Actuarial Science

**ACTS 6301** Theory of Actuarial Models: Life Contingencies I (3 semester 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 3L and SOA Exam MLC. Prerequisite: STAT 5351 or instructor consent required (3-0) T (2016-02-05 21:02:53)

**ACTS 6302** Theory of Actuarial Models: Financial Economics (3 semester hours) This 3 semester 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. Prerequisite: STAT 5351 or instructor consent required. (3-0) T (2016-02-05 21:02:53)

**ACTS 6303** Theory of Actuarial Models: Life Contingencies II (3 semester hours) The purpose of this class is to develop the student's knowledge of the theoretical basis of life contingent actuarial models for multiple lives and the application of those models to insurance and other financial risks. Reserves, life contingencies for multiple lives, expenses and stochastic processes will be studied. This class covers parts of CAS Exam 3L and SOA Exam MLC. Prerequisite: ACTS 6301 or instructor consent required. (3-0) T (2016-02-05 21:02:53)

**ACTS 6304** Construction and Evaluation of Actuarial Models I (3 semester hours) Introduction to useful frequency and severity models beyond those covered in Theory 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 5351 or instructor consent required. (3-0) T (2016-02-05 21:02:53)

**ACTS 6305** Construction and Evaluation of Actuarial Models II (3 semester hours) Introduction to useful frequency and severity models beyond those covered in Principles of Actuarial Models. The topics discussed include parametric models, credibility and simulation. This class covers parts of CAS Exam 4/SOA Exam C. Prerequisite: ACTS 6304 or instructor consent required. (3-0) T (2016-02-05 21:02:53)

**ACTS 6306** Advanced Actuarial Applications (3 semester hours) Special topics in actuarial science will be discussed. This class covers parts of CAS Exam 5 (Basic Techniques for Ratemaking and Estimating Claim Liabilities)/SOA Exam FAP (Fundamentals of Actuarial Practice). Prerequisite: Instructor consent required. (3-0) R (2016-02-05 21:02:53)

**ACTS 6308** Actuarial Financial Mathematics (3 semester hours) The purpose of this 3 semester 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 Exam 2/FM. Prerequisite: Instructor consent required. (3-0) R (2016-02-05 21:02:53)

**Biology**

**BIOL 5375** Genes to Genomes (3 semester hours) is an expansive coverage of molecular genetics with emphasis on genomes rather than genes. Students will gain a new perspective on how genes function together and in concert in living cells, focusing at the genome level. Students also will learn how to study genomes, inspect genome anatomies, analyze how genomes function and determine how genomes replicate and evolve. The course is structured to involve students directly in individual topics by class discussions of research papers and reviews, the latest advances in genome science and new and innovative techniques. (3-0) Y (2016-02-05 21:02:53)

**BIOL 5376 (BMEN 6387)** Applied Bioinformatics (3 semester hours) Genomic information content; data searches and multiple sequence alignment; mutations and distance-based phylogenetic analysis; genomics and gene recognition; polymorphisms and forensic applications; nucleic-acid and protein array analysis; structure prediction of biological macromolecules. Prerequisites: STAT 1342 (introductory statistics) and MATH 1325 and MATH 1326 (2 semesters of calculus). (3-0) T (2016-02-05 21:02:53)

**BIOL 5381** Genomics (3 semester hours) Genome sequence acquisition and analysis; genomic identification; biomedical genome research; DNA microarrays and their use in applied and healthcare research. (3-0) T (2016-02-05 21:02:53)

**BIOL 5410 (MSEN 5410)** Biochemistry (4 semester hours) Analysis of the structure and function of proteins and nucleic acids and of their interactions. Metabolic biochemistry, especially as it relates to disease states. Prerequisite: BIOL 3361 (biochemistry) or equivalent. (4-0) Y (2016-02-05 21:02:53)

**BIOL 5420** Molecular Biology (4 semester hours) Genetic analysis of gene structure (mutations and their analysis, complementation, and recombination), gene expression (transcription, RNA processing, translation), and the regulation of gene expression in selected model systems (viral, prokaryotic, organellar, eukaryotic); principles of genetic engineering (cloning and recombinant DNA technology). (4-0) Y (2016-02-05 21:02:53)

**BIOL 5440 (MSEN 5440)** Cell Biology (4 semester hours) Molecular architecture and function of cells and subcellular organelles; structure and function of membranes; hormone and neurotransmitter action; growth regulation and oncogenes; immune response; eukaryotic gene expression. Prerequisites: BIOL 5410 and BIOL 5420, or the equivalent, or permission of the instructor. (4-0) Y (2016-02-05 21:02:53)

**BIOL 5460** Mathematical Biology (4 semester hours) Fundamental mathematical and statistical concepts; hypothesis testing. Quantitative approaches to studying gene expression and protein-DNA interactions. Prerequisites: MATH 2417 (calculus) and PHYS 1301 (general physics). (4-0) Y (2016-02-05 21:02:53)

**BIOL 5v00** Topics in Biological Sciences (1-6 semester hours) May be repeated for credit to a maximum of 9 hours. ([1-6]-0) Y (2016-02-05 21:02:53)

**BIOL 5v01** Topics in Biological Sciences (1-6 semester hours) Includes a laboratory component. May be repeated for credit to a maximum of 9 hours (1-[0-10]) Y (2016-02-05 21:02:53)

[http://catalog.utdallas.edu/2013/graduate/courses/school/nsm](http://catalog.utdallas.edu/2013/graduate/courses/school/nsm)
**BIOL 5v95** Advanced Topics in Molecular and Cell Biology (Individual instruction) (1-6 semester hours) May be repeated for credit with permission of the graduate advisor. ([1-6]-0) Y (2016-02-05 21:02:53)

**BIOL 6121** Biotechnology I (1 semester hour) Gene cloning, nucleotide sequencing and other aspects of genetic engineering. This course has between one and five components, which will be offered sequentially and which may therefore be taken independently (with consent of instructor). (0-2) Y (2016-02-05 21:02:53)

**BIOL 6122** Biotechnology II (1 semester hour) Gene cloning, nucleotide sequencing and other aspects of genetic engineering. This course has between one and five components, which will be offered sequentially and which may therefore be taken independently (with consent of instructor). (0-2) Y (2016-02-05 21:02:53)

**BIOL 6123** Biotechnology III (1 semester hour) Gene cloning, nucleotide sequencing and other aspects of genetic engineering. This course has between one and five components, which will be offered sequentially and which may therefore be taken independently (with consent of instructor). (0-2) Y (2016-02-05 21:02:53)

**BIOL 6150** Current Research in Molecular and Cell Biology (1 semester hour) Analysis of recent developments in molecular and cell biology. Students will attend presentations of current research literature. P/F grading only. May be repeated for credit (4 hours maximum). (1-0) Y (2016-02-05 21:02:53)

**BIOL 6193** Colloquium in Molecular and Cell Biology (1 semester hour) Required for all degree students except non-thesis M.S., to be taken before a Supervising Committee is appointed. (P/F grading) (1-0) Y (2016-02-05 21:02:53)

**BIOL 6211** Posttranscriptional Regulation of Gene Expression (2 semester hours) Emphasis on current research in regulation of gene expression involving posttranscriptional mechanisms. Topics include translational regulation of gene expression, protein and messenger RNA turnover, regulation of protein folding and localization, protein phosphorylation, and the formation of active and inactive protein complexes. (2-0) T (2016-02-05 21:02:53)

**BIOL 6227** RNA World (2 semester hours) The nature of modern RNA suggests a prebiotic RNA world. This course will begin with a presentation of the arguments that a RNA world existed before the evolution of protein synthesis. Additional topics will include RNA evolution, the origin and evolution of introns, RNA replication, the evolution and involvement of tRNAs and rRNAs in protein synthesis, the structure and mechanism of large catalytic RNAs such as Group I and Group II introns and the RNase P RNA, the structure and mechanism of small nuclear RNAs such as hammerheads and hairpins, RNA editing, and the mechanism of telomerase. (2-0) T (2016-02-05 21:02:53)

**BIOL 6228** Prokaryotic Gene Expression (2 semester hours) Principles of gene regulation in bacteria are discussed. The readings consist of recent developments described in the research literature. Topics will vary, but will include bacterial chromosome structure, function and structure of RNA polymerase and promoters, the mechanism of action of various repressors and activators, the coordination of gene expression in phage lambda, during nitrogen limitation, and during sporulation. (2-0) T (2016-02-05 21:02:53)

**BIOL 6252** Current Research in Molecular Biology (2 semester hours) Recent developments in biosynthesis, structure, function and expression of nucleic acids in prokaryotes and eukaryotes. Students will participate in a critical analysis of current research publications. (P/F grading, may be repeated for credit to a maximum of 8 hours.) (2-0) S (2016-02-05 21:02:53)
BIOL 6335 Graduate Medical Microbiology (3 semester hours) This course exposes students to advanced concepts and principles of medical microbiology. In addition, the course will deal with mechanisms associated with disease processes, microbial virulence, the control of bacterial growth, and host responses to infection. (3-0) T (2016-02-05 21:02:53)

BIOL 6336 Parasitology (3 semester hours) A look at the molecular level at microorganisms that live at the expense of higher eukaryotes. Emphasis will be given to the latest scientific literature describing these important pathogenic interactions. Therapeutic treatments and preventive methods will also be covered. (3-0) T (2016-02-05 21:02:53)

BIOL 6337 Regulation of Gene Expression (3 semester hours) An in depth look at how the cell makes use of its genetic information, with a primary focus on the mechanisms of transcription regulation. The course emphasizes a critical discussion of techniques and results from the recent scientific literature. Topics are taken from eukaryotic and/or prokaryotic systems and typically cover areas such as promoter organization, RNA polymerase and transcription factor structure and function, the organization and packaging of chromosomes, whole-genome analyses, and the pathways that control gene expression during growth and development. (3-0) Y (2016-02-05 21:02:53)

BIOL 6338 Symbiotic Interactions (3 semester hours) An in depth look, at the molecular level, of well characterized symbiotic interactions between prokaryotes and eukaryotes. This course makes use of recent scientific literature and the latest discoveries in the area of symbiosis. (3-0) R (2016-02-05 21:02:53)

BIOL 6340 Developmental Neurobiology (3 semester hours) The course will cover the molecular and cellular mechanisms underlying key processes in the development of the vertebrate nervous system such as neural induction, k morphogenesis of the neural tube, patterning of the brain, differentiation and migration of neurons, axon guidance, synaptogenesis and the regulation of neuronal survival. The course is designed to be interactive and will include lectures, student presentations, and discussion of important discoveries in the area. (3-0) Y (2016-02-05 21:02:53)

BIOL 6345 Molecular Basis of Acquired Immune Deficiency Syndrome (3 semester hours) Topics include an analysis of the molecular basis of the infection of target cells by HIV, the intracellular replication of retroviruses, with special attention given to the HIV tat and rev genes, and an analysis of the roles of the HIV accessory genes: vif, vpr, vpu and nef. The immunological response of the host to HIV is considered, as is the biological basis for the ultimate failure of the immune system to contain this virus, with attendant immune collapse. The molecular basis of a variety of existing and potential anti-retroviral therapies is considered. (3-0) Y (2016-02-05 21:02:53)

BIOL 6351 Cellular and Molecular Biology of the Immune System (3 semester hours) Innate and adaptive immunity. Structure and function of immunoglobulins and MHC molecules, and their role in the adaptive immune response. Function of the primary and secondary lymphoid tissues, and the role of professional antigen presenting cells. The molecular basis for the generation of diversity during cellular development of B and T lymphocytes. The role of complement in innate immunity, and details of T cell and B cell mediated immunity. (3-0) Y (2016-02-05 21:02:53)

BIOL 6352 Modern Biochemistry I (3 semester hours) Structure and function of proteins, including enzyme kinetics and catalytic mechanisms; structure and metabolism of carbohydrates, including oxidative phosphorylation and electron transport mechanisms. For students who have not had undergraduate biochemistry. (3-0) S (2016-02-05 21:02:53)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 6353</td>
<td>Modern Biochemistry II</td>
<td>3</td>
<td>Continuation of BIOL 6352. Structure and metabolism of lipids, including membrane structure and function. Nitrogen metabolism: amino acids and nucleotides. Polynucleotide replication, transcription, and translation. For students who have not had undergraduate biochemistry.</td>
<td>3-0 Y</td>
</tr>
<tr>
<td>BIOL 6354</td>
<td>Microbial Physiology</td>
<td>3</td>
<td>Microbial physiology considers the basic processes of microbes, especially those variations that are unique to microbes: energy generation, fermentations, and other pathways specific to bacteria, cellular structure and differentiation, and bacterial responses to the environment.</td>
<td>3-0 Y</td>
</tr>
<tr>
<td>BIOL 6356</td>
<td>Eukaryotic Molecular and Cell Biology</td>
<td>3</td>
<td>Regulation of cellular activities in eukaryotic cells; structural and molecular organization of eukaryotic cells; molecular basis of cell specialization; membranes and transport. For students who have not had undergraduate cell biology.</td>
<td>3-0 S</td>
</tr>
<tr>
<td>BIOL 6357</td>
<td>Cell Signaling</td>
<td>3</td>
<td>This course will provide information on signal transduction pathways controlling growth, development and diseases. Students will be required to present research papers and discuss experimental data.</td>
<td>3-0 R</td>
</tr>
<tr>
<td>BIOL 6358</td>
<td>Bionanotechnology</td>
<td>3</td>
<td>Protein, nucleic acid and lipid structures. Macromolecules as structural and functional units of the intact cell. Parallels between biology and nanotechnology. Applications of nanotechnology to biological systems.</td>
<td>3-0 T</td>
</tr>
<tr>
<td>BIOL 6359</td>
<td>Medical Cell Biology for MAT</td>
<td>3</td>
<td>Organization of cells, structure and function of DNA and proteins, gene therapy, regenerative medicine, and the endocrine system. Designed for students who are pursuing a MAT degree.</td>
<td>3-0 S</td>
</tr>
<tr>
<td>BIOL 6360</td>
<td>Medical Cell Biology for Biotechnology</td>
<td>3</td>
<td>This course will explore cell structure, the structure of DNA, mutations in DNA, gene therapy, stem cells, cell signaling, and the immune system etc. Emphasis will be placed on understanding the cellular and molecular basis of health and disease. For students who have not had undergraduate cell biology and/or molecular genetics.</td>
<td>3-0 S</td>
</tr>
<tr>
<td>BIOL 6373</td>
<td>Proteomics</td>
<td>3</td>
<td>Protein identification, sequencing, and analysis of post-translational modifications by liquid chromatography/tandem mass spectrometry; determination of protein three dimensional structure by x-ray crystallography; its use in drug design; understanding protein interactions and function using protein chip microarrays.</td>
<td>3-0 T</td>
</tr>
<tr>
<td>BIOL 6384</td>
<td>Biotechnology Laboratory</td>
<td>3</td>
<td>Laboratory instruction in LC/MS/MS mass spectral analysis of protein sequence, ICAT (isotope coded affinity tag) reagents, and MS analysis of cellular proteomes, PCR and DNA Sequencing, and DNA microarray analysis; fluorescence and confocal microscopy and fluorescence activated cell sorting.</td>
<td>1-2 Y</td>
</tr>
<tr>
<td>BIOL 6385</td>
<td>Computational Biology</td>
<td>3</td>
<td>Using computational and statistical methods to analyze biological data, and perform mathematical modeling and computational simulation techniques to understand the biological systems. The course introduces methods in DNA/protein motif discovery, gene prediction, high-throughput sequencing and microarray data analysis, computational</td>
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</tbody>
</table>
modeling gene expression regulation, and biological pathway and network analysis. Prerequisite: (BMEN 6374 and BMEN 6387) or BIOL 5376 or instructor permission. (3-0) Y (2016-02-05 21:02:53)

**BIOL 6390** (BMEN 6390) Metabolic Pathways for Translational Medicine (3 semester hours) This course will provide extensive discussion of major metabolic pathways in human and other experimental models of human diseases with emphasis on biochemical understanding, roles and effects of the pathways in the entire cellular network, and potential application to medicine. Prerequisites: BMEN 6389 or BIOL 6385 or instructor permission. (3-0) T (2016-02-05 21:02:53)

**BIOL 6v00** Topics in Biological Sciences (1-6 semester hours) May be repeated for credit to a maximum of 9 hours. (1-6) Y (2016-02-05 21:02:53)

**BIOL 6v01** Topics in Biological Sciences (1-6 semester hours) Includes a laboratory component. May be repeated for credit to a maximum of 9 hours. (1-[0-10]) Y (2016-02-05 21:02:53)

**BIOL 6v02** The Art of Scientific Presentation (1-2 semester hours) Students learn how to give an effective seminar by reading scientific articles on a central theme in biology and then delivering a presentation, first to their classmates, followed by another presentation to the Molecular and Cell Biology faculty and students. While learning the focused theme, students acquire skill sets in critical reading of scientific literature and oral presentation. Required for all Ph.D. students. (P/F grading) ([1-2]-0) Y (2016-02-05 21:02:53)

**BIOL 6v03** Research in Molecular and Cell Biology (1-9 semester hours) (May be repeated for credit.) (1-9) S (2016-02-05 21:02:53)

**BIOL 6v04** Biology Seminar (1-6 semester hours) May be repeated for credit to a maximum of 6 hours. (1-6) Y (2016-02-05 21:02:53)

**BIOL 6v19** Topics in Biochemistry (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. (2-5) Y (2016-02-05 21:02:53)

**BIOL 6v28** DNA Replication, Recombination, and Repair (2-3 semester hours) Focuses on central aspects of DNA enzymology and metabolism. The mechanisms of DNA replication, recombination, and repair are fundamental to understanding many principles of molecular biology, genetics, molecular medicine, and evolution. This course is mechanistically oriented and will provide a strong working knowledge of these processes through an extensive overview, which includes discussions of some of the most recent publications on these topics. ([2-3]-0) T (2016-02-05 21:02:53)

**BIOL 6v29** Topics in Molecular Biology (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. (2-5) Y (2016-02-05 21:02:53)

**BIOL 6v30** Biopolymers (2-4 semester hours) Structure and properties of biologically important macromolecules. ([2-4]-0) R (2016-02-05 21:02:53)

**BIOL 6v31** Molecular Genetics (3-4 semester hours) A graduate survey of the phenomena and mechanisms of heredity, its cytological and molecular basis, with a focus on bacterial and model eukaryotic systems. Topics will include fundamentals of Mendelian Genetics, genetic recombination and genetic linkage, as well as gene structure and replication, gene expression and the transfer of genetic information, mutation and mutagenesis, and applications of recombinant DNA techniques to genetic analysis. For students who have not had undergraduate genetics. ([3-4]-0) Y (2016-02-05 21:02:53)
**BIOL 6v32** Electron Microscopy (2-3 semester hours) Theory and practice of electron microscopy. The laboratory section includes specimen preparation, operation of the electron microscope, and darkroom work. ([1-2]-2) R (2016-02-05 21:02:53)

**BIOL 6v33** Biomolecular Structure (2-3 semester hours) This course includes a discussion of DNA structures, protein structures, the folding and stability of domains, and the binding of proteins to DNA. Methods used to investigate the relation of structure to function are emphasized. Types of protein structures whose structure and function are considered include transcription factors, proteinases, membrane proteins, proteins in signal transduction, proteins on the immune system, and engineered proteins. ([2-3]-0) Y (2016-02-05 21:02:53)

**BIOL 6v34** Quorum Sensing (2-3 semester hours) The focus of this course is the analysis of quorum sensing and its role in pathogenic and symbiotic interactions. This course makes use of recent scientific literature and the latest discoveries in the area of population density dependent gene expression. ([2-3]-0) R (2016-02-05 21:02:53)

**BIOL 6v39** Topics in Biophysics (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) T (2016-02-05 21:02:53)


**BIOL 6v42** Membrane Biology I (2-4 semester hours) Membrane traffic in the secretory pathway. Topics covered include insertion of proteins into membranes, the mechanism of vesicular traffic from the rough endoplasmic reticulum through the Golgi apparatus to the plasma membrane, protein sorting during secretion and membrane biogenesis. ([2-4]-0) T (2016-02-05 21:02:53)

**BIOL 6v43** Membrane Biology II (2-4 semester hours) Membrane traffic in the endocytic pathway. Topics covered include the structure, function and sorting of membrane receptors, the formation and function of clathrin-coated pits, membrane recycling and the biogenesis of endosomes and lysosomes. ([2-4]-0) R (2016-02-05 21:02:53)

**BIOL 6v44** Animal Cell Culture (2-4 semester hours) Theory and practice of the growth of animal cells in culture. Topics include: the isolation and characterization of mammalian cell mutants, chromosome mapping, the use of somatic cell hybrids to investigate eukaryotic gene regulation, gene transfer into animal cells, gene targeting and production of gene knockouts. ([2-4]-0) R (2016-02-05 21:02:53)

**BIOL 6v49** Topics in Cell Biology (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) Y (2016-02-05 21:02:53)

**BIOL 6v50** Internship in Biotechnology/Biomedicine (1-6 semester hours) Provides faculty supervision for a student's internship. Internships must be in an area relevant to the student's coursework for the MS in Biotechnology. May be repeated for credit. ([1-6]-0) R (2016-02-05 21:02:53)

**BIOL 6v92** Readings in Molecular and Cell Biology (3-9 semester hours) ([3-9]-0) Y (2016-02-05 21:02:53)
BIOL 6v95 Advanced Topics in Molecular and Cell Biology (Individual Instruction) (1-6 semester hours) May be repeated for credit with permission of the graduate advisor. ([1-6]-0) Y (2016-02-05 21:02:53)

BIOL 6v98 Thesis (3-9 semester hours) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

BIOL 7450 Research Seminar in Molecular and Cell Biology (4 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) (4-0) S (2016-02-05 21:02:53)

BIOL 7v10 Research Seminar in Biochemistry (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) ([2-5]-0) Y (2016-02-05 21:02:53)

BIOL 7v20 Research Seminar in Molecular Biology (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) ([2-5]-0) Y (2016-02-05 21:02:53)

BIOL 7v30 Research Seminar in Biophysics (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) ([2-5]-0) R (2016-02-05 21:02:53)

BIOL 7v40 Research Seminar in Cell Biology (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading, may be repeated for credit.) ([2-5]-0) Y (2016-02-05 21:02:53)

BIOL 8v01 Research in Molecular and Cell Biology (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S (2016-02-05 21:02:53)

BIOL 8v99 Dissertation (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S (2016-02-05 21:02:53)

Chemistry

CHEM 5314 Advanced Physical Chemistry (3 semester hours) Modern concepts from the three pillars of physical chemistry: quantum mechanics, thermodynamics/statistical mechanics, and kinetics. Prerequisite: CHEM 3322 or equivalent. (3-0) Y (2016-02-05 21:02:53)

CHEM 5331 (MSEN 5331) Advanced Organic Chemistry I (3 semester hours) Modern concepts of bonding and structure in covalent compounds. Static and dynamic stereochemistry and methods for study. Relationships between structure and reactivity. Prerequisite: CHEM 2325 or equivalent. (3-0) Y (2016-02-05 21:02:53)

CHEM 5333 (MSEN 5333) Advanced Organic Chemistry II (3 semester hours) Application of the principles introduced in CHEM 5331, emphasizing their use in correlating the large body of synthetic/preparative organic chemistry. Prerequisite: CHEM/ MSEN 5331. (3-0) R (2016-02-05 21:02:53)

CHEM 5340 (MSEN 5340) Advanced Polymer Science and Engineering (3 semester hours) Polymer structure-property relations, Linear and nonlinear viscoelasticity. Dynamic mechanical analysis, time-temperature superposition, creep and stress relaxation. Mechanical models for prediction of polymer deformation, rubber elasticity, environmental effects on polymer deformation, instrumentation for prediction of long term properties. (3-0) R (2016-02-05 21:02:53)
**CHEM 5341 (MSEN 5341)** Advanced Inorganic Chemistry I (3 semester hours) Physical inorganic chemistry addressing topics in structure and bonding, symmetry, acids and bases, coordination chemistry and spectroscopy. Prerequisite: **CHEM 3341**, or consent of instructor. (3-0) Y (2016-02-05 21:02:53)

**CHEM 5343** Advanced Inorganic Chemistry II (3 semester hours) Builds on **CHEM 5341** to explore the synthesis and reactivity of inorganic/organometallic molecules. Practical applications will be demonstrated by discussing industrial processes catalyzed by metal complexes. Prerequisite: **CHEM 5341**. (3-0) R (2016-02-05 21:02:53)

**CHEM 5345 (MSEN 5345)** Analytical Techniques I (3 semester hours) Study of fundamental analytical techniques, including optical spectroscopic techniques, mass spectrometry, and microscopic and surface analysis methods. (3-0) Y (2016-02-05 21:02:53)

**CHEM 5346 (MSEN 5346)** Analytical Techniques II (3 semester hours) Study of chromatography (GC, LC, CZE), statistical methods (standard tests and ANOVA), chemical problem solving, and modern bio/analytical techniques such as biochips, microfluidics, and MALDI-MS. Prerequisite: **CHEM 5345** or consent or instructor. (3-0) R (2016-02-05 21:02:53)

**CHEM 5357** Process Analytical Chemistry (3 semester hours) An introduction to process analytical chemistry as practiced in the chemical process and other industries. Includes process control, instrumental techniques, sample and conditioning systems, project integration, and chemometrics. Prerequisite: **CHEM 5345** or consent of instructor. (3-0) R (2016-02-05 21:02:53)

**CHEM 5v84** Special Topics in Chemistry/M.A.T. (1-9 semester hours) Various special topics in chemistry of interest to teachers will be discussed. (May be repeated for credit.) (May not be counted as credit toward the M.S. or Ph.D. degrees.) ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 5v87** Independent Study in Chemistry (1-9 semester hours) In conjunction with a member of the Chemistry faculty, the student will develop a paper or project which emphasizes the ways in which chemical knowledge is confirmed and extended or which leads to improved instruction in chemistry. (May not be counted as credit toward the M.S. or Ph.D. degrees.) May be repeated for credit (9 hours maximum). ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6100** Chemistry Department Seminar (1 semester hour) A weekly seminar that features accounts of current research by outstanding investigators in chemistry and related scientific areas. Course not eligible for audit. Prerequisite: graduate standing in chemistry. (May be repeated for credit.) (1-0) S (2016-02-05 21:02:53)

**CHEM 6317** Industrial Chemistry (3 semester hours) Survey of chemical industry including commodities, chemical processes, scale-up and process development, environmental concerns, patents. Study of chemical engineering principles. (3-0) R (2016-02-05 21:02:53)

**CHEM 6361** Physical Biochemistry (3 semester hours) Protein structure, fundamental metabolism, structures and properties of macromolecules, interactions with electromagnetic radiation, thermodynamics of macromolecular solutions, transport processes, and other topics. Prerequisite: Consent of instructor. (3-0) R (2016-02-05 21:02:53)

**CHEM 6372** Materials Science (3 semester hours) Relationship between the properties and behavior of materials and their internal structure. Treatment of the mechanical, thermal and electrical properties of
crystalline and amorphous solids including metals, ceramics, synthetic polymers and composites. Prerequisite: Consent of instructor. (3-0) R (2016-02-05 21:02:53)

**CHEM 6383** Computational Chemistry (3 semester hours) The application of computer techniques to the understanding of molecular structure and dynamics: force field, semi-empirical, ab initio, and molecular dynamics techniques. Information retrieval from large structural databases and use of this information. Prerequisite: Consent of instructor. (3-0) R (2016-02-05 21:02:53)

**CHEM 6389** Scientific Literature and Communication Skills (3 semester hours) Acquaints students with techniques for searching the scientific literature using hard copy and electronic approaches. Introduces students to important steps in creating and improving technical communications in both written and oral formats. (3-0) Y (2016-02-05 21:02:53)

**CHEM 6v19** Special Topics in Physical Chemistry (1-9 semester hours) Subject matter will vary and the course may be repeated for credit. Examples of topics include spectroscopy, quantum mechanics, computational chemistry, and surface chemistry. Prerequisite: **CHEM 5314** or consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6v39** Special Topics in Organic Chemistry (1-9 semester hours) Subject matter will vary and the course may be repeated for credit. Examples of topics include organic photochemistry, organometallic chemistry, homogeneous and heterogeneous catalysis, solid state, polymer chemistry, and advanced NMR techniques. Prerequisite: **CHEM 5331** or consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6v49** Special Topics in Inorganic Chemistry (1-9 semester hours) Subject matter will vary and the course may be repeated for credit. Examples of topics include physical methods of inorganic chemistry, and bioinorganic chemistry. Prerequisite: **CHEM 5341** or consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6v59** Special Topics in Analytical Chemistry (1-9 semester hours) Subject matter will vary. Examples of topics include NMR, X-ray crystallography. May be repeated to a maximum of 9 hours. Prerequisite: **CHEM 5355** or consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6v69** Special Topics in Biochemistry (1-9 semester hours) Subject matter will vary. May be repeated for credit (9 hours maximum). Prerequisite: Consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6v79** Special Topics in Materials Chemistry (1-9 semester hours) Subject matter will vary. Examples of topics include polymers, membrane technology, zeolites, nanoscience and technology. May be repeated to a maximum of 9 hours. Prerequisite: Consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 6v84** Special Topics in Applied Chemistry (1-9 semester hours) Subject matter will vary and may be repeated for credit to a maximum of 9 hours. Prerequisite: Consent of instructor. ([1-9]-0) R (2016-02-05 21:02:53)

**CHEM 8398** Thesis (3 semester hours) May be repeated for credit. (3-0) S (2016-02-05 21:02:53)

**CHEM 8399** Dissertation (3 semester hours) May be repeated for credit. (3-0) S (2016-02-05 21:02:53)

**CHEM 8v91** Research in Chemistry (2-9 semester hours) May be repeated for credit. ([2-9]-0) S (2016-02-05 21:02:53)

**CHEM 8v99** Dissertation (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)
**Geosciences**

**GEOS 5100** Introductory Graduate Seminar (1 semester hour) Presentations of current research by the Geosciences faculty members and orientation for new graduate students. (1-0) Y (2016-02-05 21:02:53)

**GEOS 5101** Internship in Geosciences (1 semester hour) An internship in which a student gains experience through temporary employment at a geosciences based company or government organization. The activity must be monitored by one of the Geosciences faculty members and must be approved in advance of the employment. The student must provide regular progress updates and a final report to the faculty monitor. May be repeated 5 times. (1-0) S (2016-02-05 21:02:53)

**GEOS 5301** Geology of the Metroplex (3 semester hours) Lithologic constituents, stratigraphic history, and geologic environments of the greater Dallas-Fort Worth metropolitan area. Special emphasis is given to the Cretaceous sediments that underlie Tarrant and Dallas Counties, with a secondary focus on the broader geologic environment. Three to four 1-day (Saturday) field trips. (3-0) T (2016-02-05 21:02:53)

**GEOS 5302** Ocean Science (3 semester hours) Overview of geological, chemical, physical and biological aspects of oceanography, marine resources and environmental concerns. This course is for students seeking the M.A.T. degree. This course cannot be used to satisfy degree requirements of geosciences majors. (3-0) R (2016-02-05 21:02:53)

**GEOS 5303** Computing for Geoscientists (3 semester hours) Application of computer techniques in solving geological problems. Includes instruction in the MATLAB (r) software, plotting facilities, introductory matrix theory, and statistics. Students will examine problems in basic statistical analysis, graphics, and mapping of geological and geophysical data. Development of programming skills in areas directly related to thesis and dissertation research is encouraged. Serves as introduction to UNIX and the U.T. Dallas computing facility. (3-0) Y (2016-02-05 21:02:53)

**GEOS 5304** Geosciences Field Trip (3 semester hours) A study of the geology of a selected region within North America and the Caribbean followed by a field trip to the selected region in order to study the relationships of geologic features within that region. This course can only be used to partially satisfy the field experience requirement and breadth requirement for geosciences majors. Field trip course. (May be repeated for credit.) (3-0) Y (2016-02-05 21:02:53)

**GEOS 5306** Data Analysis for Geoscientists (3 semester hours) Advanced statistical techniques with important applications in Earth science. Topics include robust statistics, exploratory data analysis, surface modeling and contouring, Kriging, analysis of point patterns and directional data. Factor, cluster and time series analysis may also be considered. Emphasis will be on application and theoretical understanding. (3-0) R (2016-02-05 21:02:53)

**GEOS 5310 (GISC 5310)** Hydrogeology (3 semester hours) Introduction to the principles and practice of ground- and surface- water hydrology. Study of the principles of occurrence and geologic controls of groundwater, physical flow and geochemistry of waters. Design and use of procedures for typical hydrologic investigations. (3-0) Y (2016-02-05 21:02:53)

**GEOS 5311 (GISC 5311)** Applied Groundwater Modeling (3 semester hours) This course is designed to provide students with hands-on experience using the most commonly-applied groundwater flow and transport models (e.g. modflow/modpath, MT3D/RT3D, GMS). Practical application of the models and
design of modeling studies is emphasized, modeling theory and mathematics is de-emphasized. (3-0) Y

**GEOS 5313** Applied Surface Water Modeling (3 semester hours) The development and application of watershed models emphasizing runoff, stormflow and stormwater management design. This class combines aspects of GIS, remote sensing and surface water hydrology from an applied modeling perspective, using commonly applied computer models (e.g. Rational Method, TR-20, HEC-1) to address drainage problems related to urbanization and land-use changes. (3-0) T


**GEOS 5317** Natural Resources (3 semester hours) Overview of the exploration for and exploitation of petroleum, mineral and geothermal resources. Characteristics of natural resources and design of exploration programs through integration of geophysical and geochemical methods. Emphasis on student projects and presentations. (3-0) T

**GEOS 5319 (GISC 5319)** Principles of Environmental Health (3 semester hours) Introduction to epidemiology and biostatistics. U.S. regulatory agencies. Ethics, risk assessment and public policy. Diseases spread by food and water. Lung diseases associated with particles and fibers. Health significance of exposures to arsenic, cadmium, chromium, lead and mercury compounds and to chemical substances - solvents, PCBs, PBBs, dioxins, and dibenzofurans. Ionizing radiation. Health implications of global warming. (3-0) T

**GEOS 5322 (GISC 5322)** GPS (Global Positioning System) Satellite Surveying Techniques (3 semester hours) The theory and application of satellite positioning utilizing the Global Positioning System Code and phase methodology in field observations, data processing and analysis of Differential GPS, high accuracy static and other rapid measurements, in real time and with post-processing. (3-0) Y

**GEOS 5324 (GISC 5324)** 3D Data Capture and Ground Lidar (3 semester hours) The theory and applications of 3D data acquisition in the field for geosciences and non-geosciences studies. The basics and applications of field digital mapping with emphasis on RTK GPS, laser range finder, and terrestrial scanners (ground lidar). 3D digital photorealistic modeling with field photogrammetry and digital cameras. (3-0) T

**GEOS 5325 (GISC 6325)** Remote Sensing Fundamentals (3 semester hours) Application of airborne and satellite remote sensing for understanding the surface of the earth. Focus on interpretation of images obtained by passive and active imaging systems using electromagnetic radiation, especially visible, infrared, and radar. Laboratory course. (2-3) Y

**GEOS 5326 (GISC 7365)** Remote Sensing Digital Image Processing (3 semester hours) Introduction to remote sensing digital image processing techniques. Topics covered include principles of remote sensing and remote sensors, image visualization and statistics extraction, radiometric and geometric correction, image enhancement, image classification and change detection. Innovative image processing approaches
will also be introduced. State-of-the-art commercial image processing software is used for labs and applications development. (3-0) Y (2016-02-05 21:02:53)

**GEOS 5329 (GISC 7366) Applied Remote Sensing (3 semester hours)** Focuses on the application of remote sensing techniques to solving real world urban and environmental problems in areas such as urban and suburban landscape, land use and land cover, transportation and communication, vegetation and forestry, biodiversity and ecology, water and water quality control, soils and minerals, geology and geomorphology studies. The current generation, industry standard software is used for labs and applications development. Prerequisite: (GISC 6325 or GEOS 5325) or (GISC 7365 or GEOS 5326). (3-0) Y (2016-02-05 21:02:53)

**GEOS 5330 (GISC 5330) Geospatial Applications in Earth Science (3 semester hours)** Application of geospatial techniques in solving earth science problems. Emphasis will be placed on the use of the Global Positioning System in survey and geodetic applications, airborne and ground-based LiDAR (Light Detection and Ranging), and digital acquisition and analysis techniques. Case histories will be considered and supplemented by hands-on exercises using a broad range of digital acquisition and analysis equipment and tools. (3-0) Y (2016-02-05 21:02:53)

**GEOS 5350 Geoinformatics of Igneous Rocks (3 semester hours)** How geochemical and isotopic databases (EarthChem) can be used to understand the origin and evolution of igneous rocks from different tectonic environments. Project oriented. GEOS 5352 and GEOS 5356 recommended. (3-0) T (2016-02-05 21:02:53)

**GEOS 5352 Geochemistry of Igneous Rocks (3 semester hours)** Chemical composition of igneous rocks and the major processes that control the distribution of the elements in silicate melts. Topics to be covered include the composition of the earth, the structure of silicate melts, trace element partitioning between crystals and melts, and the use of major and trace elements in deciphering the formation and evolution of silicate melts. (3-0) T (2016-02-05 21:02:53)

**GEOS 5356 Isotope Geochemistry (3 semester hours)** Synthesis of the elements in stars and chronologies for the galaxy. Isotope systematics in meteorites, abundance anomalies, cosmogenic nuclides, and solar system chronologies. The development of the modern multi-collector mass spectrometer. Mass fractionation laws, double spiking techniques, and high precision isotope ratio measurements. Isotope geochemistry of noble gases and radiogenic nuclides as pertaining to the composition and history of the mantle and crust. Application of stable isotopes to studies of diagenesis and water-rock interaction, groundwater management, paleoceanography and secular variations in the isotopic composition of seawater. High-temperature and, where applicable, low-temperature water-rock interactions pertaining to the origin of igneous rocks. The evolution of radiogenic Sr in sea water. Radiometric age dating as applied to the solution of geologic problems. (3-0) R (2016-02-05 21:02:53)

**GEOS 5369 Volcanic Successions (3 semester 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. Students will perform case studies on select volcanic environments to gain a thorough understanding of the specific processes, products and deposits associated with a diverse range of volcanic terranes. (3-0) T (2016-02-05 21:02:53)

**GEOS 5373 Physical Properties of Rocks (3 semester hours)** This course provides an understanding of the physical phenomena and processes that determine properties of rocks and soils. Topics include porosity
and permeability; surface energy, roughness, and absorption; percolation, fractures and heterogeneous media; problems of scale; mechanical behavior of dry and fluid saturated rocks; elasticity; viscoelasticity, and plasticity; acoustic, electric, dielectric, thermal, and magnetic properties. The approach is practical, with emphasis on understanding why rocks behave as they do, and how simple physical principles can be used to predict rock and soil properties under various conditions. Suitable for graduate students in any branch of geosciences who wish to obtain a broad introduction to physical properties as they pertain to lab and field measurements, and are applied to reservoir, engineering, and environmental problems. (3-0) R

GEOS 5375  Tectonics (3 semester hours) Study of the earth's present tectonic environments, including geochemistry, sedimentology, and structure; application of present tectonic environments towards the reconstruction of ancient crustal events; consideration of temporal aspects of crustal evolution. Oral and written presentations required. (3-0) Y

GEOS 5376  Tectonics and Evolution of the Gulf of Mexico Region (3 semester hours) Study of how the Gulf of Mexico formed and evolved from Precambrian times to the present, including plate tectonic environments, evolution of sedimentary basins, igneous activity and hydrocarbon resources. Oral and written presentations will be required. Prerequisite: GEOS 5375. (3-0) T

GEOS 5380  Seismic Interpretation (3 semester hours) Seismic reflection profiling as it is used to map the distribution of sedimentary layers and faults in the subsurface. Special emphasis is given to applications in hydrocarbon exploration. Extensive use is made of software processing packages. (3-0) T

GEOS 5387  Applied Geophysics (3 semester hours) This is the Geosciences core graduate course in geophysics. Emphasis is on the application of geophysical methods to the solution of geological problems and the connection between geophysical measurements and the physical properties of Earth materials. Topics include seismology; gravity; magnetics; electromagnetics; resistivity; ground penetrating radar; and well logging. Case histories will be considered in addition to the technical aspects of data collection, processing and interpretation. (3-0) Y

GEOS 5395  (GISC 5395) Satellite Geophysics and Applications (3 semester hours) This course concerns both the theory and application of observing geophysical fields from space-borne platforms. The observation procedures including orbital mechanics are introduced and signal propagation, errors and uncertainties will be addressed. Concepts of current satellite missions such as radar and laser altimetry, space gravimetry and magnetometry, and synthetic aperture radar will be discussed. Applications of satellite geophysical observations in tectonics, geodynamics, ocean and ice surface monitoring, hydrology, and terrain modeling will be introduced through student projects and presentations. (3-0) Y

GEOS 5400  Earth Science (4 semester hours) A review of Earth processes as a whole: time and geology; igneous and sedimentary processes and products; metamorphism; structure; evolution of continents and oceans. This course is open only to those students whose major undergraduate study was in subjects other than geology. Laboratory and field trip course. (3-3) R

GEOS 5441  Stratigraphy and Sedimentology (4 semester hours) Origin and classification of sedimentary rocks, reconstruction of ancient environments, and basic principles of modern stratigraphic nomenclature. Concepts of space and time in the rock record and methods of stratigraphic correlation. Integrated stratigraphic techniques. Study of sedimentary rocks in hand specimen and outcrop. Laboratory course.
Field trips. Course is directed to graduate students not majoring in geology and is meant to provide a practical overview of sedimentary geology. Permission of instructor is required to take this course. (3-3) Y (2016-02-05 21:02:53)

**GEOS 5470** Structural Geology (4 semester hours) Examination of stress and strain, failure criteria, fault analysis, rheologic properties of geologic materials, fold analysis, and a survey of major structural provinces in North America, with supplemental readings. Laboratory includes map interpretation, standard graphical techniques, and use of stereographic projections, oral presentations, and problem sets. Laboratory and field trip course. Prerequisite: PHYS 1301 or equivalent. (3-3) Y (2016-02-05 21:02:53)

**GEOS 5481** Digital Geophysical Signal Processing (4 semester hours) Principles of the analysis of geophysical signals in both time and space. Includes integral transforms, spectral analysis, linear filter theory and deconvolution techniques. Computer applications are emphasized. Laboratory course. Prerequisite: GEOS 5303 or equivalent may be taken concurrently. (3-3) R (2016-02-05 21:02:53)

**GEOS 5484** Near-Surface Geophysical Imaging (4 semester hours) This course concerns the theoretical and practical aspects of geophysical data collection. The planning and execution of small-scale surveys, of the type employed in engineering, groundwater and environmental site evaluations, is featured. Techniques covered include both refraction and reflection seismology and both low and high frequency, single and multi-channel ground-penetrating radar. Advantage is taken of both the similarities and complementary behaviors of seismic and radar waves. An integration, of both seismic and radar data is emphasized in interpretation. A background in calculus (MATH 2417) and general physics (PHYS 1301) is required. Permission of instructor is required. (3-3) T (2016-02-05 21:02:53)

**GEOS 5490** Applied Geophysics (4 semester hours) The theoretical basis and practical aspects of the collection, processing and interpretation of geophysical data. A broad range of methods will be discussed including: gravity, magnetic, electrical and seismic. Applications to geologic problems at a variety of scales from the near surface to continental will be considered. A laboratory will feature geophysical data acquisition and interpretation for a specific local geological target. (3-3) Y (2016-02-05 21:02:53)

**GEOS 5v08** Special Topics in Geosciences (1-9 semester hours) Courses dealing with a variety of topics including new techniques and specific problems in rapidly developing areas of the science. Hours vary depending on course requirements. May be repeated for credit as topics vary. ([1-9]-[0-9]) R (2016-02-05 21:02:53)

**GEOS 6381 (GISC 6381)** Geographic Information Systems Fundamentals (3 semester hours) Examines the fundamentals of Geographic Information Systems and their applications. Emphasizes the concepts needed to use GIS effectively for manipulating, querying, analyzing, and visualizing spatial-based data. Industry-standard GIS software is used to analyze spatial patterns in social, economic and environmental data, and to generate cartographic output from the analysis. (3-0) Y (2016-02-05 21:02:53)

**GEOS 6382** Geophysical Inversion Theory (3 semester hours) Theoretical and practical aspects of fitting mathematical models to data in geophysics. Topics covered include the inversion of both discrete systems and integral equations, for linear and non-linear relationships between data and parameters. Particular attention is paid to assessment of model accuracy and uniqueness. Prerequisites: Advanced calculus (MAT H 2419) and linear algebra (MATH 2418) or equivalent. (3-0) R (2016-02-05 21:02:53)

**GEOS 6383 (GISC 6382)** Applied Geographic Information Systems (3 semester hours) Further develops hands-on skills with industry-standard GIS software for application in a wide variety of areas including
urban infrastructure management, marketing and location analysis, environmental management, geologic and geophysical analysis and the Economic, Political and Policy Sciences. Prerequisite: (GISC 6381 or GEOS 6381) or equivalent with instructor's permission. (3-0) Y (2016-02-05 21:02:53)

**GEOS 6384 (GISC 6384)** Spatial Analysis and Modeling (3 semester hours) Treatment of more advanced topics in the application of spatial analysis in a GIS environment. Topics covered include raster-based cartographic modeling, 3-D visualization, geostatistics and network analysis. Student will be acquainted with state-of-the-art software through hands-on laboratory experiences. Prerequisite: GEOS 6381 or GISC 6381. (3-0) Y (2016-02-05 21:02:53)

**GEOS 6385 (GISC 6385)** GIS Theories, Models and Issues (3 semester hours) Provides an understanding of the underlying theories, mathematical and geometric tools, and their computational implementations that establish GIS capabilities to handle and analyze geo-referenced information. Associated issues (such as uncertainty, spatial analysis and spatial data management) highlighted. Prerequisites: (GEOS 6381 or GISC 6381) and (GEOS 6383 or GISC 6382), or equivalent with instructor’s permission. (3-0) Y (2016-02-05 21:02:53)

**GEOS 6387 (GISC 6387)** Geographic Information Systems Workshop (3 semester hours) Provides a structured laboratory experience focused on the students' substantive area of interest. Each participant develops a project which should include aspects of database design and manipulation, spatial analysis, and cartographic production. Projects may be designed in coordination with a local government, utility, business, or other entity that uses GIS in its operations and research. Prerequisites: (GEOS 6381 or GISC 6381) and (GEOS 6383 or GISC 6382). (3-0) Y (2016-02-05 21:02:53)

**GEOS 6392** Reflection Seismology (3 semester hours) Theoretical and practical aspects of seismic reflection data acquisition and processing. Includes the wave equation, the convolutional model, coded sources, the array response, velocity estimation, statics, filtering, pre- and post-stack migration, and direct and indirect detection of hydrocarbons, VSPs, AVO and 3-D processing. Prerequisites: GEOS 5481, and GEOS 5392 or equivalent. (3-0) R (2016-02-05 21:02:53)

**GEOS 6393** Computational Seismology (3 semester hours) Principles of parallel computing with applications to seismology. Includes overviews of current computer cluster and switch architectures, writing and debugging parallel code, characterization of machine performance, fast Fourier transforms, Radon transforms, solution of matrix and wave equations. Laboratory course. Prerequisites: GEOS 5303, GEOS 5481, and any numerical analysis course. (2-3) R (2016-02-05 21:02:53)

**GEOS 6395** Seismic Modeling (3 semester hours) Theory and application of the major techniques for computation of synthetic seismograms. Topics include asymptotic ray theory, spectral and slowness methods, finite differences, finite elements, Kirchhoff, and boundary integral methods. Readings will be drawn from the literature. Prerequisites: GEOS 5392 and any two graduate seismology courses. (3-0) R (2016-02-05 21:02:53)

**GEOS 6396** Seismic Inversion (3 semester hours) Theory and application of the major techniques for inversion of seismic data. Topics include linear and nonlinear matrix methods, Wiechert-Herglotz integration, extremal inversion, migration, wavefield imaging of body and surface waves, and tomography, imaging of VSPs, and Born inversion. Readings will be drawn from the literature. Prerequisite: Any two graduate seismology courses. (3-0) R (2016-02-05 21:02:53)
**GEOS 7110** Workshop in Environmental Geosciences (1 semester hour) Discussion of current topics in environmental geoscience, including student and faculty research, scientific literature, and advanced techniques in environmental geosciences. (1-0) R (2016-02-05 21:02:53)

**GEOS 7170** Workshop in Structure/Tectonics (1 semester hour) Presentation and discussion of current research with emphasis on problems, techniques, and recent literature. (May be repeated for credit.) (1-0) Y (2016-02-05 21:02:53)

**GEOS 7190** Workshop in Seismology (1 semester hour) Informal presentation and discussion of current research of graduate students and faculty, of new computing equipment and software, and of current research literature. (Pass/Fail grading only. May be repeated for credit.) (1-0) S (2016-02-05 21:02:53)

**GEOS 7327 (GISC 7367)** Remote Sensing Workshop (3 semester hours) An independent project is designed and conducted by the student, after instructor approval. The project develops and demonstrates student's competence in using remote sensing techniques in a substantive application to his/her field of interest. Projects may be developed in coordination with a local government, utility, business, or other entity, which uses remote sensing in its operations and research. A formal presentation and a project report are required. Prerequisite: **GISC 7365** or **GEOS 5326**. (3-0) Y (2016-02-05 21:02:53)

**GEOS 7v00** Research and Literature Seminar (1 or 2 semester hours) Presentations and critical analysis of independent work and of the recent literature. Pass/Fail only. (May be repeated for credit.) ([1-2]-0) Y (2016-02-05 21:02:53)

**GEOS 8398** Thesis (3 semester hours) May be repeated for credit. (3-0) S (2016-02-05 21:02:53)

**GEOS 8399** Dissertation (3 semester hours) May be repeated for credit. (3-0) S (2016-02-05 21:02:53)

**GEOS 8v10** Research in Hydrogeology-Environmental Geosciences (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**GEOS 8v21** Research in Remote Sensing, GIS and GPS (1-9 semester hours) May repeat for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**GEOS 8v50** Research in Geochemistry (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S (2016-02-05 21:02:53)

**GEOS 8v70** Research in Structural Geology-Tectonics (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**GEOS 8v80** Research in Geophysics (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**GEOS 8v90** Research in Seismology (1-9 semester hours) May repeat for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**GEOS 8v99** Dissertation (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**Mathematical Science**

**MATH 5301** Elementary Analysis I (3 semester hours) Real numbers, differentiation, integration, metric spaces, basic point set topology, power series, analytic functions, Cauchy's theorem. Prerequisite:
Multivariable calculus (MATH 2451) and theoretical concept of calculus (MATH 3310) or equivalent. (3-0) Y (2016-02-05 21:02:53)

MATH 5302 Elementary Analysis II (3 semester hours) Continuation of MATH 5301. Prerequisite: MATH 5301. (3-0) Y (2016-02-05 21:02:53)

MATH 5304 Applied Mathematical Analysis for Non-Majors (3 semester hours) Techniques of mathematical analysis applicable to the social, behavioral and management sciences. Differential and integral calculus of one and many variables. No credit allowed to mathematical sciences majors. Prerequisite: MATH 1314 (College Algebra). (3-1) S (2016-02-05 21:02:53)

MATH 5305 Higher Geometry for Teachers (3 semester hours) Topics in modern Euclidean geometry including distinguished points of a triangle, circles including the nine-point circle, cross ratio, transformations; introduction to projective geometry. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: Junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)

MATH 5306 Non-Euclidean Geometry for Teachers (3 semester hours) The relations among elliptic, Euclidean and hyperbolic geometries, Euclidean models of elliptic and hyperbolic geometries. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: Junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)

MATH 5313 Modern Algebra for Teachers (3 semester hours) Study of modern algebra involving groups, rings, fields and Galois Theory. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: Junior-level mathematics course. (3-0) R (2016-02-05 21:02:53)

MATH 5390 Topics in Mathematics - Level 5 (3 semester hours) May be repeated for credit as topics vary (9 hours maximum). (3-0) R (2016-02-05 21:02:53)

MATH 6301 Real Analysis (3 semester hours) Measure theory and integration. Hilbert and Banach spaces. Prerequisites: Undergraduate analysis course (e.g., MATH 4301-2 or MATH 5301-2) undergraduate course in linear algebra (MATH 2418) or equivalent. (3-0) Y (2016-02-05 21:02:53)

MATH 6302 Real and Functional Analysis (3 semester hours) Continuation of MATH 6301. Hilbert and Banach space techniques. Prerequisite: MATH 6301. (3-0) Y (2016-02-05 21:02:53)

MATH 6303 Theory of Complex Functions I (3 semester hours) Complex integration, Cauchy's theorem, calculus of residues, power series, entire functions, Riemann mapping theorems. Riemann surfaces, conformal mapping with applications. Prerequisite: Undergraduate analysis (e.g., MATH 4301-2). (3-0) Y (2016-02-05 21:02:53)

MATH 6304 Theory of Complex Functions II (3 semester hours) Continuation of MATH 6303. Prerequisite: MATH 6303. (3-0) T (2016-02-05 21:02:53)

MATH 6305 Mathematics of Signal Processing (3 semester hours) The course is devoted to a mathematical foundation of some of the key topics in signal processing: discrete and continuous signal transforms, analysis and design of filters [e.g. lattice filters], least square methods and algorithms. Prerequisites: Undergraduate analysis (MATH 4301-2 or MATH 5301-2) undergraduate course in linear algebra (MATH 2418), undergraduate course in complex variables (MATH 3379) or equivalent. (3-0) T (2016-02-05 21:02:53)
MATH 6306 Topology and Geometry (3 semester hours) Topics in topology, differential geometry and their applications to areas such as biological sciences and engineering. Prerequisite: Undergraduate analysis (MATH 4301-2 or MATH 5301-2). (3-0) T (2016-02-05 21:02:53)

MATH 6307 Wavelets and Their Applications (3 semester hours) An introduction to windowed Fourier and continuous wavelet transforms, generalized frames, discrete wavelet frames, multiresolution analysis, Daubechies' orthogonal wavelet bases, and their applications in partial differential equations and signal processing. Prerequisite: Undergraduate linear algebra (MATH 2418) and differential equations (MATH 2420) or equivalent. (3-0) T (2016-02-05 21:02:53)

MATH 6308 Inverse Problems and Applications (3 semester hours) Exact and approximate methods of nondestructive inference, such as tomography and inverse scattering theory in one and several dimensions, with applications in physical and biomedical sciences and engineering. Prerequisite: Undergraduate linear algebra (MATH 2418) and differential equations (MATH 2420) or equivalent. (3-0) T (2016-02-05 21:02:53)

MATH 6311 Abstract Algebra I (3 semester hours) Basic properties of groups, rings, fields, and modules. Prerequisite: Undergraduate algebra course (MATH 3311) or equivalent. (3-0) Y (2016-02-05 21:02:53)

MATH 6313 Numerical Analysis (3 semester hours) A study of numerical methods including the numerical solution of non-linear equations, linear systems of equations, interpolation, iterative methods and approximation by polynomials. Prerequisites: Knowledge of a high-level programming language, linear algebra (MATH 2418) and multivariable calculus (MATH 2451). (3-0) Y (2016-02-05 21:02:53)

MATH 6315 Ordinary Differential Equations (3 semester hours) The study of ordinary differential equations with emphasis on existence, uniqueness, linear systems, boundary value problems, and stability. Prerequisites: Undergraduate course in linear algebra (MATH 2418) or equivalent; undergraduate analysis (MATH 4301-2 or Math 5301/5302); undergraduate course in ordinary differential equations (MATH 2420). (3-0) Y (2016-02-05 21:02:53)

MATH 6316 Differential Equations (3 semester hours) Continuation of MATH 6315 and an introduction to partial differential equations. Prerequisite: MATH 6315. (3-0) T (2016-02-05 21:02:53)

MATH 6318 Numerical Analysis of Differential Equations (3 semester hours) Practical and theoretical aspects of numerical methods for both ordinary and partial differential equations are discussed. Topics selected from: initial value problems for ordinary differential equations, two-point boundary value problems, projection methods, finite difference, finite element and boundary element approximations for partial differential equations. Prerequisites: MATH 6313 or equivalent. (3-0) T (2016-02-05 21:02:53)

MATH 6319 Principles and Techniques in Applied Mathematics I (3 semester hours) Mathematical methods usually used in applied sciences and engineering. Topics chosen from advanced linear algebra; Hilbert spaces; positivity; quaternions; integral equations; Fourier analysis; distributions; convexity; asymptotic methods; special functions. Prerequisite: Undergraduate linear algebra (MATH 2418), and differential equations (MATH 2420) or equivalent. (3-0) T (2016-02-05 21:02:53)

MATH 6320 Principles and Techniques in Applied Mathematics II (3 semester hours) Continuation of Math 6319. Prerequisite: MATH 6319. (3-0) T (2016-02-05 21:02:53)

MATH 6321 Optimization (3 semester hours) Introduction to theoretical and practical concepts of optimization in finite and infinite dimensional setting, least-squares estimation, optimization of functionals,
local and global theory of constrained optimization, iterative methods. Prerequisites: Undergraduate ordinary differential equations (MATH 2420) and linear algebra (MATH 2418). (3-0) T (2016-02-05 21:02:53)

**MATH 6331** Linear Systems and Signals (3 semester hours) Basic principles of systems and control theory: state space representations, stability, observability, controllability, realization theory, transfer functions, feedback. Prerequisites: Undergraduate course in linear algebra (MATH 2418) and undergraduate analysis course (MATH 4301/4302) or (MATH 5301/5302). (3-0) T (2016-02-05 21:02:53)

**MATH 6332** Advanced Control (3 semester hours) Theoretical and practical aspects of modern control methodologies in state space and frequency domain, in particular LQG and H-infinity control: coprime factorizations, internal stability, Kalman filter, optimal regulator, robust control, sensitivity minimization, loop shaping, model reduction. Prerequisite: **MATH 6331**. (3-0) T (2016-02-05 21:02:53)

**MATH 6336** Nonlinear Control Systems (3 semester hours) Differential geometric tools, input-output maps, feedback linearization, nonlinear observers, input-output linearization, output tracking, and regulation. Prerequisites: MATH 6315 and MATH 6331. (3-0) T (2016-02-05 21:02:53)

**MATH 6339** Control of Distributed Parameter Systems (3 semester hours) Theoretical and technical issues for control of distributed parameter systems in the context of linear infinite dimensional dynamical systems: Evolution equations and control on Euclidean space, elements of functional analysis, semigroups of linear operators, abstract evolution equations, control of linear infinite dimensional dynamical systems, approximation techniques. Prerequisites: Undergraduate course in partial differential equations (MATH 4362) and analysis (MATH 4301). (3-0) T (2016-02-05 21:02:53)

**MATH 6341** Bioinformatics (3 semester hours) Fundamental mathematical and algorithmic theory behind current bioinformatics techniques are covered and implemented. They include hidden Markov models, dynamic programming, genetic algorithms, simulated annealing, neural networks, cluster analysis, and information theory. Prerequisites: Knowledge of Unix and a high level programming language. (3-0) T (2016-02-05 21:02:53)

**MATH 6343** Computational Biology (3 semester hours) Mathematical and computation methods and techniques to analyze and understand problems in molecular biology are covered. Topics include sequence homology and alignment, genetic mapping, protein folding, and DNA computing. Prerequisite: **MATH 2418** or equivalent. (3-0) T (2016-02-05 21:02:53)

**MATH 6345** Mathematical Methods in Medicine and Biology (3 semester hours) Introduction to the use of mathematical techniques in solving biologically important problems. Some examples of topics that might be covered are biochemical reactions, ion channels, cellular signaling mechanisms, kidney function, and nerve impulse propagation. Prerequisites: **MATH 2417**, **MATH 2419**. (MATH 2420 recommended). (3-0) T (2016-02-05 21:02:53)

**MATH 6364** Stochastic Calculus in Finance (3 semester hours) Brownian Motion, Itô Calculus, Feynman-Kac formula and an outline of Stochastic Control, Black Scholes Analysis, Transaction Costs, Optimal Portfolio Investment. Prerequisites: **STAT 4351** or equivalent, and **MATH 2451** or equivalent. (3-0) T (2016-02-05 21:02:53)

**MATH 6390** Topics in Mathematics - Level 6 (3 semester hours) May be repeated for credit as topics vary (9 hours maximum). (3-0) R (2016-02-05 21:02:53)
MATH 6v81  Special Topics in Mathematics - Level 6 (1-9 semester hours) Topics vary from semester to semester. May be repeated for credit as topics vary. ([1-9]-0) S (2016-02-05 21:02:53)

MATH 7313  Partial Differential and Integral Equations I (3 semester hours) Topics include theory of partial differential and integral equations. Classical and modern solution techniques to linear and nonlinear partial differential equations and boundary value problems. Introduction to the theory of Sobolev spaces. Prerequisite: MATH 6316 recommended. (3-0) T (2016-02-05 21:02:53)

MATH 7314  Partial Differential and Integral Equations II (3 semester hours) Continuation of MATH 7313. General theory of partial differential and integral equations, with emphasis on existence, uniqueness and qualitative properties of solutions. Prerequisite: MATH 7313. (3-0) T (2016-02-05 21:02:53)

MATH 7316  Wave Propagation with Applications (3 semester hours) Study of the wave equation in one, two and three dimensions, the Helmholtz equation, associated Green's functions, asymptotic techniques for solving the propagation problems with applications in physical and biomedical sciences and engineering. Prerequisites: MATH 6303, MATH 6318. (3-0) T (2016-02-05 21:02:53)

MATH 7319  Functional Analysis (3 semester hours) Elements of operator theory, spectral theory, topics in Banach and operator algebras. Prerequisites: MATH 6301/6302. MATH 6303 recommended. (3-0) T (2016-02-05 21:02:53)

MATH 7390  Topics in Mathematics - Level 7 (3 semester hours) May be repeated for credit as topics vary (9 hours maximum). (3-0) R (2016-02-05 21:02:53)

MATH 8v02  Individual Instruction in Mathematics (1-6 semester hours) Topics may vary. May be repeated for credit. ([1-6]-0) S (2016-02-05 21:02:53)

MATH 8v04  Topics in Mathematics - Level 8 (1-6 semester hours) May be repeated for credit. ([1-6]-0) R (2016-02-05 21:02:53)

MATH 8v07  Research (1-9 semester hours) Open to students with advanced standing subject to approval of the Graduate Advisor. May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

MATH 8v98  Thesis (3-9 semester hours) May be repeated for credit. ([3-9]-0) S (2016-02-05 21:02:53)

MATH 8v99  Dissertation (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**Math Education**

MTHE 5321  Problems Using Algebra (3 semester hours) Analysis of the relationship of "school algebra" to "abstract algebra," solving non-routine problems involving these concepts and adapting them for classroom use. The role of functions, the relationships between the verbal, visual, and symbolic representations of algebraic concepts, and the role of technology in learning algebra will be emphasized. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: A junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)

MTHE 5322  Problems Using Geometry (3 semester hours) Analysis of the relationship of "school geometry" to "college geometry," solving non-routine problems involving these concepts, and adapting them for classroom use. Topics include the van Hiele levels of reasoning, geometric transformations, the role of conjecture and proof, applications of geometry, and the role of technology in learning geometry. No credit
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTHE 5323</td>
<td>Problems Using Pre-calculus</td>
<td>3</td>
<td>Analysis of the relationship of pre-calculus to real analysis, solving non-routine problems involving these concepts and adapting them for classroom use. The role of functions will be emphasized. Topics include functions [polynomial, rational, trigonometric, exponential, logarithmic], measurement trigonometry, vector functions [parametric equations], conic sections, real-world applications, and the role of technology in learning pre-calculus. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: A junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)</td>
</tr>
<tr>
<td>MTHE 5324</td>
<td>Problems Using Discrete Mathematics</td>
<td>3</td>
<td>Selected concepts in discrete mathematics. Solving non-routine problems and adapting them for classroom use and incorporating topics from discrete mathematics into existing high school courses. Topics include number theory, combinatorics, probability, and applications of matrices. Appropriate technology will be used. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: A junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)</td>
</tr>
<tr>
<td>MTHE 5325</td>
<td>Problems Using Mathematical Modeling</td>
<td>3</td>
<td>Selected concepts in mathematical modeling. Solving non-routine problems and adapting them for classroom use and incorporating topics from mathematical modeling into existing high school courses. Topics include the construction, use, and analysis of empirical and analytical mathematical models, using modeling tools such as functions, curve fitting, simulation, matrices, difference and differential equations, finite graph theory. Appropriate technology will be used. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: A junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)</td>
</tr>
<tr>
<td>MTHE 5326</td>
<td>Problems Using Statistics and Probability</td>
<td>3</td>
<td>Selected concepts in statistics and probability. Solving non-routine problems and adapting them for classroom use and incorporating topics from statistics, probability, and data analysis into existing high school courses. Topics include describing patterns in data and their variability, sampling and experimental design, exploring random phenomena using probability and simulation, and statistical inference. Appropriate technology will be used. No credit allowed to mathematical sciences majors except those in M.A.T. program. Prerequisite: A junior-level mathematics course. (3-0) T (2016-02-05 21:02:53)</td>
</tr>
<tr>
<td>MTHE 5327</td>
<td>Functions and Modeling</td>
<td>3</td>
<td>Explorations and lab activities designed to strengthen and expand knowledge of topics taught in middle school mathematics using functions as a basis for real world application models in science, engineering and technology. Emphasis on models involving proportional reasoning. Analysis of relationships between analogous topics in middle school and high school/college mathematics. Approaches may include lecture, explorations, laboratory activities, technology use, and problem based learning. No credit allowed to mathematical sciences majors except those in M.A.T. program. (3-0) R (2016-02-05 21:02:53)</td>
</tr>
<tr>
<td>MTHE 5v06</td>
<td>Special Topics in Mathematics Education</td>
<td>1-3</td>
<td>(May be repeated for credit to a maximum of 9 hours) (May not be counted as credits toward the M.S. or Ph.D. degrees in Mathematical Sciences.) ([1-3]-0) R (2016-02-05 21:02:53)</td>
</tr>
<tr>
<td>MTHE 5v09</td>
<td>Math Ed Independent Study</td>
<td>1-6</td>
<td>Faculty-supervised independent study in mathematics education and mathematics education research. May be repeated for credit regardless of topics (12 hours maximum). ([1-6]-0) Y (2016-02-05 21:02:53)</td>
</tr>
</tbody>
</table>
Physics

**PHYS 5301** Mathematical Methods of Physics I (3 semester hours) Vector analysis (and index notation); orthogonal coordinates; Sturm-Liouville theory; Legendre & Bessel functions; integral transforms; differential equations (including Green functions). (3-0) Y (2016-02-05 21:02:53)

**PHYS 5302** Mathematical Methods of Physics II (3 semester hours) Functions of complex variable (including contour integration and the residue theorem); tensor analysis; gamma and beta functions; probability. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5303** Mathematical Methods of Physics III (3 semester hours) Continuation and extension of topics from **PHYS 5301** and 5302 with applications related to problems and techniques encountered in physical sciences. (3-0) R (2016-02-05 21:02:53)

**PHYS 5305** Monte Carlo Simulation Method and its Application (3 semester hours) An introductory course on the method of Monte Carlo simulation of physical events. This course covers the generation of 0-1 random number, simulation of arbitrary distributions, modeling, simulation and statistical analysis of experimental activities in physics research and engineering studies. As a comparison the concepts and applications of the Neural Networks will be discussed. Prerequisites: Calculus (**MATH 2417**), Statistics (**STAT 1342**), C (**CS 3335**) or FORTRAN programming languages. (3-0) T (2016-02-05 21:02:53)

**PHYS 5311** Classical Mechanics (3 semester hours) A course that aims to provide intensive training in problem solving. Rigorous survey of Newtonian mechanics of systems, including its relativity principle and applications to cosmology; the ellipsoid of inertia and its eigenstructure, with applications, Poinsot's theorem; Euler's equations, spinning tops; Lagrangian and Hamiltonian formalism with applications; chaos, small oscillations, velocity dependent potentials, Lagrange multipliers and corresponding constraint forces, canonical transformations, Lagrange and Poisson brackets, Hamilton-Jacobi theory. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5313** Statistical Physics (3 semester hours) Phase space, distribution functions and density matrices; microcanonical, canonical and grand canonical ensembles; partition functions; principle of maximum entropy; thermodynamic potentials and laws of thermodynamics; classical and quantum ideal gases; non-interacting magnetic moments; phonons and specific heat of solids; degenerate electron gas, its specific heat and magnetism; statistics of carriers in semiconductors; Bose-Einstein condensation; Black-body radiation; Boltzmann transport equation and H-theorem; relaxation time and conductivity; Brownian motion, random walks and Langevin equation; Einstein's relation; fluctuations in ideal gases; linear response and fluctuation-dissipation theorem; virial and cluster expansions, van der Waals equation of state; Poisson-Boltzmann and Thomas-Fermi equations; phases, phase diagrams and phase transitions of the first and second order; lattice spin models; ordering, order parameters and broken symmetries; Mean-field theory of ferromagnetism; Landau and Ginzburg-Landau theories; elements of modern theory of critical phenomena. (3-0) (2016-02-05 21:02:53)

**PHYS 5314** Applied Numerical Methods (3 semester hours) Core course for Applied Physics Concentration. A hands-on approach to the development and use of computational tools in solving problems routinely encountered in upper level applied physics and engineering. Main topics include curve fitting and regression analysis, significance tests, principles of numerical modeling, verification and validation of numerical algorithms, and nonlinear model building. Examples from real world applications will be
presented and discussed to illustrate the appropriate use of numerical techniques. Prerequisites: PHYS 5301 or equivalent, and proficiency in a programming language. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5315** Scientific Computing (3 semester hours) An introduction to computational methods for solving systems of ordinary and partial differential equations using numerical techniques. Prerequisite or co-requisite: PHYS 5301. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5317** Atoms, Molecules and Solids I (3 semester hours) Core course for Applied Physics Concentration. Fundamental physical description of microsystems starting with the need for quantum mechanics and proceeding through the application of quantum mechanics to atomic systems. Emphasis will be on a physical understanding of the principles which apply to technologically important devices. Computer simulations will be used to focus the student on the important physical principals and not on detailed exact solutions to differential equations. Topics covered include: justification for quantum mechanics, application of quantum mechanics to one-electron problems, application to multi-electron problems in atomic systems. Prerequisites: MATH 2451, PHYS 2325 and PHYS 2326 or PHYS 2327. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5318** Atoms, Molecules and Solids II (3 semester hours) Core course for Applied Physics Concentration. Application of quantum mechanics to molecules and solids. Topics in solids include optical, thermal, magnetic and electric properties, impurity doping and its effects on electronic properties, superconductivity, and surface effects. Various devices, such as transistors, FETs, quantum wells, detectors and lasers will also be discussed. Prerequisite: PHYS 5317, or equivalent. (3-0) R (2016-02-05 21:02:53)

**PHYS 5319 (SCI 5326)** Astronomy: Our Place in Space (3 semester hours) Focus is on developing student understanding of how our planet fits within a larger astronomical context. Topics include common misconceptions in astronomy, scale in the Solar System and beyond, phases of the Moon, seasons, navigating the night sky, our Sun as a star, space weather, properties and lifecycles of stars, galaxies, and cosmology. (3-0) T (2016-02-05 21:02:53)

**PHYS 5320** Electromagnetism I (3 semester hours) Electrostatic boundary value problems, uniqueness theorems, method of images, Green's functions, multipole potentials, Legendre polynomials and spherical harmonics, dielectric and magnetic materials, magnetostatics, time-varying field and Maxwell's equations, energy and momentum of the field, Lienard-Wiechert potentials, electromagnetic radiation, polarization, refraction and reflection at plane interfaces. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5321** Experimental Operation and Data Collection Using Personal Computers (3 semester hours) Computer interfacing to physical experiments using high level interface languages and environments. The student will have the opportunity to learn how to develop data acquisition software using LabView and LabWindows/CVI as well as how to write drivers to interface these languages to devices over the general purpose interface buss (GPIB). A laboratory is provided for hands-on training in these devices. (3-0) R (2016-02-05 21:02:53)

**PHYS 5322** Electromagnetism II (3 semester hours) Fields and potentials, Gauge transformations and the wave equation. Electromagnetic waves in unbounded media - non-dispersive and dispersive media. Boundary conditions at interfaces. Solutions to the wave equation in rectangular cylindrical and spherical coordinates. Electromagnetic waves in bonded media - waveguides and resonant cavities. Radiating systems - electric and magnetic dipole radiation, electric quadruple radiation. Fundamentals of scattering and scalar diffraction. Lorentz transformation and covariant forms for Maxwell's equations. Radiation from
moving charges - Synchrotron, Cherenkov and Bremstrahlung Radiation. Prerequisite: **PHYS 5320** or equivalent. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5323** Virtual Instrumentation with Biomedical Clinical and Healthcare Applications (3 semester hours) The application of the graphical programming environment of LabView will be demonstrated with examples related to the health care industry. Examples will be provided to highlight the use of the personal computer as a virtual instrument in the clinical and laboratory environment. A laboratory is provided for hands-on training to augment the lecture. (3-0) R (2016-02-05 21:02:53)

**PHYS 5327 (SCI 5327)** Comparative Planetology (3 semester hours) Every world in the solar system is unique, but none more so than our own planet Earth. The course is an exploration of the astrophysical, chemical, and geological processes that have shaped each planet, moons and the myriad of rocky and icy bodies in our solar system with a special emphasis on what each tells us about Earth, and what discoveries of worlds orbiting other stars may tell us about our planetary system and home world. (3-0) T (2016-02-05 21:02:53)

**PHYS 5331 (SCI 5331)** Conceptual Physics I: Force and Motion (3 semester hours) Focus is on deepening the participants' conceptual understanding of physics, emphasizing its applicability to the pre-college and undergraduate classroom. Uses inquiry-based approaches including examples of physics in the everyday world and connections to other fields of science. Topics include foundational concepts of forces, Newton's laws, energy, and momentum. (3-0) T (2016-02-05 21:02:53)

**PHYS 5332 (SCI 5332)** Conceptual Physics II: Particles and Systems (3 semester hours) Focus is on deepening the participants' conceptual understanding of physics emphasizing its applicability to the pre-college and undergraduate classroom. Uses an inquiry-based approach including examples of physics in the everyday world and connections to other fields of science. This second class in the Conceptual Physics series builds on concepts from **SCI 5331** to explore transfers of energy and forces within and between systems of particles. Topics include states of matter, fluids, waves and sound, and thermodynamics. (3-0) T (2016-02-05 21:02:53)

**PHYS 5333 (SCI 5333)** Conceptual Physics III: Atoms, Charges, and Interactions (3 semester hours) Focus is on deepening the participants' conceptual understanding of physics, emphasizing critical thinking and applications to the pre-college and undergraduate classroom. Uses inquiry-based approaches including examples of physics in the everyday world and connections to other fields of science. This third class in the Conceptual Physics series builds on concepts from **SCI 5331** and **SCI 5332** to explore interactions between particles of matter. Topics include inter- and intra-molecular forces, light, electricity and magnetism, and the nature of the atom. (3-1) T (2016-02-05 21:02:53)

**PHYS 5335** Remote Sensing of the Earth (3 semester 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 (2016-02-05 21:02:53)

**PHYS 5341 (SCI 5341)** Astrobiology (3 semester hours) The ultimate integrated science, astrobiology brings together cutting-edge research from the fields of astrophysics, planetary science, terrestrial geosciences, and biology, to build understanding of how the history and diversity of life on our own planet relates to the possibilities for life on other worlds. This graduate-level survey course is designed to challenge participants of all backgrounds in a thoughtful and scientifically-based exploration of the young and dynamic multidisciplinary field of astrobiology. (3-0) T (2016-02-05 21:02:53)
**PHYS 5367** Photonic Devices (3 semester hours) Basic principles of Photophysics of Condensed Matter with application to devices. Topics covered include photonic crystals, PBG systems, low threshold lasers, photonic switches, super-prisms and super-lenses. Photodetectors and photocells. (3-0) R (2016-02-05 21:02:53)

**PHYS 5371 (MSEN 5371)** Solid State Physics (3 semester hours) Symmetry description of crystals, bonding, properties of metals, electronic band theory, thermal properties, lattice vibration, elementary properties of semiconductors. Prerequisites: PHYS 5301 and 5320 or equivalent. (3-0) Y (2016-02-05 21:02:53)

**PHYS 5372** Solid State Devices (3 semester hours) Basic concepts of solid state physics with application to devices. Topics covered include semiconductor homojunctions and heterojunctions, low dimensional physics, one and two dimensional electron gases, hot electron systems, semiconductor lasers, field effect and heterojunction transistors, microwave diodes and infrared and solar devices. Prerequisite: PHYS 5318. (3-0) R (2016-02-05 21:02:53)

**PHYS 5376 (MSEN 5300)** Introduction to Materials Science (3 semester hours) This course provides an intensive overview of materials science and engineering and includes the foundations required for further graduate study in the field. Topics include atomic structure, crystalline solids, defects, failure mechanisms, phase diagrams and transformations, metal alloys, ceramics, polymers as well as their thermal, electrical, magnetic and optical properties. (3-0) R (2016-02-05 21:02:53)

**PHYS 5377 (MSEN 5377)** Computational Physics of Nanomaterials (3 semester hours) This course introduces atomistic and quantum simulation methods and their applications to modeling study nanomaterials (nanoparticles, nanowires, and thin films). The course has three main parts: basic theory of materials (thermodynamics, statistical mechanics, and solid state physics), computational methods to model materials systems, and applications to practical problems. There are three main themes of the course: structure-property relationship of nanomaterials; atomistic modeling for atomic structure optimization; and quantum simulations for electronic structure study and functional property analysis. Prerequisite: MSEN 6319 or equivalent. (3-0) R (2016-02-05 21:02:53)

**PHYS 5381** Space Science (3 semester hours) Introduction to the dynamics of the middle and upper atmospheres, ionospheres and magnetospheres of the earth and planets and the interplanetary medium. Topics include: turbulence and diffusion, photochemistry, aurorae and airglow, space weather and the global electric circuit. (3-0) R (2016-02-05 21:02:53)

**PHYS 5382** Space Science Instrumentation (3 semester hours) Design, testing and operational criteria for space flight instrumentation including retarding potential analyzers, drift meters, neutral and ion mass spectrometers, auroral particle spectrometers, fast ion mass spectrometers, Langmuir probes, and optical spectrometers; ground support equipment; microprocessor design and operations. (3-0) R (2016-02-05 21:02:53)

**PHYS 5383 (EEMF 5383, MECH 5383, MSEN 5383)** Plasma Technology (3 semester hours) Hardware oriented study of useful laboratory plasmas. Topics will include vacuum technology, gas kinetic theory, basic plasma theory and an introduction to the uses of plasmas in various industries. (3-0) T (2016-02-05 21:02:53)

**PHYS 5385** Natural And Anthropogenic Effects on The Atmosphere (3 semester hours) An examination of the physical, chemical and electrical effects on the atmosphere and clouds due to varying solar photon and solar wind inputs; and of the physical and chemical effects on ozone and atmospheric temperature
following anthropogenic release of CFC’s and greenhouse gases into the atmosphere. Suitable for Science Education and other non-physics majors. (3-0) R (2016-02-05 21:02:53)

**PHYS 5391** Relativity I (3 semester hours) Mach's principle and the abolition of absolute space; the principle of relativity; the principle of equivalence; basic cosmology; four-vector calculus; special relativistic kinematics, optics, mechanics, and electromagnetism; basic ideas of general relativity. (3-0) T (2016-02-05 21:02:53)

**PHYS 5392** Relativity II (3 semester hours) Tensor calculus and Riemannian geometry; mathematical foundation of general relativity; the crucial tests; fundamentals of theoretical relativistic cosmology; the Friedmann model universes; comparison with observation. (Normally follows **PHYS 5391**.) (3-0) T (2016-02-05 21:02:53)

**PHYS 5395** Cosmology (3 semester hours) The course is an overview of contemporary cosmology including: cosmological models of the universe and their parameters; large scale structure of the universe; dark matter; cosmological probes and techniques such as gravitational lensing, cosmic microwave background radiation, and supernova searches; very early stages of the universe; dark energy and recent cosmic acceleration. (3-0) T (2016-02-05 21:02:53)

**PHYS 5v48** Topics in Physics (1-6 semester hours) Topics may vary from semester to semester. May be repeated for credit to a maximum of 9 hours. ([1-6]-0) R (2016-02-05 21:02:53)

**PHYS 5v49** Special Topics in Physics (1-6 semester hours) Topics may vary from semester to semester. P/F grading. (May be repeated for credit to a maximum of 9 hours.) ([1-6]-0) R (2016-02-05 21:02:53)

**PHYS 6300** Quantum Mechanics I (3 semester hours) Dirac formalism, kets, bras, operators and position, momentum, and matrix representations, change of basis, Stern-Gerlach experiment, observables and uncertainty principle, translations, wave functions, time evolution, the Schrodinger and Heisenberg pictures, simple harmonic oscillator, wave equation, WKB approximation, rotations, angular momentum, spin, Clebsch-Gordan coefficients, perturbation theory, variational methods. Prerequisite: **PHYS 5311** or consent of instructor. (3-0) Y (2016-02-05 21:02:53)

**PHYS 6301** Quantum Mechanics II (3 semester hours) Non-relativistic many-particle systems and their second quantization description with creation and annihilation operators; Interactions and Hartree-Fock approximation, quasi-particles; attraction of fermions and superconductivity; repulsion of bosons and super fluidity; lattice systems, classical fields and canonical quantization of wave equations; free electromagnetic field, gauges and quantization: photons; coherent states; Interaction of light with atoms and condensed systems: emission, absorption and scattering; vacuum fluctuations and Casimir force; elements of relativistic quantum mechanics: Klein-Gordon and Dirac equations; particles and antiparticles; spin-orbit coupling; fine structure of the hydrogen atom; micro-causality and spin-statistics theorem; non-relativistic scattering theory: scattering amplitudes, phase shifts, cross-section and optical theorem; Born series; inelastic and resonance scattering; perturbative analysis of the interacting fields: Time evolution and interaction representation, S-matrix and Feynman diagrams; simple scattering processes; Dyson's equation, self-energy and renormalization. Prerequisite: **PHYS 6300**. (3-0) Y (2016-02-05 21:02:53)

**PHYS 6302** Quantum Mechanics III (3 semester hours) Advanced topics in quantum mechanics. Prerequisite: **PHYS 6300** and 6301 (3-0) R (2016-02-05 21:02:53)

**PHYS 6303** Applications of Group Theory In Physics (3 semester hours) Group representation theory and selected applications in atomic, molecular and elementary-particle physics. Survey of abstract group
theory and matrix representations of SU(2) and the rotation group, group theory and special functions, the role of group theory in the calculation of energy levels, matrix elements and selection rules, Abelian and non-Abelian gauge field theories, the Dirac equation, representations of SU(3), and the standard model of elementary-particle physics. Prerequisite: PHYS 5301. (3-0) R (2016-02-05 21:02:53)

**PHYS 6313** Elementary Particles (3 semester hours) Elementary particles and their interaction; classification of elementary particles; fermions and bosons; particles and antiparticles; leptons and hadrons; mesons and baryons; stable particles and resonances; hadrons as composites of quarks and antiquarks; fundamental interactions and fields; electromagnetic, gravitational, weak and strong interactions; conservation laws in fundamental interactions; parity, isospin, strangeness, G-parity; helicity and chirality; charge conjugation and time reversal; strong reflection and CPT theorem; gauge invariance; quarks and gluons; discovery of c, b and t quarks and the W+ and Z0 particles; recent discoveries. (Normally follows PHYS 6300 or 6301.) (3-0) T (2016-02-05 21:02:53)

**PHYS 6314** High Energy Physics (3 semester hours) Electromagnetic and nuclear interactions of particles with matter; particle detectors; accelerators and colliding beam machines; invariance principles and conservation laws; hadron-hadron interactions; static quark model of hadrons; weak interactions; lepton-quark interactions; the parton model of hadrons; fundamental interactions and their unification; generalized gauge invariance; the Weinberg-Salam Model and its experimental tests: quantum chromodynamics; quark-quark interactions; grand unification theories; proton decay, magnetic monopoles, neutrino oscillations and cosmological aspects; supersymmetries. (3-0) R (2016-02-05 21:02:53)

**PHYS 6339** Special Topics In Quantum Electronics (3 semester hours) Topics vary from semester to semester. (May be repeated for credit to a maximum of 9 hours.) (3-0) R (2016-02-05 21:02:53)

**PHYS 6341** Nuclear Physics I: The Principles of Nuclear Physics (3 semester hours) Atomic physics; atomic spectra, x-rays and atomic structure. The constitution of the nucleus; isotopes, natural radioactivity, artificial nuclear disintegration and artificial radioactivity; alpha-, beta-, and gamma-decay; nuclear reactions, nuclear forces and nuclear structure. Nuclear models, neutron physics and nuclear fission. (3-0) R (2016-02-05 21:02:53)

**PHYS 6342** Nuclear Physics II: Physics and Measurement Of Nuclear Radiations (3 semester hours) Interaction of nuclear radiation with matter; electromagnetic interaction of electrons and photons; nuclear interactions. Operation and construction of counters and particle track detectors; electronic data acquisition and analysis systems. Statistical evaluation of experimental data. (3-0) R (2016-02-05 21:02:53)

**PHYS 6349** Special Topics in High Energy Physics (3 semester hours) Topics vary from semester to semester. (May be repeated for credit to a maximum of 9 hours.) (3-0) R (2016-02-05 21:02:53)

**PHYS 6353** Atomic and Molecular Processes (3 semester hours) Study of theory and experimental methods applied to elastic scattering, excitation and ionization of atoms and molecules by electron and ion impact, electron attachment and detachment, and charge transfer processes. (3-0) R (2016-02-05 21:02:53)

**PHYS 6369** Special Topics in Optics (3 semester hours) Topics vary from semester to semester. (May be repeated for credit to a maximum of 9 hours.) (3-0) R (2016-02-05 21:02:53)

**PHYS 6371** (MSEN 6371) Advanced Solid State Physics (3 semester hours) Continuation of PHYS 5371/MSEN 5371, transport properties of semiconductors, ferroelectricity and structural phase transitions, magnetism, superconductivity, quantum devices, surfaces. Prerequisite: PHYS/MSEN 5371 or equivalent. (3-0) R (2016-02-05 21:02:53)
**PHYS 6372** Physical Materials Science (3 semester hours) Advanced concepts of Materials Science. New directions in fabrication routes and materials design, such as biologically-inspired routes to electronic materials. Advanced materials and device characterization. Prerequisite: **PHYS 5376** or equivalent. (3-0) R (2016-02-05 21:02:53)

**PHYS 6374** (MSEN 6474) Optical Properties of Solids (3 semester hours) Optical response in solids and its applications. Lorentz, Drude and quantum mechanical models for dielectric response function. Kramers-Kronig transformation and sum rules considered. Basic properties related to band structure effects, excitons and other excitations. Experimental techniques including reflectance, absorption, modulated reflectance, Raman scattering. Prerequisite: **PHYS/MSEN 5371** or equivalent. (3-0) R (2016-02-05 21:02:53)


**PHYS 6379** Special Topics in Solid State Physics (3 semester hours) Topics vary from semester to semester. (May be repeated for credit to a maximum of 9 hours.) (3-0) R (2016-02-05 21:02:53)

**PHYS 6383** (EEMF 6383, MECH 6383) Plasma Science (3 semester hours) Theoretically oriented study of plasmas. Topics to include: fundamental properties of plasmas, fundamental equations (kinetic and fluid theory, electromagnetic waves, plasma waves, plasma sheaths), plasma chemistry and plasma diagnostics. Prerequisite: **EEGR 6316** or equivalent. (3-0) T (2016-02-05 21:02:53)

**PHYS 6388** Ionospheric Electrodynamics (3 semester hours) Generation of electric fields in the earth’s ionosphere. The role of internal dynamos and external generators from the interaction of the earth with the solar wind. Satellite and ground-based observations of ionospheric phenomena such as ExB drift, the polar wind and plasma instabilities. Prerequisites: **PHYS 5320, PHYS 6383**. (3-0) R (2016-02-05 21:02:53)

**PHYS 6389** Special Topics in Space Physics (3 semester hours) Topics will vary from semester to semester. (May be repeated for credit to a maximum of 9 hours.) (3-0) S (2016-02-05 21:02:53)

**PHYS 6399** Special Topics in Relativity (3 semester hours) Topics vary from semester to semester. (May be repeated for credit to a maximum of 9 hours.) (3-0) R (2016-02-05 21:02:53)

**PHYS 7v10** Internal Research (3-6 Semester Hours) On campus research for Masters in Applied Physics. May be repeated for credit. ([3-6]-0) S (2016-02-05 21:02:53)
**PHYS 7v20** Industrial Research (3-6 Semester Hours) Industrial research for Masters in Applied Physics. May be repeated for credit. ([3-6]-0) S (2016-02-05 21:02:53)

**PHYS 8398** Thesis (3 semester hours) (May be repeated for credit.) (3-0) R (2016-02-05 21:02:53)

**PHYS 8399** Dissertation (3 semester hours) (May be repeated for credit.) (3-0) S (2016-02-05 21:02:53)

**PHYS 8v10** Research in High Energy Physics And Elementary Particles (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v20** Research in Cosmology and Astrophysics (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v30** Research in Quantum Electronics (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v40** Research in Applied Physics (3-9 semester hours) P/F grading. May be repeated for credit. ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v50** Research in Atomic And Molecular Physics (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v60** Research in Optics (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v70** Research in Materials Physics (3-9 semester hours) P/F grading. May be repeated for credit. ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v80** Research in Atmospheric And Space Physics (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v90** Research in Mathematical Physics (3-9 semester hours) (P/F grading) (May be repeated for credit.) ([3-9]-0) S (2016-02-05 21:02:53)

**PHYS 8v99** Dissertation (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S (2016-02-05 21:02:53)

### Science Education

**SCE 5334** Instructional Strategies in Science (3 semester hours) Designed for the master teacher/department leader, strategies for fostering an integrated science program based on national and Texas curriculum and assessment standards are presented through hands-on activities. (3-0) T (2016-02-05 21:02:53)

**SCE 5v06** Special Topics in Science Education (1-3 semester hours) (May be repeated for credit to a maximum of 9 hours.) ([1-3]-0) S (2016-02-05 21:02:53)

**SCE 5v07** Independent Study in Science Education (1-6 semester hours) Individual independent study in science education under the supervision of a faculty member. May be repeated for credit to a maximum of 12 hours. ([1-6]-0) R (2016-02-05 21:02:53)
**Science**

**SCI 5322** Basis of Evolution (3 semester hours) From Assembling the Tree of Life to new drug developments, evolution theory is at the core of biology advancements. The concept of evolution is discussed for its relevance as a basic understanding for a scientifically literate society and processes and mechanisms of natural selection are examined. Topics include pertinent history, the fossil record, extinction, emergent species, the human experience, and applied evolution technologies. Students will explore the origins of evolution theory, public misconceptions, teaching, and evolution education research. An intensive scientific argumentation component (rather than debate) through discourse, advanced readings, presentations, panel discussions, and formal writing is required. Viewpoints examined include those of evolutionary biologists and research scientists. (3-0) T (2016-02-05 21:02:53)

**SCI 5323** Laboratories and Demonstrations for Middle School Science Teachers (3 semester hours) This course will emphasize ways that laboratory work and demonstrations help pre-high school students to acquire lasting understanding of concepts in chemistry and physics. Through a variety of laboratory exercises and demonstrations, teachers will be encouraged to select appropriate materials for their curriculum. Development of laboratory and demonstration presentation skills as well as new modules will be included in the course work. (2-3) Y (2016-02-05 21:02:53)

**SCI 5324** Ecology (3 semester hours) Ecology is the study of the interrelationships and patterns of organisms and their environments. Students will examine general ecological principles as related to productivity, population diversity, communities and ecosystem functions. Hands-on activities explore plant/insect interactions through traditional research and digital field sampling methods. This inquiry-based introductory course is aligned with instructional technology and ecology science teaching standards in the context of real-world constructivist practices. Participants will conduct student designed scientific investigations, including research question development, field collections, data analysis methods, and scientific writing. Students will prepare and submit a scientific journal manuscript. Includes a major field study component with daily and overnight off-campus field trips. Viewpoints examined include those of ecologists, entomologists, environmental scientists, and teachers. (2-3) T (2016-02-05 21:02:53)

**SCI 5326 (PHYS 5319)** Astronomy: Our Place in Space (3 semester hours) Focus is on developing student understanding of how our planet fits within a larger astronomical context. Topics include common misconceptions in astronomy, scale in the Solar System and beyond, phases of the Moon, seasons, navigating the night sky, our Sun as a star, space weather, properties and lifecycles of stars, galaxies, and cosmology. (3-0) T (2016-02-05 21:02:53)

**SCI 5327 (PHYS 5327)** Comparative Planetology (3 semester hours) Every world in the solar system is unique, but none more so than our own planet Earth. The course is an exploration of the astrophysical, chemical, and geological processes that have shaped each planet, moons and the myriad of rocky and icy bodies in our solar system with a special emphasis on what each tells us about Earth, and what discoveries of worlds orbiting other stars may tell us about our planetary system and home world. (3-0) T (2016-02-05 21:02:53)

**SCI 5328** Marine Science (3 semester hours) Acquaint STEM teachers with basic principles of marine science and with issues surrounding our use of the oceans and their resources. Students will also gain experience in conducting research, presenting results, and developing lessons for their students. (2-3) Y (2016-02-05 21:02:53)
**SCI 5329** Bioethics (3 semester hours) Bioethics incorporates philosophy and values that are at the heart of emerging technology, research, public understanding, and government policy. Focus on issues related to biotechnology in health care, ecology, agriculture and environmental disciplines including genetic transference, applied evolution technologies, assisted suicide, and new reproductive technologies. Students explore hypothetical and actual cases of bioethical dilemmas. Intensive writing component and discussion of teaching and policy development. Viewpoints examined include those of scientists, health professionals, theologians, policymakers and laypeople. (3-0) T (2016-02-05 21:02:53)

**SCI 5330** Emerging Topics in Biology (3 semester hours) The media frequently announce biology advancements and research that affect human health, basic living needs, and biology education without critical analysis, often resulting in confusing the public and curtailing scientific literacy. Examination of resources and methods to critically evaluate biological information and scientific articles for sound theory development, research methods, and practical application. Topics include recent discoveries in the life sciences that meet the needs of society, health, and environmental issues. Although the topics build on emerging issues, they may include content areas such as cell and molecular biology, agriculture, epidemiology, and global warming. Students will examine effective ways to bring in new curricula into established course settings. Advanced curriculum writing component focused on science literacy. Viewpoints include those of biological research scientists, health professionals, and science education researchers. (3-0) T (2016-02-05 21:02:53)

**SCI 5331 (PHYS 5331)** Conceptual Physics I: Force and Motion (3 semester hours) Focus is on deepening the participants' conceptual understanding of physics, emphasizing its applicability to the pre-college and undergraduate classroom. Uses inquiry-based approaches including examples of physics in the everyday world and connections to other fields of science. Topics include foundational concepts of forces, Newton's laws, energy, and momentum. (3-0) T (2016-02-05 21:02:53)

**SCI 5332 (PHYS 5332)** Conceptual Physics II: Particles and Systems (3 semester hours) Focus is on deepening the participants' conceptual understanding of physics emphasizing its applicability to the pre-college and undergraduate classroom. Uses an inquiry-based approach including examples of physics in the everyday world and connections to other fields of science. This second class in the Conceptual Physics series builds on concepts from **SCI 5331** to explore transfers of energy and forces within and between systems of particles. Topics include states of matter, fluids, waves and sound, and thermodynamics. (3-0) T (2016-02-05 21:02:53)

**SCI 5333 (PHYS 5333)** Conceptual Physics III: Atoms, Charges, and Interactions (3 semester hours) Focus is on deepening the participants' conceptual understanding of physics, emphasizing critical thinking and applications to the pre-college and undergraduate classroom. Uses inquiry-based approaches including examples of physics in the everyday world and connections to other fields of science. This third class in the Conceptual Physics series builds on concepts from **SCI 5331** and **SCI 5332** to explore interactions between particles of matter. Topics include inter- and intra-molecular forces, light, electricity and magnetism, and the nature of the atom. (3-1) T (2016-02-05 21:02:53)

**SCI 5337** Rockin' Around Texas (3 semester hours) Provides greater familiarity with earth science and a bank of resources and instructional materials needed to lead geology field trips anywhere in Texas. Teachers will participate in extensive field, laboratory, and class work mostly conducted in a problem-based learning format. (2-3) T (2016-02-05 21:02:53)
SCI 5340 Statistics for Science/Mathematics Education (3 semester hours) Understanding and application of statistical techniques needed in design and interpretation of research in Science/Mathematics Education. Includes descriptive and inferential statistics, computer-based tools, and other appropriate topics. (3-0) Y (2016-02-05 21:02:53)

SCI 5341 (PHYS 5341) Astrobiology (3 semester hours) The ultimate integrated science, astrobiology brings together cutting-edge research from the fields of astrophysics, planetary science, terrestrial geosciences, and biology, to build understanding of how the history and diversity of life on our own planet relates to the possibilities for life on other worlds. This graduate-level survey course is designed to challenge participants of all backgrounds in a thoughtful and scientifically-based exploration of the young and dynamic multidisciplinary field of astrobiology. (3-0) T (2016-02-05 21:02:53)

SCI 5342 Research Methods in STEM (3 semester hours) an introduction research process used by faculty in STEM disciplines. Through examples and/or projects, students will see the STEM research process, including conception, design, experimentation, analysis of results, and writing/publication. (3-0) T (2016-02-05 21:02:53)

SCI 5v06 Special Topics in Science (1-3 semester hours) May be repeated for credit to a maximum of 9 hours. ([1-3]-1) S (2016-02-05 21:02:53)

SCI 5v08 Independent Study in Science (1-6 semester hours) Faculty-supervised independent study in science content areas. May be repeated for credit regardless of topics (12 hours maximum). ([1-6]-0) Y (2016-02-05 21:02:53)

Science Math Education

SMED 5100 Introductory Graduate Seminar (1 semester hour) An introduction to the resources and opportunities available within the M.A.T. degree programs and the University of Texas at Dallas. (1-0) S (2016-02-05 21:02:53)

SMED 5301 Science, Mathematics, and Society (3 semester hours) An exploration of STEM issues in society that impact the teaching of science and mathematics. Students define researchable science and mathematics questions, set up research studies, use mathematics and technology in context, make applications to global STEM issues in society, and study the importance of citizen involvement in the learning and teaching of science and mathematics. (3-0) Y (2016-02-05 21:02:53)

SMED 5302 Teaching and Learning of Science and Mathematics (3 semester hours) Theories of learning and teaching in science and mathematics are explored through the lens of metacognition. Students apply metacognition theory and education research techniques to their own learning. Topics include student motivation, causation vs. correlation, cognitive and psychological development (brain research), qualitative and quantitative research methods, validity and reliability of research, ethics of research with human subjects, and decision-making strategies for education issues and policies. (3-0) Y (2016-02-05 21:02:53)

SMED 5303 Introduction to Research and Evaluation in Science and Mathematics Education (3 semester hours) Expansion of students' knowledge and application of STEM education research including research approaches to evaluation of curricula and student achievement. Focus on designing research questions concerning current understanding in science and mathematics education and questions for future investigations. What we can know through research and what research cannot/does not tell the teacher
will be central to the course. Students explore the appropriateness of specific methods of doing education research in answering particular questions and developing creative education research (as opposed to replication of previous research). Prerequisite: SMED 5302. (3-0) Y (2016-02-05 21:02:53)

SMED 5304 Reflections on Science and Mathematics Education (3 semester hours) Critical reflection on prior courses in the Science/Mathematics Education core sequence emphasizing metacognition and STEM education research. Students reflect on themselves as teachers and learners, on research-based strategies for overcoming challenges in teaching and learning, and on their own potential for impacting education as individual practitioners and researchers. All students will conduct a small research study. Prerequisite: SMED 5303. (3-0) Y (2016-02-05 21:02:53)

SMED 6v98 Thesis Research (3-6 semester hours) May be repeated. (3-6-0) Y (2016-02-05 21:02:53)

Statistics

STAT 5191 Statistical Computing Packages (1 semester hour) Introduction to use of major statistical packages such as SAS, BMD, and Minitab. Based primarily on self-study materials. No credit allowed to mathematical sciences majors. Prerequisite: One semester of statistics. (1-0) S (2016-02-05 21:02:53)

STAT 5351 Probability and Statistics I (3 semester hours) A mathematical treatment of probability theory. Random variables, distributions, conditioning, expectations, special distributions and the central limit theorem. The theory is illustrated by numerous examples. This is a basic course in probability and uses calculus extensively. Prerequisite: Multivariable calculus (MATH 2451). (3-0) T (2016-02-05 21:02:53)

STAT 5352 Probability and Statistics II (3 semester hours) Theory and methods of statistical inference. Sampling, estimation, confidence intervals, hypothesis testing, analysis of variance, and regression with applications. Prerequisite: STAT 5351. (3-0) T (2016-02-05 21:02:53)

STAT 5390 Topics in Statistics - Level 5 (3 semester hours) May be repeated for credit as topics vary (9 hours maximum). (3-0) R (2016-02-05 21:02:53)

STAT 6326 Sampling Theory (3 semester hours) Introduction to survey sampling theory and methods. Topics include simple random, stratified, systematic, cluster, unequal probability, multistage, spatial sampling designs. Estimation of means, proportions, variances, ratios, and other parameters for a finite population, optimal allocation, detectability, multiplicity. Prerequisite: STAT 5351. (3-0) T (2016-02-05 21:02:53)

STAT 6329 Applied Probability and Stochastic Processes (3 semester hours) Basic random processes used in stochastic modeling, including Poisson, Gaussian, and Markov processes with an introduction to renewal processes and queuing theory. Measure theory not required. Prerequisite: STAT 5351. (3-0) T (2016-02-05 21:02:53)

STAT 6331 Statistical Inference I (3 semester hours) Introduction to fundamental concepts and methods of statistical modeling and decision making. Basic distribution theory. Decision theory. Exponential families of models. Sufficiency. Estimation and hypothesis testing. Likelihood methods and optimality. Large sample approximations. Prerequisites: STAT 5352 or equivalent and MATH 5302 or equivalent. (3-0) Y (2016-02-05 21:02:53)

STAT 6337 Advanced Statistical Methods I (3 semester hours) Statistical methods most often used in the analysis of data. Study of statistical models, including multiple regression, nonlinear regression, stepwise regression, regression diagnostics, balanced and unbalanced analysis of variance, analysis of covariance and log-linear analysis of multiway contingency tables. Prerequisites: MATH 2418 and STAT 5352 or STAT 6331. (3-0) T (2016-02-05 21:02:53)

STAT 6338 Advanced Statistical Methods II (3 semester hours) This course continues STAT 6337. Topics include one way and multiway analysis of variance, fixed, random, and mixed effects models, nested designs, repeated measures designs, fractional designs, Latin squares, diagnostics, and implementation of statistical methods in SAS. Prerequisite: STAT 6337. (3-0) T (2016-02-05 21:02:53)

STAT 6339 Linear Statistical Models (3 semester hours) Vectors of random variables, multivariate normal distribution, quadratic forms. Theoretical treatment of general linear models, including the Gauss-Markov theorem, estimation, hypotheses testing, and polynomial regression. Introduction to the analysis of variance and analysis of covariance. Prerequisites: STAT 6331 and MATH 2418 or equivalent. (3-0) T (2016-02-05 21:02:53)

STAT 6341 Numerical Linear Algebra and Statistical Computing (3 semester hours) A study of computational methods used in statistics. Topics to be covered include the simulation of stochastic processes, numerical linear algebra, QR decomposition and least squares regression, SV decomposition and multivariate data, statistical programming languages, and graphical methods. Prerequisite: STAT 5352 or STAT 6337. (3-0) T (2016-02-05 21:02:53)

STAT 6343 Experimental Design (3 semester hours) This course focuses on the planning, development, implementation and analysis of data collected under controlled experimental conditions. Repeated measures designs, Graeco-Latin square designs, randomized block designs, balanced incomplete block designs, partially balanced incomplete block designs, fractional replication and confounding. The course requires substantial use of computer facilities. Prerequisite: STAT 6338 or equivalent knowledge of fixed and random effects crossed ANOVA designs. (3-0) T (2016-02-05 21:02:53)

STAT 6344 Probability Theory I (3 semester hours) Measure theoretic coverage of probability theory. Topics include: Axioms of probability, Integration; Distributions and moments; Probability Inequalities; Convergence of probability measures; Laws of large numbers; Central limit theorem; Three-series theorem; Zero-one laws; Glivenko-Cantelli theorem; Law of iterated logarithm; Conditional probability and expectation; Introduction to martingales. Prerequisite: MATH 5302 or equivalent. (3-0) T (2016-02-05 21:02:53)

STAT 6347 Applied Time Series Analysis (3 semester hours) Methods and theory for the analysis of data collected over time. The course covers techniques commonly used in both the frequency domain (harmonic analysis) and the time domain (autoregressive, moving average models). Prerequisite: STAT 6337 or equivalent. (3-0) T (2016-02-05 21:02:53)
**STAT 6348** Applied Multivariate Analysis (3 semester hours) Currently used techniques of multivariate analysis. Topics include Hotelling's T test, the multivariate linear model, principal components analysis, factor analysis, cluster analysis, classification problems, graphics and visualization tools. Emphasis on computations with R or other software. Additional topics may be covered based on current research of the instructor. Prerequisite: **STAT 5352** or **STAT 6331**. (3-0) T (2016-02-05 21:02:53)

**STAT 6365** Statistical Quality and Process Control (3 semester hours) Statistical methodology of monitoring, testing, and improving the quality of goods and services is developed at the intermediate level. Topics include control charts for variables and attributes, assessment of process stability and capability, construction and interpretation of CUSUM, moving average charts and V-masks, optimal sampling techniques, and evaluation of operating-characteristic curves and average time to detection. Prerequisite: **STAT 5351** or equivalent. (3-0) T (2016-02-05 21:02:53)

**STAT 6390** Topics in Statistics - Level 6 (3 semester hours) May be repeated for credit as topics vary (9 hours maximum). Topics selected from but not limited to choices such as spatial statics, nonparametric curve estimation, functional data analysis, statistical learning and data mining, actuarial science, sampling theory, statistical quality and process control, sequential analysis, survival analysis, longitudinal data analysis, categorical data analysis, and clinical trials, for example. (3-0) R (2016-02-05 21:02:53)

**STAT 6v99** Statistical Consulting (1-3 semester hours) Practical experience in collaboration with individuals who are working on problems which are amenable to statistical analysis. Problem formulation, statistical abstraction of the problem, and analysis of the data. Course may be repeated but a maximum of three hours may be counted toward the requirements for the master's degree. Prerequisite: Consent of instructor. ([1-3]-0) T (2016-02-05 21:02:53)

**STAT 7330** Decision Theory and Bayesian Inference (3 semester hours) Statistical decision theory and Bayesian inference are developed at an intermediate mathematical level. Prerequisites: **MATH 5302** or equivalent and **STAT 6331**. (3-0) T (2016-02-05 21:02:53)

**STAT 7331** Multivariate Analysis (3 semester hours) Vector space foundations and geometric considerations. The multivariate normal distribution: properties, estimation, and hypothesis testing. Multivariate t-test. Classification problems. The Wishart distribution. General linear hypothesis and MANOVA. Principal components, canonical correlations, factor analysis. Multivariate nonparametric and robust methods. Prerequisite: **STAT 6331** or equivalent. (3-0) T (2016-02-05 21:02:53)


**STAT 7345** Advanced Probability and Stochastic Processes (3 semester hours) Taught as a continuation of **STAT 6344**. Martingales, Kolmogorov’s existence theorem, random walk, Markov chains, the Poisson
process, the general birth and death process, other Markov processes, renewal processes, Brownian motion and diffusion, stationary processes, and the empirical process. Prerequisite: STAT 6344. (3-0) T

**STAT 7390** Topics in Statistics - Level 7 (3 semester hours) May be repeated for credit as topics vary (9 hours maximum). Topics selected from but not limited to choices such as spatial statistics, nonparametric curve estimation, functional data analysis, statistical learning and data mining, actuarial science, sampling theory, statistical quality and process control, sequential analysis, survival analysis, longitudinal data analysis, categorical data analysis, and clinical trials, for example. (3-0) R (2016-02-05 21:02:53)

**STAT 8v02** Individual Instruction in Statistics (1-6 semester hours) May be repeated for credit. ([1-6]-0) S (2016-02-05 21:02:53)

**STAT 8v03** Advanced Topics in Statistics (1-6 semester hours) May be repeated for credit. ([1-6]-0) R (2016-02-05 21:02:53)

**STAT 8v07** Research in Statistics (1-9 semester hours) Open to students with advanced standing, subject to approval of the graduate adviser. May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)

**STAT 8v98** Thesis (3-9 semester hours) May be repeated for credit. ([3-9]-0) S (2016-02-05 21:02:53)

**STAT 8v99** Dissertation (1-9 semester hours) May be repeated for credit. ([1-9]-0) S (2016-02-05 21:02:53)