemistry of things of everyday life. Vitamins, minerals, chemical additives, plastics, cosmetics, proteins, carbohydrates, poisons, fats, and oils. Prerequisite: CHEM 1445 or equivalent with a grade of C or better. CHEM 1445, CHEM 1446 cannot be used to fulfill the CHEM 1441/ CHEM 1442 requirement in any degree program.

CHEM 1451. CHEMISTRY FOR HEALTH SCIENCES. 4 Hours.
Survey of general, organic, and biochemistry with emphasis on applications to the human body. Measurement, atomic theory and structure, bonding, quantitative relationships in chemical reactions, gases, solutions, electrolytes, organic functional groups and nomenclature, organic reactions, carbohydrates, lipids, proteins, enzymes, metabolism, and nucleic acids. CHEM 1451 cannot count for major credit toward a degree in chemistry. Prerequisite: MATH 1301 or MATH 1302 or MATH 1303 or MATH 1315 or MATH 1316 or MATH 1322 or MATH 1323 or MATH 1324 or MATH 1421 or MATH 1426 or equivalent.

CHEM 1465. CHEMISTRY FOR ENGINEERS. 4 Hours.
An introduction to important concepts and principles of chemistry with emphasis on areas considered most relevant in an engineering context. Topics include chemical stoichiometry, bonding, chemical thermodynamics, equilibria, electrochemistry, and kinetics. Engineering students may substitute the eight hour sequence CHEM 1441 and CHEM 1442 for this class, but not either CHEM 1441 or CHEM 1442 alone. Students who complete CHEM 1465 and subsequently change majors to curricula that require both CHEM 1441 and CHEM 1442 may substitute CHEM 1465 for CHEM 1441. Prerequisite: C or better in MATH 1322 or C or better in MATH 1323 or C or better in MATH 1324 or C or better in MATH 1421 (or concurrent enrollment) or MATH 1426 (or concurrent enrollment) or HONR-SC 1426 (or concurrent enrollment) or MATH 2425 (or concurrent enrollment) or HONR-SC 2425 (or concurrent enrollment) or Student Group CHEM 1465.

CHEM 2101. CHEMICAL INFORMATICS I. 1 Hour.
Developing quantitative understanding in chemistry relies heavily on models, from very crude and simple ideas to complex theoretical frameworks. This class aims to introduce students into models and modeling chemical phenomena that develop understanding of chemical processes. Working with observations and data, we develop the art of developing qualitative relations and explore their limitations. The class is delivered as a practical tour with hands-on practice. Good number skills, basic knowledge of coding and handling of computers is required. Prerequisite: (CHEM 1442 with a grade of C or better) and (MATH 1426 with a grade of C or better or Concurrent enrollment in MATH 1426 or Instructor's permission).

CHEM 2180. RESEARCH IN CHEMISTRY. 1 Hour.
Research for undergraduate students supervised by faculty of the department. May be repeated. Graded pass/fail only. Prerequisite: written permission of the instructor. Students may take a maximum of 12 hours credit on a pass/fail basis.

CHEM 2181. ORGANIC CHEMISTRY I LABORATORY. 1 Hour. (TCCN = CHEM 2123)
Experiments which illustrate laboratory techniques, theoretical concepts, and synthesis. Prerequisite: CHEM 1442 with a grade of C or better or ((CHEM 1342 with a grade C or better) and (CHEM 1343 with a grade C or better)) or Student Group CHEM 2181. Corequisite: CHEM 2321. If student withdraws from CHEM 2321 prior to midsemester date, student must also withdraw from CHEM 2181.

CHEM 2182. ORGANIC CHEMISTRY II LABORATORY. 1 Hour. (TCCN = CHEM 2125)
Experiments which will include syntheses, characterization of unknown substances, and use of the chemical literature. Prerequisite: (CHEM 2181 with a grade of C or better) and (CHEM 2321 with a grade of C or better). Corequisite: CHEM 2322. If student withdraws from CHEM 2322 prior to the midsemester date, student must also withdraw from CHEM 2182.

CHEM 2283. SYNTHESIS AND ANALYSIS LABORATORY I. 2 Hours.
Students will perform experiments that build mastery in standard laboratory techniques and illustrate theoretical concepts related to organic synthesis and quantitative analysis methods. Students will continue to develop their mastery of analysis through an introduction to the acquisition and statistical analysis of quantitative and qualitative data, acquired in the context of a series of guided inquiry design and synthesis projects. Syntheses may involve small molecules, polymers, and materials designed to perform specific functions. Students will continue to develop their communication and group work skills by sharing independent data and critical feedback with peers. Additionally, laboratory exercises will involve basic titrimetric, spectrophotometric, and chromatographic methods. Prerequisite: CHEM 1442/CHEM 1342 and CHEM 1182 or equivalent with a grade of C or better. Corequisites: Concurrent enrollment or previous credit in CHEM 2321 and CHEM 2335. Students must remain enrolled in at least one of CHEM 2321 and CHEM 2335 beyond the mid-semester date to remain enrolled in CHEM 2283.

CHEM 2284. SYNTHESIS AND ANALYSIS LABORATORY II. 2 Hours.
Experiments will include syntheses and analysis, characterization of unknown substances, and use of the chemical literature. A focus will be placed on advancing the use of modern chemical technologies for both synthetic and analytical work in a guided inquiry format. Prerequisite: CHEM 2283 and CHEM 2321 with a grade of C or better. Corequisite: CHEM 2322.

CHEM 2285. QUANTITATIVE CHEMISTRY LABORATORY. 2 Hours.
An introduction to computers for the acquisition and statistical analysis of data. Laboratory exercises involving basic titrimetric, spectrophotometric and chromatographic methods. Prerequisite: CHEM 1442 or equivalent with a grade of C or better, and concurrent enrollment/previous credit in CHEM 2335.

CHEM 2321. ORGANIC CHEMISTRY I. 3 Hours. (TCCN = CHEM 2323)
The fundamentals of molecular structure, stereochemistry, and the reactions of aliphatic hydrocarbons. Electronic theory, synthetic methods, and mechanisms. Prerequisite: CHEM 1442 with a grade of C or better or ((CHEM 1342 with a grade C or better) and (CHEM 1182 with a grade C or better)) or Student Group CHEM 2321.

CHEM 2322. ORGANIC CHEMISTRY II. 3 Hours. (TCCN = CHEM 2325)
Organic spectroscopic analysis. The chemistry of aromatic hydrocarbons, alcohols and ethers, aldehydes, ketones, carboxylic acids and derivatives, amines, amino acid, carbohydrates, and other functional groups. Mechanisms and synthesis. Prerequisite: CHEM 2321 with a grade of C or better.

CHEM 2335. QUANTITATIVE CHEMISTRY. 3 Hours.
Basic methods of error analysis, simple and advanced methods for the solution of complex equilibria, fundamentals of titrimetric, spectrophotometric and chromatographic instrumental analysis. Prerequisite: (CHEM 1442 or CHEM 1342 or equivalent) and (MATH 1324 or MATH 1325 or MATH 1421 or MATH 1426 or equivalent or higher) and (CHEM 2285 or CHEM 2283 concurrent enrollment or previous credit).

CHEM 2380. UNDERGRADUATE RESEARCH. 3 Hours.
Research in chemistry supervised by a faculty member of the department. May be repeated. Graded pass/fail only. Prerequisite: written permission of the instructor. Students may take a maximum of 12 hours credit on a pass/fail basis.

CHEM 3101. CHEMICAL INFORMATICS II. 1 Hour.
This course provides a succinct overview of the emerging discipline of Chemical Informatics at the intersection of chemistry, computational science, and information science. Efficient and reliable analysis of chemical analytical data is a great challenge due to the increase in data size, variety and velocity. Attention in this class is drawn to specific opportunities afforded by this new field in accelerating discovery and understanding of cause and effect. The class is delivered as a practical tour with hands-on practice. Good number skills, basic knowledge of coding and handling of computers is required. Prerequisite: (CHEM 2101 with a grade C or better) or (Instructor's permission).

CHEM 3131. CHEMISTRY COMMUNITY SERVICE LEARNING. 1 Hour.
Service learning is a credit-bearing learning experience; therefore, credit is awarded for academic learning and not for service hours. Students engage in classroom activities, assignments, and discussions and in addition, integrate course content and learning outcomes with genuine community needs or issues. Collaborations with the community result in relationship-building and partnerships through intentional, structured service experiences. Students are required to analyze and evaluate these experiences by engaging in reflective activities, such as discussion and journaling. This process of structured service and learning in the community promote a sense of civic responsibility and commitment to others. Students commit to serve weekly time resulting in at least fifteen hours during one semester. This time is agreed upon by student, faculty, and community agency. Prerequisites: Permission of the Instructor.

CHEM 3175. BIOPHYSICAL CHEMISTRY LABORATORY. 1 Hour.
Introduction to the physical experimental techniques used in quantitative biochemical practice. Prerequisite: CHEM 3315 or concurrent enrollment.

CHEM 3181. PHYSICAL CHEMISTRY I LABORATORY. 1 Hour.
The physical and thermodynamic properties of substances, experimentally determined. Prerequisite: Grade of C or better in CHEM 2285 or CHEM 2343 , CHEM 2335, and CHEM 3321 or concurrent enrollment.

CHEM 3182. PHYSICAL CHEMISTRY II LABORATORY. 1 Hour.
Experiments in kinetics, equilibria, spectroscopy, and electrochemistry. Modern instrumental techniques. Prerequisite: Grade C or better in CHEM 2285 or CHEM 2343, CHEM 2335, and CHEM 3322 or concurrent enrollment.

CHEM 3231. CHEMISTRY/BIOCHEMISTRY COMMUNITY SERVICE LEARNING. 2 Hours.
Service learning is a credit-bearing learning experience; therefore, credit is awarded for academic learning and not for service hours. Students engage in classroom activities, assignments, and discussions and in addition, integrate course content and learning outcomes with genuine community needs or issues. Collaborations with the community result in relationship-building and partnerships through intentional, structured service experiences. Students are required to analyze and evaluate these experiences by engaging in reflective activities, such as discussion and journaling. This process of structured service and learning in the community promote a sense of civic responsibility and commitment to others. Students commit to serve weekly time resulting in at least fifteen hours during one semester. This time is agreed upon by student, faculty, and community agency. Prerequisites: Permission of the Instructor.

CHEM 3307. INTRODUCTION TO POLYMER CHEMISTRY. 3 Hours.
The chemistry and technology of polymeric systems. The chemistry of natural systems such as proteins as well as the synthesis of fibers, films, plastics, and elastomers. Discussion of the characterization of polymers by modern techniques using instrumental analysis is followed by a summary of end-use and processing techniques. Prerequisite: CHEM 2322 with a grade of C or better or permission of instructor.

CHEM 3315. INTRODUCTION TO BIOPHYSICAL CHEMISTRY. 3 Hours.
A basic course introducing the physical principles that govern biological systems and processes, and the methods used for their investigation. Topics include solution thermodynamics, biomolecular interactions, enzyme kinetics, transport processes (diffusion, sedimentation, electrophoresis, viscous flow), and the applications of spectroscopic methods (absorption, emission and scattering of radiation, and the utilization of polarized light). Prerequisite: A grade of C or better in each of the following: CHEM 2335, MATH 2425, and 8 hours of college level physics.

CHEM 3317. INORGANIC CHEMISTRY. 3 Hours.
An overview of descriptive main group chemistry, solid state structures and the energetics of ionic, metallic, and covalent solids, acid-base chemistry and the coordination chemistry of the transition metals. The course is intended to explore and describe the role of inorganic chemistry in other natural sciences with an emphasis on the biological and geological sciences. Important compounds and reactions in industrial chemistry are also covered. Intended for both chemistry and non-chemistry majors. Prerequisite: Grade of C or better in CHEM 2322 or concurrent enrollment.

CHEM 3321. PHYSICAL CHEMISTRY I. 3 Hours.
Thermodynamics, gases, First and Second Law, pure substances, mixtures and solutions, equilibrium; Statistical Thermodynamics; Kinetics, rates, mechanisms, transitions state theory. In this class you will learn to understand the basic principles of Chemistry as the Science of Transformation and Change. We emphasize conceptual understanding and will become skilled in a quantitative description of the phenomena we study. The goal is that at the end of the course every student can outline the basic principles of Thermodynamics, has a sound understanding of ideal and approximate systems, and can apply the tools to engage in self-driven investigations. Prerequisites: CHEM 2335, MATH 2326, both with a grade of C or better and PHYS 1443 and PHYS 1444. MATH 3318 concurrent enrollment recommended.

CHEM 3322. PHYSICAL CHEMISTRY II. 3 Hours.
Quantum theory, introduction, principles. Schrödinger Equation, wavefunction; particle in a box, uncertainty; postulates of quantum mechanics; hydrogen atom, orbitals, structure of multi-electron atoms, atomic spectra and selection rules; molecular structure of diatomic molecules; introduction to molecular spectroscopy; materials and structure: lattices, diffraction methods, properties of solids. In this class you will learn to understand the principles of Quantum Chemistry and how it applies to atoms, molecules, and solids. We emphasize conceptual understanding and will become skilled in quantitative descriptions. The goal is that at the end of the course every student can outline the basic principles of Quantum Chemistry, both qualitatively and quantitatively. Students will obtain a sound understanding of probability, wavefunctions, orbitals, and spectroscopy, and can apply the learned concepts and tools to engage in self-driven investigations. This course is designated as the capstone course. Prerequisite: CHEM 2335, MATH 2326, both with a grade of C or better and PHYS 1443 and PHYS 1444. MATH 3318 concurrent enrollment recommended.

CHEM 3331. CHEMISTRY/BIOCHEMISTRY COMMUNITY SERVICE LEARNING. 3 Hours.
Service learning is a credit-bearing learning experience; therefore, credit is awarded for academic learning and not for service hours. Students engage in classroom activities, assignments, and discussions and in addition, integrate course content and learning outcomes with genuine community needs or issues. Collaborations with the community result in relationship-building and partnerships through intentional, structured service experiences. Students are required to analyze and evaluate these experiences by engaging in reflective activities, such as discussion and journaling. This process of structured service and learning in the community promote a sense of civic responsibility and commitment to others. Students commit to serve weekly time resulting in at least fifteen hours during one semester. This time is agreed upon by student, faculty, and community agency. Prerequisites: Permission of the Instructor.

CHEM 4080. UNDERGRADUATE RESEARCH. 0 Hours.
Research problems on an individual basis, conducted on a selected topic under the direction of a member of the chemistry and biochemistry faculty. May be repeated. This is a non-credit course and cannot be used to meet degree requirements. Prerequisite: Permission of the instructor.

CHEM 4101. SEMINAR IN CHEMISTRY. 1 Hour.
Oral and written communication of chemical information. Seminars will be presented by students on topics from the current chemical literature. A term paper is required. The use of the library for researching the chemical literature will be emphasized. May be repeated for a total of two semester hours of credit. Students must be within 12 credits hours from the degree completion. Departmental permission required.

CHEM 4180. UNDERGRADUATE RESEARCH. 1 Hour.
Research under the direction of a member of the department. No more than six hours of CHEM 4180, CHEM 4280, CHEM 4380 and CHEM 4381 may be taken for a letter grade. Prerequisite: Written permission of the instructor and a minimum grade point average of 2.5.

CHEM 4181. COMPUTATIONAL CHEMISTRY LABORATORY. 1 Hour.
Molecular modeling. Application of various computational techniques to chemical problems, including determination of molecular geometry, conformational analysis, and molecular energetics. Prerequisite: CHEM 3321 or CHEM 3322 with a grade C or better.

CHEM 4191. READINGS IN CHEMISTRY. 1 Hour.
May be repeated for a maximum of six hours credit. Topics arranged on an individual basis. Performance may be assessed by oral exam, written test, or review paper. Prerequisite: permission of department chair. Graded pass/fail only.

CHEM 4203. COMPUTATIONAL CHEMISTRY. 2 Hours.
A course emphasizing molecular quantum mechanics. Topics include the basic postulates of quantum mechanics, many electron wave functions, the variation method, and molecular orbital theory at various levels of approximation (Hueckel, Extended Hueckel, semi-empirical, ab initio, etc.). Related methods, such as force-field approaches and molecular dynamics, will be discussed. Prerequisite: CHEM 3322, with a grade of "C" or better.

CHEM 4242. LABORATORY TECHNIQUES IN BIOCHEMISTRY. 2 Hours.
Designed to introduce the student to biochemical laboratory methods; a practical approach to the properties of carbohydrates, proteins, enzymes, and nucleotides. Prerequisite: CHEM 4311, with a grade of "C" or better.

CHEM 4280. UNDERGRADUATE RESEARCH. 2 Hours.
Research under the direction of a member of the department. No more than six hours of CHEM 4180, CHEM 4280, CHEM 4380 and CHEM 4381 may be taken for a letter grade. Prerequisite: Written permission of the instructor and a minimum grade point average of 2.5.

CHEM 4291. READINGS IN CHEMISTRY. 2 Hours.
May be repeated for a maximum of six hours credit. Topics arranged on an individual basis. Performance may be assessed by oral exam, written test, or review paper. Prerequisite: permission of department chair. Graded pass/fail only.

CHEM 4311. BIOCHEMISTRY I. 3 Hours.
The chemistry of the sugars, amino acids, proteins, and nucleic acids, followed by an introduction to enzyme chemistry. The major metabolic pathways of the cell, glycolysis, TCA cycle, and pentose phosphate pathway. Auditing of this class is NOT permitted. Prerequisite: CHEM 2322, with a grade of "C" or better.

CHEM 4312. BIOCHEMISTRY II. 3 Hours.
A continuation of CHEM 4311. The breakdown and biosynthesis of fats and the synthesis of carbohydrates, including photosynthesis. Metabolic utilization of proteins and amino acids together with an introduction to protein synthesis. Prerequisite: CHEM 4311, with a grade of "C" or better, or equivalent.

CHEM 4313. METABOLISM AND REGULATION. 3 Hours.
Selected topics in advanced metabolism including biosynthesis of phospholipids, steroids, porphyrins and related molecules, and prostaglandins. Membranes and transport phenomena, regulation of glycogen and glucose metabolism in muscle and lipid metabolism in adipose tissue. Prerequisite: CHEM 4312 with a grade of C or better.

CHEM 4314. ENZYMOLOGY. 3 Hours.
A comprehensive study of enzymes including structures, reaction mechanisms, regulation, and kinetics. Prerequisite: CHEM 4311 with a grade of C or better.

CHEM 4316. BIOCHEMICAL GENETICS. 3 Hours.
Aspects of the biochemistry of gene expression in prokaryotic and eukaryotic organisms and its regulation, together with genetic manipulations and the methodology of recombinant DNA technology. Prerequisite: CHEM 4312 with a grade of C or better.

CHEM 4318. INORGANIC CHEMISTRY. 3 Hours.
An overview of the chemistry of the transition metals. Topics include symmetry and applications, bonding models, magnetism, synthesis of metal complexes, modern characterization techniques including IR, NMR, and electronic spectroscopy, organometallic compounds, reaction mechanisms, catalysis, and bioinorganic chemistry. Prerequisite: CHEM 2322 with a grade of C or better.

CHEM 4343. RESEARCH METHODS - UTEACH. 3 Hours.
The purpose of this course is to present UTeach students with the tools scientists use to solve scientific problems. These tools enable scientists to develop new knowledge and insights, the most important of which are eventually presented in textbooks and taught in more conventional science classes. These tools include: design of experiments to answer scientific questions; use of statistics to interpret experimental results and deal with sampling errors; mathematical modeling of scientific phenomena; finding and reading articles in the current scientific literature; applying scientific arguments in matters of social importance; writing scientific papers; reviewing scientific papers; oral presentation of scientific work; use of probes and computers to gather and analyze data; ethical treatment of human subjects; laboratory safety. Research Methods is primarily a laboratory course, and most of these topics are developed in connection with four independent inquiries UTeach students design and carry out. Written inquiries will be evaluated as examples of scientific writing. Prerequisite: SCIE 1201 or SCIE 1334 or concurrent enrollment; junior or senior standing.

CHEM 4346. ADVANCED SYNTHETIC METHODS. 3 Hours.
Methods and techniques for the synthesis and characterization of organic, inorganic, and organometallic compounds. Prerequisite: Grade of C or better in CHEM 2182, CHEM 2322, and CHEM 3317 or CHEM 4318.

CHEM 4380. UNDERGRADUATE RESEARCH. 3 Hours.
Research under the direction of a member of the department. No more than six hours of CHEM 4180, CHEM 4280, CHEM 4380 and CHEM 4381 may be taken for a letter grade. Prerequisite: Written permission of the instructor and a minimum grade point average of 2.5.

CHEM 4381. HONORS RESEARCH. 3 Hours.
Research in chemistry under the direction of a member of the department, resulting in a written honors thesis. No more than 6 hours of CHEM 4180, CHEM 4280, CHEM 4380 and CHEM 4381 may be taken for a letter grade. Prerequisite: CHEM 2322, CHEM 2182, and admission to the University Honors College.

CHEM 4385. INSTRUCTIONAL TECHNIQUES IN CHEMISTRY. 3 Hours.
Students participate in undergraduate laboratory instruction or recitation sessions under the supervision of a faculty member. No more than 6 hours of CHEM 4385 may be taken for a letter grade. Enrollment by departmental permission only.

CHEM 4387. UNIVERSITY-INDUSTRY CHEMISTRY COOPERATIVE. 3 Hours.
By special arrangement only. Cooperative study assignment doing chemical research in a local industrial chemical laboratory. Enrollment by departmental permission only. Graded pass/fail only.

CHEM 4391. READINGS IN CHEMISTRY. 3 Hours.
May be repeated for a maximum of six hours credit. Topics arranged on an individual basis. Performance may be assessed by oral exam, written test, or review paper. Prerequisite: permission of department chair. Graded pass/fail only.

CHEM 4392. ADVANCED TOPICS IN CHEMISTRY. 3 Hours.
Topics arranged on an individual basis. May be repeated for credit as the topic varies. Prerequisite: permission of instructor.

CHEM 4461. INSTRUMENTAL ANALYSIS. 4 Hours.
The principles involved in the operation of modern analytical instruments and the laboratory use of such instruments. Students must be within 30 hours of completing their bachelor degrees. Prerequisite: Grades of C or better in CHEM 2285 or CHEM 2343 and CHEM 2335.

CHEM 5011. SEMINAR IN CHEMISTRY. 0 Hours.
Students will present a talk, prepare a poster, and engage in scientific writing and communication. Includes learning how to prepare, present, and defend an oral presentation. May not be counted for credit toward the degree requirements.

CHEM 5168. QUANTUM CHEMISTRY LABORATORY. 1 Hour.
Molecular modeling. Application of various computational techniques to chemical problems, including determination of molecular geometry, conformational analysis, and molecular energetics. Prerequisite: concurrent enrollment in CHEM 5262.

CHEM 5191. READINGS IN CHEMISTRY. 1 Hour.
Conference course which may be repeated for credit, with credit granted according to work performed. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5192. RESEARCH IN CHEMISTRY. 1 Hour.
Conference course with laboratory with credit granted according to work performed. May be repeated for credit. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5262. COMPUTATIONAL CHEMISTRY. 2 Hours.
Molecular quantum mechanics. Fundamental principles of quantum mechanics, with a special emphasis on molecular electronic structure theory. Topics covered include molecular mechanics, semi-empirical and ab initio molecular orbital theory, density functional theory, calculation of thermodynamic properties and molecular dynamics. Prerequisite: CHEM 5301 or permission of instructor. concurrent enrollment in CHEM 5168 required.

CHEM 5291. READINGS IN CHEMISTRY. 2 Hours.
Conference course which may be repeated for credit, with credit granted according to work performed. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5292. RESEARCH IN CHEMISTRY. 2 Hours.
Conference course with laboratory with credit granted according to work performed. May be repeated for credit. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5300. SELECTED TOPICS IN ADVANCED CHEMISTRY. 3 Hours.
The area may vary (typically analytical, applied, biological, colloid, environmental, inorganic, organic, physical, polymer, materials, theoretical, etc.) and will be announced in advance. More than one area may be covered simultaneously, in parallel courses offered under different section numbers. May be repeated for credit when area or topics vary. Prerequisite: permission of instructor.

CHEM 5324. ANALYTICAL MASS SPECTROMETRY AND SPECTROSCOPY. 3 Hours.
This course covers modern aspects of atomic and molecular mass spectrometry, as well as spectrochemical analysis. Upon completion of this course, the student will be able to: describe the basic setup and operation of mass spectrometric and spectroscopic instrumentation; interpret spectra from various instruments as a means for qualitative and quantitative analysis; apply basic knowledge of mass spectrometry and spectroscopy for practical problem solving; relate the use of mass spectrometry and spectroscopy to his or her own research interests; and compile, present, and explain modern techniques for analytical research. Written and oral presentations, as well as traditional classroom examinations, homework, and quizzes will be used to assess student performance. Prerequisite: CHEM 4461 or equivalent; or permission of instructor.

CHEM 5325. SEPARATION SCIENCE. 3 Hours.
A comprehensive examination of most areas involving the separation of molecules and ions. Theoretical, practical and historical aspects of: distillation, sublimation, liquid-liquid extraction, sold phase extraction, chromatography, electrophoresis, field flow fractionation, membrane/barrier processes, and crystallization will be considered. Students taking this course must have a good basic background in organic chemistry and physical chemistry.

CHEM 5326. ANALYTICAL CHEMISTRY - CONCEPTS AND IMPLEMENTATION. 3 Hours.
This course familiarizes students with basic electronic design in analytical instrumentation. Familiarization with active and passive components, operational amplifiers, timers, logic gates, and designing analytical instrumentation based on such components, especially in Wet Chemistry. The course covers ionic equilibria and acid-base equilibria and solving complex problems by iterative numerical methods and nonlinear curve fitting using programming in BASIC and MS Excel SolverTM. The course covers present day applications of wet chemical analysis, specific methods and instrumentation, practical aspects of automated liquid phase analytical methods including component availability and cost. A design problem, chosen by lottery, will be given to each student early in the semester. The newly acquired knowledge of chemistry and electronics will be used to design a new instrument and present it. Prerequisite: CHEM 4461 or equivalent undergraduate instrumental analysis course.

CHEM 5327. ANALYTICAL ELECTROCHEMISTRY. 3 Hours.
This course covers modern aspects of electroanalytical chemistry. Upon completion of this course, the student will be able to: understand the concepts of redox potentials and their role in electron transfer, the thermodynamic aspects of electrochemical cells, mass transport in electrochemical systems, and the principles underlying various electroanalytical techniques such as potentiometry, amperometry, coulometry and voltammetry. The instrumental aspects of these techniques will also be addressed, including specialized approaches such as spectroelectrochemistry. The student will be able to relate the use of these analytical techniques to his or her own research needs and interests. Written and oral examinations, as well as traditional classroom examinations, will be used to assess student performance. Prerequisite: CHEM 4461 or equivalent; or permission of instructor.

CHEM 5328. ANALYTICAL SPECTROSCOPY. 3 Hours.
This course covers many of the methods of spectrochemical analysis used in the analytical laboratory. At the end of this course, students should be able to: explain the fundamental theory of many spectroscopy methods, including atomic spectroscopy, molecular spectroscopy, UV/Vis spectroscopy, molecular luminescence, and infrared spectrometry, among others; describe basic instrumental components; apply basic statistics (e.g., measurement errors, and calibration methods) for data analysis; and understand the fundamental use and applications of spectroscopy methods for basic research and laboratory measurements. Student performance will be evaluated based on homework assignments, exams, quizzes, and presentations. Prerequisite: CHEM 4461 or equivalent, or permission of instructor.

CHEM 5331. ADVANCED BIOCHEMISTRY I. 3 Hours.
1) Learn the vocabulary and conceptually understand at an advanced level the biochemical processes by which cells break down organic molecules and trap some of the released energy in the form of reactive nucleotides; use these reactive nucleotides to drive the synthesis of organic building blocks such as sugars, lipids, amino acids and nucleic acids from simpler molecules that serve as precursors. 2) To learn to critically review primary research articles in biochemistry by reading the assigned material related to proteins, expression and purification, kinetics, and metabolism as they are presented in class. 3) Research Project: To learn to critically review primary research articles in biochemistry by preparing a presenting and NIH R15 proposal/paper on a topic relevant to the topics covered in class. This project will teach students how to design and interpret experiments, thereby contributing to the creation of new knowledge in the fields of biochemistry and biophysics. This project will allow students to become knowledgeable in a specific subfield of biochemistry. 4) Develop an awareness of ethical responsibilities when conducting and reporting research and reviewing the research of others. 5) Understanding of the structures and functions of biological molecules. 6) Understanding of intermediary metabolism and its control. 7) Understanding of molecular genetics. 8) Ability to present concepts in oral, written and visual forms.

CHEM 5332. CELL SIGNALING & HUMAN BIOCHEMISTRY. 3 Hours.
Explores different aspects of signal transduction and different types of signaling pathways including enzyme linked receptors, G-protein signaling, G-protein coupled receptors, cytokine signaling, cyclic AMP based signaling, Calcium signaling, lipid signaling, NO-signaling, hormone signaling, peptide hormones, amino acid based hormones, steroid hormones; immune response and inflammation; cancer cell signaling, hypoxia and angiogenesis, aging; metabolic interrelation, vitamins and mineral, dietary supplements; recent topics in signaling, clinical correlation and health impacts.

CHEM 5333. BIOPHYSICAL METHODS AND SPECTROSCOPY IN BIOCHEMISTRY. 3 Hours.
A) Examination of various biophysical methods that determine enzyme functions: the methods includes purification of enzymes, determination of various kinetic parameters, and choice of methodology. B) Discussion of various spectroscopic approaches that determine the enzyme structures and functions: the approaches includes the modern spectroscopic techniques including fluorescence fluctuation spectroscopy as well as UV spec, fragonomics, surface plasmon resonance, FTIR-spectroscopy, and advanced NMR techniques such as HSQC and NOE.

CHEM 5334. MECHANISMS OF ENZYME ACTIONS. 3 Hours.
A) Exploration of enzyme properties that include enzyme kinetics, allostery, structure and their functions. B) Evaluation of enzyme functions associated with cofactors and regulators and their significance with respect to human health and diseases; evaluation of emerging scientific advances and challenges associated with enzyme actions will also be discoursed throughout lectures, student paper presentation and student written proposal. Prerequisite: A passing grade in the ACS-test in Biochemistry.

CHEM 5335. GENES, GENOMES, AND NUCLEIC ACIDS. 3 Hours.
Concepts of genes and genomes in prokaryotes and eukaryotes. Nucleic acids structures and functions. Detailed mechanisms of prokaryotic and eukaryotic DNA replication and transcription; mRNA processing; Gene regulation, epigenetics and non-coding RNA. Fundamental theory of each topic will be covered with emphasis on current research literature and clinical correlations. Prerequisite: Passing grade in ACS-test in Biochemistry.

CHEM 5336. STRUCTURE & FUNCTION OF PROTEINS, MEMBRANES & CARBOHYDRATES AND FAST KINETICS. 3 Hours.
This is a one-semester course that extends fundamental concepts in chemistry, such as kinetic phenomena and thermodynamics into an exploration of biology. The content includes structure and function of proteins and membranes, and catalysis of biological reactions through: 1) applying equilibrium processes to study biochemical reactions 2) analyzing the kinetic parameters of enzymes that cause disease states as well as exploration of how drugs are used to inhibit enzymes.

CHEM 5337. MEDICINAL CHEMISTRY AND DRUG Discovery. 3 Hours.
This course will provide students with an understanding of the history of the modern drug discovery process, drugs and drug ionization states, biological targets, lead molecule discovery and optimization, cell signaling and metabolism, the investigation of structure activity relationships, translation with preclinical models, intellectual property and commercialization, and the regulatory process from target/lead discovery to clinical use. History and introduction to Discovery; Foundations: predicting structural ionization states using concepts from pH/pKa/acids and bases/buffers; Biological Targets: Enzymes, Receptors, Oligonucleotides; Drug-Target Structures and Interactions, Lead identification and optimization, Structure Activity Relationships: Computational Approaches (ligand based; structure based); Cell signaling and Metabolism, cardiovascular diseases, diabetes, obesity, neurological disorders, and cancer; and current therapies; Translation and intellectual property; FDA regulations and clinical trials. To enroll students must have completed or be concurrently enrolled in CHEM 4311 or receive special permission of the instructor. Prerequisite: CHEM 4311 or permission of the instructor.

CHEM 5341. INORGANIC CHEMISTRY. 3 Hours.
Structures, bonding, and properties of main group and transition element compounds including: symmetry, coordination chemistry, reaction mechanisms, organometallic chemistry, and modern characterization techniques. Prerequisite: CHEM 4318 or permission of instructor.

CHEM 5342. SOLID STATE CHEMISTRY. 3 Hours.
Chemical synthesis and characterization methods of extended structures. Principles of solid-state synthesis, classical equilibrium approaches, diffusion and chemical transport, non-equilibrium and deposition methods; high temperature and high pressure synthesis; basic characterization techniques using X-rays, electrons, and neutrons; basic structure types and symmetry; optical, electrical and magnetic properties; examples will relate to materials used for energy harvesting, sensors, and catalysis.

CHEM 5344. X-RAY DIFFRACTION, SCATTERING AND ABSORPTION. 3 Hours.
The class will focus on modern applications of X-ray diffraction and absorption techniques in crystal and molecular structure determination. A practical component will address aspects of state of the art methods, including how to solve structures using data collected on powder and single-crystal diffractometers, X-ray photoelectron spectroscopy (XPS), etc.

CHEM 5351. ORGANIC CHEMISTRY I. 3 Hours.
Bonding, structure, stereochemistry, substituent effects, isotope effects, solvent effects, kinetics, and linear free-energy relationships in determining reaction mechanisms. Acids and bases, orbital symmetry, pericyclic reactions, photochemistry, and nucleophilic substitution reactions. Prerequisites: CHEM 2322 and CHEM 3322 or equivalent.

CHEM 5354. ORGANIC CHEMISTRY II. 3 Hours.
A survey of organic reaction mechanisms including addition and elimination reactions, nucleophilic carbon species, carbonyl reactions, electrophilic substitution reactions, rearrangement reactions, electron deficient species, and free radical reactions. Prerequisite: CHEM 5309 or permission.

CHEM 5355. ADVANCED ORGANIC SYNTHESIS. 3 Hours.
Synthetically important reactions, strategy in organic synthesis using retrosynthetic analysis and mechanistic understanding of reactions, synthons, asymmetric synthesis. Prerequisite: CHEM 5310 or permission of instructor.

CHEM 5356. ADVANCED POLYMER CHEMISTRY. 3 Hours.
Polymer synthesis and reactions including condensation, free-radical, ionic, and coordination polymerizations; principles of polymerization including thermodynamics and kinetic considerations; physical characterizations including determinations of absolute molecular weights, relative molecular weights, morphology, glass transitions, and polymer crystallinity; relationships between macromolecular structure, properties, and uses of polymeric materials. Also offered as MSE 5346. Prerequisite: CHEM 2321 and CHEM 2322 or permission of instructor.

CHEM 5358. DETERMINATION OF MOLECULAR STRUCTURE BY PHYSICAL METHODS. 3 Hours.
The use of modern instrumental techniques to determine structure: infrared, ultraviolet, and magnetic resonance spectroscopy, mass spectrometry, optical rotatory dispersion. Emphasis on interpretation of spectra.

CHEM 5361. INTRODUCTION TO GRADUATE PHYSICAL CHEMISTRY. 3 Hours.
Classical thermodynamics and statistical thermodynamics. Equilibrium and kinetic processes. Reaction dynamics. Principles of quantum chemistry and its application to spectroscopy. Introduction to bonding in molecules and solids.

CHEM 5364. ADVANCED GRADUATE PHYSICAL CHEMISTRY. 3 Hours.
Statistical thermodynamics and its application to kinetics and spectroscopy. Quantum theory, ab initio methods and density functional theory. Advanced spectroscopic methods to investigate bonding in molecules and solids. Prerequisite: CHEM 5301 or permission of the instructor.

CHEM 5365. THERMODYNAMICS OF MATERIALS. 3 Hours.
Applications of thermodynamics to the study of materials, thermodynamic properties of liquid and solid solutions and their relationship to surface and crystalline defects.

CHEM 5366. CHEMICAL KINETICS. 3 Hours.
Experimental and theoretical aspects of chemical reaction kinetics. Classical and modern techniques for mechanistic characterization, methods for approximation, analysis and interpretation. Simple and complex reaction matrices are considered (gas, liquid, solid state). Specific topics include microscopic reversibility, transition state theory, homo/heterogenous catalysis, and quantum/statistical mechanical estimation of rate constants and chemical activation. Relevant examples relating to atmospheric and environmental, biological, organic, and inorganic reactions will be discussed. Prerequisite: CHEM 5301 or by permission from the instructor.

CHEM 5381. ADVANCED LABORATORY TECHNIQUES IN CHEMISTRY I. 3 Hours.
The course will introduce to advanced laboratory techniques used in research laboratories in the Chemistry department. Handling of chemicals, synthesis procedures, characterization methods, data analysis, and safety regulations. Student will engage in reading primary literature and detailed process descriptions. Goal is to prepare students for successful work on their initial research project.

CHEM 5382. ADVANCED LABORATORY TECHNIQUES IN CHEMISTRY II. 3 Hours.
The course will continue to provide up-to-date laboratory techniques used in research laboratories in the Chemistry department. Synthesis procedures, analytical instrumentation, characterization methods, and data analysis. Free literature studies and assignments by instructor will prepare student for research and development. Goal is to support the research progress of students towards their comprehensive exam. Prerequisite: CHEM 5381.

CHEM 5383. ADVANCED LABORATORY TECHNIQUES IN CHEMISTRY III. 3 Hours.
The course will complete exposure to advanced laboratory techniques used in research laboratories in the Chemistry department and will make students ready for developing their own project proposal. Synthesis procedures, analytical instrumentation, characterization methods, and data analysis. Literature studies and explicit writing of scientific notes will prepare students for their comprehensive exam. Prerequisite: CHEM 5381, CHEM 5382.

CHEM 5391. READINGS IN CHEMISTRY. 3 Hours.
Conference course which may be repeated for credit, with credit granted according to work performed. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5392. RESEARCH IN CHEMISTRY. 3 Hours.
Conference course with laboratory with credit granted according to work performed. May be repeated for credit. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5398. THESIS. 3 Hours.
Graded R/F only. Prerequisite: permission of instructor.

CHEM 5421. ANALYTICAL INSTRUMENTATION. 4 Hours.
Theory of instrumentation and chemical signal source. Practical experiments utilizing atomic and molecular absorption and emission spectroscopy, chromatographic analysis, and electrochemical techniques.

CHEM 5491. READINGS IN CHEMISTRY. 4 Hours.
Conference course which may be repeated for credit, with credit granted according to work performed. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5492. RESEARCH IN CHEMISTRY. 4 Hours.
Conference course with laboratory with credit granted according to work performed. May be repeated for credit. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5591. READINGS IN CHEMISTRY. 5 Hours.
Conference course which may be repeated for credit, with credit granted according to work performed. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5592. RESEARCH IN CHEMISTRY. 5 Hours.
Conference course with laboratory with credit granted according to work performed. May be repeated for credit. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5691. READINGS IN CHEMISTRY. 6 Hours.
Conference course which may be repeated for credit, with credit granted according to work performed. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5692. RESEARCH IN CHEMISTRY. 6 Hours.
Conference course with laboratory with credit granted according to work performed. May be repeated for credit. Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5698. THESIS. 6 Hours.
Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 5998. THESIS. 9 Hours.
Graded P/F/R only. Prerequisite: permission of instructor.

CHEM 6011. TOPICS IN GRADUATE RESEARCH. 0 Hours.
Lectures by departmental and university faculty on current chemical research at U.T. Arlington. All graduate students are required to take this course once. May not be counted toward degree requirements. Graded P/F only.

CHEM 6012. ISSUES IN MODERN CHEMICAL RESEARCH. 0 Hours.
Topics to be discussed include the use of the library, maintenance of a research notebook, ethics in research, aspects of technical writing and presentations, and how research is funded. May not be counted toward degree requirements.

CHEM 6104. CHEMISTRY CAREER DEVELOPMENT. 1 Hour.
Every PhD-bound student is required to spend time for professional development outside his UTA laboratory. Possible opportunities include traditional internships in an industrial setting, working at a national laboratory, international exchange programs, extended collaborative visits, teaching engagements and other educational projects outside UTA. The career advancement may consist of one or multiple portions, in total time no less than three and not more than six months. Prerequisite: Permission of research supervisor and graduate advisor.

CHEM 6202. PRINCIPLES OF INDUSTRIAL CHEMISTRY. 2 Hours.
Survey of industrial inorganic and organic chemical processes. Prerequisite: permission of instructor.

CHEM 6203. REGULATORY ASPECTS OF THE CHEMICAL INDUSTRY. 2 Hours.
Survey of chemical toxicology, regulatory aspects involved in the chemical industry, industrial safety, patents and patent law.

CHEM 6304. CHEMISTRY CAREER DEVELOPMENT. 3 Hours.
Every PhD-bound student is required to spend time for professional development outside his UTA laboratory. Possible opportunities include traditional internships in an industrial setting, working at a national laboratory, international exchange programs, extended collaborative visits, teaching engagements and other educational projects outside UTA. The career advancement may consist of one or multiple portions, in total time no less than three and not more than six months. Prerequisite: Permission of the research supervisor and Graduate Advisor.

CHEM 6399. DISSERTATION. 3 Hours.
Graded R/F only. Prerequisite: admission to candidacy for the degree of Ph.D. in Applied Chemistry.

CHEM 6699. DISSERTATION. 6 Hours.
Graded R/F/P/W. Prerequisite: admission to candidacy for the degree of Ph.D. in Applied Chemistry.

CHEM 6904. CHEMISTRY CAREER DEVELOPMENT. 9 Hours.
Every PhD-bound student is required to spend time for professional development outside his UTA laboratory. Possible opportunities include traditional internships in an industrial setting, working at a national laboratory, international exchange programs, extended collaborative visits, teaching engagements and other educational projects outside UTA. The career advancement may consist of one or multiple portions, in total time no less than three and not more than six months. Prerequisite: Permission of Graduate Advisor and research supervisor.

CHEM 6999. DISSERTATION. 9 Hours.
Graded P/F/R only. Prerequisite: admission to candidacy for the degree of Ph.D. in Applied Chemistry.

CHEM 7399. DOCTORAL DEGREE COMPLETION. 3 Hours.
This course may be taken during the semester in which a student expects to complete all requirements for the doctoral degree and graduate. Enrolling in this course meets minimum enrollment requirements for graduation, for holding fellowships awarded by The Office of Graduate Studies and for full-time GTA or GRA positions. Students should verify that enrollment in this course meets other applicable enrollment requirements. To remain eligible in their final semester of study for grants, loans or other forms of financial aid administered by the Financial Aid Office must enroll in a minimum of 5 hours as required by the Office of Financial Aid. Other funding sources may also require more than 3-hours of enrollment. Additional hours may also be required to meet to requirements set by immigration law or by the policies of the student's degree program. Students should contact the Financial Aid Office, other sources of funding, Office of International Education and/or their graduate advisor to verify enrollment requirements before registering for this course. This course may only be taken once and may not be repeated. Students who do not complete all graduation requirements while enrolled in this course must enroll in a minimum of 6 dissertation hours (6699 or 6999) in their graduation term. Graded P/F/R.