Actuarial Science

**ACTS 4301** Principles of Actuarial Models: Life Contingencies I (3 semester credit hours) The purpose of this class is to develop the student’s knowledge of the theoretical basis of life contingent actuarial models and the application of those models to insurance and other financial risks. Life contingencies, survival models, life insurances, annuities, and premiums will be studied. This class covers parts of CAS Exam LC and SOA Exam MLC. Prerequisites: (STAT 4351 and ACTS 4308) or instructor consent required. (3-0) T

**ACTS 4302** Principles of Actuarial Models: Financial Economics (3 semester credit hours) This 3 semester credit hour course develops the student's knowledge of the theoretical basis of certain actuarial models and the application of those models to insurance and other financial risks. The topics discussed include interest rate models, rational valuation of derivative securities, mathematical and probabilistic foundation of risk management. This class covers parts of CAS exam 3F and SOA exam MFE. Prerequisites: STAT 4351 or instructor consent required. (3-0) T

**ACTS 4304** Construction and Evaluation of Actuarial Models (3 semester credit hours) Introduction to useful frequency and severity models beyond those covered in Principles of Actuarial Models. Discussion of the steps involved in the modeling process and how to carry out these steps in solving business problems. At the end of the course the students should be able to: 1) analyze data from an application in a business context; 2) determine a suitable model including parameter values; and 3) provide measures of confidence for decisions based upon the model. This class also provides an introduction to a variety of tools for the calibration and evaluation of the models. This class covers parts of CAS Exam 4/SOA Exam C. Prerequisite: STAT 4352 or instructor consent required. (3-0) T

**ACTS 4306** Actuarial Probability as Problem Solving (3 semester credit hours) Topics in actuarial probability via solving problems. This class covers topics of Exam 1/P. Prerequisite: STAT 4351 or instructor consent required. (3-0) R

**ACTS 4308** Actuarial Financial Mathematics (3 semester credit hours) The purpose of this 3 semester credit hour course is to provide an understanding of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. The students will also be given an introduction to financial instruments, including derivatives, and the concept of no-arbitrage as it relates to financial mathematics. This class covers topics of CAS Exam 2/SOA Exam FM. Prerequisites: (MATH 2451 and FIN 3320) or instructor consent required. (3-0) R

Biology

**BIOL 1300** Body Systems with Lab (3 semester credit hours) Examines the organ systems of mammals, predominantly the human. Function in relation to structure is emphasized. The effects of one organ system on others are stressed. The overall objective of the course is an appreciation of the integration and control of all systems. There is a model-based human anatomy lab. This course is specifically designed for
non-majors. (2-2) S

**BIOL 1318 (BIOL 2316)** Human Genetics (3 semester credit hours) Elementary course in the fundamentals of human genetics. Topics include patterns of inheritance; DNA structure and replication; gene function; mutation and its role in genetic diseases, cancer, and the immune system; matters of sex; evolution; genetic engineering and gene therapy; forensics and bioethics. This course is specifically designed for non-majors. (3-0) Y

**BIOL 1350** Body Systems (3 semester credit hours) Examines the organ systems of mammals, predominantly the human. Function in relation to structure is emphasized. The effects of one organ system on others is stressed. The overall objective of the course is an appreciation of the integration and control of all systems. This course is specifically designed for non-majors. (3-0) S

**BIOL 1V00** Topics in Biological Sciences (1-6 semester credit hours) May be repeated for credit as topics vary (6 semester credit hours maximum). ([1-6]-0) R

**BIOL 1V01** Topics in Biological Sciences with Lab (1-6 semester credit hours) May be repeated as topics vary (6 semester credit hours maximum). ([1-5]-[1-5]) R

**BIOL 1V95** Individual Instruction in Biology (1-6 semester credit hours) Individual study under a faculty member's direction. May be repeated for credit as topics vary (6 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

**BIOL 2111** Introduction to Modern Biology Workshop I (1 semester credit hour) Problem solving and discussion related to the subject matter in **BIOL 2311**. Prerequisites: (**CHEM 1311** or equivalent) and **CHEM 1312**. Corequisite: **BIOL 2311**. (1-0) S

**BIOL 2112** Introduction to Modern Biology Workshop II (1 semester credit hour) Problem solving and discussion related to the subject matter in **BIOL 2312**. Corequisite: **BIOL 2312**. (1-0) S

**BIOL 2281** Introductory Biology Laboratory (2 semester credit hours) Introductory lectures discuss the theoretical and historical aspects of the experiments carried out in the laboratory. Laboratory experiments introduce the student to bioinformatics, basic cellular biology, and structure and function of proteins and nucleic acids. Computer exercises in bioinformatics involve multiple alignment analyses, BLAST and literature searches, and construction of phylogenetic trees. Laboratory experiments include microscopy, microbial techniques, yeast genetics, and the electrophoretic behavior of normal and mutant proteins. DNA related experiments include isolation (nuclear and mtDNA), amplification, restriction digests, electrophoresis, plasmid mapping, and transformations. Students present posters of their long-term investigations at the end of the semester. Prerequisite: **BIOL 2311** (also see prerequisites for **BIOL 2311**). ([0-1]-[1-2]) S

**BIOL 2311 (BIOL 1306)** Introduction to Modern Biology I (3 semester credit hours) Presentation of some of the fundamental concepts of modern biology, with an emphasis on the molecular and cellular basis of biological phenomena. Topics include the chemistry and metabolism of biological molecules, elementary classical and molecular genetics, and selected aspects of developmental biology, physiology (including hormone action), immunity, and neurophysiology. Prerequisites: (**CHEM 1311** or **CHEM 1315** and (**CHEM 1312** or **CHEM 1316**)) or **CHEM 1301**. Corequisite: **BIOL 2111**. (3-0) S
BIOL 2312 (BIOL 1307) Introduction to Modern Biology II (3 semester credit hours) The overall emphasis will be on organ physiology and regulatory mechanisms involving individual organs and organ systems. Factors considered will be organ development and structure, evolutionary processes and biological diversity, and their effects on physiological mechanisms regulating the internal environment. Corequisite: BIOL 2112. (3-0) S

BIOL 2350 Biological Basis of Health and Disease (3 semester credit hours) Fundamentals of pathophysiology, focusing on the dynamic processes that cause disease, give rise to symptoms, and signal the body's attempt to overcome disease. The course covers diseases which may affect dramatically the life of an individual and society in the modern age. Topics include 1) mechanisms of infectious disease, immunity, and inflammation and 2) alterations in structure and function of the reproductive, circulatory, respiratory, and urinary systems. Special emphasis is given to preventative aspects for each disease based on non-drug, wellness-promoting approaches. This course is designed as a science elective open to all majors. (3-0) S

BIOL 2V00 Topics in Biological Sciences (1-6 semester credit hours) May be repeated as topics vary (6 semester credit hours maximum). Instructor consent required. ([1-6]-0) R

BIOL 2V01 Topics in Biological Sciences with Lab (1-6 semester credit hours) May be repeated as topics vary (6 semester credit hours maximum). ([1-5]-[1-5]) R

BIOL 2V95 Individual Instruction in Biology (1-6 semester credit hours) Individual study under a faculty member's direction. May be repeated for credit as topics vary (6 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

BIOL 3101 Classical and Molecular Genetics Workshop (1 semester credit hour) Problem solving and discussion related to the subject matter in BIOL 3301. Prerequisites: BIOL 2311 and (BIOL 2281 or CHEM 2401 or equivalent) and (CHEM 2323 or equivalent). Corequisite: BIOL 3301. (1-0) S

BIOL 3102 Eukaryotic Molecular and Cell Biology Workshop (1 semester credit hour) Problem solving and discussion related to the subject matter in BIOL 3302. Prerequisites: BIOL 3301 and (BIOL 3361 or CHEM 3361 or equivalent). Corequisite: BIOL 3302. (1-0) S

BIOL 3110 Nanomedicine Workshop (1 semester credit hour) Discussions and student presentations related to the subject matter in BIOL 3310. (1-0) Y

BIOL 3161 Biochemistry Workshop I (1 semester credit hour) Problem solving methodology in biochemistry; discussion of recent advances in areas related to the subject matter in BIOL 3361 or CHEM 3361. Prerequisites: (CHEM 2323 or equivalent) and CHEM 2325. Corequisite: BIOL 3361 or CHEM 3361. (1-0) S

BIOL 3162 Biochemistry Workshop II (1 semester credit hour) Problem-solving methodology in biochemistry; discussion of recent advances in areas related to the subject matter in BIOL 3362 or CHEM 3362. Prerequisite: BIOL 3361 or CHEM 3361 or equivalent, or instructor consent required. Corequisite: BIOL 3362 or CHEM 3362. (1-0) Y

BIOL 3301 Classical and Molecular Genetics (3 semester credit hours) The phenomenon of heredity, its cytological and molecular basis; gene expression and transfer of genetic information, with major focus on
bacterial and model eukaryotic systems; genetic recombination and chromosome mapping; tetrad analysis; mutations and mutagenesis; genetic interactions; application of recombinant DNA techniques to genetic analysis. Prerequisites: BiOL 2311 and (BiOL 2281 or Chem 2401 or equivalent) and (Chem 2323 or equivalent). Corequisite: BiOL 3101. (3-0) S

BiOL 3302 Eukaryotic Molecular and Cell Biology (3 semester credit hours) Structural organization of eukaryotic cells; regulation of cellular activities; membranes and transport; cellular replication; examples of cell specialization such as blood (immunoglobulins) and muscle cells. Prerequisites: BiOL 3301 and (BiOL 3361 or Chem 3361) or equivalent. Corequisite: BiOL 3102. (3-0) S

BiOL 3303 Introduction to Microbiology (3 semester credit hours) Microbes contribute to major biogeochemical processes, live in environments inhospitable to other organisms, and may comprise the majority of biomass on Earth. They form beneficial symbioses with multicellular organisms and play critical roles in the development of those organisms. In contrast to these beneficial roles, certain microbes are global public health concerns. This course surveys the form and function of the microbial world. Prerequisites: (BiOL 2281 or equivalent) and BiOL 2311 and BiOL 2312. (3-0) S

BiOL 3305 Evolutionary Analysis (3 semester credit hours) Molecular and fossil evidence for evolution. Darwinian natural selection, mechanisms of evolution, Mendelian genetics in populations, forms of adaptation, evolutionary trees, molecular phylogeny, theories on the origin of life. Prerequisite: BiOL 3301. (3-0) Y

BiOL 3310 Nanomedicine (3 semester credit hours) Nanomedicine is an emerging area where biology and nanotechnology converge, combining multidisciplinary fields such as biology, medicine, chemistry, physics and engineering. The rapid development of nanomedicine also has ethical and environmental implications. This course provides an introduction and overview of nanomedicine for undergraduate Curriculum V honors students. The course consists of a 3-hour lecture series one day a week, plus a workshop. The lectures begin with the basics of protein and lipid structure, providing a review for understanding how biomacromolecules combine to form the structural and functional units of the intact cell that are important for nanomedicine applications. Guest lecturers from academia and industry will also present talks in their specialty areas, including a lecture on emerging ethical issues related to the practice of nanomedicine. The last part of the course consists of student presentations on topics of interest. Prerequisite or Corequisite: BiOL 3361 and instructor consent required. (3-0) Y

BiOL 3312 Introduction to Programming for Biological Sciences (3 semester credit hours) This course is an introduction to programming practices using C++ designed specifically for students in the biological sciences. Special emphasis will be put in particular features of C++ like object oriented programming, some data structures as well as applications to process, model and analyze biological data. One goal of this course is to provide a strong background on programming skills on a basic level while leaving more advanced techniques of software development and algorithms for other advanced courses. This course also covers an introduction to data analysis with R, a statistical platform used widely in the biological sciences community. Prerequisites: (BiOL 2281 or equivalent) and BiOL 2311 and BiOL 2312. (3-0) Y

BiOL 3315 Epigenetics (3 semester credit hours) Almost all cell types in our body share the same genetic information, but they perform very different functions. For example, our nerve cells are morphologically and functionally distinct from our muscle cells. How can the same genome give rise to hundreds of distinct cell types in our body? How can different diseases affect identical twins sharing the same genetic
information? Why our parents and grandparents diet and health may have lasting influences in our own health? The field of epigenetics emerged over the past decades to tackle these fundamental questions that intersect our genome, development, environment and disease. This course will provide a broad overview of epigenetic phenomena and epigenetic mechanisms with weekly lectures and small group discussion of primary literature. The course will introduce students to seminal works in epigenetics and recent developments with the goal of instilling critical knowledge of the field. Prerequisites: (BIOL 3101 and BIOL 3301) or equivalent or instructor consent required. (3-0) Y

BIOL 3318 Forensic Biology (3 semester credit hours) Role and methodology of biological testing in criminal investigation and forensic science. Analysis of the procedures and methodologies employed in the collection, preservation and screening of biological evidence, and protein and DNA testing. Population genetics employed during the statistical evaluation of data is covered. The course is structured to allow individuals with and without biological training to participate. The subject matter will be developed from the concept of "What is DNA?" through "What does a statistical estimate really mean?" (3-0) T

BIOL 3320 Applied Genetics (3 semester credit hours) Genetic model organisms such as the flatworm (Planaria), fruit fly (Drosophila melanogaster), nematode (Caenorhabditis elegans), and the zebrafish (Danio rerio) are the cornerstones of biomedical research. These organisms known for their simplicity of structure and gene similarity to humans have been seminal in advancing our understanding of many biological processes and human diseases. In this inquiry-based course, learners will apply basic principles of genetic model systems, transmission genetics, and molecular genetics to investigate important biological concepts such as embryonic cell division, stem cells and regeneration, Mendelian inheritance, gene mutations, and phenotypes. Throughout this exploratory course, students will gain practical hands-on experience conducting basic culturing, genetic manipulation and phenotypic analysis necessary to utilize genetic model organisms in their investigation. Learners will engage in class discussions and activities to draw connections between the concepts learned in class and their real-time application(s) in biomedical sciences. Instructor consent required. Prerequisites: BIOL 2281 or equivalent and (BIOL 2311 and (BIOL 2111 or equivalent)) and (BIOL 2312 and (BIOL 2112 or equivalent)). (3-0) S

BIOL 3335 Microbial Physiology (3 semester credit hours) Life processes of microbes: fermentations, N2 assimilation, and other biochemical pathways specific to bacteria; cellular structure and differentiation, among others. Substitutes for BIOL 3362 or CHEM 3362 for Biology majors. Prerequisites: BIOL 2311 and (BIOL 3361 or CHEM 3361). (3-0) T

BIOL 3336 Protein and Nucleic Acid Structure (3 semester credit hours) Examines the different types of protein motifs, protein and DNA folding and stability, and the relation of structure to function. Circular dichroism, NMR, and crystallographic methods of structural determination are presented. Types of proteins considered include transcription factors, proteinases, membrane proteins, proteins in signal transduction, proteins of the immune system, and engineered proteins. Students also receive instruction in the viewing and manipulation of protein and DNA structures using various modeling programs and data from national web sites. Prerequisite: BIOL 3361 or CHEM 3361. (3-0) T

BIOL 3351 Medical Cell Biology (3 semester credit hours) Explores topics in cell biology and medicine. Topics include cellular organization, structure and inheritance of DNA, gene therapy, stem cells, regenerative medicine, cell to cell signaling, the functioning of different types of cells and tissues, including those of the immune and endocrine system, and the study of several genetic diseases, such as cancer and cardiovascular disease. Prerequisites: BIOL 2311 and BIOL 2312 or equivalent. (3-0) S
BIOL 3355 Pathophysiology (3 semester credit hours) The focus of this course is to meet the interests of the students who plan to become professionals working in the health-care field. The strategic goal of the course is to make students internalize the notion of the complexity of the processes leading to the onset and the development (pathogenesis) of a diseased condition, to emphasize the concept of the unbalanced homeostatic regulation underlying any pathology. To understand the idea of the involvement of all body systems in the seemingly "local" manifestations of a disease, and to realize the importance of the mind-body connections in the subjective and objective characteristics of an individual ailment and its influence on the process of sanogenesis (recovery). We will incorporate the most recent scientific data into the fundamentals of pathophysiology and discuss the classical typological problems like the etiology, diagnosis, clinical characteristics, treatment, and the prognosis of the condition. The pathological conditions that will be covered in this course include the infectious diseases and some immune disorders, the diseases of the reproductive, cardiovascular, respiratory, and urinary systems. Prerequisites: BIOL 231 2 and BIOL 3456. ([1-3]-0) S

BIOL 3357 Mammalian Physiology with Lab (3 semester credit hours) This course will focus on human body systems and physiological pathways related to organ system functions and control including, but not limited to, central nervous system control and feedback, cardiovascular, respiratory, and neuromuscular physiology as well as topics such as blood pressure regulation and exercise physiology. This course will use computer software and electronic instrumentation for performing electrocardiography, electromyography, electroencephalography, plethysmography, pulmonary function analysis, polygraph analysis, and biofeedback. Instructor consent required. Prerequisites: BIOL 3455 or equivalent and BIOL 3456 or equivalent. (3-1) S

BIOL 3361 Biochemistry I (3 semester credit hours) Structures and chemical properties of amino acids; protein purification and characterization; protein structure and thermodynamics of polypeptide chain folding; catalytic mechanisms, kinetics and regulation of enzymes; energetics of biochemical reactions; generation and storage of metabolic energy associated with carbohydrates; oxidative phosphorylation and electron transport mechanisms; photosynthesis. Prerequisites: (CHEM 2323 or equivalent) and CHEM 232 5. Corequisite: BIOL 3161. (Same as CHEM 3361) (3-0) S

BIOL 3362 Biochemistry II (3 semester credit hours) Breakdown and synthesis of lipids; membrane structure and function; nitrogen metabolism and fixation; nucleotide metabolism; structure and properties of nucleic acids; sequencing and genetic engineering; replication, transcription, and translation; chromosome structure; hormone action; biochemical basis of certain pathological processes. Prerequisite: (BIOL 3361 or CHEM 3361) or its equivalent, or instructor consent required. Corequisite: BIOL 3162. (Same as CHEM 3362) (3-0) S

BIOL 3370 Exercise Physiology (3 semester credit hours) Examines the operation and adaptation of human organ systems (cardiovascular, respiratory, renal, skeletal, and hormonal) during exercise. Clinical aspects of exercise, including the effects of training, nutrition, performance, and ergogenic aids, are also discussed. Prerequisites: BIOL 2312 and (BIOL 3455 or BIOL 3456). (3-0) Y

BIOL 3380 Biochemistry Laboratory (3 semester credit hours) Current techniques in the purification and characterization of enzymes to demonstrate fundamental principles that are utilized in modern biochemistry and molecular biology research laboratories. Practical skills taught include micropipetting, basic solution preparation, conducting pH measurements, isolating crude enzyme extracts, and performing standard activity assays. Advanced experiments with Green Fluorescent Protein and Lactate
Dehydrogenase include Ni++-NTA affinity chromatography, ion chromatography, protein detection using Bradford, Lowry, and spectrophotometric assays, SDS-PAGE separation, Western Blot analysis, and enzyme kinetics. Prerequisite: BIOL 2281 or CHEM 2401 or equivalent. Prerequisite or Corequisite: BIOL 3361 or CHEM 3361. (1-4) S

**BIOL 3385** Medical Histology (3 semester credit hours) Medical histology will cover the microscopic structure and function of human cells and tissues that make up the organ systems in normal and pathological conditions. The lecture component will include understanding of relevant disease and pathophysiological conditions from a histological standpoint. The laboratory component of this course will involve the microscopic study of cells and tissues using the compound light microscope and prepared slides. Laboratory studies will complement and correlate with the study of cells and tissue organization. Prerequisites: BIOL 2311 and BIOL 2312. (1.5-3) S

**BIOL 3388** Honey Bee Biology (3 semester credit hours) This survey course explores the biology of honey bees at the colony, organism, and molecular levels. Topics include honey bee anatomy, nest architecture, caste development and social organization, reproduction and genetic diversity, pheromones and communication, foraging behavior, colony reproduction, pest and disease management, and basic beekeeping. Optional hands on experience may be provided. Prerequisites: (BIOL 2281 or CHEM 2401 or equivalent) and BIOL 2311 and BIOL 2312. (3-0) Y

**BIOL 3455** Human Anatomy and Physiology with Lab I (4 semester credit hours) First of a two-course sequence providing a comprehensive study of the basic principles of human physiology in conjunction with a detailed, model-based human anatomy laboratory and computer-assisted physiology experiments. Examination of structure-function relationships includes a survey of human histology and skeletal, muscular, neural, and sensory organ systems. Prerequisite: BIOL 2312 or equivalent. (3-3) S

**BIOL 3456** Human Anatomy and Physiology with Lab II (4 semester credit hours) Continuation of the comprehensive study of the basic principles of human physiology in conjunction with a detailed, model-based human anatomy laboratory and computer-assisted physiology experiments. Endocrine, cardiovascular, respiratory, digestive, renal, and reproductive systems are examined. Prerequisite: BIOL 3455 or equivalent. (3-3) S

**BIOL 3520** General Microbiology with Lab (5 semester credit hours) Majors course in general microbiology. Lectures include topics recommended by the Education Division of the American Society for Microbiology: microbial structure, diversity, growth and growth control, metabolism, genetics, and gene regulation. Among additional topics covered are virology, immunology and microbial diseases (plant and animal) including epidemiology, transmission, and host-microbe interactions. The laboratory focuses on developing laboratory skills in classical microbiology by the individual student. Exercises include various staining and pure culture techniques, biochemical and other in vitro testing, as well as isolation and identification of unknown organisms. Prerequisites: (BIOL 2281 or CHEM 2401 or equivalent) and (BIOL 2311 and BIOL 2312) or equivalent and CHEM 2323. (2-3) Y

**BIOL 3V00** Topics in Biological Sciences (1-6 semester credit hours) May be repeated as topics vary (9 semester credit hours maximum). Prerequisites: (BIOL 2281 or CHEM 2401 or equivalent) and BIOL 2311 and BIOL 2312 or equivalent. ([1-6]-0) S

**BIOL 3V01** Topics in Biological Sciences with Lab (1-6 semester credit hour) May be repeated as topics
vary (6 semester credit hours maximum). Prerequisites: (BIOL 2281 or CHEM 2401 or equivalent) and BIOL 2311 and BIOL 2312 or equivalent. ([1-5]-[1-5]) R

**BIOL 3V15** Research Practicum for UT-PACT (1-6 semester credit hours) Students in the UT-PACT program participate in clinical or biomedical research projects under the joint supervision of UT Southwestern faculty and UT Dallas UT-PACT program coordinator. Students receive training in relevant research methodology and research ethics prior to placement in clinical settings. Consult with UT-PACT program coordinator prior to enrollment for information on prerequisites and minimum on-site hours. May be repeated for credit. (9 semester credit hours maximum). UT-PACT program coordinator consent required. ([1-6]-0) S

**BIOL 3V40** Topics in Molecular and Cell Biology (1-6 semester credit hours) May be repeated as topics vary (9 semester credit hours maximum). Prerequisites: (BIOL 2281 or CHEM 2401 or equivalent) and BIOL 2311 and BIOL 2312 or equivalent. ([1-6]-[0-5]) S

**BIOL 3V81** Clinical Medicine I (1-6 semester credit hours) Clinical Medicine I is a component of the UT Partnership in Advancing Clinical Transition (UT PACT) program that addresses clinical competencies in the medical profession, including communication skills, professional identity formation, interprofessional teamwork, and medical ethics. Students participate in small group sessions, clinical preceptorships, and hospital rotations at UT Southwestern Medical Center. Enrollment is limited to students who have completed at least one year of the UT PACT Program. Credit/No Credit only. UT PACT advisor consent required. ([1-6]-[1-9]) Y

**BIOL 3V82** Clinical Medicine II (1-6 semester credit hours) Clinical Medicine II addresses clinical competencies in the medical profession, building on skills already addressed in Clinical Medicine I and other parts of the UT Partnership in Advancing Clinical Transition (UT PACT) curriculum. Topics to be addressed include the application of basic science to clinical practice, interpersonal skills in medicine, cultural competency, and professionalism and medical ethics in clinical settings. Students participate in small group sessions and clinical preceptorships and rotations at UT Southwestern Medical Center. Enrollment is limited to students who have completed their second year in the UT PACT Program. Credit/No Credit only. UT PACT advisor consent required. Prerequisite: **BIOL 3V81**. ([1-6]-[1-9]) Y

**BIOL 3V83** Clinical Medicine III (1-6 semester credit hours) Clinical Medicine III is a continuation of Clinical Medicine I and II that is offered to students in the UT Partnership in Advancing Clinical Transition (UT PACT) program, to be taken during students' third academic year at UT Dallas. Enrollment is limited to students who have completed Clinical Medicine I and II, and at least two years of the UT PACT Program. UT PACT advisor consent required. ([1-6]-[1-9]) Y

**BIOL 3V84** Clinical Medicine IV (1-6 semester credit hours) Clinical Medicine IV is a continuation of Clinical Medicine I, II, and III that is offered to students in the UT Partnership in Advancing Clinical Transition (UT PACT) program to be taken during students' third academic year at UT Dallas. Enrollment is limited to students who have completed Clinical Medicine I, II, and III, and at least two years of the UT PACT Program. Credit/No Credit only. UT PACT advisor consent required. ([1-6]-[1-9]) Y

**BIOL 3V90** Undergraduate Readings in Biology (1-3 semester credit hours) Subject and scope to be determined on an individual basis. May be repeated for credit as topics vary. Instructor consent required. ([1-3]-0) S
BIOL 3V91 Undergraduate Research in Biology (1-3 semester credit hours) Subject and scope to be determined on an individual basis. May be repeated for credit as topics vary. Instructor consent required. ([1-3]-0) S

BIOL 3V92 Undergraduate Readings in Biochemistry (1-3 semester credit hours) Subject and scope to be determined on an individual basis. May be repeated for credit as topics vary. Instructor consent required. ([1-3]-0) S

BIOL 3V93 Undergraduate Research in Biochemistry (1-3 semester credit hours) Subject and scope to be determined on an individual basis. May be repeated for credit as topics vary. Instructor consent required. ([1-3]-0) S

BIOL 3V94 Topics in Biology: Individual Instruction (1-6 semester credit hours) Individual study under a faculty member's direction. May be repeated for credit as topics vary. Instructor consent required. ([1-6]-0) S

BIOL 3V95 Undergraduate Readings in Molecular and Cell Biology (1-3 semester credit hours) Subject and scope to be determined on an individual basis. May be repeated for credit as topics vary. Instructor consent required. ([1-3]-0) S

BIOL 3V96 Undergraduate Research in Molecular and Cell Biology (1-3 semester credit hours) Subject and scope to be determined on an individual basis. May be repeated for credit as topics vary. Instructor consent required. ([1-3]-0) S

BIOL 4302 TA Apprenticeship (3 semester credit hours) Development and practice of teaching skills in the classroom and laboratory in the biological sciences. May be repeated only once for credit (6 semester credit hours maximum). Instructor consent required. (3-0) S

BIOL 4305 Molecular Evolution (3 semester credit hours) This course describes principles and models of evolutionary theory at the molecular level. It focuses primarily on the evolution of nucleotide sequences including genes, pseudogenes, and genomes as well as amino acid sequences used to study the evolution of proteins, protein complexes, and interactions. Phylogenetics and current leading quantitative models of sequence evolution are discussed in detail. Recent methods on amino acid evolution and its connections to molecular structure and function are also studied. Relevant examples of molecular evolution presented in this course include protein interactions, signaling networks, and viral evolution. Students learn computational tools and algorithms used to study evolution at the molecular level and work on a proposal-like research project applying tools and concepts learned in class to investigate new research questions in their area of specialization. Prerequisites: BIOL 3301 and BIOL 3302. (3-0) S

BIOL 4310 Cellular Microbiology (3 semester credit hours) The course covers topics related to pathogenesis of infectious diseases in the context of host cell properties. It introduces various human pathogens and describes their virulence, and explores the evolutionary aspects of how pathogens interact with their host cells and how host cells defend themselves against invading microorganisms. Topics include bacterial toxins and secretion mechanisms, virus infections, microbial invasion and intracellular parasitism, manipulation of host cell functions and induction of cell death by pathogens, innate and acquired defense mechanisms of the host, inflammation, sepsis, and advances of microbial genomics involving human microbiome, vaccines, and anti-infectives. The course aims to complement the scientific knowledge and principles established in cell biology, medical microbiology, and immunology with
appropriate relevance to clinical applications involving parasitology and infectious disease control. 
Prerequisite: **Biol 2311**. (3-0) Y

**Biol 4315** Genes, Disease and Therapeutics (3 semester credit hours) This course explores models of genetic disease beginning with the genetic basis and traveling through the clinical presentation. Therapeutic approaches as well as particular issues relevant to each disease are also covered. These issues include legal aspects, prenatal screening and ethical concerns. Prerequisites: **Biol 2311** and **Biol 2312** and (**Biol 2281** or **Chem 2401** or equivalent). (3-0) S

**Biol 4317** Cellular and Molecular Medicine of Human Diseases (3 semester credit hours) This course is designed to provide upper level undergraduate students with current understandings of and experimental approaches (e.g. animal models) to human diseases with emphasis on cellular and molecular basis of cancer, metabolic diseases, inflammation, and tissue injuries. Students will become aware of the most recent advancements in biomedical research and the contributions of various animal models to basic and clinical studies. Students are also expected to acquire the necessary skills to interpret and present recent landmark research articles. Sessions include lectures, seminars from invited guest lecturers, and journal article presentation. Prerequisites: (**Biol 3301** and **Biol 3302** and **Biol 3361**) or instructor consent required. (3-0) S

**Biol 4320** Cell Migration in Health and Disease (3 semester credit hours) Cell adhesion and migration play important roles in normal development, immune responses, wound healing, and regeneration. Dysregulated migration underlies many conditions including congenital disorders, chronic inflammation, and cancer invasion and metastasis. This course will examine the cellular and molecular mechanisms underlying cell adhesion and migration in normal, regenerative and diseased states. Model systems, tools, and technologies used to study and analyze cell migration will be discussed. The course will include didactic lectures, enquiry-based learning and student presentations. Prerequisites: (**Biol 3301** and **Biol 3302**) and (**Biol 3361** or **Chem 3361**) or equivalent or instructor consent required. (3-0) S

**Biol 4325** Nutrition and Metabolism (3 semester credit hours) This course examines nutrient utilization and requirements with an emphasis on multifaceted links between diet, health, genetics, microbiome, and diseases. The course intends to support studies towards medicine, health professions, biomedical research, and biotechnology. Topics cover the basis of nutritional physiological phenomena and metabolic hemostasis in the context of human development, aging, exercise, health and diseases. Integration of energy metabolism and physiological requirements concerning macronutrients and major vitamins and minerals as well as benefits of potentially-protective compounds in food are reviewed. How unbalanced intake of nutrients contributes to the initiation, development and severity of various chronic diseases, including coronary heart disease, atherosclerosis, lipedema, hypertension, diabetes, obesity, osteoporosis, thyroid disorders, immune dysfunction, inflammatory conditions, cancer, and dysbiosis are discussed with relevance to clinical nutrition and public health. The course also introduces the fields of microbiomics, nutrigenomics, nutrigenetics and chrononutrition to explore evolving concepts concerning the influence of diet on intestinal microbiota and the effect of foods and sleep on metabolism and genes. Instructor consent required. Prerequisites: (**Biol 3361** and **Biol 3161** or equivalent and (**Biol 3362** and **Biol 3162**) or equivalent. (3-0) S

**Biol 4337** Seminal Papers in Biology (3 semester credit hours) Theoretical and experimental papers in selected areas of biology will be discussed in a senior seminar format. The historical and biographical context of the papers and their authors will also be explored. The areas to be covered in any semester will
vary with the instructor. Each student is expected to make an oral presentation and to prepare a written paper. Prerequisites: (BIOL 3301 and BIOL 3302) and (BIOL 3361 or CHEM 3361) and (BIOL 3362 or CHEM 3362). (3-0) S

**BIOL 4340** Proteomics (3 semester credit hours) Covers the modern techniques for analyzing the protein complement of cells, to understand cell development and physiology in healthy and diseased states. Topics include protein isolation techniques; IEF-SDS PAGE; protein structure determination by X-ray crystallography and NMR; techniques for identification of protein interactions; the use of mass spectrometry to quantitate, sequence, and identify post-translational modifications of proteins; the development of protein chips and how they can be used for protein identification and quantitation. Prerequisite: BIOL 3361 or CHEM 3361. (3-0) T

**BIOL 4341** Genomics (3 semester credit hours) Fundamentals of how the human genome sequence was acquired and the impact of the human genome era on biomedical research, medical care and genetic testing. Also covered is the impact new tools such as DNA microarray, real time PCR, mass spectrometry and bioinformatics will have on approaches to how scientific questions are investigated. The class will be a mixture of didactic lectures and paper presentations on examples of applied genomics. There will be two computer-based labs where students will perform online bioinformatics and data mining using the NCBI public database. Prerequisite: BIOL 3301 with a grade of C or better. (3-0) T

**BIOL 4342** Regulation of Gene Expression (3 semester credit hours) How genetic information is regulated in prokaryotic and eukaryotic systems. Topics include mechanisms of transcription, promoter architecture, function and regulation of transcription factors, organization of chromosomes, pathways that control gene expression during growth and development, genome organization and whole-genome expression analysis, and related areas. The course emphasizes presentation and critical discussion of techniques and results from the recent scientific literature. Prerequisites: (BIOL 3301 and BIOL 3302) and (BIOL 3361 or CHEM 3361) or their equivalents, or instructor consent required. (3-0) T


**BIOL 4350** Medical Microbiology (3 semester credit hours) This course will cover the methods used for identification of pathogenic organisms and the study of these organisms in relation to their disease process in humans. We will also cover at the molecular level important concepts such as microbial virulence, the control of bacterial growth, and host responses to infection. Prerequisite: BIOL 3301 or BIOL 3V20. (3-0) T

**BIOL 4352** Medical Molecular and Cell Biology (3 semester credit hours) Topics related to health and disease will be examined from a molecular and cellular perspective. Topics will vary but will be selected from new and developing applications of cell biology to cancer, heart disease, fat metabolism, mitochondrial disorders, aging, Alzheimer's, etc. Students are expected to participate actively in discussions and make an oral presentation. Prerequisite: BIOL 3302. (3-0) T

**BIOL 4353** Molecular Biology of HIV/AIDS (3 semester credit hours) Topics include a discussion of the
history and epidemiology of AIDS, the likely origins of human immunodeficiency virus (HIV), and the molecular and cell biology of HIV replication. The cell biological basis of the immunodeficiency induced by HIV infection is examined, as well as that of common accompanying pathologies such as Kaposi's sarcoma. The molecular basis of a variety of existing and potential anti-viral therapies is considered. Suggested prerequisite: BIOL 3302. (3-0) T

**BIOL 4356** Molecular Neuropathology (3 semester credit hours) Molecular Neuropathology course offers a 360 degree view on neurological diseases and the underlying molecular causes. In this course, we will be looking at the pathology of the brain and CNS in various diseases. Following a look at the pathology, we will dive into the molecular aspects of the same diseases looking at it from the genetic and protein structure-function point of view. We love an open class format and enjoy discussions on the various topics on the syllabus. Prerequisites: BIOL 3301 and BIOL 3302 and (BIOL 3361 or CHEM 3361) or equivalent or instructor consent required. (3-0) S

**BIOL 4357** Molecular Neuropathology II (3 semester credit hours) Molecular Neuropathology course offers a 360 degree view on neurological diseases and the underlying molecular causes. In this course, we will be looking at the pathology of the brain and CNS in various diseases. Following a look at the pathology, we will dive into the molecular aspects of the same diseases looking at it from the genetic and protein structure-function point of view. We love an open class format and enjoy discussions on the various topics on the syllabus. Prerequisites: BIOL 3301 and BIOL 3302 and (BIOL 3361 or CHEM 3361) or equivalent or instructor consent required. (3-0) Y

**BIOL 4360** Evolution and Development (3 semester credit hours) The objective of the course is to integrate evolutionary biology and developmental biology into a common framework, focusing on the evolution of developmental pathways as a basis for the evolution of animal morphology. This is a reading intensive course with a heavy focus on scientific research. Prerequisite or Corequisite: BIOL 3301. (3-0) S

**BIOL 4365** Advanced Human Physiology (3 semester credit hours) Function and integration of human organ systems. The role of these systems in the adaptation of humans to, and their interaction with, the environment. Maintenance and perturbation of homeostasis. Pathophysiological basis of certain diseases. Prerequisite: BIOL 3302 or instructor consent required. (3-0) T

**BIOL 4366** Molecular Biology of Cancer (3 semester credit hours) Subject matter includes a discussion of representative examples of the principal categories of dominantly acting oncogenes. The role in oncogenesis of tumor suppressor genes ("recessive oncogenes") is also considered, as are anti-apoptotic oncogenes such as Bcl. The roles that the proteins encoded by these genes play in growth hormone signal transduction, gene regulation, cell cycle regulation, and programmed cell death will be examined. Students will also read and discuss the primary literature in this field. Prerequisite: BIOL 3302. (3-0) T

**BIOL 4371** General and Molecular Virology (3 semester credit hours) What is a virus? What is the basis of virus/host specificity? How do viruses replicate? This course will cover virus structure, classification, gene expression, and replication. Once we have covered the basics using a few select model systems, we will consider selected groups of viruses from each of the three domains of life and discuss in detail virus replication from attachment to release of progeny virions (and/or alternative fates such as lysogeny, abortive infections and others). This course is designed for upper level undergraduate students who have a firm grasp on the basics of Central Dogma: transcription, translation, replication, as well as a background in bacteriology and eukaryotic cell biology. BIOL 3302 is recommended but not required. Prerequisites: BIOL 3302 and
OL 3301 and (BIOL 3520 or BIOL 3V20) or instructor consent required. (3-0) Y

BIOL 4375 Bioinformatics (3 semester credit hours) A practical approach to quantitative and statistical analysis of biological sequence and structural information. Classroom lectures are accompanied by practical demonstrations and computer lab exercises. Topics include genomic information content, data searches and sequence alignment, mutations and distance-based phylogenetic analysis, genomics and gene recognition, polymorphisms and forensic applications, nucleic-acid and protein array analysis, and structure prediction of biological macromolecules. Recommended prerequisite: one semester of introductory statistics. Prerequisites: BIOL 3301 and (BIOL 3361 or CHEM 3361) and two semesters of calculus. (3-0) T

BIOL 4380 Cell and Molecular Biology Laboratory (3 semester credit hour) Current techniques that are utilized in a modern molecular biology research laboratory. Practical skills taught include monitoring bacterial growth, phenotype testing, plasmid isolation, restriction digest analysis, DNA cloning, and DNA fingerprinting using the polymerase chain reaction (PCR). Advanced techniques include fundamental microscopy, DNA transfection and general characterization of animal cell cultures, sub-cellular fractionation using differential centrifugation, basic immunological techniques, and chemical mutagen testing. Prerequisite: BIOL 3380. Prerequisite or Corequisite: BIOL 3302. (1-4) S

BIOL 4385 Oral Histology and Embryology (3 semester credit hours) This course will provide exposure to and broad coverage of maxillofacial and oral histological structures and embryology of the face, neck, and teeth using lectures and electronic images of calcified and soft tissues cells. Prerequisites: (BIOL 3361 and (BIOL 3455 or BIOL 3456)) or instructor consent required. (3-0) S

BIOL 4390 Senior Readings in Molecular and Cell Biology (3 semester credit hours) For students conducting independent literature research and scientific writing in Biology or Molecular and Cell Biology. Subject and scope to be determined on an individual basis. Topics may vary. Instructor consent required. (3-0) S

BIOL 4391 Senior Research in Molecular and Cell Biology (3 semester credit hours) For students conducting laboratory research and scientific writing in Biology or Molecular and Cell Biology. Subject and scope to be determined on an individual basis. Topics may vary. Instructor consent required. (3-0) S

BIOL 4398 Senior Honors Readings for Thesis in Molecular and Cell Biology (3 semester credit hours) For students conducting independent literature research for honors in Biology or Molecular and Cell Biology. Besides the university specifications the student should contact the undergraduate academic advisor in biology for program requirements. Topics may vary. Instructor consent required. (3-0) S

BIOL 4399 Senior Honors Research for Thesis in Molecular and Cell Biology (3 semester credit hours) For students conducting independent laboratory research for honors in Biology or Molecular and Cell Biology. Besides the university specifications the student should contact the undergraduate academic advisor in biology for program requirements. Topics may vary. Instructor consent required. (3-0) S

BIOL 4461 Biophysical Chemistry (4 semester credit hours) For students interested in the interface between biochemistry and structural biology. Provides an advanced treatment of the physical principles underlying modern molecular biology techniques. Topics include classical and statistical thermodynamics, biochemical kinetics, transport processes (e.g., diffusion, sedimentation, viscosity), chemical bonding, and spectroscopy. Prerequisites: (MATH 2413 and MATH 2414) or MATH 2417 and (PHYS 1301 or PHYS 2325 or equivalent) and (BIOL 3361 or CHEM 3361). (4-0) Y
**BIOL 4V00** Special Topics in Biology (1-6 semester credit hours) May be repeated as topics vary (9 semester credit hours maximum). Prerequisites: (BIOL 3301 and BIOL 3302) and (BIOL 3361 or CHEM 3361) or equivalent or instructor consent required. ([1-6]-0) S

**BIOL 4V01** Topics in Biological Sciences with Lab (1-6 semester credit hours) May be repeated as topics vary (6 semester credit hours maximum). Prerequisites: (BIOL 3301 and BIOL 3302) and (BIOL 3361 or CHEM 3361) or equivalent or instructor consent required. ([1-5]-[1-5]) R

**BIOL 4V40** Special Topics in Molecular and Cell Biology (1-6 semester credit hours) May be repeated as topics vary (9 semester credit hours maximum). Prerequisites: (BIOL 3301 and BIOL 3302) and (BIOL 3361 or CHEM 3361) or equivalent or instructor consent required. ([1-6]-[0-5]) S

**BIOL 4V95** Advanced Topics in Biology (Individual Instruction) (1-6 semester credit hours) Individual study under a faculty member's direction. May be repeated for credit as topics vary. Instructor consent required. ([1-6]-0) S

**BIOL 4V98** Senior Honors Readings in Molecular and Cell Biology (3-6 semester credit hours) For students conducting independent library research for honors theses or projects. Besides the university specifications, the student should contact the undergraduate advisor in biology for program requirements. May be repeated for credit as topics vary. Instructor consent required. ([3-6]-0) S

**BIOL 4V99** Senior Honors Research in Molecular and Cell Biology (3-6 semester credit hours) For students conducting independent research for honors theses or projects. Besides the university specifications, the student should contact the undergraduate advisor in biology for program requirements. May be repeated for credit as topics vary. Instructor consent required. ([3-6]-0) S

**Chemistry**

**CHEM 1111** (CHEM 1111) General Chemistry Laboratory I (1 semester credit hour) Introduction to the chemistry laboratory. Experiments are designed to demonstrate concepts covered in CHEM 1311; including properties and reactions of inorganic substances and elementary qualitative and quantitative analysis. Corequisite: CHEM 1311. (0-3) S

**CHEM 1112** (CHEM 1112) General Chemistry Laboratory II (1 semester credit hour) A continuation of CHEM 1111 demonstrating the concepts covered in CHEM 1312, including acid-base chemistry, reaction kinetics, electrochemistry, polymers, and organic synthesis. Prerequisite: CHEM 1111 or CHEM 1115. Corequisite: CHEM 1312. (0-3) S

**CHEM 1115** Honors Freshman Chemistry Laboratory I (1 semester credit hour) This course and its follow-on (CHEM 1116) reinforce the concepts of Freshman Chemistry via experiments. Students are offered the opportunity to acquire basic laboratory skills and an appreciation for the presence of chemistry in daily living through a combination of laboratory and computer experiments and applied research modules. Corequisite: CHEM 1315. (0-3) Y

**CHEM 1116** Honors Freshman Chemistry Laboratory II (1 semester credit hour) A continuation of CHEM 1115. This course reinforces concepts presented in CHEM 1316. Prerequisite: CHEM 1115. Corequisite: CHEM 1316. (0-3) Y
CHEM 1301 General Chemistry for Engineers (3 semester credit hours) Covers fundamental concepts and selected material developed in a traditional two-semester General Chemistry lecture sequence (CHEM 1311 and CHEM 1312), with a focus on those important for Engineering students. May not be used to fulfill degree requirements for pre-health majors. Students will also be registered for the exam section. Department consent required. (3-0) S

CHEM 1311 (CHEM 1311) General Chemistry I (3 semester credit hours) Introduction to elementary concepts of chemistry theory. The course emphasizes chemical reactions, the mole concept and its applications, and molecular structure and bonding. Students will also be registered for the exam section. Corequisite: CHEM 1111. (3-0) S

CHEM 1312 (CHEM 1312) General Chemistry II (3 semester credit hours) A continuation of CHEM 1311 treating metals; solids, liquids, and intermolecular forces; chemical equilibrium; electrochemistry; organic chemistry; rates of reactions; and environmental, polymer, nuclear, and biochemistry. Students will also be registered for the exam section. Prerequisite: CHEM 1311 or CHEM 1315. Corequisite: CHEM 1112. (3-0) S

CHEM 1315 Honors Freshman Chemistry I (3 semester credit hours) An advanced course dealing with the principles of structure and bonding and the physical laws that govern the interactions of molecules. The course is intended for students who have a solid background in chemistry at the secondary level and the desire to explore general chemistry concepts more deeply. Corequisite: CHEM 1115. (3-0) Y

CHEM 1316 Honors Freshman Chemistry II (3 semester credit hours) A continuation of the presentation of concepts begun in CHEM 1315. This course will present advanced topics including those in organic, biochemistry, and environmental chemistry. Prerequisite: CHEM 1315 or instructor consent required. Corequisite: CHEM 1116. (3-0) Y

CHEM 2123 (CHEM 2123) Introductory Organic Chemistry Laboratory I (1 semester credit hour) The experimental skills associated with organic functional group reactions. Corequisite: CHEM 2323. (0-4) S

CHEM 2125 (CHEM 2125) Introductory Organic Chemistry Laboratory II (1 semester credit hour) Continuation of Introductory Organic Chemistry Laboratory I (CHEM 2123). Prerequisites: CHEM 2123 and CHEM 2323. Corequisite: CHEM 2325. (0-4) S

CHEM 2127 Honors Organic Chemistry Laboratory I (1 semester credit hour) Introduction to the experimental skills required for organic reactions. Experiments are designed to demonstrate concepts covered in CHEM 2327. Corequisite: CHEM 2327. (0-3) Y

CHEM 2128 Honors Organic Chemistry Laboratory II (1 semester credit hour) Continuation of CHEM 2127. This course reinforces concepts presented in CHEM 2328, including reactions of aromatic and carbonyl containing compounds and the use of spectroscopy to identify reaction products. Prerequisite: CHEM 2127. Corequisite: CHEM 2328. (0-3) Y

CHEM 2130 Introductory Organic Chemistry for Medical Science Laboratory (1 semester credit hour) The experimental skills associated with organic functional group reactions. Topics covered include fundamental skills, as well as selected experiments developed in a traditional two-semester Introductory Organic Chemistry Laboratory sequence (CHEM 2123 and CHEM 2125). Required course for students in the Partnership in Advancing Clinical Transition (UT-PACT) Program. May not be used to fulfill degree requirements for pre-health majors. Corequisite: CHEM 2330 and instructor consent required. (0-4) Y

**CHEM 2323** (CHEM 2323) Introductory Organic Chemistry I (3 semester credit hours) The covalent bond. Organic chemistry: aliphatic and aromatic compounds; covalent inorganic and organometallic compounds; a survey of the organic functional groups and their typical reactions; stereochemistry. The first course in organic chemistry. Satisfies the basic organic chemistry lecture requirements for pre-health profession students. Students will also be registered for the exam section. Prerequisite: **CHEM 1312** or **CHEM 1316**. Corequisite: **CHEM 2123**. (3-0) S

**CHEM 2324** Introductory Organic Chemistry for Engineers (3 semester credit hours) Covers fundamental concepts and selected material developed in a traditional two-semester Introductory Organic Chemistry lecture sequence (**CHEM 2323** and **CHEM 2325**), with a focus on those important for Engineering students. May not be used to fulfill degree requirements for pre-health majors. Prerequisites: (**CHEM 1301** or **CHEM 1312** or **CHEM 1316**) and department consent required. (3-0) Y

**CHEM 2325** (CHEM 2325) Introductory Organic Chemistry II (3 semester credit hours) Continuation of **CHEM 2323**. Methods of structure determination. Synthesis, degradation, spectroscopy. Naturally occurring compounds: carbohydrates, amino acids and proteins, lipids, alkaloids. Students will also be registered for the exam section. Prerequisite: **CHEM 2323**. Corequisite: **CHEM 2125**. (3-0) S

**CHEM 2327** Honors Organic Chemistry I (3 semester credit hours) This course, intended for students who have a solid background in general chemistry, offers a unified overview of fundamental organic chemistry, providing students with an integrated understanding of molecular architecture, molecular transformations, reaction energetics and mechanisms, synthetic strategy, and structure determination. Prerequisites: (**CHEM 1312** or **CHEM 1316**) and instructor consent required. Corequisite: **CHEM 2127**. (3-0) Y

**CHEM 2328** Honors Organic Chemistry II (3 semester credit hours) A continuation of the presentation of concepts begun in **CHEM 2327**. This course will present advanced topics including properties and reactions of aromatic compounds, reactions of carbonyl containing compounds, and the use of spectroscopic techniques to determine the structure of organic compounds. Prerequisite: **CHEM 2327**. Corequisite: **CHEM 2128**. (3-0) Y

**CHEM 2330** Introductory Organic Chemistry for Medical Science (3 semester credit hours) Covers fundamental concepts and selected material developed in a traditional two-semester Introductory Organic Chemistry lecture sequence (**CHEM 2323** and **CHEM 2325**). Required course for students in the Partnership in Advancing Clinical Transition (UT-PACT) Program. May not be used to fulfill degree requirements for pre-health majors. Prerequisites: (**CHEM 1312** or **CHEM 1316**) and instructor consent required. Corequisite: **CHEM 2130**. (3-0) Y

**CHEM 2401** Introductory Quantitative Methods in Chemistry (4 semester credit hours) A study of the theory, applications, and calculations involved in the methods of analysis. Theory and practice of volumetric, gravimetric, and spectrophotometric methods. Prerequisites: **CHEM 1112** and **CHEM 1312**. (2-6) Y

**CHEM 2V01** Topics in Chemistry (1-3 semester credit hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-3]-0) R

**CHEM 3321** Physical Chemistry I (3 semester credit hours) Fundamental properties of macroscopic
biophysical chemical systems are introduced and described in quantitative terms. A core of topics in
thermodynamics, molecular motion, kinetics, molecular distributions and statistical thermodynamics is
supplemented with topics germane to students taking physical chemistry with biophysical applications.
Students will also be registered for the exam section. Prerequisites: CHEM 2325 and (MATH 2415 or MATH
2451) or instructor consent required. (CHEM 3361 is recommended). (3-0) Y

CHEM 3322 Physical Chemistry II (3 semester credit hours) Fundamental microscopic properties of matter
and radiation are discussed. A core of topics including quantum chemistry, atomic and molecular structure
and spectroscopy, non-bonded interactions, and computational chemistry is supplemented with topics
germane to students taking physical chemistry with biophysical applications. Students will also be
registered for the exam section. Prerequisites: CHEM 3321 and (MATH 2415 or MATH 2451) or instructor
consent required. (3-0) Y

CHEM 3341 Inorganic Chemistry I (3 semester credit hours) Survey of inorganic chemistry with emphasis
on the modern concepts and theories of inorganic chemistry including electronic and geometric structure
of inorganic compounds. Topics address contemporary physical and descriptive inorganic chemistry.
Prerequisites: (CHEM 2323 and CHEM 2325) or equivalent. (3-0) Y

CHEM 3361 Biochemistry I (3 semester credit hours) Structures and chemical properties of amino acids;
protein purification and characterization; protein structure and thermodynamics of polypeptide chain
folding; catalytic mechanisms, kinetics and regulation of enzymes; energetics of biochemical reactions;
generation and storage of metabolic energy associated with carbohydrates; oxidative phosphorylation and
electron transport mechanisms; photosynthesis. Prerequisites: (CHEM 2323 or equivalent) and CHEM 232
5. Corequisite: BIOL 3161. (Same as BIOL 3361) (3-0) S

CHEM 3362 Biochemistry II (3 semester credit hours) Breakdown and synthesis of lipids; membrane
structure and function; nitrogen metabolism and fixation; nucleotide metabolism; structure and properties
of nucleic acids; sequencing and genetic engineering; replication, transcription, and translation;
chromosome structure; hormone action; biochemical basis of certain pathological processes. Prerequisite:
(BIOL 3361 or CHEM 3361) or its equivalent, or instructor consent required. Corequisite: BIOL 3162. (Same
as BIOL 3362) (3-0) S

CHEM 3471 Advanced Chemical Synthesis Laboratory (4 semester credit hours) Careful handling practices
and controlled variation of reaction parameters to obtain high yield syntheses. Use of standard separation
techniques and spectrophotometric methods to identify reaction products and assess their purity.
Prerequisite: (CHEM 2125 and CHEM 2401) or instructor consent required. (1-7) Y

CHEM 3472 Instrumental Analysis (4 semester credit hours) Basic processes, instrumentation and
applications of ultraviolet, visible, fluorescence, atomic and mass spectroscopy, electrochemistry, surface
and microanalysis, and separations. Emphasis will be placed upon acquisition, treatment, and
interpretation of data and report writing. Prerequisite: CHEM 2401. (2-6) Y

CHEM 3V92 Undergraduate Research in Biochemistry (2-6 semester credit hours) Students will pursue an
independent project under the supervision of a member of the Chemistry, Biology, or UT Southwestern
faculty. May be repeated for credit (9 semester credit hours maximum). Instructor consent required.
((2-6)-0) S

CHEM 4335 Polymer Chemistry (3 semester credit hours) Macromolecules. Synthesis, structure, and
properties of polymers. Polymer-polymer and polymer-solvent interactions. Applications in industry and biochemistry. Recommended: CHEM 3322. Prerequisite: CHEM 3321 or instructor consent required. (3-0) Y

**CHEM 4355** Computational Modeling (3 semester credit hours) This course will introduce students to computational modeling approaches commonly used to tackle chemical and biophysical problems. Prerequisites: (CHEM 3321 and MATH 2451) or instructor consent required. (3-0) Y

**CHEM 4381** Green Chemistry and Green Fuels (3 semester credit hours) This course encompasses the study of the sources, reactions, transport, effects, and fates of chemical species in water, soil, and air environments and the effects of technology thereon. Prerequisite: CHEM 2325 or instructor consent required. (3-0) T

**CHEM 4390** Research and Advanced Writing in Chemistry (3 semester credit hours) For students conducting independent research and scientific writing. Students will pursue an independent project under the supervision of a member of the Chemistry faculty. Subject and scope to be determined on an individual basis. This course satisfies the university advanced writing requirement. Instructor consent required and submission of research plans with approval from supervising faculty and the Undergraduate Committee in Chemistry. Prerequisite: at least 3 semester credit hours of undergraduate research (e.g. CHEM 4V91). (3-0) S

**CHEM 4399** Research and Advanced Writing in Chemistry for Honors Students (3 semester credit hours) For students conducting independent research for honors theses or projects. Satisfies the university advanced writing requirement. Prerequisites: Senior level standing with at least 3 semester credit hours of undergraduate research (e.g. CHEM 4V91), and consent of supervising faculty and (filing a research plan approved by supervising faculty and the Undergraduate Committee in Chemistry prior to the 12th class day). (3-0) S

**CHEM 4473** Physical Measurements Laboratory (4 semester credit hours) Modules may include topics in physical chemistry and biophysics such as bio-nanotechnology, calorimetry, centrifugation, computational methods, computer-instrument interfaces, electrochemistry, electronics, kinetics, literature skills, property of matter, spectroscopy, and statistical methods. Prerequisites: (CHEM 3321 and CHEM 3472) or instructor consent required. (1-7) Y

**CHEM 4V01** Topics in Chemistry (1-9 semester credit hours) Subject matter will vary from semester to semester. Examples would include, as required, bioorganic chemistry, industrial processes, applied spectroscopy, drugs and people, practical analysis, or other topics that span several subdisciplines. May be repeated for credit (9 semester credit hours maximum). Instructor consent required. ([1-9]-0) R

**CHEM 4V91** Research in Chemistry (2-6 semester credit hours) Students will pursue an independent project under the supervision of a member of the Chemistry faculty. May be repeated for credit (12 semester credit hours maximum). Instructor consent required. ([2-6]-0) S

### Geosciences

**GEOS 1103 (GEOL 1103)** Physical Geology Laboratory (1 semester credit hour) A laboratory to accompany GEOS 1303. The exercises include mineral and rock identification. Topographic maps, geologic maps, and aerial photographs are used to study surface landforms, geologic phenomena and tectonic processes.
Prerequisite or Corequisite: GEOS 1303. (0-3) S

GEOS 1104 (GEOL 1104) History of Earth and Life Laboratory (1 semester credit hour) A laboratory to accompany GEOS 1304. Exercises include fossil identification, stratigraphy, and correlation, the geologic time scale, age-determination techniques, and maps. Prerequisite or Corequisite: GEOS 1304. (0-3) Y

GEOS 1303 (GEOL 1303) Physical Geology (3 semester credit hours) Introduction to Earth as a unique planet. Rock-forming minerals and rock-forming processes are discussed. The structure of the Earth, in the context of rock types, and dynamics of its internal mechanisms are explored. Plate tectonics and surface processes that sculpt the Earth are the topics of the second half of the course. Other planets and celestial bodies within the solar system are contrasted with Earth. (3-0) S

GEOS 1304 (GEOL 1304) History of Earth and Life (3 semester credit hours) Introduction to the history of the Earth. The history of life and an introduction to the principles of paleontology, stratigraphy and global change will be discussed. All topics will be discussed in the context of the tectonic evolution of North America. Field trip. Prerequisites: GEOS 1303 and GEOS 1103. (3-0) Y

GEOS 2302 (GEOL 1305) The Global Environment (3 semester credit hours) An introduction to the physical aspects of the world's geography emphasizing the interrelationships between the earth and its climate, vegetations, soils, and landforms. Provides a global perspective on the physical environment and the interactions between global systems to produce regional differences. (Same as ENVR 2302 and GEOG 2302) (3-0) Y

GEOS 2305 Spatial Thinking and Data Analytics (3 semester credit hours) This course explores the role that Spatial Thinking plays across a variety of subject areas in science, engineering, mathematics, arts and humanities. We will introduce rich resources of geospatial data from government agencies, social media, and semantic web. Students will be exposed to introductory methods in Spatial Data Analytics afforded by Global Positioning Systems (GPS), Remote Sensing (RS), Geographic Information Systems (GIS), Spatial Analysis, and Mapping technologies and learn how to bring spatial considerations into research and applications. The course is intended to empower students with spatial intelligence (one of the nine intelligences on Howard Gardner's Theory of Multiple Intelligences) and with experiences of applying spatial thinking and data analytics to problem solving. (Same as EPPS 2305 or GISC 2305) (3-0) Y

GEOS 2306 Essentials of Field Geologic Methods (3 semester credit hours) Introduction to fundamental methods of field geologic investigations, including topographic, air photo, and geologic map interpretation and preparation and use of common field geologic tools (Brunton compass, hand-held GPS, and a field notebook). Applications of field methods in the Earth Sciences will be presented. There will be a mandatory field trip over part of spring break with a fee, which covers the cost of transportation and camping fees for the spring break field trip. Prerequisites: GEOS 1103 and GEOS 1303. (3-0) Y

GEOS 2310 Environmental Geology (3 semester credit hours) A course examining the interactions of people and our physical environment. Natural hazards, including landslides, flooding, tsunamis, volcanoes, earthquakes, erosion, and sea-level change. Air, soil, fresh and ocean water pollution problems and solutions including greenhouse gases, ozone depletion, acid rain, aquifer depletion, toxic wastes, and contamination. Energy supplies and the environment, including radioactive waste problems, and human impacts on climate. (3-0) Y

GEOS 2321 Geology, Resources, and Environment of Latin America (3 semester credit hours) An overview
of the physical environment of Mexico, Central America, and South America. Topics include evolution of Latin American crust and continent; location and formation of major geologic resources and physiographic features; resource exploitation and present environmental problems with an historic perspective. (3-0) R

**GEOS 2324** Energy, the Environment and Human Health (3 semester credit hours) This course will focus on the environmental and human health impacts of geologic materials and geologic processes with particular emphasis on fossil fuels. A balanced, fact-based discussion will be provided on both positive and negative effects of various energy sources on the natural environment and human health. Old and new myths about the environmental and health consequences of fossil fuels, especially coal, will be debunked. The course will cultivate an awareness of both the positive and negative aspects of energy production and use and enable informed decision making with respect to societal issues associated with energy and mineral resources. (3-0) Y

**GEOS 2328** Geologic Time: An Historical Perspective (3 semester credit hours) Notions of immortality and concepts of eternity—the struggle to understand human existence and the physical world. The geocentric universe—a Graeco-Christian compromise. The Hexaemeron and the 6000 year-old earth. The Renaissance and the slow acceptance of the Copernican universe. Seventeenth century attempts to explain the earth in biblical terms. Steno's laws and the demonstration that the Earth had a history. James Hutton's Earth machine and William Smith's strata—the progeny of the Enlightenment and the Industrial Revolution. Biostratigraphy, the great stratigraphers, and Darwin. Victorian reaction to the realization of Earth's antiquity, as expressed in literature. Lord Kelvin's arguments for a young Earth. Discovery of radioactivity and the refutation of Kelvin. Patterson and the age of the solar system. Modern rock dating techniques. A walk through geologic time. Current concepts of the origin of the universe and the solar system. (3-0) Y

**GEOS 2332** Age of Dinosaurs (3 semester credit hours) Introductory survey of the origin, evolution, anatomy, physiology, life-styles, population dynamics, and extinction of dinosaurs and marine and flying reptiles, as well as Mesozoic climates and basic Earth history of the "Age of Dinosaurs." Extensive use of fossils is a component of this course that is taught in a Problem Based Learning format. (3-0) Y

**GEOS 2333** Introduction to Fossils (3 semester credit hours) Introduction to the study of invertebrate fossils occurring in Cretaceous sedimentary strata in North Texas. Hands on approach to the study of invertebrate macrofossils and microfossils includes learning how to (1) collect fossils at selected outcrops in the field; (2) process fossils (3) illustration of fossils and identification using the available paleontological literature. Lectures and exercises will focus on the invertebrate phyla occurring in selected North Texas Cretaceous outcrops. (3-0) Y

**GEOS 2409** Rocks and Minerals (4 semester credit hours) Introduction to crystallography, mineralogy, and petrography. Laboratory course. Prerequisites or Corequisites: **GEOS 1103** and **GEOS 1303**. (3-3) Y

**GEOS 2V08** Special Topics in Geology or Geophysics I (1-4 semester credit hours) Subject matter will vary from semester to semester. Instructor consent required. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ((1-4)-0) R

**GEOS 3122** Coal in Our Society (1 semester credit hour) Coal plays an important role in the U.S. energy mix and a critical role in Texas society. Yet it may be the most misunderstood natural resource. It is the objective of this course to familiarize the students with the origin, properties, and uses of coal and examine how coal use may impact the environment and human health. This will be accomplished by
exploring the facts and fallacies surrounding coal in our society. There will be a field trip to a coal mine and/or a coal-burning power plant. The course will last approximately 1 month during a semester. (1-0) Y

**GEOS 3124** Energy, the Environment and Human Health (1 semester credit hour) This course will focus on the environmental and human health impacts of geologic materials and geologic processes with particular emphasis on fossil fuels. A balanced, fact-based discussion will be provided on both positive and negative effects of various energy sources on the natural environment and human health. Old and new myths about the environmental and health consequences of fossil fuels, especially coal, will be debunked. The course will cultivate an awareness of both the positive and negative aspects of energy production and use and enable informed decision making with respect to societal issues associated with energy and mineral resources. (1-0) Y

**GEOS 3300** Field Geology I (Summer Field Camp I) (3 semester credit hours) A three-week, early summer field based course designed to provide practical introductory field geological experience. Course emphasizes mapping in sedimentary and igneous terrains and will also cover techniques for mapping geomorphic features. Reports on each project in professional form are required. NOTE: A field trip fee, which covers the cost of food, lodging, and transportation, is charged for this course. Students are responsible for any other personal expenses related to camp. Prerequisites: **GEOS 1103** and **GEOS 1104** and **GEOS 1303** and **GEOS 1304** and **GEOS 2306**. (3-0) Y

**GEOS 3304** Principles of Geospatial Information Sciences (3 semester credit hours) An introduction to the primary Geospatial Information Sciences (GIS) methods for manipulating, querying, analyzing, and visualizing spatial-based data. Topics include spatial data models, data acquisition and editing, cartography, and spatial analysis. This course is designed to provide a foundation for all other upper level GISC courses. (Same as **GEOG 3304** and **GISC 3304**) (3-0) Y

**GEOS 3331** Paleoecology (3 semester credit hours) Introduction to the characteristics, distribution, and relationships of individual organisms, communities, and ecosystems at selected intervals in time. The course objective is to use all available data to interpret extensive collections of both fossil and recent organisms. With a primary focus of paleoecology, the course ranges through geography, biology, botany, archaeology, paleontology, and other disciplines. (3-0) Y

**GEOS 3421** Stratigraphy and Sedimentology (4 semester credit hours) Principles and evolution of modern stratigraphic nomenclature; concepts of space and time in the rock record and methods of stratigraphic correlation; factors controlling stratigraphic architecture of sedimentary basins; integrated stratigraphic techniques. Origin, transportation, and deposition of carbonate and siliciclastic sediments; weathering, textural analysis, and depositional environments. Laboratory course. Field trips. Prerequisites: **GEOS 1103** and **GEOS 1104** and **GEOS 1303** and **GEOS 1304** and **GEOS 2409**. (3-3) Y

**GEOS 3434** Paleobiology (4 semester credit hours) History of life as documented by the fossil record. Basic concepts of paleontology and biostratigraphy followed by a review of major fossil groups and major events in the evolution of life, speciation, mass extinction, evolution of communities and ecosystems through geologic time. Paleontological methods to paleoenvironmental reconstruction. Field trip. Prerequisites: **GEOS 1103** and **GEOS 1104** and **GEOS 1303** and **GEOS 1304** and **GEOS 2409**. (3-3) Y

**GEOS 3464** Igneous and Metamorphic Petrology (4 semester credit hours) Introduction to the petrographic microscope and its use for study of igneous and metamorphic minerals and rocks. Identification and
classification of volcanic and plutonic igneous rocks and metamorphic rocks and their identification in thin sections. Introduction to major element chemical analyses of igneous and metamorphic rocks.

Introduction to igneous and metamorphic petrogenesis. Prerequisites: CHEM 1111 and CHEM 1112 and CHEM 1311 and CHEM 1312 and GEOS 1103 and GEOS 1104 and GEOS 1303 and GEOS 1304 and GEOS 2409. (3-3) Y

**GEOS 3470** Structural Geology (4 semester credit hours) Modern tectonic concepts, survey of major structural provinces, examination of material behavior, stress-strain concepts, failure criteria, soil mechanics, fault analysis, rheology, fold analysis and applications of structural concepts to neotectonics and environmental problems. Training in graphical techniques, use of stereographic projections, and geological map interpretation. Integrated lecture and laboratory course. Prerequisites: GEOS 1103 and GEOS 1104 and GEOS 1303 and GEOS 1304 and GEOS 2409 and PHYS 2125 and PHYS 2126 and PHYS 2325 and PHYS 2326. (3-3) Y

**GEOS 4300** Field Geology II (Summer Field Camp II) (3 semester credit hours) A three-week, early summer field based course designed to provide practical advanced field geological experience. Course emphasizes mapping in sedimentary, metamorphic, and igneous terranes and will also cover techniques used in imaging and analyzing geomorphic features. Reports on each project in professional form are required.

NOTE: A field trip fee, which covers the cost of food, lodging, and transportation, is charged for this course. Students are responsible for all personal expenses related to camp. Prerequisites: GEOS 3300 and GEOS 3421 and GEOS 3464 and GEOS 3470. (0-3) Y

**GEOS 4320** The Physics and Chemistry of the Solid Earth (3 semester credit hours) The study of the structure and evolution of the Earth through petrology, geochemistry and geophysics. Plate tectonics will be emphasized as a framework for crust and mantle dynamics. The roles of gravity, thermal processes and the mechanical behavior of rocks are investigated. Tectonic settings of igneous and metamorphic rocks will be explored. Prerequisites: CHEM 1111 and CHEM 1112 and CHEM 1311 and CHEM 1312 and GEOS 1103 and GEOS 1104 and GEOS 1303 and GEOS 1304 and GEOS 2409 and PHYS 2125 and PHYS 2126 and PHYS 2325 and PHYS 2326. (3-0) Y

**GEOS 4322** The Earth System (3 semester credit hours) Planet Earth comprises a system of interacting spheres: atmosphere, hydrosphere, lithosphere and biosphere, all of which have played an important role in Earth processes and Earth history. This course examines these Earth systems and how their interactions over time have affected their evolving compositions, the evolution of life and Earth's climate. The short-term and long-term parts of the carbon cycle provide the underlying theme for the study of the Earth System. Prerequisites: CHEM 1111 and CHEM 1112 and CHEM 1311 and CHEM 1312 and GEOS 1103 and GEOS 1104 and GEOS 1303 and GEOS 1304 and GEOS 2409. (3-0) Y

**GEOS 4325** Introduction to Remote Sensing (3 semester credit hours) Topics include principles of remote sensing and sensors, image visualization and statistics, radiometric and geometric correction, enhancement, classification, change detection, and innovative image processing approaches. (Same as GIS C 4325) (3-0) Y

**GEOS 4369** Volcanic Successions (3 semester credit hours) Terrestrial volcanism is considered from the perspective of volcanic processes, and the properties, products and deposits of volcanic eruptions, all in the context of definable facies models. The effects of subsequent sedimentological processes are also considered. Volcanic settings are explored in detail as they are related to their plate tectonic settings.
Recognition of volcanically derived deposits are emphasized using the facies model concepts, and are considered with respect to their geological and economic significance. (3-0) T

**GEOS 4390** Communication in the Geosciences (3 semester credit hours) For all Geoscience students. Independent research and all forms of scientific communication in the Geosciences are emphasized. Subject and scope of material presented is determined on an individual basis. Satisfies the Advanced Writing Requirement for Geoscience majors. Prerequisites: Instructor consent required and senior level standing in Geosciences. (3-0) S

**GEOS 4399** Senior Honors in Geosciences (3 semester credit hours) For students conducting independent research for honors theses or projects. Satisfies the School of Natural Sciences and Mathematics' advanced writing requirement. Instructor consent required. (3-0) R

**GEOS 4430** Hydrogeology and Aqueous Geochemistry (4 semester credit hours) An introduction to the principles of physical and chemical hydrogeology. Physical topics include the nature and quantification of the components of the hydrologic cycle, fundamentals of water supply and quality, overview of aquifer testing and environmental assessment. Chemical topics include behavior of low-temperature aqueous solutions, water-rock interaction and applications of chemistry to understand the Earth and its geochemical cycles. Prerequisites: **CHEM 1111** and **CHEM 1112** and **CHEM 1311** and **CHEM 1312** and **GEOS 1103** and **GEOS 1104** and **GEOS 1303** and **GEOS 1304** and **GEOS 2409**. (4-0) Y

**GEOS 4V08** Special Topics in Geology or Geophysics II (1-4 semester credit hours) Subject matter will vary from semester to semester. Instructor consent required. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-4]-0) R

**GEOS 4V09** Senior Research in Geology (1-6 semester credit hours) Topics may vary. No more than 3 semester credit hours of senior research may be used to satisfy the upper-division course work requirement in the major unless approved in advance by the undergraduate advisor. May be repeated for credit. Instructor consent required. ([1-6]-0) S

**GEOS 4V80** Senior Research in Geophysics (1-6 semester credit hours) Topics may vary. No more than 3 semester credit hours of senior research may be used to satisfy the upper-division course work requirement in the major unless approved in advance by the undergraduate advisor. May be repeated for credit. Instructor consent required. ([1-6]-0) S

### Interdisciplinary Studies-Natural Science and Mathematics

**ISNS 2359** Earthquakes and Volcanoes (3 semester credit hours) Earthquakes and volcanoes appear capricious and devastating in human terms, but they are also a regular part of geological history. This course will integrate current geological thinking with elements of statistics, physics, chemistry, human history, sociology, psychology, and religion to develop an understanding and to provide pragmatic strategies for living with these events. (3-0) Y

**ISNS 2367 (GEOL 1345)** The Oceans (3 semester credit hours) Physical, chemical, biological, and geological aspects of oceanography. Description and origin of features on sea floor; evolution of ocean basins;
chemistry of sea water; influence of oceans on weather and climate; formation of waves, tides, currents; factors affecting biological productivity; economic resources and environmental problems. (3-0) S

**ISNS 2368 (GEOL 1347)** Weather and Climate (3 semester credit hours) An overview of the fields of meteorology and climatology. The approach is scientific yet nonmathematical, and students will be exposed to a wide spectrum of ideas from folklore, history, law, economics, and environmental issues. (3-0) S

**ISNS 3371** The Phenomena of Nature: Forces, Gases, Motion, Heat, Light and Electricity (3 semester credit hours) The purpose of the course is to cultivate in students an intuitive perception of the nature of observable physical reality through the presentation and analysis of striking experimental demonstrations. No substantial prior training in science is assumed, but students with a background in science may profit from this course. There will be considerable reference to the historical growth of scientific knowledge and to the aesthetic quality of the explanations offered by science. (3-0) Y

**ISNS 3373** Our Nearest Neighbors in the Sky (3 semester credit hours) A description of the tools and principles the astronomer and space scientist use in exploration of the solar system; the earth, moon, the sun, planets, asteroids, meteors, and comets; the origin of the solar system; classroom demonstrations, multimedia presentations, and telescope observations. (3-0) Y

### Mathematical Science

**MATH 1306** College Algebra for the Non-Scientist (3 semester credit hours) This course is intended for students NOT continuing on to precalculus or calculus. The course is designed to develop both abstract thinking and a practical approach to problem solving. The emphasis is on understanding rather than purely computational skills. Topics include logic, sets, the real numbers, linear equations and their applications, functions, and graphs. May not be used to satisfy major requirements for majors in the Schools of Natural Sciences and Mathematics or Management, or degree requirements for the School of Engineering and Computer Science. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: ALEKS score required. (3-0) S

**MATH 1314 (MATH 1314)** College Algebra (3 semester credit hours) Topics chosen from areas such as equations and inequalities, rational expressions, exponents, radicals and logarithms, functions, and graphs. Exam section required for **MATH 1314**. May not be used to satisfy major requirements for majors in the Schools of Natural Sciences and Mathematics or Management, or degree requirements for the School of Engineering and Computer Science. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: ALEKS score required. (3-0) S

**MATH 1316 (MATH 1316)** Trigonometry (3 semester credit hours) Angular measure, trigonometric functions, their properties; trigonometric identities, equations, and applications; trigonometric form of complex number and related topics. May not be used to satisfy major requirements for majors in the School of Natural Sciences and Mathematics or Management, or degree requirements for the School of Engineering and Computer Science. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements.
Prerequisite: ALEKS score required or a grade of at least a C- in MATH 1314 or concurrent enrollment in MATH 1314. (3-0) S

**MATH 1325** (MATH 1325) Applied Calculus I (3 semester credit hours) Functions and graphs, differentiation, maxima and minima, exponential and logarithmic functions, integration, applications of integrals. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science or major requirements in the School of Natural Sciences and Mathematics. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Cannot be used to replace MATH 2417 or MATH 2413. Prerequisite: ALEKS score required or a grade of at least a C- in MATH 1314. (3-0) S

**MATH 1326** Applied Calculus II (3 semester credit hours) Applications of differential equations, functions of several variables, least squares modeling, multiple integrals, infinite series. May not be used to satisfy degree requirements for BS majors in Schools of Engineering and Computer Science or Natural Sciences and Mathematics. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Cannot be used to replace MATH 2414 or MATH 2419. Prerequisite: A grade of at least a C- in MATH 1325. (3-0) S

**MATH 2306** Analytic Geometry (3 semester credit hours) Similarity, congruence, proofs (similarity transformations, rigid motions in the plane, proving geometric theorems, geometric constructions); Linear, quadratic, and other basic functions; Circles and basic areas; Right triangle trigonometry; Addition formulas; Modeling geometry in the plane; Rectangular and polar coordinates; Conics; The principal axes theorem; Three dimensional space: lines and planes; Vectors in plane and space; Dot and cross product; Rectangular, cylindrical, and spherical coordinates; Parameterization of basic curves in plane and space; Elementary surfaces; Intersections of surfaces; Visualization; Examples of rigid motions in space; Volume formulas. Prerequisite: ALEKS score required or a grade of at least a C- in MATH 1314 and MATH 1316. (3-0) S

**MATH 2312** (MATH 2312) Precalculus (3 semester credit hours) Real numbers, subsets of real line, absolute value; algebra of functions, domain, range, composition, inverse; elements of analytical geometry including vectors in plane, conics, polar coordinates, translation and rotation of axes and related topics. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: ALEKS score required or (a grade of at least a C- in MATH 1314 and MATH 1316). (3-0) S

**MATH 2333** Matrices, Vectors, and Their Application (3 semester credit hours) Matrices, vectors, determinants, inverses, systems of linear equations, and applications. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science or major requirements in the School of Natural Sciences and Mathematics. Cannot be used to replace MATH 2418. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: MATH 1314 or equivalent. (3-0) S

**MATH 2370** Introduction to Programming with MATLAB (3 semester credit hours) Introduces the basic concepts of programming and problem solving using MATLAB. Topics include data types, data input/output, control structures, functions, scripts, debugging, data visualization techniques, symbolic computation, and basic algorithms. Programming projects related to mathematical and statistical applications and elementary numerical methods. Prerequisite: ALEKS score required or a grade of at least

a C- in MATH 2312 or equivalent (3-0) S

MATH 2399 Research and Advanced Writing (3 semester credit hours) For students conducting independent research and scientific writing. Individual instruction course designed to develop skills for research and clear, precise and accurate scientific writing. Students will select the topic of the research from specific areas of mathematics. Subject and scope to be determined on an individual basis. Satisfies the School of Natural Sciences and Mathematics' advanced writing requirement. Prerequisites: Sophomore level standing in Mathematics and instructor consent required. (3-0) S

MATH 2413 (MATH 2413) Differential Calculus (4 semester credit hours) Course covers topics in differential calculus of functions of one variable; topics include limits, continuity, derivative, chain rule, implicit differentiation, mean value theorem, maxima and minima, curve sketching, derivatives of inverse trigonometric functions, antiderivative, substitution method, and applications. Three lecture hours and two discussion hours a week; a problem section required with MATH 2413, and will also be registered for exam section. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: ALEKS score required or a grade of at least a C- in MATH 2306 or MATH 2312. (3-2) S

MATH 2414 (MATH 2414) Integral Calculus (4 semester credit hours) Continuation of Math 2413. Course covers topics in integral calculus, sequences and series. Topics include techniques of integration, improper integrals, and applications. Polar coordinates, parametric equations, and arc length. Infinite sequences and series, tests for convergence, power series, radius of convergence and Taylor series. Three lecture hours and two discussion hours a week; registration in a problem section as well as the exam section is required with MATH 2414. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Cannot be used to replace MATH 2419. Prerequisite: A grade of C- or better in either MATH 2417 or in MATH 2413 or equivalent. (3-2) S

MATH 2415 (MATH 2415) Calculus of Several Variables (4 semester credit hours) The course covers differential and integral calculus of functions of several variables. Topics include vector valued and scalar functions, partial derivatives, directional derivatives, chain rule, Lagrange multipliers, multiple integrals, double and triple integrals, the line integral, Green's theorem, Stokes' theorem, Divergence theorem. Three lecture hours and two discussion hours a week; problem section required with MATH 2415, and will also be registered for exam section. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: A grade of C- or better in MATH 2414. (3-2) S

MATH 2417 Calculus I (4 semester credit hours) Functions, limits, continuity, differentiation; integration of function of one variable; logarithmic, exponential, and inverse trigonometric functions; techniques of integration, and applications. Three lecture hours and two discussion hours a week; problem section required with MATH 2417, and will also be registered for exam section. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: ALEKS score required or a grade of at least a C- in MATH 2306 or MATH 2312. (3-2) S

MATH 2418 (MATH 2418) Linear Algebra (4 semester credit hours) Introduces and provides models for application of the concepts of vector algebra. Topics include finite dimensional vector spaces and their
geometric significance; representing and solving systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion; matrices; determinants; linear transformations; quadratic forms; eigenvalues and eigenvectors; and applications in science and engineering. Three lecture hours and two discussion hours a week; problem section required with MATH 2418, and will also be registered for exam section. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: A grade of at least a C- in either MATH 2306 or MATH 2413 or MATH 2417. (3-2) S

MATH 2419 Calculus II (4 semester credit hours) Continuation of MATH 2417. Improper integrals, sequences, infinite series, power series, parametric equations and polar coordinates, vectors, vector valued functions, functions of several variables, partial derivatives and applications, and multiple integration. Three lecture hours and two discussion hours a week; problem section required with MATH 2419, and will also be registered for exam section. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisite: A grade of at least a C- in MATH 2417. (3-2) S

MATH 2420 (MATH 2420) Differential Equations with Applications (4 semester credit hours) Ordinary differential equations, including linear equations, systems of equations, equations with variable coefficients, existence and uniqueness of solutions, series solutions, singular points, transform methods, and boundary value problems; application of differential equations to real-world problems. Three lecture hours and two discussion hours a week; problem section required with MATH 2420, and will also be registered for exam section. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisites: A grade of at least a C- in either MATH 2415 or in MATH 2419 or equivalent and a grade of at least a C- in MATH 2418 or equivalent. (3-2) S

MATH 2451 Multivariable Calculus with Applications (4 semester credit hours) Vectors, matrices, vector functions, partial derivatives, divergence, curl, Laplacian, multiple integrals, line and surface integrals, Green's, Stokes', and Gauss' theorems, and applications in physical sciences and engineering. Topics drawn from implicit function theorem, differential forms and vector fields. Three lecture hours and two discussion hours per week; problem section required with MATH 2451. Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisites: A grade of at least a C- in either MATH 2415 or in MATH 2419 or equivalent and a grade of at least a C- in MATH 2418 or equivalent. (3-2) S

MATH 2V90 Topics in Mathematics - Level 2 (1-6 semester credit hours) Special topics in mathematics outside the normal course of offerings. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

MATH 3301 Mathematics for Elementary and Middle School Teachers (3 semester credit hours) This course is intended to develop future teachers' depth of mathematical understanding by examining concepts in school mathematics from an advanced perspective. Topics include: numeration systems; arithmetic algorithms, prime factorization and other properties of the integers; proportional reasoning involving fractions and decimals; counting methods; and basic ideas of geometry and measurement. Problem solving is stressed. May not be used to satisfy: [1] undergraduate mathematics core requirement, [2] degree requirements by students in Mathematics, [3] electives, or [4] certification requirements in 8-12 mathematics. Prerequisite: MATH 1306 or MATH 1314 or equivalent. (3-0) S

MATH 3303 Introduction to Mathematical Modeling (3 semester credit hours) An introduction to construction, use, and analysis of empirical and analytical mathematical models. Emphasis on using appropriate technology with tools such as curve fitting, probability and simulation, difference and differential equations, and dimensional analysis. May not be used to satisfy mathematics requirements by students in Mathematics and may not be used to satisfy electives. Prerequisites: MATH 2418 and a grade of at least a C- in either MATH 2415 or in MATH 2419 or equivalent. (3-0) Y

MATH 3305 Foundations of Measurement and Informal Geometry (3 semester credit hours) An analysis, from an advanced perspective, of the basic concepts and methods of geometry and measurement. Topics include visualization, geometric figures and their properties; transformations and symmetry; congruence and similarity; coordinate systems; measurement (especially length, area, and volume); and geometry as an axiomatic system. Emphasis on problem solving and logical reasoning. May not be used to satisfy: [1] undergraduate mathematics core requirement, [2] degree requirements by students in Mathematics, [3] electives, or [4] certification requirements in 8-12 mathematics. Prerequisite: MATH 2312 or MATH 3301 or equivalent. (3-0) Y

MATH 3307 Mathematical Problem Solving for Teachers (3 semester credit hours) Development of the ability to solve mathematical problems and communicate their solutions through the study of strategies and heuristics. Practice in solving problems involving ideas from number theory, algebra, combinatorics and probability, etc. Communicating mathematics, logical reasoning, and connections between mathematical topics will be emphasized. May not be used to satisfy degree requirements for Mathematics majors. Prerequisites: MATH 2312 and (MATH 3305 or MATH 3321). (3-0) Y

MATH 3310 Theoretical Concepts of Calculus (3 semester credit hours) Mathematical theory of calculus. Limits, types of convergence, power series, differentiation, and Riemann integration. Prerequisite: A grade of at least a C- in either MATH 2415 or in MATH 2419 or equivalent. (3-0) S

MATH 3311 Abstract Algebra I (3 semester credit hours) Groups, rings, fields, vector spaces modules, linear transformations, and Galois theory. Prerequisites: A grade of at least a C- in either MATH 2415 or in MATH 2419 or equivalent and a grade of at least C- in MATH 2418 or equivalent. (3-0) S

MATH 3312 Abstract Algebra II (3 semester credit hours) Continuation of MATH 3311. Prerequisite: MATH 3311. (3-0) Y

MATH 3321 Geometry (3 semester credit hours) Elements of Euclidean, non-Euclidean, and projective geometry. Topics covered will be drawn from the following list: triangles and their distinguishing points, Euler line, nine point circle, extremum problems, circles and spheres, inversions, the circles of Apollonius, projective geometry, axioms of the projective plane, Desargues' theorem, conics, elementary facts of the non-Euclidean geometries. Prerequisite: A grade of at least a C- in either MATH 2306 or MATH 2415 or MATH 2419 or equivalent. (3-0) Y

MATH 3323 Elementary Number Theory (3 semester credit hours) Divisibility of integers, prime numbers, the Euclidean algorithm, greatest common divisors, Bezout coefficients, the fundamental theorem of arithmetic, linear congruences, the Chinese remainder theorem, Euler's totient function, polynomial congruences, Hensel's lemma, order, primitive roots, quadratic reciprocity, primality testing, factorization techniques, public key encryption algorithms, and additional topics. Prerequisite: A grade of at least a C- in either MATH 2414 or in MATH 2418 or MATH 2419. (3-0) Y

**MATH 3379** Complex Variables (3 semester credit hours) Geometry and algebra of complex numbers, functions of a complex variable, power series, integration, calculus of residues, conformal mapping. Prerequisites: MATH 2451 and MATH 3310. (3-0) S

**MATH 3380** Differential Geometry (3 semester credit hours) Curves and surfaces, multilinear algebra, alternating tensors, tangent vectors, tangent space, vector fields, differential forms; Curvature and torsion of curves, Riemannian metrics, curvature of surfaces, isometries, geodesics, Gauss map, First and Second Fundamental Forms, area on surfaces, Gauss-Bonnet Theorem, surfaces with constant negative curvature and elements of hyperbolic geometry. Prerequisites: MATH 2451 and MATH 2418 and MATH 2420 or equivalent courses. (3-0) Y

**MATH 4301** Mathematical Analysis I (3 semester credit hours) Sets, real number system, metric spaces, real functions of several variables. Riemann-Stieltjes integration and other selected topics. Prerequisites: MATH 2451 and MATH 3310. (3-0) S

**MATH 4302** Mathematical Analysis II (3 semester credit hours) Continuation of MATH 4301. Prerequisite: MATH 4301. (3-0) S

**MATH 4332** Scientific Math Computing (3 semester credit hours) Topics covered include introduction to Unix shells, basic and advanced use of Matlab for mathematical and scientific problem solving. Course is conducted in a computer classroom and assignments include applications in numerical and statistical analysis, image processing, and signal processing. Prerequisites: A grade of at least a C- in either MATH 2415 or in MATH 2419 or equivalent and a grade of at least C- in MATH 2418 or equivalent. (3-0) S

**MATH 4334** Numerical Analysis (3 semester credit hours) Solution of linear equations, roots of polynomial equations, interpolation and approximation, numerical differentiation and integration, solution of ordinary differential equations, computer arithmetic, and error analysis. Prerequisites: (MATH 2370 or CS 1324 or CS 1325 or CE 1337 or CS 1337 or TE 1337) and (MATH 2418 and MATH 2451). (Same as CS 4334) (3-0) Y

**MATH 4341** Topology (3 semester credit hours) Elements of general topology, topological spaces, continuous functions, connectedness, compactness, completeness, separation axioms, and metric spaces. Prerequisites: MATH 2451 and MATH 3310. (3-0) S

**MATH 4355** Methods of Applied Mathematics (3 semester credit hours) Topics include some frequently used tools in applied mathematics: Matrix theory, Fourier series and transforms, and special functions as relevant to applications in engineering and the sciences. Prerequisites: MATH 2418 and MATH 2420 or instructor consent required. (3-0) R

**MATH 4362** Partial Differential Equations (3 semester credit hours) This course presents a survey of classical and numerical methods for the solution of linear and nonlinear boundary value problems governed by partial differential equations. Modeling and application-related issues are included throughout. Prerequisites: MATH 2420 and MATH 2451. (3-0) Y

**MATH 4381** Structure of Modern Geometry (3 semester credit hours) The course is designed to familiarize students with the geometrical concepts which relate to two and three dimensional geometry and the mathematical techniques used in the study of geometry. The emphasis is both on the development of understanding of the concepts and the ability to use the concepts in proving theorems. The course includes study of axiom systems, transformational geometry, and an introduction to non-Euclidean
geometries, supplemented by other topics as determined by the instructor. Prerequisite: A grade of at least a C- in MATH 2418 or equivalent. (3-0) Y

**MATH 4390** Senior Research and Advanced Writing (3 semester credit hours) For students conducting independent research and scientific writing. Individual instruction course designed to develop skills for research and clear, precise and accurate scientific writing. Topics will vary from section to section depending upon the interests of the student, but will be selected from a specific area of mathematics. Subject and scope to be determined on an individual basis. Satisfies the School of Natural Sciences and Mathematics' advanced writing requirement. This course will retain core notation for a transition period - see http://go.utdallas.edu/core-curriculum-transition. Please consult advisors for more detailed information. Prerequisite: Senior level standing in Mathematics and instructor consent required. (3-0) S

**MATH 4399** Senior Honors in Mathematics (3 semester credit hours) For students conducting independent research for honors theses or projects. Satisfies the School of Natural Sciences and Mathematics' advanced writing requirement. Instructor consent required. (3-0) S

**MATH 4V03** Independent Study in Mathematics (1-6 semester credit hours) Independent study under a faculty member's direction. Student must obtain approval from participating math sciences faculty member and the undergraduate advisor. May satisfy the School of Natural Sciences and Mathematics' advanced writing requirement if it has a major writing/report component. May be repeated for credit (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

**MATH 4V91** Undergraduate Topics in Mathematics (1-9 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-9]-0) S

**Natural Sciences**

**NATS 1101** Natural Sciences and Mathematics Freshman Seminar (1 semester credit hour) This course is designed to introduce incoming freshmen to the intellectual and cultural environment of the School of Natural Sciences and Mathematics (NS&M). Students will learn about plans of study and career paths for majors in Biology, Chemistry, Physics, Mathematics, Geosciences, and Science and Mathematics Education. Basic study, problem solving and other skills needed to succeed as an NS&M major will be covered. An overview of the connections within the disciplines of Natural Sciences and Mathematics will be presented, as well as their relationship to engineering, medicine and health, and other fields. Required for all first time in college freshmen in NS&M. Corequisite: **UNIV 1010**, (1-1) Y

**NATS 1141** UTeach STEP 1 (1 semester credit hour) Introduction to STEM teaching as a career. Master teachers introduce students to examples of high quality inquiry-based lesson design as well as model various pedagogical concepts and behavior management strategies. Students are also introduced to the portfolio project. Fieldwork consists of two classroom observations plus planning and teaching three inquiry-based lessons to students in grades four to six in local elementary schools. One and one-half class hours a week for one semester; at least five hours of fieldwork a semester are also required. Prerequisites: A university grade point average of at least 2.750 and admission to the UTeach Dallas program by consent of the UTeach advisor. (1-0) S

**NATS 1143** UTeach STEP 2 (1 semester credit hour) Continued exploration into STEM teaching as a career.
Topics include various teaching methods that are designed to meet instructional goals; use of various technologies; and learner outcomes. Fieldwork consists of classroom observations and teaching three inquiry-based math, science, or computer science lessons in a middle school classroom. One and one-half class hours a week for one semester; at least five hours of fieldwork a semester are also required. Prerequisites: A university grade point average of at least 2.750 and a grade of B- or better in NATS 1141 and UTeach advisor consent required. (1-0) S

NATS 1311 The Universe, and Everything Else (3 semester credit hours) A multidisciplinary study of nature expressly designed for those who have chosen not to major in the natural sciences or engineering. Early models of the solar system and the transformation to current models are examined, as are order in the universe, the nature of matter and the planets, sun, and life cycle of stars. The course will be enhanced by frequent demonstrations of the principles underlying the origin and evolution of the universe. (3-0) Y

NATS 2330 The Basis of Evolution (3 semester credit hours) Wide-ranging discussions of the unifying theory of the origin and modification through time of all organisms. Pertinent history, the fossil record, evolution as concerns the human experience, processes and mechanisms and a look at the future are major topics. This course is specifically designed for non-majors and may not satisfy degree requirements in the School of Natural Science and Mathematics. (3-0) S

NATS 2333 Energy, Water, and the Environment (3 semester credit hours) An introduction to the impacts that humans have on the environment, with emphasis on impacts resulting from energy and water use. The course is designed for students who are not seeking a technical major and who wish to enhance their use of science and engineering principles and techniques in making decisions affecting both their own use of energy and water and use by the United States and the world. The course includes discussions of ways to ameliorate and/or adapt to the impacts. (3-0) Y

NATS 2V10 Special Topics in Natural Sciences (1-6 semester credit hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

NATS 3301 Contemporary Issues in Marine Science (3 semester credit hours) Contemporary issues in marine science with a focus on the circum-Gulf of Mexico. Case studies are explored utilizing research literature, remote sensing, core analysis, and other means. Topics include estuarine ecology, sedimentary dynamics of barrier islands, relative sea level change, human influence, and major events such as hurricanes. The course includes grounding in the fundamentals of general theory and principles of marine science. Short lectures, demonstrations, group work and reports, and laboratory activities are the norm. (3-0) Y

NATS 3331 The Clash of Cosmologies (3 semester credit hours) Science and revelation in the nineteenth century. A study of the nineteenth century rise of scientific inquiry into the origins of life, and the reaction and response to its discoveries by the Victorian culture that both maintained biblical authority and celebrated man’s achievements. A study abroad component supplements this course. (3-0) Y

NATS 3341 Knowing and Learning in Mathematics and Science (3 semester credit hours) This course expands the prospective teacher's understanding of current theories of learning and conceptual development. Students examine their own assumptions about learning. Topics include psychological foundations of learning; problem solving in mathematics and science education utilizing technology;
principles of expertise and novice understanding of subject matter; implications of high-stakes testing; and foundations of formative and summative assessment. Content also includes dyslexia training. Three lecture hours a week for one semester; additional hours may be required. Restricted to students in the UTeach Dallas program. Prerequisites: A university grade point average (GPA) of at least 2.750 and a GPA of 3.000 or better in UTeach coursework and UTeach advisor consent required. (3-0) S

NATS 3343 Classroom Interactions (3 semester credit hours) This course moves from a focus on thinking and learning to a focus on teaching and learning. Topics include principles of delivering effective instruction in various formats (lecture, lab activity, collaborative settings); examination of gender, class, race, and culture in STEM education; overview of policy related to STEM education. Students participate in an intensive, highly coached high school field experience comprised of 3 observations and 2 co-teaching events, including a multiple-period or day, connected lesson. Three lecture hours a week for one semester; at least nine hours of fieldwork a semester are also required. Students should also expect to dedicate out-of-class time to video transfer, lesson planning, and working on the portfolio project. Restricted to students in the UTeach Dallas program. Prerequisites: A university grade point average (GPA) of at least 2.750 and credit or registration for NATS 3341 and a GPA of 3.000 or better in UTeach coursework and UTeach advisor consent required. (3-0) S

NATS 4141 UTeach Apprentice Teaching Seminar (1 semester credit hour) Discussions include student teaching experiences, and contemporary critical issues in education. The portfolio project must be completed during the Apprentice Teaching semester. One class hour a week for one semester. Prerequisites: NATS 3343 and NATS 4341 and (NATS 4390 or MATH 3303) and a university grade point average (GPA) of at least 2.750 and a GPA of 3.000 or better in UTeach coursework and consent of the UTeach advisor. Corequisite: NATS 4694 or NATS 4696. (1-0) S

NATS 4310 Advanced Writing in the Natural Sciences and Mathematics (3 semester credit hours) A writing-intensive course on questions or problems in natural sciences and mathematics. Satisfies the School of Natural Sciences and Mathematics' advanced writing requirement. (3-0) S

NATS 4341 Project-Based Instruction (3 semester credit hours) Students explore topics including foundations of project-based, case-based, and problem-based learning environments; principles of project-based curriculum development in STEM education; and, classroom management and organization of project-based learning classrooms are covered. Fieldwork usually includes 11 hours of observation, including at least 3 teaching days. Three lecture hours a week for one semester with additional fieldwork hours to be arranged. Prerequisites: NATS 3343 and a university grade point average (GPA) of at least 2.750 and a GPA of 3.000 or better in UTeach coursework and UTeach advisor consent required. Prerequisite or Corequisite: NATS 4390 or MATH 3303. (3-0) S

NATS 4390 Research Methods (3 semester credit hours) This UTeach science certification preparation course explores the nature of science and authentic scientific investigations through multiple, independent, student-driven research projects and scientific communication including scientific discourse in the context of advanced scientific writing. Prerequisites: NATS 3341 and a university grade point average (GPA) of at least 2.750 and a GPA of 3.000 or better in UTeach coursework and upper-level standing and UTeach advisor consent required. Prerequisite or Corequisite: NATS 3343. (3-0) S

NATS 4694 UTeach Apprentice Teaching, 7-12 Science and Mathematics (6 semester credit hours) Closely supervised observation and teaching in a science or mathematics classroom for Grades 7-12. Experience
includes carrying out the duties of a high school teacher and requires a minimum of 7 hours of fieldwork a day for 14 weeks. Students must apply for Apprentice Teaching the semester prior to enrollment. Additional fee attached to course. Prerequisites: NATS 4341 and (NATS 4390 or MATH 3303) and a university grade point average (GPA) of at least 2.750 and a GPA of 3.000 or better in UTeach coursework and UTeach advisor consent required. Admission to the university's teacher certification program by the Teacher Development Center. Corequisite: NATS 4141. (6-0) S

NATS 4696 UTeach Apprentice Teaching, 4-8 Science and Mathematics (6 semester credit hours) Closely supervised observation and teaching in a science or mathematics classroom for Grades 4-8. Experience includes carrying out the duties of a middle grades teacher and requires a minimum of 7 hours of fieldwork a day for 14 weeks. Students must apply for Apprentice Teaching the semester prior to enrollment. Additional fee attached to course. Prerequisites: NATS 4341 and (NATS 4390 or MATH 3303) and a university grade point average (GPA) of at least 2.750 and a GPA of 3.000 or better in UTeach coursework and UTeach advisor consent required. Admission to the university's teacher certification program by the Teacher Development Center. Corequisite: NATS 4141. (6-0) S

NATS 4V41 Independent Study in Science and Math Education (1-6 semester credit hours) Independent study under a faculty member's direction. Student must obtain approval from participating Science and Math Education (SME) faculty member and the undergraduate advisor. May be repeated for credit (6 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

NATS 4V90 Special Topics in Natural Sciences (1-6 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

Physics

PHYS 1100 The Fun of Physics (1 semester credit hour) An introductory course in physics in the modern world. Focuses on the work of a physicist. What does a physicist do? What are some of the exciting topics on which physicists are working today? The faculty discusses their favorite concepts and the opportunities for student participation in research. Credit/No Credit only. (1-0) Y

PHYS 1101 (PHYS 1101) College Physics Laboratory I (1 semester credit hour) A laboratory course to accompany PHYS 1301 and PHYS 2325. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science. (0-3) R

PHYS 1102 (PHYS 1102) College Physics Laboratory II (1 semester credit hour) A laboratory course to accompany PHYS 1302 and PHYS 2326. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science. (0-3) R

PHYS 1301 (PHYS 1301) College Physics I (3 semester credit hours) Algebra and trigonometry based basic physics. Topics include mechanics, heat and thermodynamics. Students will also be registered for an exam section. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science. Check with your program advisor. Prerequisite: MATH 1314 or equivalent. Corequisite: PHYS 2125. (3-0) S

PHYS 1302 (PHYS 1302) College Physics II (3 semester credit hours) Continuation of PHYS 1301. Topics include electricity, magnetism and optics. Students will also be registered for an exam section. May not be
used to satisfy degree requirements for majors in the School of Engineering and Computer Science. Check with your program advisor. Prerequisite: PHYS 1301. Corequisite: PHYS 2126. (3-0) S

**PHYS 2121** Honors Physics Lab I (1 semester credit hour) Laboratory course to accompany Honors Physics I or the calculus-based Mechanics class. Experiments based on topics covered in the lecture course are used as a vehicle to present measurement techniques, calibration concepts, use of computers for graphing and analysis, and calculation of experimental uncertainty. Prerequisite: MATH 2413 or MATH 2417 with a minimum grade of B+ in either course. Corequisite: (MATH 2414 or MATH 2419) and PHYS 2421. (0-3) Y

**PHYS 2125** (PHYS 2125) Physics Laboratory I (1 semester credit hour) Laboratory course to accompany any Physics I or Mechanics course. Experiments investigate basic measurements and statistics including error, mean, standard deviation and error propagation; one dimensional and two dimensional motion; Newton’s laws; conservation laws of energy and momentum; rotational motion; and oscillations. Corequisite: PHYS 1301 or PHYS 2325 or PHYS 2421. (0-3) S

**PHYS 2126** (PHYS 2126) Physics Laboratory II (1 semester credit hour) Laboratory course to accompany any Physics II or Electricity and Magnetism course. Experiments investigate electrostatics, electricity in simple circuits, RC circuits and magnetism. Corequisite: PHYS 1302 or PHYS 2326 or PHYS 2422. (0-3) S

**PHYS 2303** Contemporary Physics (3 semester credit hours) Topics include the fundamentals of geometric optics, interference, diffraction, special relativity, structure of the atom, nuclear physics, radioactivity, and elementary particles. (3-0) S

**PHYS 2325** (PHYS 2325) Mechanics (3 semester credit hours) Calculus based. Basic physics including a study of space and time, kinematics, forces, energy and momentum, conservation laws, rotational motion, torques, and harmonic oscillation. Two lectures per week. Students will also be registered for an exam section. Prerequisite: MATH 2413 or MATH 2417. Corequisites: (MATH 2414 or MATH 2419) and (PHYS 2121 or PHYS 2125). (3-0) S

**PHYS 2326** (PHYS 2326) Electromagnetism and Waves (3 semester credit hours) Continuation of PHYS 2325. Topics include electrostatics and electromagnetics, electric field and potential, electric currents, magnetic fields, laws of Coulomb, Ampere, and Faraday, Maxwell's theory of wave propagation. Two lectures per week. Students will also be registered for an exam section. Prerequisites: PHYS 2325 and (MATH 2414 or MATH 2419). Corequisite: PHYS 2126. (3-0) S

**PHYS 2421** Honors Physics I - Mechanics and Heat (4 semester credit hours) Calculus-based physics. This class is a more rigorous version of PHYS 2325 with additional topics in thermal physics. Derivations are more general and rely more heavily on calculus and the use of vectors. More challenging problems and applications. Two lectures plus a required recitation session per week. Students will also be registered for an exam section. Prerequisite: MATH 2413 or MATH 2417 with a minimum grade of B+ in either course. Corequisites: (MATH 2414 or MATH 2419) and (PHYS 2121 or PHYS 2125). (4-0) Y

**PHYS 2422** Honors Physics II - Electromagnetism and Waves (4 semester credit hours) Calculus-based basic physics. This class is a more rigorous version of PHYS 2326. Derivations are more general and rely more heavily on multi-dimensional calculus concepts such as divergence, gradient, curl, and the theorems of Green, Stokes, and Gauss. More challenging problems and applications. Two lectures plus a required recitation session per week. Students will also be registered for an exam section. Prerequisites: (PHYS 2325 with a grade of B+ or PHYS 2421) and (MATH 2414 or MATH 2419). Corequisites: (MATH 2415 or MATH 245
1) and PHYS 2126. (4-0) Y

PHYS 3312 Classical Mechanics (3 semester credit hours) Newton's laws; collisions; two body problems and trajectories; Lagrangian formulation; rotational dynamics and the inertia tensor; rotating coordinate systems; gravitation; special relativity. Prerequisite: PHYS 3311 or PHYS 3411 or equivalent. (3-0) Y

PHYS 3317 Physics of the Human Body (3 semester credit hours) This course would be an introduction to basic biophysics of the human body. Topics include body motion and the forces which cause it, properties of the body like elasticity and how it affects things like muscles and bones, energy conservation of the body and how it affects metabolism, fluid flow and the circulatory system, waves and how they affect hearing and sight. Prerequisites: (PHYS 1301 or PHYS 2325) and MATH 2413. (3-0) R

PHYS 3330 Numerical Methods in Physics and Computational Techniques (3 semester credit hours) The course covers concepts and computational techniques in numerical methods for solving physics problems. Topics typically include probability, statistics, data analysis, fits, numerical solutions, and interpretation of the experimental data. Prerequisites: (MATH 2415 or MATH 2419 or equivalent) and MATH 2418. (3-0) Y

PHYS 3380 Astronomy (3 semester credit hours) An essentially descriptive course outlining the current views of the universe and the sources of data supporting those views. The solar system and its origin, stars, galaxies, pulsars, quasars, black holes, nebulae, and the evolution of the universe. Opportunity to use a UT Dallas telescope is provided. Prerequisite: PHYS 2326 or PHYS 2422. (3-0) Y

PHYS 3411 Theoretical Physics (4 semester credit hours) Index Notation; Vector spaces and linear operators; Line integrals; surface and volume integrals; Gradient, divergence and curl; vector integral theorems; Fourier series; Separating variables in PDEs. Corequisite: MATH 2420. Prerequisites: MATH 2418 with a grade of at least C- and (MATH 2415 with a grade of at least B- or MATH 2451 with a grade of at least C-) and (PHYS 2326 or PHYS 2422). (4-0) S

PHYS 3416 Electricity and Magnetism (4 semester credit hours) Coulomb's and Gauss' laws; potentials, methods for solving electric field distributions near conductors; potentials due to clusters of charges; polarization of dielectric materials; electric displacement. Magnetic fields in a vacuum and in matter; time varying electric and magnetic fields; Maxwell's equations; electromagnetic waves. Prerequisite: PHYS 3311 or PHYS 3411 or equivalent. (4-0) Y

PHYS 3427 Electronics with Laboratory (4 semester credit hours) Topics include direct and alternating current circuits, diodes and transistors, feedback, passive and active filters, simple amplifiers, and combinatorial and sequential digital electronics. Includes laboratory where students will learn to use typical laboratory instruments to test and to diagnose and troubleshoot problems inherent in the circuits they build in lab. The lab exercises are closely tied to the topics covered weekly in the lectures. Prerequisite: PHYS 2326 or PHYS 2422. (3-3) Y

PHYS 4301 Quantum Mechanics I (3 semester credit hours) Fundamental concepts: the Stern Gerlach experiment; the Dirac formalism; kets; bras and operators; base kets and matrix representations. Measurements, observables and the uncertainty relations. Position, momentum, and translation. Wave functions in position and momentum space. Time evolution and Schrodinger's equation, Heisenberg picture. Orbital angular momentum, spin, and angular momentum addition. Applications include simple harmonic oscillator and the Hydrogen atom. Prerequisites: (PHYS 3311 or PHYS 3411) and MATH 2418. (3-0) Y
PHYS 4302 Quantum Mechanics II (3 semester credit hours) Fermions and bosons, perturbation theory, WKB approximation, scattering. Prerequisite: PHYS 4301. (3-0) Y

PHYS 4311 Thermodynamics and Statistical Mechanics (3 semester credit hours) Study of the elements of thermodynamics, kinetic theory, and statistical mechanics; the concepts of temperature, entropy, phase transitions, transport phenomena, partition functions, statistical ensembles; the Maxwell Boltzmann, Fermi-Dirac, and Bose-Einstein distributions; and the equipartition theorem. Applications of the theories will be considered. Corequisite: PHYS 3311 or PHYS 3411. Prerequisite: PHYS 2325 or PHYS 2421. (3-0) Y

PHYS 4319 Cyber-Physical Systems (3 semester credit hours) This course introduces students to cyber-physical systems - systems that involve the synergy between physical measurement, physical computation and physical control. Physical sensors paired with embedded computers and networks monitor and control physical processes, with feedback where physical processes affect computations and vice versa. Applications of such systems include laboratory instrumentation, process control, energy management and conservation, environmental control, aircraft control systems, communications systems, instrumentation, critical infrastructure control (electric power, water resources, and communications systems for example), robotics and distributed robotics (telepresence and telemedicine), defense systems, manufacturing, smart structures, medical devices and systems, consumer electronics, toys and games, assisted living, traffic control and safety, and automotive systems. The scientific, economic and societal potential of such systems is massive, and major investments are being made worldwide to develop the technology. The class will give hands on experience with micro-controllers, analog to digital converters, digital electronics interfaces, and cyber physical systems. Prerequisite: PHYS 2326. (3-0) R

PHYS 4328 Optics (3 semester credit hours) Topics include electromagnetic waves and radiation, the interaction of light and matter, geometric optics, polarization, interference, and diffraction. Prerequisite: PHYS 3416. (3-0) Y

PHYS 4335 Remote Sensing of the Earth (3 semester credit hours) This course covers the basic physical principles and applications of remote sensing of the earth system (air, land and sea), covering the types of platforms (satellites and aerial vehicles) and sensors used (UV/Visible, IR, Microwave, Radio) (3-0) R

PHYS 4352 Concepts of Modern Physics (3 semester credit hours) Quantum mechanics at an advanced undergraduate level will be applied to the discussion of applications such as lasers, semiconductors, superconductors, solid state devices, and elementary particle physics. Selection of topics may vary by semester. Prerequisite: PHYS 4302. (3-0) Y

PHYS 4371 Solid State Physics (3 semester credit hours) This course provides a basic but detailed picture of important concepts in solid state physics. Material covered includes crystal structure, x-ray crystallography, reciprocal space, lattice vibrations, thermal properties of solids, free electron gas, Bloch functions, metals, insulators, and semiconductors. The course concludes with a description of basic semiconductor devices. Prerequisite: PHYS 3416 and PHYS 4301. (3-0) Y

PHYS 4373 Physical Measurements Laboratory (3 semester credit hours) Experiments illustrating concepts in thermodynamics and physical properties of matter, vacuum technology, gas phase kinetics, mass spectroscopy and optical spectroscopy, basic operations in electronics, literature skills, and use of computers. Prerequisite: PHYS 3416. (0-6) S

PHYS 4381 Space Science (3 semester credit hours) A survey of the structure and dynamics of the
atmospheres of planets, including ionospheres and magnetospheres, as influenced by the sun's radiation and the solar wind. Topics include aurora and airglow, photochemistry, and atmospheric electricity. Prerequisite: PHYS 2422 or PHYS 2326 or equivalent. (3-0) T

**PHYS 4383** Plasma Physics (3 semester credit hours) Plasmas are the fourth state of matter, in which some or all of the neutral particles in a gas are ionized. A working knowledge of plasma physics is important in nuclear physics, semiconductor processing, space science, astronomy, and many other areas. This course will examine the fundamental treatment of plasmas as embodied in the fluid equations, magnetohydrodynamics, and simple kinetic theory. Specific topics include plasma waves and instabilities, diffusion, guiding center motion and drifts, currents in plasmas, and particle collisions. Prerequisite: PHYS 3311 or PHYS 3411. Prerequisite or corequisite: PHYS 3416. (3-0) R

**PHYS 4386** Elementary Particle Physics (3 semester credit hours) The course will cover current knowledge and understanding of elementary particle physics, the kinematics of productions and decays of particles, the Quark Model and the Standard Model, particle compositions, and the principles of modern particle detectors. Prerequisites: PHYS 4301 and PHYS 4311. (3-0) T

**PHYS 4390** Senior Research (3 semester credit hours) Individual instruction course designed to develop skills for research and clear, precise and accurate scientific writing. Research may be either scientific experimentation or critical analysis of scientific literature. Topics will vary from section to section depending upon the interests of the student, but will be selected from a specific area of physics. Instructor consent required. (3-0) S

**PHYS 4392** Extragalactic Astrophysics (3 semester credit hours) This course provides a grounding in the key concepts and physical principles of modern extragalactic astrophysics. Topics covered include galaxies and galaxy clusters (e.g. galaxy formation, and constituents such as dark matter and stellar populations); exotic objects in the universe like quasars, black holes; finding the most distant objects in the universe; and gravitational waves. The theoretical principles will be related to observational signatures already seen or expected to be observed using telescopes and other experiments in the next few years. Prerequisite: PHYS 2326 or PHYS 2422. (3-0) R

**PHYS 4395** Cosmology (3 semester credit hours) The course is a simplified overview of contemporary cosmology including: cosmological principle; scale of distance and expansion law of the universe; redshift; Friedmann equations and cosmological models of the universe; cosmological probes and techniques; baryonic matter; dark matter; dark energy and cosmic acceleration. Prerequisite: (PHYS 3311 or PHYS 3411) or (ENGR 3300 or MATH 2420). (3-0) T

**PHYS 4398** Senior Research Project for BA Degree (3 semester credit hours) Individual instruction course for students seeking the Bachelor of Arts degree designed to develop skills for clear, precise and accurate scientific writing. The Bachelor of Arts degree is designed as a strong base in physics to pursue graduate studies or work in fields other than physics. The requirement involves research in a topic of the student's choice that the shows the physics involved and the application of the physics background to the field and the development of a plan for implementing such a program. Possibilities include other sciences, medical fields including radiology and diagnostic tools involving physics principles, economics, finance, accounting, patent or high technology law and education at the primary or secondary school level. The research culminates in a minimum of a 12 page paper submitted to the faculty mentor, critiqued and rewritten by the student incorporating the suggestions from the mentor and resubmitted. Instructor consent required.
Please consult advisors for more detailed information. (3-0) S

**PHYS 4399** Senior Honors Research in Physics (3 semester credit hours) Individual instruction course designed to develop skills for research and clear, precise and accurate scientific writing. Research may be either scientific experimentation or critical analysis of scientific literature. Topics will vary from section to section depending on the interests of the student, but will be selected from a specific area of physics. See current catalog for information on graduation with major honors and honors with distinction. Instructor consent required. (3-0) S

**PHYS 4V07** Senior Research Projects (1-6 semester credit hours) Intended as an introduction to research, this course involves independent research activities under the guidance of a faculty member on advanced topics in physics. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) R

**PHYS 4V10** Research Topics in Physics (1-9 semester credit hours) Independent research under the guidance of a faculty member on advanced topics in physics. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-9]-0) R

**PHYS 4V11** Topics in Physics (1-4 semester credit hours) This course is for new offerings prior to placing them in the catalog. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-4]-0) R

## Statistics

**STAT 1342 (MATH 1342)** Statistical Decision Making (3 semester credit hours) Principles of quantitative decision making: summarizing data, modeling uncertainty, loss functions, probability, conditional probability, random variables. Introduction to statistics: estimation, confidence intervals, hypothesis testing, regression. Introduction to statistical packages. May not be used to satisfy degree requirements for majors in the School of Engineering and Computer Science, or major requirements in the Schools of Management or Natural Sciences and Mathematics. Prerequisite: MATH 1306 or MATH 1314 or equivalent. (3-0) S

**STAT 2332** Introductory Statistics for Life Sciences (3 semester credit hours) Graphs, histograms, mean, median, standard deviation, standardized scores, simple linear regression and correlation; basic rules of probability, Normal t, chi squared, binomial and Poisson distributions; point estimation; hypothesis tests and confidence intervals for means, proportions; contingency tables. Applications in life sciences will be emphasized throughout the course. May not be used to satisfy degree requirements for mathematics, engineering, or computer science majors. Prerequisite: MATH 1325 or MATH 2312 or equivalent. (3-0) S

**STAT 3103** Statistical Computer Packages (1 semester credit hour) An introduction to the use of statistics packages, such as SAS, BMD, SPSS, Minitab, and S, for the analysis of data. Based primarily on self-study materials. May not be used to satisfy degree requirements for mathematics majors. Prerequisites: one semester of statistics and instructor consent required. (1-0) S

**STAT 3332** Statistics for Life Sciences (3 semester credit hours) Graphs, histograms, mean, median, standard deviation, Chebyshev's inequality, standardized scores, simple linear regression and correlation; basic rules of probability, Bayes theorem; Normal t, chi squared, F, binomial and Poisson distributions;
point estimation; hypothesis tests and confidence intervals for means, proportions regression coefficients, and correlation; one way ANOVA; contingency tables. Applications in life sciences will be emphasized throughout the course. May not used to satisfy degree requirements for mathematics, engineering, or computer science majors. Prerequisite: **MATH 2312** or **MATH 1325** or equivalent. (3-0) S

**STAT 3341** Probability and Statistics in Computer Science and Software Engineering (3 semester credit hours) Axiomatic probability theory, independence, conditional probability. Discrete and continuous random variables, special distributions of importance to CS/SE, and expectation. Simulation of random variables and Monte Carlo methods. Central limit theorem. Basic statistical inference, parameter estimation, hypothesis testing, and linear regression. Introduction to stochastic processes. Illustrative examples and simulation exercises from queuing, reliability, and other CS/SE applications. Credit cannot be received for both courses, (**CS 3341** or **SE 3341** or **STAT 3341**) and **ENGR 3341**. Prerequisites: (**MATH 1326** or **MATH 2414** or **MATH 2419**), and (**CE 2305** or **CS 2305** or **TE 2305** with a grade of C or better). (Same as **CS 3341** and **SE 3341**) (3-0) S

**STAT 3355** Data Analysis for Statisticians and Actuaries (3 semester credit hours) Methods of data analysis used in different areas of Statistics and Actuarial Science. Sampling, fitting and testing models, regression, and comparison of populations. A statistical computer package will be used. Prerequisite: **MATH 2415** or **MATH 2419** or equivalent. (3-0) Y

**STAT 3360** Probability and Statistics for Management and Economics (3 semester credit hours) Probability theory including independence, conditioning, density functions, frequently used families of distributions, random variables, expectation, moments, and the central limit theorem; statistical inference including sampling, estimation, hypothesis testing, and regression. May not used to satisfy degree requirements for mathematics, engineering, or computer science majors. Prerequisite: **MATH 1326**. (3-0) S

**STAT 4351** Probability (3 semester credit hours) Sample spaces, probability of events, Kolmogorov's axioms, independence and dependence, Bayesian methodology. Discrete and continuous random variables. Probability distributions, mass functions and densities of univariate and multivariate random variables. Expected values, variances, moment generating functions, covariances and related issues. Probability inequalities. Special probability distributions and special probability densities. Functions of random variables, distribution function techniques, transformation techniques for one and several variables, moment-generating techniques. The law of large numbers, the central limit theorem and classical sampling distributions. Proofs of all main results. Practical examples illustrating the theory. The course can be used as a preparation for the first (Probability) actuarial exam. Prerequisite: **MATH 2451**. (3-0) Y

**STAT 4352** Mathematical Statistics (3 semester credit hours) Sampling distributions. Order statistics. Decision theory including minimax and Bayes criterion. Point estimation including unbiased estimators, efficiency, consistency, sufficiency, robustness, the method of moments, the method of maximum likelihood, Bayesian estimation. Interval estimation including the estimation of means, differences of means, proportions, differences between proportions, variances and ratios of variances. Hypothesis testing including Neyman-Pearson lemma, power function and likelihood ratio test. Special tests involving means, variances and proportions. Nonparametric tests. Foundations of regression, correlation, design and analysis of experiments. Proofs of all main results. Practical examples illustrating the theory. The course can be used as a preparation for the statistical part of the fourth actuarial exam. Prerequisite: **STAT 4351** or equivalent. (3-0) Y
STAT 4354 Numerical and Statistical Computing (3 semester credit hours) Solving linear and nonlinear equations; numerical differentiation and integration; optimization; Newton-Raphson and EM algorithms; QR, Cholesky, eigenvalue, and singular value decompositions; random number generation; Monte Carlo methods; Markov chain Monte Carlo methods; bootstrap and jackknife; power analysis and sample size determination; and use of a statistical software package such as R. Prerequisites: MATH 2451 and STAT 4351, or instructor consent required. (3-0) Y

STAT 4355 Applied Linear Models (3 semester credit hours) Introduction to linear statistical models and their application to empirical data. Topics include linear and logistic regression; diagnostic measures; detection of outliers and influential observations; variable selection; one- and two-way ANOVA; analysis of covariance; model fitting and validation using the statistical programming language R. Prerequisite: STAT 3355 or instructor consent required. (3-0) Y

STAT 4360 Introduction to Statistical Learning (3 semester credit hours) Supervised and unsupervised learning; classification; clustering; tree-based methods; support vector machines; cross-validation; model selection and regularization; and principal components analysis. Prerequisites: STAT 4355 or instructor consent required. (3-0) Y

STAT 4382 Stochastic Processes (3 semester credit hours) Stochastic models including Markov chains, random walks, Poisson processes, renewal processes, and an introduction to time series and forecasting. Prerequisite: STAT 4351 or equivalent. (3-0) Y

STAT 4V02 Independent Study in Statistics (1-6 semester credit hours) Independent study under a faculty member's direction. Student must obtain approval from participating mathematics faculty member and the undergraduate advisor. May satisfy the School of Natural Sciences and Mathematics' advanced writing requirement if it has a major writing/report component. May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

STAT 4V97 Undergraduate Topics in Statistics (1-9 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-9]-0) S