College of Sciences and Mathematics

EDWARD THOMAS, *Dean*
MAGGIE HAN, *Associate Dean for Academic Affairs*
MARK LILES, *Associate Dean for Research*

THE COLLEGE OF SCIENCES AND MATHEMATICS provides programs in the physical sciences, life sciences, and mathematics at the undergraduate and graduate levels. The college also offers scientific and mathematical service courses for students enrolled in all of the other colleges and schools. The college includes the departments of Biological Sciences, Chemistry and Biochemistry, Geosciences, Mathematics and Statistics, and Physics. The Arboretum, Natural History Museum, and the Leach Science Center are also included in the College of Sciences and Mathematics.

Undergraduate Degrees

1. Four-year bachelor's degree programs are offered in two areas:
   a. Departmental curricula are available in actuarial science, biomedical sciences, biochemistry, chemistry, clinical laboratory and medical sciences, genetics, geography and environmental studies, geology, microbiology, molecular biology, marine biology, mathematics, applied mathematics, organismal biology, and physics.
   b. Pre-professional curricula are offered in pre-dentistry, pre-medicine, pre-optometry, pre-physical therapy, pre-pharmacy, pre-physician assistant and pre-veterinary medicine.
   Embodied in these curricula are the requirements of the University Core Curriculum.
2. Admission - The academic requirements and demands on majors in sciences and mathematics necessitate a high school preparation of high intellectual quality. The following courses are recommended as minimum preparation: English, four units; mathematics (including algebra, geometry, trigonometry and pre-calculus), four units; chemistry, one unit; biology, one unit; history, literature, social science, two or three units. Both physics and foreign language are highly recommended.

Students must complete the ALEKS Math Placement Assessment in order to be eligible to register for a mathematics course. Students who did not place into MATH 1610 or another first mathematics course required in their major must first take a prerequisite course determined by the ALEKS score. See aub.ie/mathplacement (https://nam11.safelinks.protection.outlook.com/?url=http%3A%2F%2Faub.ie%2Fmathplacement&data=05%7C02%7Ckcc0019%40auburn.edu%7C70e4ba93526e4791909308dc3bb162fa%7Cccb6deedbd294b388979d72780f62d3b%7C0%7C0%7C638450880254436040%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=kq%2BxuB3Pudr6zxPkW4PKHH%2B%2F1mIvxFFsamSoFoF3aHM%3D&reserved=0) or Academic Advisor for details.

On-campus transfers may declare a major in the College of Sciences and Mathematics if they: (1) have a cumulative Auburn grade-point average of at least 2.0 (on all work attempted) and (2) have completed at least 10 hours of Auburn University course work in the desired major with at least a 2.0 grade-point average in all such courses. Courses in the major are those carrying the appropriate prefix(es) of the specific curriculum. Students not meeting these standards may enroll in the Undeclared Sciences and Mathematics (UNSM) curriculum if they have not reached senior standing. Students in the UNSM curriculum may declare a Sciences and Mathematics major after satisfying the above requirements. A student who enters the UNSM curriculum because he or she is not qualified to declare a major can remain in UNSM for a maximum of one year or until senior standing is reached. After this, if the student is still not qualified to declare a major, he or she will be disenrolled from the College of Sciences and Mathematics.

Graduate Degrees

Master of science and doctor of philosophy degrees are offered in the College of Sciences and Mathematics. Degree programs are described in this *Bulletin*.

Web Page

Additional information about the College of Sciences and Mathematics can be found at: https://www.auburn.edu/cosam/.

General Sciences and Mathematics Curriculum (UNSM)

This curriculum is primarily for freshmen who have not decided on a specific major field of study and for transfer students having deficiencies which preclude their acceptance in a degree program. Freshmen entering this curriculum must declare a major by the end of their first year. Transfer students must complete a specific approved program to clear their admission to a major field of study.

The General Curriculum (UNSM)

First Year

Fall	Hours	Spring	Hours
MATH 1610 Calculus I	4	Science	4
ENGL 1100 English Composition I	3	Core Social Science	3
Science	4	Elective	2
Core Social Science	3	MATH 1620 Calculus II	4
Career Exp	2	ENGL 1120 English Composition II	3

Departmental Curricula

Departmental curricula leading to the bachelor's degree include actuarial science, biomedical sciences, biochemistry, chemistry, clinical laboratory and medical sciences, genetics, geography and environmental studies, geology, microbiology, molecular biology, marine biology, mathematics, applied mathematics, organismal biology, and physics.

Majors

- Applied Mathematics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/mathematicsandstatistics/appliedmathematics_major/)
- Applied Mathematics — Actuarial Science Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/mathematicsandstatistics/actuarialscience_major/)
- Applied Mathematics — Applied Discrete Mathematics Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/mathematicsandstatistics/applieddiscretemathematics_major/)
- Biomedical Sciences — Pre-professional concentrations in:
  - Pre-Pharmacy (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/biomedicalsciences_major_pre-phar/)
  - Pre-Medicine, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/biomedicalsciences_major_pre-med/)
  - Pre-Anesthesiologist Assistant (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/biomedicalsciences_major_anesth/)
  - Interdisciplinary Health Sciences (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/biomedicalsciences_major_InterHealth/)
- Chemistry (BA) (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/bacurriculuminchemistry_major/)
- Chemistry (BA) — Forensics Track (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/bacurriculuminchemistryforensics_major/)
- Chemistry (BA) — Pre-professional concentrations in:
  - Pre-Medicine, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/bacurriculuminchemistry_major_pre-meddenopt/)
- Chemistry (BS) (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/bscurriculuminchemistry_major/)
  - Biochemistry Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/biochemistry_major/)
- Genetics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/genetics_major/)
- Genetics — Pre-professional concentrations in:
  - Pre-Medicine, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/genetics_major_pre-med/)
  - Pre-Veterinary Medicine (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/genetics_major_pre-vet/)

- Geography and Environmental Studies (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/geologyandgeography/geography_major/)
- Geology (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/geologyandgeography/geology_major/)
  - Geology — Earth System Science Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/geologyandgeography/geologyearthscienceoption_major/)
- Laboratory Science (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/laboratorytechnology_major/)
- Laboratory Science - Histotechnology Track (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/laboratoryhistotechnology_major/)
- Laboratory Science — Pre-professional concentrations in:
  - Laboratory Science — Pre-Medicine (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/laboratorytechnology_premed_major/)
  - Laboratory Science — Pre-Physician Assistant (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/laboratorytechnology_prepa_major/)
- Marine Biology (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/marinebiology_major/)
- Mathematics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/mathematicsandstatistics/mathematics_major/)
- Medical Laboratory Science (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/medicaltechnology_major/)
- Microbiology — Pre-professional concentrations in:
  - Pre-Medical, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/microbialcellularmolecularbiology-microbiology_major_pre-med/)
  - Pre-Physical Therapy, Pre-Physician Assistant (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/microbialcellularmolecularbiology-microbiology_major_pre-pphsppat/)
  - Pre-Veterinary Medicine (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/microbiology_preveterinarymedicine_major/)
- Microbial, Cellular and Molecular Biology — Microbiology Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/microbialcellularmolecularbiology-microbiology_major/)
- Microbial, Cellular and Molecular Biology — Cell & Molecular Biology Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/microbialcellularmolecularbiology-cellmolecularbiology_major/)
- Organismal Biology — Conservation & Biodiversity Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/orgbio-conversationbiodiversity_major/)
- Organismal Biology — Ecology, Evolution & Behavior Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/orgbio-ecoevolutionbehavior_major/)
- Organismal Biology — Integrative Biology Option (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/orgbiointegrativebio_major/)
- Organismal Biology — Pre-professional concentrations in:
  - Pre-Medicine, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/ibio_major_premed/)
  - Pre-Physical Therapy, Pre-Physician Assistant (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/ibio_major_prepphsppat/)
  - Pre-Veterinary Medicine (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/prehealthprofessionalcurricula/orgbio_preveterinarymedicine_major/)
- Physics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_major/)
- Physics — Pre-professional concentrations in:
  - Pre-Medicine, Pre-Dental, Pre-Optometry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_major_pre-med/)
  - Pre-Physical Therapy, Pre-Physician Assistant (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_major_pre-pphsppat/)
- Science Teaching (http://bulletin.auburn.edu/undergraduate/collegeofeducation/curriculumandteaching/scienceteachingdouble_major/)

Minors

- Biological Sciences (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/biologicalsciences/biosci_minor/)
- Chemistry (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/chemistryandbiochemistry/chemistry_minor/)
- Geography (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/geologyandgeography/geography_minor/)
- Geology (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/geologyandgeography/geology_minor/)
- Mathematics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/mathematicsandstatistics/mathematics_minor/)
- Physics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/physics/physics_minor/)
- Statistics (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/mathematicsandstatistics/statistics_minor/)

Undergraduate Certificates

- Geographic Information Systems (GIS) (http://bulletin.auburn.edu/undergraduate/collegeofsciencesandmathematics/geologyandgeography/certificate_gis/)

Graduate Programs

- Biological Sciences — Graduate Certificate, MS, PhD (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/biologicalsciencesmsphd_major/)
- Biomedical Sciences — MS, PhD (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/biomedicalsciencesmsphd_major/)
- Chemistry and Biochemistry — MS, PhD (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/chemistryandbiochemistrymsphd_major/)
- Data Science — Graduate Certificate (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/datascience_gcrt/)
- Data Science and Engineering — MS (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/computerscienceandsoftwareengineeringmswemsphd_major/datascienceandengineering_major/)
- Earth System Science — Interdisciplinary PhD Program (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/interdisciplinaryprogramineearthsystem_phd/)
- Geographic Information Science — Graduate Certificate (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/geograpic_gradcert/)
- Geography and Environmental Studies — MS (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/geographyms_major/)
- Geology — MS (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/geologyms_major/)
- Mathematics — MAM, MS, PhD (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/mathematicsandstatisticsmsmammpsphd_major/)
- Physics — MS, PhD (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/physicsmsphd_major/)
- Statistics — MS (http://bulletin.auburn.edu/thegraduateschool/graduatedegreesoffered/statisticsmsmps_major/)

Biochemistry Courses

BCHE 3180 NUTRITIONAL BIOCHEMISTRY (3) LEC. 3. Pr. CHEM 2030 or CHEM 2070 or CHEM 2077 or CHEM 2080 or CHEM 2087. Fundamental pathways of carbohydrate, lipid, and amino acid metabolism in human beings.

BCHE 3200 PRINCIPLES OF BIOCHEMISTRY (3) LEC. 3. Pr. (BIOL 1010 or BIOL 1020 or BIOL 1030 or BIOL 1027 or BIOL 1037) and (CHEM 2030 or CHEM 2070 or CHEM 2077 or CHEM 2080 or CHEM 2087). Structure and function of biomolecules, enzyme catalysis, processing of genetic information, bioenergetics and metabolism, and regulatory mechanisms in cellular processes.

BCHE 5180 BIOCHEMISTRY I (3) LEC. 3. Pr. CHEM 2080 or CHEM 2087. Fundamentals of metabolism, focusing on the design and regulation of the major catabolic and biosynthetic metabolic pathways. Bioenergetics.

BCHE 5181 BIOCHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C BCHE 5180 or P/C CHEM 5180. Laboratory techniques required for identification and quantification of compounds of important biochemical classes.

BCHE 5190 BIOCHEMISTRY II (3) LEC. 3. Pr. BCHE 5180 or BCHE 6180. Fundamentals of metabolism, focusing on the design and regulation of the major catabolic and biosynthetic metabolic pathways.

BCHE 5191 BIOCHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C BCHE 5190 or P/C CHEM 5190. Laboratory techniques required for partial purification, kinetic studies, and characterization of enzymes and nucleotides from various plants, animals and bacteria.

BCHE 6180 BIOCHEMISTRY I (3) LEC. 3. Pr. CHEM 2080 or CHEM 2087. Departmental approval. Fundamentals of the classification, structure, and reactions of the major constituents of living matter and evaluation of binding phenomena and bioenergetics.

BCHE 6181 BIOCHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C BCHE 6180 or P/C CHEM 6180. Laboratory techniques required for identification and quantification of compounds of important biochemical classes.

BCHE 6190 BIOCHEMISTRY II (3) LEC. 3. Pr. BCHE 6180. Departmental approval. Fundamentals of metabolism, focusing on the design and regulation of the major catabolic and biosynthetic metabolic pathways.

BCHE 6191 BIOCHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 6190. Laboratory techniques required for partial purification, kinetic studies, and characterization of enzymes and nucleotides from various plants, animals, and bacteria.

BCHE 7200 ADVANCED BIOCHEMISTRY I (3) LEC. 3. Graduate credit will not be given for both BCHE 6190 and BCHE 7200.

BCHE 7210 ADVANCED BIOCHEMISTRY II (3) LEC. 3. Structure and function of macromolecules participating in the flow of molecular information. Graduate credit will not be given for both BCHE 6180 and BCHE 7210. Or equivalent.

BCHE 7220 PRINCIPLES OF CELLULAR AND MOLECULAR ENZYMOLOGY (3) LEC. 3. Pr. BCHE 6190 or CHEM 6190 or BCHE 7200. Departmental approval. The principles of enzyme chemistry including the physical, chemical, and catalytic properties of enzymes.

BCHE 7230 BIOCHEMISTRY OF MACROMOLECULES (3) LEC. 3. Pr. BCHE 6180 or BCHE 7200. Departmental approval. Advanced study of the structure of protein and nucleic acids: DNA replication, RNA transcription and protein synthesis.

BCHE 7260 BIOINFORMATICS (3) LEC. 3. Pr. BCHE 7210. Departmental approval. Advanced study of main concepts and tools of genomics and proteomics.

BCHE 7270 BIOCHEMICAL RESEARCH TECHNIQUES (3) LEC. 3. Pr. BCHE 6190. Modern biochemical laboratory techniques. Course may be repeated for a maximum of 6 credit hours.

BCHE 7280 TOPICS IN BIOCHEMISTRY (1-3) LEC. Pr. BCHE 7210. Departmental approval. Directed studies in biochemistry. BCHE 7210 or equivalent. Course may be repeated for a maximum of 3 credit hours.

Biology Courses

BIOL 1000 INTRODUCTION TO BIOLOGY (3) LEC. 3. Science Core. Introduction to biological principles relevant to human society. Designed for non-science majors. Credit will not be given for both BIOL 1000 and BIOL 1020 or BIOL 1027.

BIOL 1001 INTRODUCTION TO BIOLOGY LABORATORY (1) LAB. 2. Pr. P/C BIOL 1000 or P/C BIOL 1003. Laboratory course for BIOL 1000 or BIOL 1003.

BIOL 1010 A SURVEY OF LIFE (3) LEC. 3. Pr. BIOL 1000 or BIOL 1020 or BIOL 1023 or BIOL 1027 or SCMH 1010 or SCMH 1013 or SCMH 1017 or SCMH 1020 or SCMH 1023 or SCMH 1027. Science Core. Emphasis on contrasting strategies employed by organisms to meet similar biological needs. Credit will not be given for both BIOL 1010 and BIOL 1030 or BIOL 1037.

BIOL 1011 A SURVEY OF LIFE LABORATORY (1) LAB. 2. Pr. P/C BIOL 1010 or P/C BIOL 1013. Laboratory course for BIOL 1010.

BIOL 1020 PRINCIPLES OF BIOLOGY (3) LEC. 3. Science Core. Introduction to the physical, chemical, and biological principles common to all organisms. Credit will not be given for both BIOL 1020 and BIOL 1000 or BIOL 1027.

BIOL 1021 PRINCIPLES OF BIOLOGY LABORATORY (1) LAB. 2. Pr. P/C BIOL 1020 or P/C BIOL 1023 or P/C BIOL 1027. Laboratory Course for BIOL 1020.

BIOL 1027 HONORS BIOLOGY (4) LEC. 3. LAB. 2. Pr. Honors College. Science Core. Introduction to the physical, chemical, and biological principles common to all organisms. Credit will not be given for both BIOL 1027 and BIOL 1000 or BIOL 1020.

BIOL 1030 ORGANISMAL BIOLOGY (3) LEC. 3. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027. Science Core. Principles and fundamentals of biology at the organismal level. Credit will not be given for both BIOL 1030 and BIOL 1010 or BIOL 1037.

BIOL 1031 ORGANISMAL BIOLOGY LABORATORY (1) LAB. 2. Pr. P/C BIOL 1030. Laboratory Course for BIOL 1030.

BIOL 1037 HONORS ORGANISMAL BIOLOGY (4) LEC. 3. LAB. 1. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027. Science Core. Principles and fundamentals of biology at the organismal level. Credit will not be given for both BIOL 1037 and BIOL 1010 or BIOL 1030.

BIOL 2100 PROFESSIONAL DEVELOPMENT (1) LEC. 1. Introduction to career opportunities and student development options for majors in biological sciences. Students will investigate post-graduation academic and professional options, develop writing skills by creating resumes and ePortfolios, and explore course and research options with the department. Biology majors only.

BIOL 2425 MARINE BIOLOGY (4) LEC. 4. Pr. BIOL 1030 or BIOL 1037. Departmental approval. The invertebrates, vertebrates and marine plants as communities with emphasis on local examples. Taught only at Dauphin Island Sea Lab. (DISL).

BIOL 2500 HUMAN ANATOMY AND PHYSIOLOGY I (3) LEC. 3. Pr. BIOL 1000 or BIOL 1020 or BIOL 1023 or BIOL 1027. Study of the structure and function of the human body. First half of two-part sequence with BIOL 2510, concentrating on tissues, muscle, and nervous system.

BIOL 2501 HUMAN ANATOMY AND PHYSIOLOGY I LABORATORY (1) LAB. 1. Pr. (BIOL 1000 or BIOL 1020 or BIOL 1027) and (P/C BIOL 2500 or P/C BIOL 2503 or P/C BIOL 2507). Lab course for study of the structure and function of the human body. First half of two-part sequence with BIOL 2510, concentrating on tissues, muscle, and nervous system.

BIOL 2507 HONORS HUMAN ANATOMY AND PHYSIOLOGY I (3) LEC. 3. Pr. Honors College. BIOL 1000 or BIOL 1020 or BIOL 1023 or BIOL 1027. Study of the structure and function of the human body. First half of two-part sequence with BIOL 2510, concentrating on tissues, muscle, and nervous system.

BIOL 2510 HUMAN ANATOMY AND PHYSIOLOGY II (3) LEC. 3. Pr. (BIOL 2500 or BIOL 2503 or BIOL 2507) and BIOL 2501. Study of the structure and function of the human body. Second half of two-part sequence with BIOL 2500/2501, concentrating on cardiovascular, respiratory, digestive, urinary, reproductive, and endocrine systems.

BIOL 2511 HUMAN ANATOMY AND PHYSIOLOGY II LABORATORY (1) LAB. 1. Pr. (BIOL 2500 or BIOL 2503 or BIOL 2507) and BIOL 2501 and (P/C BIOL 2510 or P/C BIOL 2517). Lab course for study of the structure and function of the human body. Second half of two-part sequence with BIOL 2500, concentrating on the individual organ systems.

BIOL 2517 HONORS HUMAN ANATOMY AND PHYSIOLOGY II (3) LEC. 3. Pr. Honors College. BIOL 2501 and BIOL 2500 or BIOL 2503 or BIOL 2507. Study of the structure and function of the human body. Second half of two-part sequence with BIOL 2500/2501, concentrating on cardiovascular, respiratory, digestive, urinary, reproductive, and endocrine systems.

BIOL 3000 GENETICS (3) LEC. 3. Pr. (BIOL 1020 or BIOL 1023 or BIOL 1027). An overview of theoretical principles of transmission, cytological, molecular, and population genetics. Problem solving will be emphasized. May count either BIOL 3000 or BIOL 3003 or AGRI 3000.

BIOL 3001 GENERAL GENETICS LABORATORY (1) LAB. 2. Pr. (BIOL 1020 or BIOL 1023 or BIOL 1027) and (P/C BIOL 3000 or P/C BIOL 3003). Laboratory provides practical experience in the areas of transmission, cytological, molecular, and population genetics. Problem solving is emphasized though analysis of simulated and real genetics data sets.

BIOL 3010 COMPARATIVE ANATOMY (4) LEC. 3. LAB. 1. Pr. BIOL 1030 or BIOL 1037. We will examine evolution of anatomical structures from early chordates through vertebrates (both living and extinct). Students will learn the main vertebrate taxa and how each anatomical system appears in them. Students will also examine the linkage of these systems through all vertebrates. The phylogenetic tree (evolutionary relationships of the vertebrates) will be the backbone on which we explore the diversity of anatomy. In lab, students will use and develop their integrative skills by examining the anatomy of a wide variety of organisms.

BIOL 3011 COMPARATIVE ANATOMY LABORATORY (1) LAB. 1. Pr. P/C BIOL 1030 or BIOL 1037. Laboratory to accompany Comparative Anatomy Lecture. This lab course will explore the diverse morphologies of vertebrates.

BIOL 3020 GENOMIC BIOLOGY (4) LEC. 3. LAB. 2. Pr. BIOL 3000 or BIOL 3003 or AGRI 3000. An overview of genes, genomes, and genomic and proteomic approaches and methodology. Application of principles of biology at the genomic level. Includes an introduction to bioinformatic approaches to genomic problems in a computer laboratory setting.

BIOL 3030 EVOLUTION AND SYSTEMATICS (3) LEC. 3. Pr. BIOL 1030 or BIOL 1037. An introduction to evolutionary processes, classification, of organisms and scientific nomenclature.

BIOL 3040 BIOLOGY OF MARINE SYSTEMS (3) LEC. 3. Pr. (BIOL 1020 or BIOL 1023 or BIOL 1027) and (BIOL 1030 or BIOL 1037). Introduction to marine systems and biological investigations of coastal, near shore and open ocean organisms and processes.

BIOL 3060 ECOLOGY (4) LEC. 3. LAB. 3. Pr. (BIOL 1020 or BIOL 1023 or BIOL 1027) and (BIOL 1030 or BIOL 1037). Interactions of organisms with their environments and characteristics of populations, communities, and ecosystems. 8 hours of Biology.

BIOL 3075 INTRODUCTION TO OCEANOGRAPHY (4) LEC. 4. Pr. (MATH 1150 or MATH 1153) and (CHEM 1110 or CHEM 1117 or CHEM 1030 or CHEM 1033) and PHYS 1500. Departmental approval. The physics, chemistry, biology, and geology of the oceans. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 3100 PLANT BIOLOGY (4) LEC. 4. LAB. 1. Pr. (BIOL 1030 or BIOL 1037) and (CHEM 1010 or CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117). Introduction to the morphology, anatomy, physiology and classification of plants with laboratory.

BIOL 3200 GENERAL MICROBIOLOGY (3) LEC. 3. Pr. (BIOL 1020 or BIOL 1023 or BIOL 1027) and (CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117) and P/C BIOL 3201. Introduction to the science of microbiology, emphasizing cell structure, systematics, growth, genetics, and the role in human affairs.

BIOL 3201 GENERAL MICROBIOLOGY LABORATORY (1) LAB. 2. Pr. (BIOL 1020 or BIOL 1023 or BIOL 1027) and (CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117) and (P/C BIOL 3200 or P/C BIOL 3203 or P/C BIOL 3207). Fundamental laboratory techniques required to safely handle, enumerate, identify, and provide basic biochemical characterization of microorganisms.

BIOL 3207 HONORS GENERAL MICROBIOLOGY (3) LEC. 3. Pr. Honors College. CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117 and BIOL 3201. and BIOL 1020 or BIOL 1023 or BIOL 1027. Introduction to the science of microbiology, emphasizing cell structure, systematics, growth, genetics, and the role in human affairs.

BIOL 4000 HISTOLOGY (3) LEC. 3. Pr. (BIOL 1030 or BIOL 1037) and BIOL 1031 and (BIOL 2500 or BIOL 2507 or BIOL 2510 or BIOL 2517 or BIOL 3010 or BIOL 5240). Coreq. BIOL 4001. Morphology and classification of tissues; arrangement of tissues in organs and systems of vertebrate animals.

BIOL 4001 HISTOLOGY LABORATORY (1) LAB. 3. Pr. (BIOL 1030 or BIOL 1037). Coreq. BIOL 4000. Laboratory investigation of the morphology and classification of tissues using prepared slides to reveal the arrangement of tissues in organs and organ systems of vertebrate animals.

BIOL 4010 INVERTEBRATE BIODIVERSITY (4) LEC. 3. LAB. 3. Pr. BIOL 1030 or BIOL 1037. Survey of the phyla of invertebrates with emphasis on morphology, anatomy, ecology, evolution, and systematics.

BIOL 4015 BIOLOGY AND CONSERVATION OF MARINE TURTLES (2) LEC. 15. LAB. 45. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and BIOL 3040. OR permission of Marine Biology coordinator. An introductory overview of the biology of marine turtles. Topics include: identification, distribution, nesting & migratory behavior, feeding, population biology, development, paleontology and conservation. Extensive laboratory and field studies of multiple species of turtles. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4020 VERTEBRATE BIODIVERSITY (4) LEC. 3. LAB. 3. Pr. BIOL 1030 or BIOL 1037. Ecology and evolution of living vertebrates of the world.

BIOL 4025 ECOLOGY OF THE FLORIDA EVERGLADES (2) LEC. 15. LAB. 45. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and BIOL 3040. Examines the natural history, ecology and evolution, and human impact on the Everglades. Includes intensive lectures and a more than 1-week long campsite based field trip in the Everglades. Multiple short trips to various locales within the Everglades. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4035 INTRODUCTION TO MARINE ANIMAL NEUROBIOLOGY (3) LEC. 15. LAB. 60. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037. The neuroanatomy and neurophysiology of marine invertebrates and vertebrates. Lectures and labs on neurons, glia, resting and action potentials, synapses and neurotransmitters, muscle contraction, sensorimotor integration; neurophysiological bases of behavior; labs include computer simulation of cellular neurobiology. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4045 MARINE MAMMAL BIOLOGY (4) LEC. 30. LAB. 60. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and BIOL 3040. Introduction to the evolution, taxonomy and classification, anatomy, physiology, behavior, conservation and management issues of marine mammals, including cetaceans, pinnipeds, mustelids, sirenians and the polar bear. Lab and field research methods used to study marine mammals will be covered. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4065 MARINE CONSERVATION BIOLOGY (4) LEC. 45. LAB. 30. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and (BIOL 3040 or BIOL 3060). Study of major threats to marine biodiversity as and potential solutions to the threats. Students discuss current topics in marine conservation biology and critically debate marine conservation literature. Field trips to impacted and pristine sites will demonstrate principles. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4085 HURRICANES OF THE GULF OF MEXICO (2) LEC. 30. An introductory survey with emphasis on Gulf of Mexico hurricanes. Hurricane features. Basic principles of the atmosphere, review of Gulf, Atlantic and Caribbean hurricanes, El Nino, changes in the Atlantic circulation, hurricane formation, development, features, movement, steering and forecasting. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4095 COASTAL BIRDS OF ALABAMA (2) LEC. 15. LAB. 30. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and BIOL 3040. Behavior and ecology-oriented avian field biology. Identification, banding, record/broadcast, other survey methods. Emphasis on behavioral ecology. Extensive field effort along the Gulf Coast and in the Mobile/Alabama/Tombigbee/Tensaw River Delta, other riparian environments, and salt marshes. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4100 CELL BIOLOGY (3) LEC. 3. Pr. CHEM 2030 or (CHEM 2070 or CHEM 2077) and (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and (BIOL 1030 or BIOL 1037). Introduction to cellular structure and processes, including evolution, organization, physiology, molecular biology of cells, membranes, cytoplasm, and organelles as well as energy, transport, motility, cell division, signaling, transcription, and translation.

BIOL 4101 CELL BIOLOGY LABORATORY (2) LAB. 4. Pr. P/C BIOL 4100 or P/C BIOL 4103. Light/electron microscopy, cell structure, origins of life, centrifugation, protein/nucleic acid electrophoresis, and blotting, motility, DNA purification, chromatography, pH, fluorescence microscopy.

BIOL 4135 MARINE BEHAVIORAL ECOLOGY (4) LEC. 30. LAB. 60. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and BIOL 3040. Animal behavior in the context of the marine environment. Students study the ecological and evolutionary significance of behavior in a marine setting. Topics include principles of marine behavioral ecology, techniques for observing behavior, conducting behavior experiments, and data collection. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4150 HUMAN GENETICS (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003 or AGRI 3000 or FISH 3000 and BIOL 4100 and (CHEM 2080 or CHEM 2087). Study of the biological interaction of genes, effects of mutation and changes in gene frequency in human populations. Emphasis on molecular approach to study evolutionary changes in human gene pools.

BIOL 4410 VERTEBRATE DEVELOPMENT (5) LEC. 3. LAB. 4. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000. Morphogenesis and organogenesis of frog, chick, pig, and human from a descriptive and analytical viewpoint.

BIOL 4415 SHARK AND RAY BIOLOGY (2) LEC. 15. LAB. 45. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027 and BIOL 1030 or BIOL 1037 and BIOL 3040. An introduction to the biology of sharks and rays with special emphasis on regional shark fauna and field technique. Topics: chondrichthyan origin, systematics, sensory biology, trophic ecology, reproductive biology, life history, ecology, fisheries and conservation. Extensive lab and field work. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4445 SPECIAL PROBLEMS IN MARINE SCIENCE (1-6) AAB/LEC. Departmental approval. Individualized research-oriented experience. Taught at Gulf Coast Research Laboratory. Course may be repeated for a maximum of 6 credit hours.

BIOL 4455 MARINE INVERTEBRATE ZOOLOGY (6) LEC. 6. Departmental approval. Structure, classification, phyogenetics, larval development and functional processes of marine and estuarine invertebrates. Taught at Gulf Coast Research Laboratory.

BIOL 4475 MARINE ICHTHYOLOGY (6) LEC. 6. Departmental approval. Biology of the major piscine taxa in Mississippi Sound. Principles involved in classification and evolutionary relationships of these organisms. Taught at Gulf Coast Research Laboratory.

BIOL 4515 MARINE INVERTEBRATE ZOOLOGY (4) LEC. 4. Pr. At least 10 credits in BIOL 2000-8990. Departmental approval. The natural history, systematics, and morphology of marine invertebrates from the Gulf of Mexico; oriented toward a field and laboratory approach. Participation in extended field trips is part of the course. Taught at DISL.

BIOL 4525 DOLPHINS AND WHALES (2) LEC. 2. Pr. BIOL 1030 or BIOL 1037. Departmental approval. Classification, anatomy, and ecology of the cetaceans. Taught at DISL.

BIOL 4565 MARINE VERTEBRATE ZOOLOGY (4) LEC. 4. Pr. BIOL 1030 or BIOL 1037. Departmental approval. Systematics, zoogeography and ecology of marine fishes, reptiles, and mammals. Taught at DISL. May not be substituted for BIOL 4020.

BIOL 4575 MARINE ECOLOGY (4) LEC. 4. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027. Prerequisites: BIOL1020 or marine biology. Departmental approval. Experimental ecological theory and its application to interactions of marine organisms with each other and the environment. Includes laboratory, extensive field trip experience. Taught at DISL.

BIOL 4585 PLANKTON BIOLOGY (2) LEC. 15. LAB. 45. Pr. (BIOL 1020 and BIOL 1021 or BIOL 1023 or BIOL 1027) and (BIOL 1030 and BIOL 1031 or BIOL 1037). Students will learn about the biology of all forms of plankton and the methods for their study including optical, chemical and molecular techniques. Students will understand the basic methods of study and be able to sight-identify major groups. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 4700 PEDAGOGY OF PEER-LED INSTRUCTION (1) LEC. 1. Departmental approval. This is the pedagogical training course designed for students serving as peer instructors who are interested in effective instructional strategies in the STEM disciplines. This course helps peer instructors integrate educational theory, pedagogy, content, and practice. Course meetings will focus on practical concerns as well as associated theoretical models. This is a seminar course where students are responsible for weekly readings, in-class discussions, reflections and projects which are coordinated with students' practice.

BIOL 4920 INTERNSHIP IN BIOLOGY (1-4) INT. SU. Application of biology concepts and skills in a professional experience. 12 credit hours in 3000-level or higher BIOL courses. Departmental approval. Student must be enrolled in a major offered by the Department of Biological Sciences. Course may be repeated for a maximum of 4 credit hours.

BIOL 4950 SENIOR SEMINAR (1) LEC. 1. Oral presentation and discussion of recent scientific publications from a selected area of biological sciences. One hour is required for all majors. Course may be repeated for a maximum of 3 credit hours.

BIOL 4967 HONORS SPECIAL PROBLEMS (1-3) DSL/LEC. Pr. Honors College. Departmental approval and membership in the Honor College. Course may be repeated for a maximum of 3 credit hours.

BIOL 4970 SPECIAL TOPICS (1-4) AAB. Departmental approval. Instruction and discussion in a selected current topic in Biological Sciences. Course may be repeated for a maximum of 8 credit hours.

BIOL 4980 UNDERGRADUATE RESEARCH (2-4) AAB/IND. Directed research in an area of specialty within the department. Course may be repeated for a maximum of 6 credit hours.

BIOL 4997 HONORS THESIS (1-3) IND. Pr. Honors College. Undergraduate research and thesis. Course may be repeated for a maximum of 3 credit hours.

BIOL 4AA0 PROFESSIONAL DEVELOPMENT II (0) PRA. SU. Students enrolled in this course will complete the ePortfolio that they began developing as Freshmen, in BIOL 2100 - Professional Development I. Successfully designing and completing a professional ePortfolio will provide students with: 1. An opportunity to create a unified, polished and coherent educational and professional history of themselves. 2. A platform to organize their thinking about skills and experiences and the opportunity to connect them to the next step in career development. 3. A place to collect, present and reflect on evidence of professional development and growth during the undergraduate experience.

BIOL 5000 HUMAN CARDIOVASCULAR PHYSIOLOGY (4) LEC. 3. LAB. 2. Pr. BIOL 2510 or BIOL 5240 or BIOL 5600. An in-depth exploration of molecular events and mechanisms governing heart and vascular function in health and disease. Laboratory will provide hands-on experiences with ECG, local blood flow, and case study examples.

BIOL 5020 EMBRYONIC DEVELOPMENT (3) LEC. 3. Pr. (BIOL 4100 or BIOL 4103). This course is designed to teach students the evolution of the molecular mechanisms used by developing embryos to form the adult body plan with a focus on the vertebrate model systems used to understand human developmental biology. In addition, the course will expose students to current research on these processes and the techniques used to carry out these studies.

BIOL 5050 FUNDAMENTALS OF BIOPHYSICS (2) LEC. 2. Pr. PHYS 1510 or BIOL 4100. Introduction to use of theories and methods of physics in biology, illustrated by discussion of organism size, metabolism, physiology, vision, hearing, cell cellular and molecular processesern medicine, physiology and molecular biology.

BIOL 5090 CONSERVATION BIOLOGY (3) LEC. 3. Pr. BIOL 3060. This course is an overview of ethical, economic and biological aspects of conservation biology at scales ranging from local to global. Credit will not be given for both BIOL 5090 and BIOL 6090.

BIOL 5110 PARASITOLOGY (4) LEC. 3. LAB. 3. Pr. BIOL 1030 or BIOL 1037 or BIOL 2500 or BIOL 2503. Students must have Junior or Senior standing. Development, identification, host-parasite relationships, and medical significance of parasitic protozoa, helminthes, and arthropods that infect humans, domestic animals and wildlife. May count either BIOL 5110 or LABT 4050.

BIOL 5120 SYSTEMATIC BOTANY (4) LEC. 3. LAB. 3. Pr. (BIOL 1030 or BIOL 1037). Classification, nomenclature, distribution, systematics, and evolution of vascular plants.

BIOL 5130 ADVANCED PLANT PHYSIOLOGY (3) LEC. 3. Pr. BIOL 3100 and (CHEM 2030 or CHEM 2080 or CHEM 2087). Physiological and biochemical processes affecting plant growth and development including water relations, photosynthesis, respiration, and hormones.

BIOL 5131 ADVANCED PLANT PHYSIOLOGY LABORATORY (1) LAB. 3. Pr. BIOL 3100 and (CHEM 2081 or BIOL 5130). Laboratory exercises in plant physiology. Including water relations, metabolism and growth, and development.

BIOL 5140 PLANT ECOLOGY (4) LEC. 3. LAB. 4. Pr. (BIOL 1030 or BIOL 1037) and BIOL 3060. Exploration of ecological interactions between plants and their environment. Field trips emphasize Southeastern habitats/plant examples. Includes 3-day weekend field trip.

BIOL 5150 POPULATION AND COMMUNITY ECOLOGY (3) LEC. 3. Pr. BIOL 3060. Quantitative study of natural population and ecological communities. Selected topics include density-dependent population growth, life-history theory, mark-recapture analysis, eco-evolutionary dynamics, and species interactions especially how they relate to questions of species distributions in time and space.

BIOL 5160 FIELD BIOLOGY AND ECOLOGY (3-15) LEC. 3. Prereq. 15 hours of biology. Intensive classroom and field studies of an area outside Alabama. Course may be repeated for a maximum of 15 credit hours.

BIOL 5190 CELL AND MOLECULAR SIGNAL TRANSDUCTION (3) LEC. 3. Pr. BIOL 4100 and BIOL 5220. Study of cellular communication and regulation with emphasis on integration between cellular, molecular, genetic, and biochemical approaches.

BIOL 5200 CLINICAL MICROBIOLOGY (5) LEC. 3. LAB. 4. Pr. (BIOL 3200 or BIOL 3203 or BIOL 3207) and BIOL 3201. Isolation, cultivation, identification, classification and pathogenesis of infectious agents with emphasis on bacteria; includes clinical materials, Eubacteria, Mycoplasmata, Rickettsiae and Spirochetes. May count either BIOL 5200 or BIOL 6200.

BIOL 5210 MICROBIAL PHYSIOLOGY (3) LEC. 3. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201 and (CHEM 2030 or CHEM 2080 or CHEM 2087). General physiology of microbial cells emphasizing fermentation, respiration, photosynthesis, nitrogen fixation, cell wall synthesis, membranes, and macromolecular synthesis.

BIOL 5220 INTRODUCTORY MOLECULAR GENETICS (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and (BIOL 3200 or BIOL 3203) and BIOL 3201. Principles of gene expression including replication, transcription, and translation; structure and regulation of genes; concepts and techniques in recombinant DNA.

BIOL 5230 VIROLOGY (3) LEC. 3. Pr. (P/C BIOL 5220 or P/C BIOL 6220) or (P/C BIOL 5260 or P/C BIOL 6260). Biology of viruses, including structure, entry, replication, assembly and release, pathogenesis, and epidemiology of viral infections. May count BIOL 5230 or BIOL 6230.

BIOL 5240 ANIMAL PHYSIOLOGY (4) LEC. 3. LAB. 3. Pr. BIOL 4100 or (CHEM 2030 or CHEM 2070 or CHEM 2077). General overview of the function of the major systems in animals, including evolution and adaptation to specific environments.

BIOL 5250 MICROBIAL EVOLUTION AND DIVERSITY (4) LEC. 3. LAB. 2. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000 and (BIOL 3200 or BIOL 3203) and BIOL 3201. Introduction to microbial evolutionary history and theory, and survey of microbial diversity. Credit will not be given for both BIOL 5250 and BIOL 6250.

BIOL 5260 PROKARYOTIC MOLECULAR GENETICS (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000 and (BIOL 3200 or BIOL 3203) and BIOL 3201. Molecular principles of bacterial genetics including gene structure, genetic organization, regulation of gene expression, acquisition and loss of genes leading to microbial evolution. Credit will not be given for both BIOL 5260 and BIOL 6260.

BIOL 5270 HOST-MICROBE INTERACTIONS (3) LEC. 3. Pr. (BIOL 3200 or BIOL 3203) and (BIOL 3201) and (BIOL 5220 or BIOL 5260). This course will explore interactions between microbes and their hosts including plants, insects and animals. Credit will not be given for both BIOL 5270 and 6270.

BIOL 5280 GENETHICS (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000. Twenty-first century biotechnology and related ethical issues, including human cloning, stem cells, neuroenhancement, age retardation, genetic enhancement, and nanobiology. May count BIOL 5280 or 6280.

BIOL 5290 CASE STUDIES IN INFECTION AND IMMUNITY (3) LEC. 3. Pr. BIOL 5500. This course is designed to enrich student understanding of infection and immunity in the context of clinical presentations. Students will learn to use deductive reasoning to narrow down potential causes of symptoms and then use scientific literature to gain a detailed understanding of the mechanisms underlying disease. Cases covered will include infectious disease, immunodeficiency, neoplasms and/or autoimmunity.

BIOL 5300 PLANT ANATOMY AND DEVELOPMENT (4) LEC. 3. LAB. 4. Pr. BIOL 3100. Investigation of the various levels of plant organization from subcellular to organ through use of light and scanning electron microscopes.

BIOL 5320 PLANT GENE EXPRESSION (3) LEC. 3. Pr. BIOL 3100. Departmental approval. Genetic expression of genetic elements in plants from the recent literature.

BIOL 5330 DEVELOPMENTAL GENETICS (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003 or AGRI 3000 or FISH 3000. Study of the genetics and genetic mechanisms behind developmental processes occurring in a range of species. May count either BIOL 5330 or BIOL 6330.

BIOL 5340 PROTOZOOLOGY (4) LEC. 3. LAB. 3. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000. Life history, identification, cell biology, and evolution of free-living and parasitic protozoa of the major groups. Laboratory includes techniques for microscopy.

BIOL 5350 BEHAVIORAL ECOLOGY (3) LEC. 3. Pr. (BIOL 3030 or BIOL 3033) and BIOL 3060. Evolution of behaviors via natural, sexual, and kin selections; evolutionary influences on social groups, mating systems, cooperative breeding, and other interactions.

BIOL 5370 MOLECULAR ECOLOGY (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and BIOL 3060. General overview of the concepts and techniques regarding the application of molecular variation in answering questions pertaining to populations and communities of organisms. Credit will not be given for both BIOL 5370 and BIOL 6370.

BIOL 5380 GENERAL ICHTHYOLOGY (4) LEC. 3. LAB. 4. Pr. BIOL 1030 or BIOL 1037. Survey of the biodiversity of world and local fishes with an overview of ecology, behavior, biology, and conservation of fishes.

BIOL 5425 MARINE BOTANY (4) LEC. 4. Pr. BIOL 1020 or BIOL 1023 or BIOL 1027. Departmental approval. Pr. BIOL 1020 or equiv. Survey of microscopic and macroscopic algae, salt marsh vegetation, sea grasses, mangroves and maritime forests with regard to identification, distribution, structure, ecology and physiology. Field trips and laboratory work. Taught at DISL.

BIOL 5440 CLIMATE CHANGE PHYSIOLOGY AND EVOLUTION (3) LEC. 3. LAB. 0. This class investigates on the basic mechanisms of climate change and its impact on living organisms, focusing on their physiological, evolutionary, behavioral and molecular responses. Special interest is given to plants and marine organisms.

BIOL 5500 IMMUNOLOGY (3) LEC. 3. Pr. (BIOL 3200 or BIOL 3203 or BIOL 3207) and BIOL 3201 and (BIOL 3000 or BIOL 3003 or BIOL 3020). The cellular and molecular basis of the immune response, including antigen presentation, immunogenetics, effector mechanisms, and medical immunology. May count either BIOL 3500 or BIOL 5500.

BIOL 5501 IMMUNOLOGY LAB (2) LAB. 2. Pr. P/C BIOL 5500 or P/C BIOL 3500. Techniques illustrating principles of antigen-antibody interactions and their application in immunoassays, identification of leukocytes, cellular interactions, and antibody production.

BIOL 5521 GENE EXPRESSION AND RECOMBINANT DNA LABORATORY (2) LEC. 2. LAB. 4. Pr. P/C BIOL 5220 or P/C BIOL 5260. Laboratory experiences demonstrating concepts and techniques in recombinant DNA.

BIOL 5550 NANOMEDICINE (2) LEC. 2. Pr. PHYS 1510 and CHEM 2080 and BCHE 5180. Nanomedicine is a branch of medicine that applies the knowledge and tools of nanotechnology to the prevention and treatment of disease. It involves the use of nanoscale materials, such as biocompatible nanoparticles, nanorobots and nanosensors, for diagnosis, drug delivery, and sensing in living organisms.

BIOL 5560 RNA IN BIOMEDICINE (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003. This course introduces the basic and novel types and functions of RNAs, as well as the integration of these molecules in biomedical contexts. Students will learn about the ‘RNA World’ theory, the diverse roles of RNA in cellular processes, and pathogenesis. Technological approaches to RNA research will be covered, as well as the application of this research to the diagnosis and therapy of genetic diseases.

BIOL 5600 MAMMALIAN PHYSIOLOGY (BIOMEDICAL PHYSIOLOGY) (5) LEC. 4.25. LAB. 2.75. Pr. (BIOL 1030 or BIOL 1037) or (BIOL 2500 or BIOL 2503) and BIOL 2501 and (CHEM 2030 or CHEM 2070 or CHEM 2077). An in-depth investigation of the physiology of the major mammalian organ systems.

BIOL 5650 ANIMAL BEHAVIOR (3) LEC. 3. Pr. (BIOL 1030 or BIOL 1037) and BIOL 3060. Animal behaviors, analysis of their adaptive value, development, and evolution.

BIOL 5660 FOOD MICROBIOLOGY (4) LEC. 3. LAB. 3. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201. Introduction to basic and applied microbiology in food, including how bacteria, viruses, parasites, yeasts and mold affect and in turn are affected by foods both positively and negatively. May count either FDSC 5660, BIOL 5660, FDSC 6600, or BIOL 6600.

BIOL 5700 APPLIED AND ENVIRONMENTAL MICROBIOLOGY (4) LEC. 3. LAB. 2. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201. Introduction to the ecology, systematics, interrelationships, and role of micro-organisms in geochemical cycles, bioremediation and pharmaceutical production.

BIOL 5740 HERPETOLOGY (4) LEC. 3. LAB. 3. Ecology and evolution of living amphibians and reptiles of the world.

BIOL 5750 ORNITHOLOGY (4) LEC. 3. LAB. 3. Pr. (BIOL 3030 or BIOL 3033) and BIOL 3060. Taxonomy, evolution, ecology, and behavior of birds.

BIOL 5760 MAMMALOGY (4) LEC. 3. LAB. 3. Characteristics, origins, ecology, behavior, reproduction, physiology, and diversity of mammals. Labs include survey or current literature, field trips, data analysis, and report preparation.

BIOL 5800 INTRODUCTION TO COMPUTATIONAL BIOLOGY (3) LEC. 2. LAB. 1. Pr. STAT 2510 or STAT 2513. Overview of computational approaches to biological data analysis. Additionally, students will learn basic statistical and graphical analysis. May count either BIOL 5800 or BIOL 6800.

BIOL 5850 FUNCTIONAL GENOMICS (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or BIOL 3020 or FISH 3000 or AGRI 3000) and BIOL 4100 and BIOL 5800. An active-learning course to study the functional aspects of the genome emphasizing gene regulation and functional genetic variation. May count either BIOL 5850 or BIOL 6850.

BIOL 5860 BIOINFORMATICS AND GENOME ANALYSIS (3) LEC. 2. LAB. 1. Pr. (BIOL 3000 or BIOL 3003 or BIOL 3020 or FISH 3000 or AGRI 3000) and BIOL 5800. Overview of informatic approaches to biological data analysis. Students will use the scientific method to investigate key questions in model organisms through emerging 'omics fields. May count either BIOL 5860 or BIOL 6860.

BIOL 6020 EMBRYONIC DEVELOPMENT (3) LEC. 3. Pr. BIOL 4100 or BIOL 4103. Consideration of induction, constancy of the genome, pathfinding by migrating cells, morphogenetic movements, and other developmental processes.

BIOL 6050 FUNDAMENTALS OF BIOPHYSICS (2) LEC. 2. Pr. PHYS 1510 or BIOL 4100. Introduction to use of theories and methods of physics in biology, illustrated by discussion of organism size, metabolism, physiology, vision, hearing, cell cellular and molecular processesern medicine, physiology and molecular biology.

BIOL 6090 CONSERVATION BIOLOGY (3) LEC. 3. Pr. BIOL 3060. This course is an overview of ethical, economic and biological aspects of conservation biology at scales ranging from local to global. Credit will not be given for both BIOL 5090 and BIOL 6090.

BIOL 6110 PARASITOLOGY (4) LEC. 3. LAB. 3. Pr. (BIOL 1030 or BIOL 1037) or (BIOL 2500 or BIOL 2503) and BIOL 2501. Development, identification, host-parasite relationships, and medical significance of parasitic protozoa, helminthes, and arthropods that infect humans, domestic animals, and wildlife.

BIOL 6120 SYSTEMATIC BOTANY (4) LEC. 3. LAB. 3. Pr. (BIOL 1030 or BIOL 1037). Classification, nomenclature, distribution, systematics, and evolution of vascular plants.

BIOL 6130 ADVANCED PLANT PHYSIOLOGY (3) LEC. 3. Pr. BIOL 3100 and (CHEM 2030 or CHEM 2080 or CHEM 2087). Physiological and biochemical processes affecting plant growth and development including water relations, photosynthesis, respiration, and hormones.

BIOL 6131 ADV PLANT PHYSIOLOGY LAB (1) LAB. 3. Pr. BIOL 3100 and (CHEM 2081 or CHEM 2088). Laboratory exercises in plant physiology. Including water relations, metabolism, and growth and development.

BIOL 6140 PLANT ECOLOGY (4) LEC. 3. LAB. 4. Pr. (BIOL 1030 or BIOL 1037) and BIOL 3060. Departmental approval. Exploration of ecological interactions between plants and their environment. Field trips emphasize Southeastern habitats/plant examples. Includes 3-day weekend field trip.

BIOL 6150 POPULATION AND COMMUNITY ECOLOGY (3) LEC. 3. Pr. BIOL 3060. Quantitative study of natural population and ecological communities. Selected topics include density-dependent population growth, life-history theory, mark-recapture analysis, eco-evolutionary dynamics, and species interactions especially how they relate to questions of species distributions in time and space.

BIOL 6190 CELL AND MOLECULAR SIGNAL TRANSDUCTION (3) LEC. 3. Pr. BIOL 4100 and BIOL 5220 and (CHEM 2080 or CHEM 2087). Study of cellular communication and regulation with emphasis on integration between cellular, molecular, genetic, and biochemical approaches.

BIOL 6200 CLINICAL MICROBIOLOGY (5) LEC. 3. LAB. 4. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201. Isolation, cultivation, identification, classification and pathogenesis of infectious agents with emphasis on bacteria; includes clinical materials, Eubacteria, Mycoplasmata, Rickettsiae and Spirochetes. May count either BIOL 5200 or BIOL 6200.

BIOL 6210 MICROBIAL PHYSIOLOGY (3) LEC. 3. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201 and (CHEM 2030 or CHEM 2080 or CHEM 2087). General physiology of microbial cells emphasizing fermentation, respiration, photosynthesis, nitrogen fixation, cell wall synthesis, membranes, and macromolecular synthesis.

BIOL 6220 INTRODUCTORY MOLECULAR GENETICS (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or AGRI 3000) and (BIOL 3200 or BIOL 3203) and BIOL 3201. Advanced principles of gene expression including replication, transcription and translation; structure and regulation of genes; detailed concepts and techniques in recombinant DNA. Credit will not be given for both BIOL 6220 and CMBL 6220.

BIOL 6230 VIROLOGY (3) LEC. 3. Pr. (P/C BIOL 5220 or P/C BIOL 6220) or (P/C BIOL 5260 or P/C BIOL 6260). Biology of viruses, including structure, entry, replication, assembly and release, pathogenesis, and epidemiology of viral infections. May count BIOL 5230 or BIOL 6230.

BIOL 6240 ANIMAL PHYSIOLOGY (4) LEC. 3. LAB. 3. Pr. BIOL 4100 or CHEM 2030 or CHEM 2070 or CHEM 2077. General overview of the function of the major systems in animals, including evolution and adaptation to specific environments.

BIOL 6250 MICROBIAL EVOLUTION AND DIVERSITY (4) LEC. 3. LAB. 2. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and (BIOL 3200 or BIOL 3203) and BIOL 3201. Introduction to microbial evolutionary history and theory, and survey of microbial diversity. Credit will not be given for both BIOL 5250 and BIOL 6250.

BIOL 6260 PROKARYOTIC MOLECULAR GENETICS (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and (BIOL 3200 or BIOL 3203) and BIOL 3201. Molecular principles of bacterial genetics including gene structure, genetic organization, regulation of gene expression, acquisition and loss of genes leading to microbial evolution. Course will not be given for both BIOL 5260 and BIOL 6260.

BIOL 6270 HOST-MICROBE INTERACTIONS (3) LEC. 3. Pr. (BIOL 3200 or BIOL 3203) and (BIOL 3201) and (BIOL 5200 or BIOL 5260). This course will explore interactions between microbes and their hosts including plants, insects and animals. Credit will not be given for both BIOL 5270 and BIOL 6270.

BIOL 6290 CASE STUDIES IN INFECTION AND IMMUNITY (3) LEC. 3. Pr. BIOL 6500. This course is designed to enrich student understanding of infection and immunity in the context of clinical presentations. Students will learn to use deductive reasoning to narrow down potential causes of symptoms and then use scientific literature to gain a detailed understanding of the mechanisms underlying disease. Cases covered will include infectious disease, immunodeficiency, neoplasms and/or autoimmunity.

BIOL 6300 PLANT ANATOMY AND DEVELOPMENT (4) LEC. 2. LAB. 4. Pr. BIOL 6130. The study of the structure and ontogeny of plant cells, tissues, and organs. Fall.

BIOL 6320 PLANT GENE EXPRESSION (3) LEC. 3. Departmental approval. Genetic expression of genetic elements in plants from the recent literature. Credit will not be given for both BIOL 6320 and CMBL 6320.

BIOL 6330 DEVELOPMENTAL GENETICS (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000. Study of the genetics and genetic mechanisms behind developmental processes occurring in a range of species. May count either BIOL 6330 or BIOL 5330.

BIOL 6340 PROTOZOOLOGY (4) LEC. 3. LAB. 3. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000. Life history, identification, cell biology, and evolution of free-living and parasitic protozoa of the major groups. Laboratory includes techniques for microscopy.

BIOL 6350 BEHAVIORAL ECOLOGY (3) LEC. 3. Pr. (BIOL 3030 or BIOL 3033) and BIOL 3060. Evolution of behaviors via natural, sexual, and kin selections; evolutionary influences on social groups, mating systems, cooperative breeding, and other interactions.

BIOL 6370 MOLECULAR ECOLOGY (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and BIOL 3060 and BIOL 6800. General overview of the concepts and techniques regarding the application of molecular variation in answering questions pertaining to populations and communities of organisms. Credit will not be given for both BIOL 5370 and BIOL 6370.

BIOL 6380 GENERAL ICHTHYOLOGY (4) LEC. 3. LAB. 4. Pr. BIOL 1030 or BIOL 1037. Survey of the biodiversity of world and local fishes with an overview of ecology, behavior, biology, and conservation of fishes.

BIOL 6440 CLIMATE CHANGE PHYSIOLOGY AND EVOLUTION (3) LEC. 3. LAB. 0. Pr. BIOL 1030. This class investigates on the basic mechanisms of climate change and its impact on living organisms, focusing on their physiological, evolutionary, behavioral and molecular responses. Special interest is given to plants and marine organisms.

BIOL 6500 IMMUNOLOGY (3) LEC. 3. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201 and (BIOL 3000 or BIOL 3003 or FISH 3000 or BIOL 3020) and P/C BIOL 6501. The cellular and molecular basis of the immune response, including antigen presentation, immunogenetics, effector mechanisms, and medical immunology.

BIOL 6501 IMMUNOLOGY LABORATORY (2) LAB. 4. Pr. P/C BIOL 5500 or P/C BIOL 6500. Techniques illustrating principles of antigen-antibody interactions and their application in immunoassays, identification of leukocytes, cellular interactions, and antibody production.

BIOL 6521 GENE EXPRESSION AND RECOMBINANT DNA LABORATORY (2) LEC. 2. LAB. 4. Pr. P/C BIOL 5220 or BIOL 6220 or BIOL 5260 or BIOL 6260. Laboratory experiences demonstrating concepts and techniques in recombinant DNA.

BIOL 6525 MARINE BEHAVIORAL ECOLOGY (4) LEC. 3. LAB. 3. Study of animal behavior and the influence by and interaction with the environment and the ecological and evolutionary significance of these behaviors. Vertebrate and Invertebrate Zoology required. Taught at DISL.

BIOL 6550 NANOMEDICINE (2) LEC. 2. Pr. PHYS 1510 and CHEM 2080 and BCHE 5180. Nanomedicine is a branch of medicine that applies the knowledge and tools of nanotechnology to the prevention and treatment of disease. It involves the use of nanoscale materials, such as biocompatible nanoparticles, nanorobots and nanosensors, for diagnosis, drug delivery, and sensing in living organisms.

BIOL 6560 RNA IN BIOMEDICINE (3) LEC. 3. This course introduces the basic and novel types and functions of RNAs, as well as the integration of these molecules in biomedical contexts. Students will learn about the ‘RNA World’ theory, the diverse roles of RNA in cellular processes, and pathogenesis. Technological approaches to RNA research will be covered, as well as the application of this research to the diagnosis and therapy of genetic diseases.

BIOL 6600 MAMMALIAN PHYSIOLOGY (BIOMEDICAL PHYSIOLOGY) (5) LEC. 4.25. LAB. 2.75. Pr. (BIOL 1030 or BIOL 1037) or (BIOL 2500 or BIOL 2503) and BIOL 2501 and (CHEM 2030 or CHEM 2070 or CHEM 2077). An in-depth investigation of the physiology of the major mammalian organ systems.

BIOL 6650 ANIMAL BEHAVIOR (3) LEC. 3. Pr. (BIOL 1030 or BIOL 1037) and BIOL 3060. Animal behaviors, analysis of their adaptive value, development, and evolution.

BIOL 6660 FOOD MICROBIOLOGY (4) LEC. 3. LAB. 3. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201. Introduction to basic and applied microbiology in food, including how bacteria, viruses, parasites, yeasts and mold affect and in turn are affected by foods both positively and negatively. May count either FDSC 5660, BIOL 5660, FDSC 6600, or BIOL 6600.

BIOL 6700 APPLIED AND ENVIRONMENTAL MICROBIOLOGY (4) LEC. 3. LAB. 2. Pr. (BIOL 3200 or BIOL 3203) and BIOL 3201. An advanced treatment of bacteria comprising the Kingdom Prokaryotae, emphasizing ecology, systematics, interrelationships, geochemical cycles, and bioremediation.

BIOL 6740 HERPETOLOGY (4) LEC. 3. LAB. 3. Ecology and evolution of living amphibians and reptiles of the world.

BIOL 6750 ORNITHOLOGY (4) LEC. 3. LAB. 3. Pr. (BIOL 3030 or BIOL 3033) and BIOL 3060. Departmental approval. An intensive investigation of the current literature and relevant research dealing with birds.

BIOL 6760 MAMMALOGY (4) LEC. 3. LAB. 3. Characteristics, origins, ecology, behavior, reproduction, physiology, and diversity of mammals. Labs include survey or current literature, fieldtrips, data analysis and report preparation.

BIOL 6800 INTRODUCTION TO COMPUTATIONAL BIOLOGY (3) LEC. 2. LAB. 1. Pr. STAT 2510 or STAT 2513. Overview of computational approaches to the analysis of biological data. Students will learn basic statistical and graphical analysis. May count either BIOL 5800 or BIOL 6800.

BIOL 6850 FUNCTIONAL GENOMICS (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or BIOL 3020 or FISH 3000 or AGRI 3000) and BIOL 4100 and BIOL 5800. Active-learning course to study the functional aspects of the genome emphasizing gene regulation and functional genetic variation. May count either BIOL 5850 or BIOL 6850.

BIOL 6860 BIOINFORMATICS AND GENOME ANALYSIS (3) LEC. 2. LAB. 1. Pr. (BIOL 3000 or BIOL 3003 or BIOL 3020 or FISH 3000 or AGRI 3000) and BIOL 5800. Overview of informatic approaches to biological data analysis. Students will use the scientific method to investigate key questions in model organisms through emerging 'omics fields. May count either BIOL 5860 or BIOL 6860.

BIOL 7035 MARINE ANIMAL NEUROBIOLOGY (4) LEC. 30. LAB. 60. Pr. BIOL 1020 or BIOL 1023 and BIOL 1021 and BIOL 1030 and BIOL 1031 and BIOL 4100. Biophysical neurobiology of marine invertebrates and vertebrates. Lectures and labs on neurons, glia, resting and action potentials, synapses, neurotransmitters, muscle contraction, sensorimotor integration, computer simulation and extensive technical methods: extra-, intracellular, patch recording, molecular neuroimmunology, confocal fluorescence microscopy. Evening/Saturday classes.

BIOL 7075 INTRODUCTION TO OCEANOGRAPHY (4) LEC. 30. LAB. 60. Pr. MATH 1150 or MATH 1153 and CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117 and PHYS 1500 and BIOL 3040. An in-depth examination of the physics, chemistry, geology and biology of the oceans. Lectures cover the interrelationships of these components to each other. Field and lab work will introduce students to research on oceanographic processes of the Gulf of Mexico. Taught only at Dauphin Island Sea Lab (DISL).

BIOL 7170 POPULATION GENETICS (3) LEC. 3. Pr. BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000. Examination of the theories relating to maintenance of variation in natural populations of plants and animals.

BIOL 7180 SCRIPTING FOR BIOLOGISTS (3) LEC. 2. LAB. 1. Pr. BIOL 6800 and STAT 7000. or Instructor approval. A hands-on course to teach students concepts, applications, and best practices of utilizing computer scripting languages in the life sciences.

BIOL 7200 EVOLUTIONARY BIOLOGY (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and (BIOL 3200 or BIOL 3203) and BIOL 3201. Topics of current interest in evolution. Readings and presentation required.

BIOL 7210 EVOLUTIONARY ECOLOGY (3) LEC. 3. The Evolutionary Ecology research paradigm is a key approach to the study of behavioral, evolutionary, and ecological processes in the context of realistic or natural environmental settings. We will investigate a number of current "hot" research topics in Evolutionary Ecology, discuss the leading hypotheses being developed and how they are cast as statistica.

BIOL 7250 PRACTICAL DATA ANALYSIS AND COMPUTATION FOR THE LIFE SCIENCES (3) LEC. 2. LAB. 3. Pr. STAT 7020 or WILD 7150. or equivalent; or permission of the instructor. Data from the life sciences and advanced statistical techniques for data analyses and computation are brought together through a cross-fertilization of graduate student students in the life sciences, statistics, and mathematics. Focus on production of publication-quality research on student-identified projects. May count either BIOL 7250 or STAT 7250.

BIOL 7290 EVOLUTIONARY GENETICS (3) LEC. 3. Pr. (BIOL 3000 or BIOL 3003 or FISH 3000 or AGRI 3000) and BIOL 6170. Departmental approval. The role of population processes as mechanisms for evolution; and evolution at the molecular level. Credit will not be given for both BIOL 7290 and CMBL 7290.

BIOL 7440 ADVANCED CELL BIOLOGY (3) LEC. 3. Pr. BIOL 4100. Examination of current areas of research in cell and developmental biology by directed reading and discussion. Credit will not be given for both BIOL 7440 and CMBL 7440.

BIOL 7470 GENOME EVOLUTION (3) LEC. 3. Provides a broad evolutionary perspective on the origin, composition, and architecture of eukaryotic genomes. Students will participate in a literature-driven discussion format and will complete weekly writing assignments.

BIOL 7485 ADVANCED MARINE ECOLOGY (4) LEC. 2. LAB. 2. Pr. (BIOL 1020 or BIOL 1023) and BIOL 1021 and BIOL 1030 and BIOL 1031 and (BIOL 3060 or BIOL 3040). An advanced course open only to MS or PhD students. Interactions between marine organisms and the environment. In-depth discussion of ecological theory with emphasis on the latest research, using extensive reference to the literature. Lecture, lab and overnight field trips.

BIOL 7490 PHYSIOLOGICAL ECOLOGY (3) LEC. 3. Pr. BIOL 3060. A study of the physiological adaptations that allow animals to survive in unusual environments. A course in ecology required.

BIOL 7500 STRESS PHYSIOLOGY (2) LEC. 2. Pr. (BIOL 4100 or BIOL 5240 or BIOL 5600). This course is a discussion-based course focusing on physiological stress responses at various levels of organization and communication among them, from molecules, cells, organ, to whole organism.

BIOL 7510 NATURAL HISTORY MUSEUM PRACTICUM (1) LAB. 3. Practical methods in natural history museum curation. Students will assist in curating collections at the Auburn University Museum of Natural History. Course may be repeated for a maximum of 4 credit hours.

BIOL 7525 MARINE INVERTEBRATES (4) LEC. 2. LAB. 2. Morphology, natural history, physiology, evolution and ecology. Students examine modern literature and develop an advanced presentation on invertebrate biology involving problem solving in an area such as sensory biology, molecular evolution or management. Term paper, classroom presentation and lecture.

BIOL 7540 PROFESSIONAL ASPECTS OF BIOLOGY (3) LEC. 3. Departmental approval. Instruction on practical aspects of a career in biological sciences.

BIOL 7550 PHYSIOLOGICAL ECOLOGY OF REPRODUCTION (3) LEC. 3. This course focuses on physiological ecology of reproduction by identifying key physiological mechanisms linking the environmental change, reproductive constraints, and reproductive performance and describing how variation in reproductive performance are impacted by ecological and evolutionary processes.

BIOL 7800 COMPUTATIONAL BIOLOGY COLLOQUIUM (2) LEC. 0. LAB. 0, LEC. 0. Pr. (BIOL 7180). Oral presentations and discussions of recent scientific publications, challenges, and opportunities within the field of computational biology. Hands-on experience in data analysis and presentation.

BIOL 7880 MITONUCLEAR ECOLOGY (2) LEC. 2. Pr. BIOL 3030. This course will explore the implications of the necessity of mitonuclear coadaptation for the evolution of quintessential eukaryotic characteristics, including sex and two sexes, a sequestered germ line, senescence, discrete species, mate choice, and adaptation. Permission of instructor may be needed.

BIOL 7950 MASTERS THESIS SEMINAR (1) LEC. 1. SU. Departmental approval. Oral presentation and discussion of research in the field of specialization. Course may be repeated for a maximum of 2 credit hours.

BIOL 7960 SPECIAL PROBLEMS (1-4) DSL/LEC. Pr. P/C BIOL 6220. Oral presentation and discussion of recent scientific publications from a selected area molecular biology. Credit will not be given for both BIOL 7960 and CMBL 7960. Course may be repeated for a maximum of 4 credit hours.

BIOL 7970 SPECIAL TOPICS (1-4) AAB. Departmental approval. Instruction and discussion in a selected current topic in botany, microbiology, molecular biology, or zoology. A different topic for advanced study will be selected each semester this course is offered. Course may be repeated for a maximum of 8 credit hours.

BIOL 7990 RESEARCH AND THESIS (1-10) MST. Course may be repeated with change in topic.

BIOL 8950 DOCTORAL SEMINAR (1) SEM. 1. SU. Oral presentation and discussion of research in the field of specialization. Course may be repeated for a maximum of 3 credit hours.

BIOL 8990 RESEARCH AND DISSERTATION (1-10) DSR. Course may be repeated with change in topic.

Chemistry Courses

CHEM 1010 SURVEY OF CHEMISTRY I (3) LEC. 3. Science Core. Survey of important topics from general and organic chemistry. Atomic and bonding theory, chemical reactions and stoichiometry, gas laws, solutions, acids and bases, hydrocarbons, alcohols, ethers and amines.

CHEM 1011 SURVEY OF CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 1010. Science Core. Laboratory experiments emphasizing course material in CHEM 1010.

CHEM 1020 SURVEY OF CHEMISTRY II (3) LEC. 3. Pr. CHEM 1010. Science Core. Survey of important topics from organic and biochemistry. Aldehydes and ketones, carboxylic acids, carbohydrates, lipids, proteins, enzymes, extracellular fluids, metabolism, nucleic acids, radioactivity.

CHEM 1021 SURVEY OF CHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 1020 and CHEM 1011. Science Core. Laboratory experiments emphasizing course material in CHEM 1020.

CHEM 1030 FUNDAMENTALS CHEMISTRY I (3) DSL/LEC. Science Core. Atomic and molecular theory, chemical equations, stoichiometry, gas laws, thermochemistry, bonding, electronic structure, molecular geometries, solids, liquids, properties of solutions, problem-solving techniques. Credit will not be given for both CHEM 1030 and CHEM 1110 or CHEM 1117.

CHEM 1031 FUNDAMENTAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 1030 or P/C CHEM 1033. Science Core. Laboratory experiments emphasizing course material in CHEM 1030. Credit will not be given for both CHEM 1031 and CHEM 1111 or CHEM 1118.

CHEM 1040 FUNDAMENTAL CHEMISTRY II (3) LEC. 3. Pr. CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117. Science Core. Chemical kinetics; chemical equilibrium; acids and bases; calculations of pH; equilibrium constants and thermodynamical properties; electrochemistry; descriptive chemistry. Credit will not be given for both CHEM 1040 and CHEM 1120 or CHEM 1127.

CHEM 1041 FUNDAMENTAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. (P/C CHEM 1040 or P/C CHEM 1043) and (CHEM 1031 or CHEM 1111 or CHEM 1118). Science Core. Laboratory experiments emphasizing course material in CHEM 1040. Credit will not be given for both CHEM 1041 and CHEM 1121 or CHEM 1128.

CHEM 1110 GENERAL CHEMISTRY I (3) LEC. 3. Pr. P/C MATH 1610 or P/C MATH 1613 or P/C MATH 1617. Science Core. Chemical principles for chemistry and related majors. Atomic and molecular theory, periodicity, chemical reactions, Stoichiometry, gases, thermochemistry, bonding, molecular geometries, liquids, solids, and solutions. Credit will not be given for both CHEM 1110 and CHEM 1030 or CHEM 1117.

CHEM 1111 GENERAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 1110 or P/C CHEM 1117. Science Core. Laboratory experiments emphasizing course material in CHEM 1110. Credit will not be given for both CHEM 1111 and CHEM 1031 or CHEM 1118.

CHEM 1117 HONORS GENERAL CHEMISTRY I (3) LEC. 3. Pr. Honors College. Science Core. General chemistry for students in the honors program. Topics similar to CHEM 1110, but covered in more depth. Credit will not be given for both CHEM 1117 and CHEM 1030 or CHEM 1110.

CHEM 1118 HONORS GENERAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. Honors College. CHEM 1117. Science Core. Laboratory experiments emphasizing course material in CHEM 1117. Credit will not be given for both CHEM 1118 and CHEM 1031 or CHEM 1111.

CHEM 1120 GENERAL CHEMISTRY FOR SCIENTISTS AND ENGINEERS II (3) LEC. 3. Pr. CHEM 1110 or CHEM 1117. Science Core. Continuation of CHEM 1110. Chemical kinetics, chemical equilibrium, acids and bases, thermodynamics, electrochemistry, representative element and transition metal chemistry. Credit will not be given for both CHEM 1120 and CHEM 1040 or CHEM 1127.

CHEM 1121 GENERAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. (P/C CHEM 1120 or P/C CHEM 1127) and (CHEM 1111 or CHEM 1118). Science Core. Laboratory experiments emphasizing course material in CHEM 1120. Credit will not be given for both CHEM 1121 and CHEM 1041 or CHEM 1128.

CHEM 1127 HONORS GENERAL CHEMISTRY II (3) LEC. 3. Pr. Honors College. CHEM 1117. Science Core. General chemistry for students in the honors program. Topics similar to CHEM 1120, but covered in more depth. Credit will not be given for both CHEM 1127 and CHEM 1040 or CHEM 1120.

CHEM 1128 HONORS GENERAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. Honors College. Science Core. Laboratory experiments emphasizing course material in CHEM 1127. Credit will not be given for both CHEM 1128 and CHEM 1041 or CHEM 1121.

CHEM 2030 SURVEY OF ORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 1040 or CHEM 1120 or CHEM 1127. Structure, nomenclature and reactions of the functional group classes of organic compounds polymers, and molecules of biological interest. Credit will not be given for both CHEM 2030 and CHEM 2070.

CHEM 2070 ORGANIC CHEMISTRY I (3) LEC. 3. Pr. CHEM 1040 or CHEM 1043 or CHEM 1120 or CHEM 1127. In-depth study of organic chemistry including structure, nomenclature, reactions, reaction mechanisms, stereochemistry, synthesis and spectroscopic structure determination organized by the functional group approach. Considers alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, and aromatic compounds. Credit will not be given for both CHEM 2070 and CHEM 2030.

CHEM 2071 ORGANIC CHEMISTRY I LABORATORY (1) LAB. 3. Pr. (P/C CHEM 2070 or P/C CHEM 2077) and (CHEM 1041 or CHEM 1128 or CHEM 1121). Laboratory for CHEM 2070.

CHEM 2077 HONORS ORGANIC CHEMISTRY I (3) LEC. 3. Pr. Honors College. Organic chemistry for students in the honors program and Chemistry & Biochemistry majors. Topics similar to CHEM 2070, but covered in more depth. Additional credit will not be given for CHEM 2070. Member of the Honors College or CHEM 1110 with grade of A or B or CHEM 1040 with grade of A.

CHEM 2078 HONORS ORGANIC CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 2070 or P/C CHEM 2077. Laboratory experiments emphasizing course material in CHEM 2077. Additional credit will not be given for CHEM 2071. Course may be repeated for a maximum of 3 credit hours.

CHEM 2080 ORGANIC CHEMISTRY II (3) LEC. 3. Pr. CHEM 2070 or CHEM 2077. Continuation of CHEM 2070. Aldehydes, ketones, amines, carboxylic acids, esters, amides, anhydrides, polymers, carbohydrates and amino acids.

CHEM 2081 ORGANIC CHEMISTRY II LABORATORY (1) LAB. 1. Pr. (CHEM 2070 or CHEM 2077) and (CHEM 2071 or CHEM 2078) and (P/C CHEM 2080 or P/C CHEM 2087). Laboratory for CHEM 2080.

CHEM 2087 HONORS ORGANIC CHEMISTRY II (3) LEC. 3. Pr. Honors College or departmental approval. Organic chemistry for students in the honors program and Chemistry & Biochemistry majors. Topics similar to CHEM 2080, but covered in more depth. Additional credit will not be given for CHEM 2080. Member of the Honors College or CHEM 2077

CHEM 2088 HONORS ORGANIC CHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 2080 or P/C CHEM 2087. Laboratory experiments emphasizing course material in CHEM 2087. Additional credit will not be given for CHEM 2081. May count either CHEM 2081 or CHEM 2088. Course may be repeated for a maximum of 3 credit hours.

CHEM 2100 PROFESSIONAL DEVELOPMENT (1) LEC. 1. This course is designed to introduce students to the many opportunities available in chemistry, both as a career choice and while as a student. Students will have the opportunity to investigate available options, will reflect on what career success means to the student, and will chart a pathway to student professional success.

CHEM 2980 INTRODUCTION TO UNDERGRADUATE RESEARCH IN CHEMISTRY (1-3) LAB. SU. Individual problems course. Students will work under the direction of a staff member on some problem of mutual interest. Departmental approval required. Only Freshman or Sophomore. Course may be repeated for a maximum of 6 credit hours.

CHEM 3000 CHEMICAL LITERATURE (1) LEC. 1. Pr. CHEM 2080 or CHEM 2087. Chemical literature with emphasis on primary and secondary sources and the various computer data bases available.

CHEM 3050 ANALYTICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 1040 or CHEM 1120 or CHEM 1127. Theory and application of volumetric, potentiometric and photometric chemical analysis.

CHEM 3051 ANALYTICAL CHEMISTRY LABORATORY (1) LAB. 3. Pr. P/C CHEM 3050. Analytical techniques applied to chemical analysis.

CHEM 3160 SURVEY OF PHYSICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 1040 or (CHEM 1120 or CHEM 1127). The principles of physical chemistry.

CHEM 4070 PHYSICAL CHEMISTRY I (3) LEC. 3. Pr. (CHEM 1040 or CHEM 1120 or CHEM 1127) and (MATH 2630 or MATH 2637) and (MATH 2650) and (PHYS 1610 or PHYS 1617). Principles of chemical thermodynamics, principles of application to problems of chemical interest.

CHEM 4071 PHYSICAL CHEMISTRY I LABORATORY (1) LAB. 3. Pr. P/C CHEM 4070.

CHEM 4080 PHYSICAL CHEMISTRY II (3) LEC. 3. Pr. CHEM 1040 or (CHEM 1120 or CHEM 1127) and (MATH 2630 or MATH 2637) and MATH 2650 and (PHYS 1610 or PHYS 1617). Principles of quantum mechanics and spectroscopy; application in molecular structure and in statistical thermodynamics.

CHEM 4081 PHYSICAL CHEMISTRY II LABORATORY (1) LAB. 3. Pr. P/C CHEM 4080. Laboratory for CHEM 4080.

CHEM 4100 INORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 4080 or CHEM 3160. Principles of inorganic chemistry emphasizing periodic properties, bonding, structure and symmetry, the solid state, acid-base theory and coordination chemistry.

CHEM 4101 INORGANIC CHEMISTRY LABORATORY (1) LAB. 3. Pr. P/C CHEM 4100. Synthesis and characterization of a variety of inorganic compounds.

CHEM 4110 ORGANOMETALLICS AND CATALYSIS (3) LEC. 3. Pr. CHEM 4100. Departmental approval. Survey of organometallic chemistry and catalysis with main group, transition metal, and f-block elements.

CHEM 4130 INSTRUMENTAL ANALYSIS (3) LEC. 3. Pr. P/C CHEM 3050. Fundamental concepts used in instrumental analytical chemistry emphasizing spectrophotometric, electroanalytical and chromatographic analysis.

CHEM 4131 INSTRUMENTAL ANALYSIS LABORATORY (1) LAB. 3. Pr. P/C CHEM 4130. Laboratory for CHEM 4130.

CHEM 4920 CHEMISTRY INTERNSHIP (3) INT. 12. Departmental approval. Application of chemistry concepts and skills in a professional setting. The course may be repeated for a maximum of 6 credit hours.

CHEM 4950 UNDERGRADUATE SEMINAR (1) LEC. 1. Oral presentation and discussion of research in the area of specialization.

CHEM 4980 UNDERGRADUATE RESEARCH IN CHEMISTRY (3) LAB. 9. Departmental approval. This is an individual problem course. Each student will work under the direction of a staff member on some problem of mutual interest. Course may be repeated for a maximum of 9 credit hours.

CHEM 4997 HONORS THESIS (1-3) LEC. 3. Pr. Honors College. Departmental approval. Honors College Members Only; Course may be repeated for a maximum of 6 credit hours.

CHEM 5200 PYTHON PROGRAMMING IN CHEMISTRY (3) LEC. 3. Pr. CHEM 3160 or CHEM 4080. Computer programming in the Python language using specific examples relevant to different branches of chemistry. Emphasizes best practices for collaborative writing, documenting, and validating the program so that it is readable and maintainable.

CHEM 5280 COMPUTATIONAL CHEMISTRY (4) LEC. 3. LAB. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEM 4080. Modern computational chemistry including molecular mechanics and quantum mechanical calculations.

CHEM 5450 FOUNDATIONS OF R FOR DBER (3) LEC. 3. R is an open-source statistical software that allows nearly limitless data manipulation, statistical analysis, and advance data visualizations for both the social and physical sciences required for quality research in discipline-based education research (DBER). This course will dedicate approximately one half to learning the basics of coding in R for many common tasks found in DBER (focusing on how to independently find and apply new functions as only a portion of functions can possibly be discussed) and the second half on applying these principles into real data from students' thesis or dissertation (or data can be provided by instructor).

CHEM 6200 PYTHON PROGRAMMING IN CHEMISTRY (3) LEC. 3. Computer programming in the Python language using specific examples relevant to different branches of chemistry. Emphasizes best practices for collaborative writing, documenting, and validating the program so that it is readable and maintainable.

CHEM 6280 COMPUTATIONAL CHEMISTRY (4) LEC. 3. LAB. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEM 4080. Modern computational chemistry including molecular mechanics and quantum mechanical calculations.

CHEM 6450 FOUNDATIONS OF R FOR DBER (3) LEC. 3. R is an open-source statistical software that allows nearly limitless data manipulation, statistical analysis, and advance data visualizations for both the social and physical sciences required for quality research in discipline-based education research (DBER). This course will dedicate approximately one half to learning the basics of coding in R for many common tasks found in DBER (focusing on how to independently find and apply new functions as only a portion of functions can possibly be discussed) and the second half on applying these principles into real data from students' thesis or dissertation (or data can be provided by instructor).

CHEM 7100 ADVANCED INORGANIC CHEMISTRY (3) LEC. 3. Departmental approval. Current concepts of inorganic chemistry with an emphasis on theory, structure, bonding and reactivity.

CHEM 7110 PHYSICAL METHODS IN INORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 7100. Or equivalent. Theory and application of techniques for obtaining information inorganic compounds including magnetism, multinuclear nmr, mass spectrometry, x-ray diffraction, vibrational and electronic spectroscopies.

CHEM 7120 ORGANOMETALLIC CHEMISTRY (3) LEC. 3. Pr. CHEM 7100. Departmental approval. Main group and transition metal organometallic chemistry.

CHEM 7160 ADVANCED TOPICS IN INORGANIC CHEMISTRY (3) LEC. 3. Pr. CHEM 7100. Departmental approval. Currently active research areas in inorganic chemistry. Course may be repeated for a maximum of 12 credit hours.

CHEM 7200 PHYSICAL ORGANIC CHEMISTRY (3) LEC. 3. This course will combine the foundations of undergraduate organic chemistry reactions and add to this the physical properties of chemical reactions as affected by real laboratory applications.

CHEM 7210 STRUCTURE ELUCIDATION OF ORGANIC COMPOUNDS (3) LEC. 3. Pr. CHEM 7200 or CHEM 7220. The early stages of this course will focus on the identification of functional groups, saturated, unsaturated and cyclic compounds using IR and NMR spectroscopy, as well as mass spectrometry. Detailed analyses of 1H NMR spectra, i.e., chemical shift, multiplet shape, and coupling constants will demonstrate the power of these methods in ascertaining atom connectivity in simple organic molecules. More advanced two-dimensional NMR techniques such as COSY, HSQC and HMBC will be discussed and used for determining the structures of more complex organic molecules. The determination of absolute and relative stereochemistry using Mosher ester analyses and NOESY, respectively, in chiral molecules will also be covered. Most of the structures that will be discussed and analyzed will be stereochemically complex systems and polycyclic molecules that require a combination of multiple one-dimensional and two-dimensional NMR techniques.

CHEM 7220 ORGANIC REACTIONS (3) LEC. 3. Pr. (CHEM 2070 or CHEM 2073 or CHEM 2077) and (CHEM 2080 or CHEM 2083 or CHEM 2087). Organic reactions are described in the context of oxidation; reduction; C-C, C-N, C-O bond forming; olefination; aldol (and related) condensations; pericyclic, fragmentation, ring-expansion and ring-contraction reactions; and, named organic reactions and their reaction mechanisms and their application to chemical synthesis. Concurrent enrollment with CHEM 7200 is highly recommended.

CHEM 7230 COMPLEX MOLECULE SYNTHESIS (3) LEC. 3. Pr. CHEM 7220. This class is focused on target-oriented chemical synthesis of complex organic molecules. The main objective is to teach students how to use retrosynthetic analysis, a method for disconnecting a complex molecule into simpler starting materials, as well classical and modern organic reactions to plan syntheses of organic compounds that are biologically relevant and important in the development of better pharmaceuticals. During the course of the semester, students will be introduced to important classes of natural products including terpenes, terpenoids, alkaloids, macrolides, polycyclic ethers, as well as designed molecules that are biologically relevant, but not natural products themselves. Identifying key structural components (i.e., retrons), stereogenic centers, and substructures that can be derived from the chiral pool will be emphasized in synthesis planning. All lecture content will come from the current literature, with only manuscripts published in the past 12 months being discussed in class. Students will be responsible for reading Classics in Total Synthesis on their own and tested on the content of this book as well as assigned current literature in class. Emphasis will be placed on identifying economical and streamlined synthetic protocols that can employ cascade or domino reaction sequences.

CHEM 7260 SPECIAL TOPICS IN ORGANIC CHEMISTRY (1-3) LEC. Pr. CHEM 7200. Advanced course in a research area in organic chemistry which is of mutual interest to graduate students and the instructor. Course may be repeated for a maximum of 6 credit hours.

CHEM 7270 SUPRAMOLECULAR CHEMISTRY: SYNTHESIS, STRUCTURES, AND APPLICATIONS (3) ST1. 3. Pr. CHEM 2080. Supramolecular Chemistry bridges organic, inorganic, surface science, and analytical chemistries. It is a topical area that explores synthesis, spatial organization, weak bonding interactions, hydrogen bonding or covalent bonding, and is interest for numerous industrial or pharmacy applications.

CHEM 7300 ADVANCED PHYSICAL CHEMISTRY (3) LEC. 3. Topics of general and current interest; may vary from year to year.

CHEM 7330 CHEMICAL KINETICS (3) LEC. 3. Theoretical and experimental aspects of reaction rates. The mathematics and characterization of chemically reacting systems.

CHEM 7350 QUANTUM AND STATISTICAL MECHANICS (3) LEC. 3. Pr. CHEM 7300. A quantum mechanical and statistical approach to molecular structure and chemistry.

CHEM 7370 SPECIAL TOPICS IN PHYSICAL CHEMISTRY (1-3) LEC. 3. Pr. CHEM 7300. Modern topics in advanced physical chemistry. Course may be repeated for a maximum of 3 credit hours.

CHEM 7380 MOLECULAR SPECTROSCOPY (3) LEC. 3. Pr. CHEM 7300. Theory and application of optical and magnetic resonance spectroscopy.

CHEM 7410 A DBER APPROACH TO TEACHING AND LEARNING IN CHEMISTRY (3) LEC. 3. Pr. CHEM 1030 and CHEM 1040. Discipline-based education research (DBER) theory andtrends, consuming and evaluating DBER research, activelearning in advanced chemistry topics, action research,review of pedagogical tools, assessment. This coursewill be of use to chemistry graduate students aimingfor careers in academia, masters education studentslooking to take a chemistry course for the fulfillmentof their degree requirements, and other fields that wantto know more about evaluating and critiquing current DBERliterature and methods.

CHEM 7500 ADVANCED ANALYTICAL CHEMISTRY (3) LEC. 3. Analytical principles, applications and methods, mathematical interpretations and current developments.

CHEM 7510 ELECTROANALYTICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 7500. Analytical applications of electrochemistry.

CHEM 7530 ADVANCES IN BIOANALYTICAL CHEMISTRY (3) LEC. 3. Pr. CHEM 7500. Analytical Chemistry of microfluidic devices and "Lab on a chip." New methods of miniaturization of separations and analysis with emphasis on bioanalytical applications.

CHEM 7540 FLUORESCENCE IN BIOANALYTICAL CHEMISTRY: SPECTROSCOPY AND IMAGING (3) LEC. 3. Pr. CHEM 7500. Modern fluorescence-based bioanalytical methods as well as an advanced study of related literature. Standard approaches such as biosensors, nucleic acid analysis will be covered, as well as modern techniques such as Fluorescence microscopy, FRET, immunoassays, ELISAs and single-molecule detection.

CHEM 7550 PHOTO AND ELECTROCHEMISTRY (3) ST1. The course offers a simultaneous and comprehensive treatment of photochemistry and electrochemistry.

CHEM 7560 MASS SPECTROMETRY: INSTRUMENTATION AND APPLICATIONS (3) LEC. 3. Departmental approval. Several notable developments in mass spectrometry instrumentation platforms have been introduced which has led to significant increase in their implementations to various research and clinical applications. Learning about the fundamental principles of these instrumentation platforms will guide the users in selecting the correct instrument for a specific application. This course is designed to offer such an approach.

CHEM 7610 BIOCHEMISTRY AND BIOPHYSICS TECHNIQUES (3) LEC. 3. Fundamental concepts in biochemistry, molecular microbiology, and principles of physics will be introduced. This will be followed by presentations on the theory and practical application of common biophysical techniques. The techniques discussed will include, but will not be limited to: Raman, NMR, and Mass Spectrometry of biological molecules, X-ray Diffraction, Ion Mobility, Fluorescence Microscopy, Single-Molecule Approaches, EM/Cryo-EM, and Nano-particle techniques.

CHEM 7750 FORMAL PRESENTATIONS IN MODERN CHEMISTRY (1) LEC. 1. Oral presentations skills will be developed with a focus on the dissemination of new discoveries in the field of Chemistry. Course may be repeated for a maximum of 6 credit hours.

CHEM 7930 DIRECTED INDIVIDUAL STUDY (1-15) IND. Credit to be arranged. Course may be repeated for a maximum of 15 credit hours.

CHEM 7950 SEMINAR (1) SEM. 1. SU. Course may be repeated for a maximum of 6 credit hours.

CHEM 7990 RESEARCH AND THESIS (1-10) MST. Course may be repeated with change in topics.

CHEM 8990 RESEARCH AND DISSERTATION (1-10) DSR. Course may be repeated with change in topics.

Geography Courses

GEOG 1000 INTRODUCTION TO GEOGRAPHY (1) LEC. 1. LAB. 0, LEC. 0. Introduction to fundamental concepts and major fields of study in geography

GEOG 1010 GLOBAL GEOGRAPHY (3) LEC. 3. Social Science I Core. Spatial and locational context for analyzing change in the contemporary world, including elements of both physical and cultural environments.

GEOG 1017 HONORS GLOBAL GEOGRAPHY (3) LEC. 3. Pr. Honors College. Spatial and locational context for analyzing change in the contemporary world, including elements of both physical and cultural environments.

GEOG 1020 GLOBAL SYSTEMS WEATHER/CLIMATE (4) DSL/LLB. The ‘Weather and Climate’ GS course will teach students the difference between weather and climate. They will evaluate the effect of weather on the food we eat, where we live, what we wear and the science behind climate change. This course will identify and describe Earth’s physical systems and make connections between them.

GEOG 1030 GLOBAL SYSTEMS LAND/WATER (4) DSL/LLB. The ‘Land and Water’ Global Systems course will compare the modification of land and water resources due to human interventions and weather anomalies over time. It will highlight the connection between temperature and precipitation, weathering of rocks, soil type and the river system, human nature interactions and ecosystems of the Earth.

GEOG 2000 PROFESSIONAL DEVELOPMENT (1) LEC. 1. Introduction to career opportunities in the Geosciences; goal selection and charting a pathway to success as a professional. Includes writing skills, research and funding opportunities, internships, creation of resumes and ePortfolios, and job applications.

GEOG 2010 HUMAN GEOGRAPHY (3) LEC. 3. Spatial perspectives on modern society such as population change, economics, politics, urban development, and local culture, and geography's approach to solving problems using case studies and issues.

GEOG 2017 HONORS HUMAN GEOGRAPHY (3) LEC. 3. Spatial perspectives on modern society such as population change, economics, politics, urban development, and local culture, and geography's approach to solving problems using case studies and issues.

GEOG 2020 PHYSICAL GEOGRAPHY (3) LEC. 3. Selected elements of the earth's physical system to include such items as landforms, basic weather elements, soils and vegetation.

GEOG 3000 SPORTS GEOGRAPHY (3) LEC. 3. Geographical basis of sports at different spatial scales, including locational strategies, sportive nationalism, and the urban political economy of sports.

GEOG 3110 UNITED STATES AND CANADA (3) LEC. 3. Survey of the region incorporating physical and cultural elements, providing a synthesis of the economic and political processes of the U.S. and Canada.

GEOG 3120 ALABAMA AND THE SOUTHEAST (3) LEC. 3. Study of the physical and cultural environments of the state.

GEOG 3130 LATIN AMERICA (3) LEC. 3. Survey of physical and human landscape of the region including historical geography, natural resources, economic development and problems and prospects affecting major countries.

GEOG 3140 AFRICA (3) LEC. 3. Analysis of the relationships among diverse population groups and the physical environments of sub-Saharan Africa.

GEOG 3150 EUROPE (3) LEC. 3. Survey of physical and human landscape of the region including historical geography, natural resources, economic development, and problems and prospects affecting several of the major countries.

GEOG 3300 INTERNATIONAL TRAVEL AND TOURISM (3) LEC. 3. Environmental and cultural patterns that characterize places attractive to tourists. Provides realistic situations for developing travel plans and programs.

GEOG 3810 CARTOGRAPHY AND GRAPHICS (4) LEC. 2. LAB. 2. Techniques of map production including relevant computer graphics applications and related laboratory exercises.

GEOG 4740 SENIOR SEMINAR (2) SEM. 2. Individual research by geoscience undergraduates is coupled with improved written and oral communication skills along with resume and ePortfolio development. May count GEOG 4740 or GEOL 4740.

GEOG 4920 INTERNSHIP (3) LEC. 3. Opportunity to apply classroom experience to real job setting. Course may be repeated for a maximum of 6 credit hours.

GEOG 4930 DIRECTED STUDIES (1-4) IND. Departmental approval. Conferences, reading, research and/or reports may fulfill course requirement. Course may be repeated for a maximum of 4 credit hours.

GEOG 5010 URBAN GEOGRAPHY AND SUSTAINABILITY (3) LEC. 3. Senior standing or Departmental approval. An introduction to the field of urban geography and urban sustainability. Basic principles and processes that constitute the growth of urban areas, history, impact of urbanization, adaptation and mitigation towards a sustainable future.

GEOG 5210 CLIMATOLOGY (3) LEC. 3. Pr., Senior standing or departmental approval. An introduction to the field of climatology. Basic principles and process that constitute the earth's climate system (e.g. surface-atmosphere energy budge, the hydrologic cycle, and atmospheric motion) as well as climate change and sea level rise.

GEOG 5220 GEOMORPHOLOGY (3) LEC. 2. LAB. 2. Basic concepts, terms, and techniques used to identify landforms and their evolutionary processes. Study of the origin of landforms with emphasis on the eologic processes and structures that generate the landforms and applications of landform analysis. Two all-day weekend trips are required. Two one-hour classes and one two-hour laboratory per week.

GEOG 5350 ECONOMIC GEOGRAPHY (3) LEC. 3. Departmental approval. Economic Geography in a global context. Spatial aspects of resource use, agricultural development, manufacturing production and services.

GEOG 5380 POLITICAL GEOGRAPHY (3) LEC. 3. Examination of political processes over space, from local to the global levels. The course examines the development of political space, geographies of voting, the role of identity in shaping nationalism, and the geopolitical relationship between power and place.

GEOG 5400 GEOGRAPHY OF NATURAL HAZARDS (3) LEC. 3. Geography of natural hazards and their impacts on society. Credit will not be given for both GEOG 5400 and GEOG 6400.

GEOG 5510 HUMAN-ENVIRONMENT INTERACTION (3) LEC. 3. Departmental approval. Investigation of the inter-relationships between humans and their natural or physical environments.

GEOG 5550 GEOGRAPHY OF WATER RESOURCES (3) LEC. 3. Study of water use, management, law, and conflicts at local and international scales. May count either GEOG 5550 or GEOG 6550.

GEOG 5600 GLOBAL RESOURCES AND THE ENVIRONMENT (3) LEC. 3. Departmental approval. Global environmental problems such as climate change, ozone and deforestation and international public agencies and private volunteer movements protecting our global commons.

GEOG 5700 QUANTITATIVE METHODS AND SPATIAL ANALYSIS (3) LEC. 3. Pr. STAT 2510 or STAT 2513. Pr., STAT 2510 or similar statistics course. Applications of quantitative methods and spatial statistics to environmental, urban and economic systems and implementations of these techniques in GIS and statistical software. Credit will not be given for both GEOG 5710 and GEOG 6710.

GEOG 5710 GEOGRAPHIC FIELD METHODS (3) LEC. 1. LAB. 4. Geographic methods and techniques used to conduct field research investigations of human and physical characteristics of the landscape. Credit will not be given for both GEOG 5710 and GEOG 6710.

GEOG 5800 GEOGRAPHIC THOUGHT (3) LEC. 3. Departmental approval. Develops effective thinking skills, evaluates written materials in geography, reviews geographical research and produces written reports and papers related to geographic issues.

GEOG 5820 AERIAL PHOTOGRAPHY AND REMOTE SENSING (4) LEC. 3. LAB. 2. Departmental approval. Aerial photo and satellite digital interpretation, photogrammetry, remote sensing technology and photogrammetry and related laboratory exercises.

GEOG 5830 GEOGRAPHIC INFORMATION SYSTEMS (4) LEC. 3. LAB. 2. Introduction to concepts and techniques used in developing a geographic information system (GIS) for evaluating spatial distribution patterns and spatial relationships.

GEOG 5850 DRONES AND GEOSPATIAL APPLICATIONS (3) LEC. 3. LAB. 3. Pr. GEOG 5830 or GEOG 6830. This course will introduce the concepts of drone data collection, processing, and analysis and focus on how these high-resolution datasets can be used in a multitude of geospatial (including GIS and remote sensing) applications. This class will have both in-class and field components. Prerequisite: An Intro to GIS class is preferred, please contact the instructor if you have questions.

GEOG 5880 ADVANCED GEOGRAPHIC INFORMATION SYSTEMS (3) LEC. 2. LAB. 2. Pr. GEOG 5830. Advanced concepts and techniques used in the collection and analysis of data for evaluating spatial patterns and process. Credit will not be given for both GEOG 5880 and GEOG 6880.

GEOG 5890 GIS PROGRAMMING (3) LEC. 2. LAB. 2. Pr. P/C GEOG 5830. This course is an introduction to programming and scripting for intermediate Geographic Information Systems (GIS) users. Students will learn how to design and write clearly structured scripts in Python using a standalone development environment. Students will develop programs to manage geospatial data, perform geoprocessing analysis, and design custom tools that can be integrated into common GIS software packages. Intro to GIS is a prerequisite which can be met if taken during the same semester (co-requisite). Credit will not be given for both GEOG 5890 and GEOG 6890

GEOG 5970 SEMINAR IN GEOGRAPHY (3) LEC. 3. Development of modern geographic thinking with attention to applied research topics. Course may be repeated for a maximum of 6 credit hours.

GEOG 6010 URBAN GEOGRAPHY AND SUSTAINABILITY (3) LEC. 3. An introduction to the field of urban geography and urban sustainability. Basic principles and processes that constitute the growth of urban areas, history, impact of urbanization, adaptation and mitigation towards a sustainable future.

GEOG 6210 CLIMATOLOGY (3) LEC. 3. Pr., Senior standing or departmental approval. An introduction to the field of climatology. Basic principles and process that constitute the earth's climate system (e.g surface-atmosphere energy budge, the hydrologic cycle, and atmospheric motion, as well as climate change and sea level rise.

GEOG 6220 GEOMORPHOLOGY (3) LEC. 3. Basic concepts, terms, and techniques used to identify landforms and their evolutionary processes. Credit will not be given for both GEOG 5220 and GEOG 6220.

GEOG 6350 ECONOMIC GEOGRAPHY (3) LEC. 3. Departmental approval. Economic Geography in a global context. Spatial aspects of resource use, agricultural development, manufacturing production and services.

GEOG 6380 POLITICAL GEOGRAPHY (3) LEC. 3. Examination of political processes over space, from local to the global levels. The course examines the development of political space, geographies of voting, the role of identity in shaping nationalism, and the geopolitical relationship between power and place.

GEOG 6400 GEOGRAPHY OF NATURAL HAZARDS (3) LEC. 3. Geography of natural hazards and their impacts on society. Credit will not be given for both GEOG 5400 and GEOG 6400.

GEOG 6510 HUMAN-ENVIRONMENT INTERACTION (3) LEC. 3. Departmental approval. Investigation the inter-relationships between humans and their natural or physical environments.

GEOG 6550 GEOGRAPHY OF WATER RESOURCES (3) LEC. 3. Study of water use, management, law, and conflicts at local and international scales. May count either GEOG 5550 or GEOG 6550.

GEOG 6700 QUANT METH & SPATIAL ANALYSIS (3) LEC. 3. Pr. STAT 2510 or STAT 2513. or similar statistics course. Applications of quantitative methods and spatial statistics to environmental, urban and economic systems and implementations of these techniques in GIS and statistical software. Credit will not be given for both GEOG 5700 and GEOG 6700.

GEOG 6710 GEOGRAPHIC FIELD METHODS (3) LEC. 1. LAB. 4. Geographic methods and techniques used to conduct field research investigations of human and physical characteristics of the landscape. Credit will not be given for both GEOG 5710 and GEOG 6710.

GEOG 6800 GEOGRAPHIC THOUGHT (3) LEC. 3. Departmental approval. Develops effective thinking skills; evaluates written materials in geography; Reviews geographical research and produces written reports and papers related to geographic issues.

GEOG 6820 AERIAL PHOTOGRAPHY AND REMOTE SENSING (4) LEC. 3. LAB. 2. Departmental approval. Aerial photo and satellite digital interpretation, photogrammetry, remote sensing technology and photogrammetry and related laboratory exercises.

GEOG 6830 GEOGRAPHIC INFORMATION SYSTEMS (4) LEC. 3. LAB. 2. Departmental approval. Introduction to concepts and techniques used in developing a geographic information system (GIS) for evaluating spatial distribution patterns and spatial relationships.

GEOG 6850 DRONES AND GEOSPATIAL APPLICATIONS (3) LEC. 3. LAB. 3. Pr. GEOG 5830 or GEOG 6830. This course will introduce the concepts of drone data collection, processing, and analysis and focus on how these high-resolution datasets can be used in a multitude of geospatial (including GIS and remote sensing) applications. This class will have both in-class and field components. Prerequisite: An Intro to GIS class is preferred, please contact the instructor if you have questions.

GEOG 6880 ADVANCED GEOGRAPHIC INFORMATION SYSTEMS (3) LEC. 2. LAB. 2. Pr. GEOG 6830. Advanced concepts and techniques used in the collection and analysis of data for evaluating spatial patterns and processes. Credit will not be given for both GEOG 5880 and GEOG 6880.

GEOG 6890 GIS PROGRAMMING (3) LEC. 2. LAB. 2. Pr. P/C GEOG 6830. This course is an introduction to programming and scripting for intermediate Geographic Information Systems (GIS) users. This course teaches students to design and write clearly structured scripts in Python using a standalone development environment. Students will develop programs to manage geospatial data, perform geoprocessing analysis, and design custom tools that can be integrated into common GIS software packages. Intro to GIS is a prerequisite which can be met if taken during the same semester (co-requisite). Credit will not be given for both GEOG 5890 and GEOG 6890

GEOG 6970 SEMINAR IN GEOGRAPHY (3) LEC. 3. Departmental approval. Development of modern geographic thinking with attention to applied research topics. Course may be repeated for a maximum of 6 credit hours.

GEOG 7930 DIRECTED STUDIES (1-3) IND/RES. Departmental approval. Individualized literature, field and/or laboratory research not available through regularly offered coursework. Subject matter and credit hours shall be determined by student and directing faculty. Course may be repeated for a maximum of 3 credit hours.

GEOG 7980 CAPSTONE RESEARCH (1-3) RES. SU. Departmental approval. enrolled as GEOG MS non-thesis student. Literature, field and/or laboratory research directed toward the completion of capstone project for non-thesis option. Course may be repeated for a maximum of 3 credit hours.

GEOG 7990 M.S. RESEARCH AND THESIS (1-10) RES. Research and Thesis. Course may be repeated with change in topics.

GEOG 8900 DIRECTED STUDIES (1-6) IND. Provides exposure to discipline-specific research procedures in Earth System Science. Students will work closely with their mentors to explore an Earth-System problem through directed readings, literature searches, field work, laboratory experimentation, and quantitative analysis. Course may be repeated for a maximum of 6 credit hours.

Geology Courses

GEOL 1100 DYNAMIC EARTH (4) LEC. 3. LAB. 2. Science Core. General physical geology. Survey of the important minerals and rocks. Origin and classification of geologic structures, earthquakes, and landforms. Study of geologic maps. Credit will not be given for both GEOL 1100 and GEOL 3150.

GEOL 1107 HONORS DYNAMIC EARTH (4) LEC. 3. LAB. 2. Pr. Honors College. General physical geology for Honors students and for Geology majors. Topics similar to GEOL 1110 but covered in greater depth. Science Core.

GEOL 1110 EARTH AND LIFE THROUGH TIME (4) LEC. 3. LAB. 2. Pr. GEOL 1100 or GEOL 1103 or GEOL 1107. Science Core. Physical and biological history of the Earth, with emphasis on the interaction between life, the atmosphere, rocks, and oceans.

GEOL 1117 HONORS EARTH AND LIFE THROUGH TIME (4) LEC. 3. LAB. 2. Pr. GEOL 1100 or GEOL 1103 or GEOL 1107. Physical and biological history of the Earth, with emphasis on the interaction between life, the atmosphere, rocks, and oceans. For Honors students and Geology majors. Science Core.

GEOL 2000 PROFESSIONAL DEVELOPMENT (1) LEC. 1. Introduction to career opportunities in the Geosciences; goal selection and charting a pathway to success as a professional. Includes writing skills, research and funding opportunities, internships, creation of resumes and ePortfolios, and job applications.

GEOL 2010 MINERALOGY AND OPTICAL CRYSTALLOGRAPHY (5) LEC. 4. LAB. 2. Physical and chemical properties of minerals, classification and roles with emphasis on natural systems, materials science, health, and environment. Credit will not be given for both GEOL 2010 and GEOL 2013.

GEOL 2050 IGNEOUS AND METAMORPHIC PETROLOGY (4) LEC. 3. LAB. 2. Pr. GEOL 2010 or GEOL 2013. Principles and processes of igneous and metamorphic activity in a plate tectonic and petrologic context. Description, classification and interpretation of igneous and metamorphic rocks.

GEOL 2100 ENVIRONMENTAL GEOLOGY (4) LEC. 3. LAB. 2. Pr. GEOL 1100 or GEOL 1103 or GEOL 1107. Emphasis on geology as an environmental science; applied geology, geological hazards and environmental regulations as applied to geologic environmental remediation.

GEOL 3060 LUNAR AND PLANETARY GEOLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 1100 or GEOL 1103 or GEOL 1107. Departmental approval. Geology of the planets, moons, asteroids and comets. Origin of the solar system. Space exploration. Impact cratering.

GEOL 3200 INTRODUCTION TO PALEOBIOLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 1110 or GEOL 1113 or GEOL 1117. The nature of the fossil record, applications of that data to geological and biological questions with emphasis on the concepts using examples from all biotic groups.

GEOL 3300 EVOLUTION AND EXTINCTION OF THE DINOSAURIA (3) LEC. 2. LAB. 2. Pr. GEOL 1100 or GEOL 1103 or GEOL 1107. Departmental approval. Survey of the dinosaurs, their evolution and extinction. Southeastern U.S. dinosaurs.

GEOL 3400 STRUCTURAL GEOLOGY (4) LEC. 3. LAB. 2. Pr. GEOL 2050. Fundamentals of rock deformation. The mechanics of rock flow, fracture, and folding. Geometric techniques of structural analysis.

GEOL 3550 FIELD GEOLOGY: METHODS AND APPLICATION (3) LEC. 2. LAB. 2, AAB/LLB. 2. Pr. GEOL 1100 and GEOL 1110. Departmental approval. Through a combination of classroom, laboratory, and field-based activities, this course develops skills of geologic data collection, observation, interpretation, and communication.

GEOL 3650 ADVANCED FIELD GEOLOGY (3) LEC. 1. LAB. 10. Pr. GEOL 3400 and GEOL 3550. Instruments and methods used in geological field mapping, interpretation of sedimentary, igneous and metamorphic rocks and deformational analysis. Summer only.

GEOL 4010 SEDIMENTARY PETROLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 2050. Departmental approval. Detailed description and classification of sediments and sedimentary rocks with emphasis on interpretation of origins, transport histories, depositional environments and diagnetic histories.

GEOL 4110 STRATIGRAPHY (3) LEC. 2. LAB. 2. Pr. GEOL 4010. Departmental approval. Description and correlation of layered earth materials. Synthesis and interpretation of stratigraphic correlations. North American Stratigraphic Code. History and theory of stratigraphy.

GEOL 4210 ECONOMIC GEOLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 3400. The origin, distribution and classification of mineral deposits formed by igneous, metamorphic and sedimentary processes. Introduction of methods of exploration and development.

GEOL 4260 INTRODUCTION TO GEOCHEMISTRY (3) LEC. 3. Pr. CHEM 1040 and GEOL 2050. Principles governing the distribution of major, minor and trace elements within the earth; differentiation of elements due to geologic processes and the hydrosphere.

GEOL 4300 GEODYNAMICS (3) LEC. 3. Pr. GEOL 3400 and (MATH 1620 or MATH 1623 or MATH 1627) and PHYS 1510. Structure and dynamics of the earth deduced from seismology, gravity, heat flow and magnetism.

GEOL 4740 SENIOR SEMINAR (2) SEM. 2. Geology majors with upperclass standing. Individual research by geoscience undergraduates is coupled with improved written and oral communication skills along with resume and ePortfolio development. May count either GEOL 4740 or GEOG 4740.

GEOL 4920 INTERNSHIP (1-3) INT. SU. Geology majors with upper-class standing (juniors or seniors). An opportunity to apply classroom experience to a real job setting. Course may be repeated for a maximum of 6 credit hours.

GEOL 4930 DIRECTED STUDIES IN UNDERGRADUATE RESEARCH (1-3) AAB. Departmental approval. Directed studies in areas of geology not covered by an existing course or to supplement knowledge gained from an existing course. Course may be repeated for a maximum of 3 credit hours.

GEOL 4970 SPECIAL TOPICS IN GEOLOGY (1-4) ST1. Instruction and discussion of selected topics in geosciences. Course may be repeated for a maximum of 8 credit hours.

GEOL 4980 UNDERGRADUATE RESEARCH METHODS (1-3) IND. Departmental approval. Active participation in original research under supervision of a senior investigator. Course may be repeated for a maximum of 3 credit hours.

GEOL 5060 INTRODUCTION TO MICROPALEONTOLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 3200 and (BIOL 1030 or BIOL 1037). A survey of major groups of fossils small enough to require a microscope for their study. Foraminifera, radiolaria, and ostracodes are emphasized; minor groups of interest include conodonts, diatoms, dinoflagellates, acritarchs, and chitinozoans. Includes laboratory, discussion sessions, and field work.

GEOL 5100 HYDROGEOLOGY (3) LEC. 2. LAB. 2. Pr. (GEOL 1100 or GEOL 1103 or GEOL 1107) and CHEM 1030 and (MATH 1610 or MATH 1613 or MATH 1617) and PHYS 1500. Departmental approval. Fundamentals of groundwater flow in porous media, hydrodynamic dispersion, determination of aquifer properties and geological aspects of groundwater occurrences.

GEOL 5220 GEOMORPHOLOGY (3) LEC. 2. LAB. 1. Study of the origin of landforms with emphasis on the geologic processes and structures that generate the landforms and applications of landform analysis. Two all-day weekend trips are required. Two one-hour classes and one two-hour laboratory per week.

GEOL 5300 BASIN ANALYSIS (3) LEC. 2. LAB. 2. Pr. P/C GEOL 4010. Study of analytical techniques of sedimentary basin fills, including thermal history, litho and biofacies analyses, depositional systems, subsurface logs, seismic reflection, provenance history, evolution, sedimentation and subsidence history.

GEOL 5440 ELECTRON MICROPROBE ANALYSIS (3) LEC. 2. LAB. 1. Pr. CHEM 1040 and PHYS 1510. Instruction in the theory and application of EMPA (electron microprobe analysis) and SEM (scanning electron microscopy). The course provides an understanding the EMPA as a research tool for evaluating the composition and structure of a wide range of materials.

GEOL 5500 PETROLEUM GEOLOGY (3) LEC. 3. Pr. GEOL 4010. Coverage of petroleum source rocks, migration, reservoir rock characters, and trapping mechanics. Overview of exploration methods including well-log analysis and seismic interpretation.

GEOL 5600 APPLIED GEOPHYSICS (4) LEC. 3. LAB. 2. Pr. (GEOL 1100 or GEOL 1103 or GEOL 1107 or GEOL 3150) and (MATH 1620 or MATH 1623 or MATH 1627) and PHYS 1510. Departmental approval. Overview of geophysical methods with applications to resource, tectonic and environmental analyses. Seismic refraction and reflection, gravity, magnetics, electrical and electromagnetic methods will be included.

GEOL 5700 GEOHEALTH (3) LEC. 3. Pr. GEOL 1100 and CHEM 1030. The effects of the composition of Earth materials and the local geological phenomena on human, plant, and animal health. The application of principles of geology and chemistry to predict and prevent diseases.

GEOL 5840 CLIMATE CHANGE AND SOCIETY (3) LEC. 3. The science of Earth's changing climate, the societal influences on climate change, as well as the expected impacts based on the collected scientific evidence. Analyzes key aspects of climate science, the drivers of climate change, Earth's climate trends, the evidence of climate change, the predicted future climate scenarios, the expected impacts, and the array of possible response options.

GEOL 6060 INTRODUCTION TO MICROPALEONTOLOGY (3) LEC. 3. LAB. 1. A survey of major groups of fossils small enough to require a microscope for their study. Foraminifera, radiolaria, and ostracodes are emphasized; minor groups of interest include conodonts, diatoms, dinoflagellates, acritarchs, and chitinozoans. Includes laboratory, discussion sessions, and field work.

GEOL 6100 HYDROGEOLOGY (3) LEC. 2. LAB. 2. Pr. (GEOL 1100 or GEOL 1103 or GEOL 1107) and CHEM 1030 and (MATH 1610 or MATH 1613 or MATH 1617) and PHYS 1500. Departmental approval. Fundamentals of groundwater flow in porous media, hydrodynamic dispersion, determination of aquifer properties and geological aspects of groundwater occurrences.

GEOL 6220 GEOMORPHOLOGY (3) LEC. 2. LAB. 1. Study of origin of landforms with emphasis on geologic processes and structures that generate landforms; includes the applications of landform analysis. May count either GEOL 6220 or GEOG 6220.

GEOL 6300 BASIN ANALYSIS (3) LEC. 2. LAB. 2. Pr. GEOL 4010. Departmental approval. Study of analytical techniques of sedimentary basin fills, including thermal history, litho and biofacies analyses, depositional systems, subsurface logs, seismic reflection, provenance history, evolution, sedimentation and subsidence history.

GEOL 6400 PRINCIPLES OF EARTH SCIENCE (3) LEC. 2. LAB. 2. Departmental approval. A special course for in-service and future teachers only. Internal and surficial geologic processes, meteorology and oceanography.

GEOL 6440 ELECTRON MICROPROBE ANALYSIS (3) LEC. 2. LAB. 1. Pr. CHEM 1040 and PHYS 1510. Instruction to theory and application of EMPA (electron microprobe analysis) and SEM (scanning electron microscopy). Provides an understanding of EMPA as a research tool for evaluating composition and structure of wide range of materials. GEOL 5440 or GEOL 6440.

GEOL 6500 PETROLEUM GEOLOGY (3) LEC. 3. Pr. P/C GEOL 4010. Geology/Geography graduate students who took GEOL 4010 ("P/C"). Coverage of petroleum source rocks, migration, reservoir rock characters, and trapping mechanics. Overview of exploration methods including well-log analysis and seismic interpretation.

GEOL 6600 APPLIED GEOPHYSICS (4) LEC. 3. LAB. 2. Pr. (GEOL 1100 or GEOL 1103 or GEOL 1107 or GEOL 3150) and (MATH 1620 or MATH 1623 or MATH 1627) and PHYS 1510. Departmental approval. Overview of geophysical methods with applications to resource, tectonic and environmental analyses. Seismic refraction and reflection, gravity, magnetics, electrical and electromagnetic methods will be included.

GEOL 6700 GEOHEALTH (3) LEC. 3. The effects of the composition of Earth materials and the local geological phenomena on human, plant, and animal health. The application of principles of geology and chemistry to predict and prevent diseases.

GEOL 6840 CLIMATE CHANGE AND SOCIETY (3) LEC. 3. The course will investigate the science of Earth's changing climate, the societal influences on climate change, as well as the expected impacts based on the collected scientific evidence. Analysis of peer-reviewed literature on the key aspects of climate science, the drivers of climate change, Earth's climate trends, the evidence of climate change, predicted future climate scenarios, expected impacts, and the array of possible societal response options to prevent/mitigate the consequences of anthropogenic climate change. The class will have a strong component of discussion of literature and foundational knowledge as well as reflection on what students have learned and the implications of this knowledge for their areas of interest and generally for their lives.

GEOL 7100 GEOCOMMUNICATION (3) LEC. 3. Departmental approval. Instruction and practice in written and oral communication skills necessary for a successful career in the geosciences; emphasis on preparation of scientific articles, technical reports, abstracts, and thesis; preparation and delivery of oral presentations.

GEOL 7170 IMPACT AND PLANETARY GEOLOGY (3) LEC. 3. Pr. GEOL 1100 and GEOL 1110. Study of impact craters and their formation. Identification of impact crates. Role of impacts in planetary evolution and in evolution and extinction of life on Earth. Study of rocky and icy geologic surface terrains and their geologic processes.

GEOL 7200 TECTONICS (3) LEC. 2. LAB. 2. Pr. GEOL 2050 and GEOL 4010. Departmental approval. Emphasis will be placed on plate tectonics and driving forces, evolution of collisional, transform and extensional systems, and dynamic indicators of past and current tectonic processes.

GEOL 7250 GROUNDWATER HYDROGEOLOGIC MODELING (3) LEC. 2. LAB. 2. Pr. GEOL 6100. Departmental approval. Overview of groundwater modeling techniques with environmental and geologic applications. Interaction of geology and subsurface groundwater flow. Basin hydrology modeling. Practical experience in computer simulations of subsurface hydrogeologic processes.

GEOL 7260 AQUEOUS AND ENVIRONMENTAL GEOCHEMISTRY (3) LEC. 2. LAB. 2. Pr. CHEM 1040 and GEOL 2050. Departmental approval. Study of water-rock reactions that control the chemical composition of groundwater; aqueous geochemistry of trace elements; groundwater pollution, remediation and geomic robiology.

GEOL 7300 CYCLES THROUGH EARTH HISTORY (3) LEC. 2. LAB. 2. Pr. GEOL 4100 and GEOL 4260. Discussion of the fundamental processes controlling sedimentary cycles at different physical, biotic, and temporal scales.

GEOL 7400 ADVANCED ECONOMIC GEOLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 4210. Departmental approval. The practical and theoretical aspects of economic geology as applied to exploration and development of natural resources.

GEOL 7410 GEOLOGY OF ORGANIC MATTER (3) LEC. 2. LAB. 2. Pr. GEOL 4010 and GEOL 4110. Departmental approval. The origins, classifications, taphonomy of organic matter, modern and ancient processes and environments of deposition of organic-rich strata, including hydrocarbon- source rocks and coals. Laboratory and field trips required.

GEOL 7450 MINERAL RESOURCES AND THE ENVIRONMENT (3) LEC. 2. LAB. 2. Pr. CHEM 1040 and GEOL 2050. Overview of geology and geographic distribution of mineral resources; economic aspects affecting their extraction; environmental impacts and cost of mineral resource extraction.

GEOL 7500 PALEOCLIMATOLOGY (3) LEC. 3. Explores how Earth's climate has evolved dynamically over time, varying within restricted boundaries that allowed life to exist and evolve. Explores interactions among Earth's surface abiotic and biotic components, and includes plate tectonics, atmospheric chemistry and physics, and ocean productivity.

GEOL 7550 ADVANCED GEOPHYSICAL METHODS (3) LEC. 2. LAB. 2. Pr. GEOL 6600. Departmental approval. Advanced treatment of geophysical methods, data interpretation and modeling. Applications to resource development and environmental assessments will be explored, with emphasis on seismic methods.

GEOL 7600 PETROLOGY (3) LEC. 2. LAB. 2. Pr. GEOL 2050 and GEOL 4010. Departmental approval. The description, classification, formative processes, and petrologic interpretation of igneous, metamorphic and sedimentary rocks.

GEOL 7610 STRUCTURAL AND METAMORPHIC ANALYSIS (3) LEC. 2. LAB. 2. Pr. GEOL 2050 and GEOL 3400 and GEOL 3650. Quantitative analysis of dynamic, kinematic and chemical responses of rocks and minerals to crustal movements and dynamo thermal metamorphism.

GEOL 7650 FACIES ANALYSIS AND SEQUENCE STRATIGRAPHY (3) LEC. 2. LAB. 2. Pr. GEOL 4010 and GEOL 4110. Departmental approval. Systematic analysis of modern and ancient deposition facies, and their interpretation in a sequence stratigrahic context. Laboratory and field trips required.

GEOL 7700 ANALYTICAL ISOTOPE GEOCHEMISTRY (3) LEC. 2. LAB. 1. Pr. CHEM 1040 or PHYS 1510 or MATH 1620. Biweekly lectures will teach the theory and principles of isotope geochemistry and mass spectrometry, leading to applications in geoscience research. Lab sessions and problem sets will support lectures and emphasize work with various mass spectrometers in the Department of Geosciences.

GEOL 7930 DIRECTED STUDIES (1-3) LEC. 3. Departmental approval. Directed studies. May incorporate literature, field and/or laboratory research in any proportion. Subject matter and credit hours shall be determined by student and directing faculty. Course may be repeated for a maximum of 3 credit hours.

GEOL 7980 CAPSTONE PROJECT (1-3) LEC. SU. Literature, field and/or laboratory research directed towards completion of capstone project required for non-thesis option. Course may be repeated for a maximum of 3 credit hours.

GEOL 7990 RESEARCH AND THESIS (1-10) MST. Departmental Approval. Course may be repeated with change in topics.

GEOL 8900 DIRECTED STUDY (1-6) IND. 3. Provides exposure to discipline-specific research procedures in Earth System Science. Students will work closely with their mentors to explore an Earth-system problem through directed readings, literature searches, field work, laboratory experimentation, and quantitative analysis. Course may be repeated for a maximum of 6 credit hours.

Laboratory Science Courses

LBSC 2010 BASICS IN LABORATORY SCIENCE (2) LEC. 1. LAB. 1. Basic laboratory skills, quality control and assurance, standard precautions for biohazard testing; requirements for careers in medical and laboratory science.

LBSC 4010 HEMATOLOGY (3) LEC. 3. Pr. CHEM 2070 or CHEM 2077. Origin, maturation, morphology, and function of normal blood cells and abnormalities in diseased blood with clinical correlation to disease processes.

LBSC 4011 HEMATOLOGY LAB (2) LAB. 6. Pr. (CHEM 2070 or CHEM 2077) and P/C LBSC 4010 and P/C LBSC 2010. Lab portion of course covering origin, maturation, morphology, and function of normal blood cells and abnormalities in disease blood with clinical correlation to disease processes.

LBSC 4050 CLINICAL IMMUNOHEMATOLOGY/PARASITOLOGY (5) LEC. 3. LAB. 6. Pr. (CHEM 2070 or CHEM 2077) and (BIOL 1020 or BIOL 1027). Immunogenetics, clinical significance of blood group antigens and antibodies, theory and techniques of serological study of human blood groups. Human parasites, life cycles and disease processes.

LBSC 4250 CLINICAL BIOCHEMISTRY/INSTRUMENTATION (4) LEC. 3. LAB. 3. Pr. P/C BCHE 5180 or P/C BCHE 3200. Biochemistry/physiology of systems in the body of elements in body fluids during the normal and abnormal processes. Theoretical and practical application of Lab techniques, atomic absorption, gaschromatograph-FID, HPLC, spectroscopy, spectrophotometry, ion selective electrodes and RIA used in analysis of body fluids.

LBSC 4910 CLINICAL PRACTICUM (0) PRA.

LBSC 4920 CLINICAL INTERNSHIP (0) INT/PRA.

Mathematics Courses

MATH 1000 COLLEGE ALGEBRA (3) LEC. 3. Pr. ALEK score of 1. Fundamental concepts of algebra, equations and inequalities, functions and graphs, polynomial and rational functions. Does not satisfy the core requirement in mathematics. Students who have previous credit in any higher-numbered math course may not also receive credit for this course.

MATH 1100 FINITE MATH AND APPLICATIONS (3) LEC. 3. Pr. ALEK score of 50 or MATH 1000 or MATH 1003. ALEKS Math Placement Assessment score of at least a 50 or MATH 1000. Mathematics Core. Overview of finite mathematics and its applications. Graph theory, matrices, finite and conditional probability; descriptive and inferential statistics, voting methods, game theory.

MATH 1120 PRE-CALCULUS ALGEBRA (3) LEC. 3. Pr. ALEK score of 50 or MATH 1000 or MATH 1003. ALEKS Math Placement Assessment score of at least a 50 or MATH 1000. Mathematics Core. Preparatory course for calculus. This course emphasizes the algebra of functions – including polynomial, rational, exponential, and logarithmic functions. In addition, the course covers non-linear inequalities as well as systems of linear and non-linear equations and inequalities. The course also includes an introduction to sequences and series. No credit is given to students with higher-numbered math course.

MATH 1121 PRE-CALCULUS ALGEBRA WORKSHOP (1) LAB. 2. SU. Pr. P/C MATH 1000 or P/C MATH 1003 or P/C MATH 1120 or P/C MATH 1123. Workshop for College Algebra and Pre-Calculus Algebra.

MATH 1130 PRE-CALCULUS TRIGONOMETRY (3) LEC. 3. Pr. ALEK score of 64 or MATH 1120 or MATH 1123. ALEKS Math Placement Assessment score of at least a 64 or MATH 1120. Mathematics Core. Preparatory course for the calculus sequence. Basic analytic and geometric properties of the trigonometric functions. Complex numbers, De Moivre' Theorem, polar coordinates. Students who have previous credit in any higher-numbered math course may not also receive credit for this course.

MATH 1150 PRE-CALCULUS ALGEBRA AND TRIGONOMETRY (4) LEC. 4. Pr. ALEK score of 64 or MATH 1000 or MATH 1003. ALEKS Math Placement Assessment score of at least a 64 or "C" or better in MATH 1000. Mathematics Core. Algebraic functions, Exponential Logarithmic functions. Analytic and geometric properties of trigonometric functions.

MATH 1151 MATHEXCEL PRECALCULUS WORKSHOP (2) LEC. 2. SU. Coreq. MATH 1150. Appropriate score on the mathematics placement exam or grade of "C" or better in MATH 1000. Workshop for MATH 1150. Two 2-hour sessions per week.

MATH 1610 CALCULUS I (4) LEC. 4. Pr. MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or ALEK score of 78. ALEKS Math Placement Assessment score of at least a 78 or "C" or better in MATH 1130 or in MATH 1150. Mathematics Core. Limits, the derivative of algebraic, trigonometric, exponential, logarithmic functions. Applications of the derivative, antiderivatives, the definite integral and applications to area problems, the fundamental theorem of calculus. Students may receive credit for only one of MATH 1610/1617.

MATH 1617 HONORS CALCULUS I (4) LEC. 4. Pr. Honors College. MATH 1130 or MATH 1150 or ALEK minimum score of 78 or MATH 1133 or MATH 1153. ALEKS Math Placement Assessment score of at least a 78 or "C" or better in MATH 1130 or in MATH 1150. Mathematics Core. Honors version of MATH 1610. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: Applied Math-Actuarial Sci (ACTU), Applied Math-Discrete (APDM), Applied Mathematics (AMTH), and Mathematics (MATH). This course covers the same material as MATH 1610 but in a greater depth appropriate for Honors students and Mathematics majors. Students may receive credit for only one of MATH 1610, MATH 1617 or MATH 1680.

MATH 1620 CALCULUS II (4) LEC. 4. Pr. MATH 1610 or MATH 1613 or MATH 1617. "C" or better in MATH 1610 or in MATH 1617. Techniques of integration, applications of the integral, parametric equations, polar coordinates. Vectors, lines and planes in space. Infinite sequences and series. Students may receive credit for only one of MATH 1620 or MATH 1627.

MATH 1627 HONORS CALCULUS II (4) LEC. 4. Pr. Honors College. MATH 1610 or MATH 1613 or MATH 1617. "C" or better in MATH 1610 or in MATH 1617. Honors version of MATH 1620. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: Applied Math-Actuarial Sci (ACTU), Applied Math-Discrete (APDM), Applied Mathematics (AMTH), and Mathematics (MATH). The same material as MATH 1620, but in greater depth appropriate for honors students and Mathematics majors. Students may receive credit for only one of MATH 1620 or MATH 1627.

MATH 1680 CALCULUS WITH BUSINESS APPLICATIONS I (4) LEC. 4. Pr. MATH 1120 or MATH 1123 or MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or ALEK score of 68. ALEKS Math Placement Assessment score of at least a 68 or MATH 1120 or MATH 1130 or MATH 1150. Students in College of Business. Mathematics Core. Differentiation and integration of exponential and logarithmic functions, applications to business. Functions of several variables, partial derivatives, multiple integrals.

MATH 1690 CALCULUS WITH BUSINESS APPS II (3) LEC. 3. Pr. MATH 1680 or MATH 1683 or MATH 1610 or MATH 1617 or MATH 1613. Probability, random variables, probability distributions. Further topics in calculus: integration, functions of several variables, applications to probability. Applications to business and related areas. Credit will not be given to majors in Engineering or Math or Physics.

MATH 1950 FIRST YEAR MATHEMATICS SEMINAR (1) SEM. 1. This seminar will provide a shared intellectual experience for incoming freshmen mathematics majors. It will serve as a focused and interactive forum to provide a glimpse into the world of mathematics that lies beyond elementary calculus. Each semester's symposium will be devoted to a specific mathematical topic. Writing about mathematics and explaining mathematical ideas to both “math people” and “non-math people” will be emphasized. Only offered to incoming first-year students (though transfer students and higher rank students may be allowed to enroll on an approval basis). May not be repeated for credit. High School Math will be required.

MATH 2630 CALCULUS III (4) LEC. 4. Pr. MATH 1620 or MATH 1623 or MATH 1627. "C" or better in MATH 1620, MATH 1623 or MATH 1627. Multivariate calculus: vector-valued functions, partial derivatives, multiple integration, vector calculus. Credit will be given for only MATH 2630 or MATH 2637.

MATH 2637 HONORS CALCULUS III (4) LEC. 4. Pr. MATH 1620 or MATH 1623 or MATH 1627. Must have earned a "C" or better in MATH 1620, MATH 1623 or MATH 1627. Honors version of MATH 2630. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: Applied Math-Actuarial Sci(ACTU), Applied Math-Discrete(DISC), Applied Mathematics(AMTH), and Mathematics(MATH). The same material as MATH 2630, but in greater depth appropriate for honors students and Mathematics majors. Credit will be given for only one of MATH 2630 or MATH 2633 or MATH 2637.

MATH 2650 LINEAR DIFFERENTIAL EQUATIONS (3) LEC. 3. Pr. P/C MATH 2630 or P/C MATH 2633 or P/C MATH 2637. Introduction to ordinary differential equations, specifically linear equations of first and second order, and applications.

MATH 2660 TOPICS IN LINEAR ALGEBRA (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Matrices, row-reduction, systems of linear equations, (finite-dimensional) vector spaces, subspaces, bases, dimension, change of basis, linear transformations, kernels, orthogonality, Gram-Schmidt.

MATH 2667 HONORS TOPICS IN LINEAR ALGEBRA (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Must have earned a "C" or better in MATH 1620 or MATH 1623 or MATH 1627. Honors version of MATH 2660. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: (Applied Math-Actuarial Sci(ACTU), Applied Math-Discrete(DISC), Applied Mathematics(AMTH), and Mathematics(MATH). Topics include: matrices, row-reduction, systems of linear equations, (finite-dimensional) vector spaces, subspaces, bases, dimension, change of basis, linear transformations, kernels, orthogonality, Gram-Schmidt. The same material as MATH 2660, but in greater depth appropriate for honors students and Mathematics majors, with possible additional topics as determined by the instructor. Credit will be given for only one of MATH 2660 or MATH 2667.

MATH 2670 INTRODUCTION TO DIFFERENTIAL EQUATIONS (3) LEC. 3. Pr. MATH 1620. Rigorous introduction to ordinary differential equations with emphasis on mathematical justification of solution methods and qualitative analysis of equations and low dimensional systems. The existence and uniqueness theorems. Separable equations, exact equations and integrating factors. Second order linear equations, the Wronskian, method of undetermined coefficients, variation of parameters. Laplace transform. Higher order equations. Systems of first order equations, fundamental matrix.

MATH 2790 MATHEMATICS OF INTEREST THEORY (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Mathematical foundations of the theory of interest necessary as preparation for the Society of Actuaries examination on the theory of interest.

MATH 2850 MATHEMATICS FOR ELEMENTARY EDUCATION I (3) LEC. 3. For Elementary Education major or departmental approval. Mathematical insights for elementary school teachers. Sets, the structure of the number system (integers, fraction, decimals).

MATH 2860 MATHEMATICS FOR ELEMENTARY EDUCATION II (3) LEC. 3. Pr. MATH 2850. For Elementary Education majors or departmental approval. Mathematical insights into measurement and geometry for elementary school teachers. Shapes in two and three dimensions. Similarities, congruences and transformations.

MATH 2870 MATHEMATICS FOR ELEMENTARY EDUCATION III (3) LEC. 3. For Elementary Education majors or departmental approval. Mathematical insights into probability, data analysis and functions for elementary school teachers. Uncertainty, probability spaces and an introduction to statistics. Relationships, functions and change.

MATH 3010 HISTORY OF MATHEMATICS (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. The evolution of modern mathematics from its motivational roots in the physical sciences; the lives and contributions of outstanding mathematicians; the parallel development of mathematics and western culture.

MATH 3100 INTRODUCTION TO ADVANCED MATHEMATICS (3) LEC. 3. Pr. MATH 2630 or MATH 2637. Teaching of the fundamental abilities necessary for the pursuance of mathematical studies. Logic and set theory, mathematical induction, basic number theory, basic analysis. Credit will not be given for both MATH 3100 and Math 3710.

MATH 3710 DISCRETE MATHEMATICS (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Methods of proof, induction, counting, inclusion-exclusion, discrete probability, relations, partial orders, graphs, trees, languages, grammars, finite state machines, automata. Credit will not be given for both MATH 3710 and Math 3100.

MATH 4110 ADVANCED LOGIC (3) LEC. 3. Pr. MATH 3100 or PHIL 3110. Advanced topics in logic. For example: soundness, completeness, incompleteness, set theory, proof theory, model theory, non-standard logics. May count either MATH 4110 or PHIL 4110.

MATH 4790 ACTUARIAL SEMINAR IN THE MATHEMATICS OF FINANCE (3) LEC. 3. Pr. MATH 2790. Intensive seminar in the mathematical aspects of finance, and the theory of interest primarily intended as preparation for the Society of Actuaries Course 2 examination.

MATH 4800 INTRODUCTION TO ACTUARIAL MATHEMATICS (3) LEC. 3. Pr. STAT 3600 and MATH 2790. An introduction to important actuarial methods in modeling and foundational principles of ratemaking and reserving for short-term coverages primarily intended as preparation for part of the Society of Actuaries Exam FAM.

MATH 4820 ACTUARIAL SEMINAR IN PROBABILITY (3) LEC. 3. Pr. STAT 3600. or equivalent. Intensive seminar in calculus, probability, and risk theory primarily intended as preparation for the Society of Actuaries Course 1 examination.

MATH 4930 DIRECTED STUDIES (1-3) IND. Study of individual problems or topics of interest to students. Course may be repeated for a maximum of 3 credit hours.

MATH 4970 SPECIAL TOPICS (1-4) IND. Departmental approval. An individual problems course. Each student will work under the direction of a staff member on a problem of mutual interest. Course may be repeated for a maximum of 4 credit hours.

MATH 4980 UNDERGRADUATE RESEARCH (1-3) IND. Departmental approval. Directed research in the area of specialty under faculty supervison. Course may be repeated for a maximum of 3 credit hours.

MATH 4997 HONORS THESIS (1-6) IND. Pr. Honors College. Course may be repeated for a maximum of 6 credit hours. Membership in Honors College.

MATH 5000 MATH MODELING CONTINUOUS (3) LEC. 3. Pr. MATH 2650 and MATH 2660. Introduction to mathematical models and related techniques. Includes general principles involving continuous deterministic problems and a detailed, specific term project. Programming ability.

MATH 5010 VECTOR CALCULUS (3) LEC. 3. Pr. (MATH 2630 or MATH 2637 or MATH 2730) and (MATH 2660 or MATH 2667). Departmental approval. Vector-valued functions, vector fields. Gradient, divergence, curl. Integral theorems: Green's Theorem, Stoke's Theorem, Gauss' Theorem. Tensors and differential forms. Applications.

MATH 5030 COMPLEX VARIABLES WITH APPLICATIONS I (3) LEC. 3. Pr. MATH 2650. Complex functions and their elementary mapping properties; contour integration and residues; Laurent series; applications to real integrals. MATH 5030-5040 are appropriate for students of engineering or science.

MATH 5040 COMPLEX VARIABLES WITH APPLICATIONS II (3) LEC. 3. Pr. MATH 5030. Linear fractional transformations; conformal mappings; harmonic functions; applications to boundary value problems; analytic continuation; entire functions. MATH 5030-5040 are appropriate for students of engineering or science.

MATH 5050 MATRIX THEORY AND APPLICATIONS (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Canonical forms, determinants, linear equations, eigenvalue problems.

MATH 5060 ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS (3) LEC. 3. Pr. MATH 2650. First and second order linear partial differential equations with emphasis on the method of eigenfunction expansions.

MATH 5110 NUMBER THEORY (3) LEC. 3. Pr. MATH 3100. Greatest common divisor, unique factorization, linear Diophantine equations. Modular arithmetic, Chinese remainder theorem, polynomial congruences. Quadratic residues, Legendre/Jacoby symbols, quadratic reciprocity. Primes. Moebius inversion. Sums of squares. Units and the integers mod n.

MATH 5120 INFORMATION THEORY (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Information and entropy, information rate optimization and channel capacity, variable-length codes, data compression (Kraft-McMillan inequality, Huffman's algorithm), maximum likelihood decoding, Shannon's Noisy Channel Theorem.

MATH 5130 CALCULUS OF VARIATION (3) LEC. 3. Pr. MATH 2650. Fundamental concepts of extrema of functions and functionals; first and second variations; generalizations; sufficient conditions; constrained functionals; the general Lagrange Problem; optimal control.

MATH 5140 DATA COMPRESSION (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627 or MATH 1720. Lossless compression methods, including static, dynamic, and higher order Huffman and arithmetic encoding, interval and recency rank encoding, and dictionary methods; lossy transform methods (JPEG).

MATH 5150 ALGEBRAIC CODING THEORY (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Linear codes, Hamming and Golay codes, BCH codes, cyclic codes. Random error detection and correction. Burst-error correction. Decoding algorithms. Credit will not be given for both MATH 5150 and MATH 6150/6156.

MATH 5170 FINITE EXTREMAL SET THEORY (3) LEC. 3. Pr. (MATH 2660 or MATH 2667) and (MATH 3100 or MATH 3710). Finite posets and their Hasse diagrams. Sequences and the Erdos-Szekeres Theorem. Chains and antichains, Dilworth's Theorem. Set systems in the hypercube, Sperner's Lemma and the LYM inequality. Intersecting families, the Erdos-Ko-Rado Theorem. Isoperimetric inequalities in the hypercube. Additional topics related to recent research. Includes paper reading and presentation component.

MATH 5180 CRYPTOGRAPHY (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Classical cryptosystems, the Data Encryption Standard, one-way functions and relevant number theoretic problems (factoring, primality testing, discrete logarithm problem), RSA and other public key cryptosystems.

MATH 5200 ANALYSIS I (3) LEC. 3. Pr. MATH 3100. "C" or better in MATH 3100. Real numbers, infima and suprema; sequences and series of real numbers, convergence and limits, Cauchy sequences and completeness; topology of the real line, Bolzano-Weierstrass and Heine-Borel theorems; real-valued functions of a real variable, continuity and uniform continuity. Emphasis on proofs.

MATH 5210 ANALYSIS II (3) LEC. 3. Pr. MATH 5200. Sequences and series of functions, modes of convergence, power series, elementary functions; derivatives and antiderivatives, the mean-value theorem; Riemann integration and the Fundamental Theorem of Calculus; R^n and abstract spaces, functions of several variables. Emphasis on proofs.

MATH 5280 SYSTEMS OF DIFFERENTIAL EQUATIONS AND APPLICATIONS (3) LEC. 3. Pr. MATH 2650 and (MATH 2660 or MATH 2667). Linear systems of differential equations, stability, phase portraits; non-linear systems, linearization, qualitative properties of orbits, Poincare-Bendixson Theorem; numerical methods; applications.

MATH 5300 THEORY OF DIFFERENCE EQUATIONS (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Linear difference equations, initial value problems, Green's functions, boundary value problems, systems, periodic solutions, nonlinear difference equations, models.

MATH 5310 INTRODUCTION TO ABSTRACT ALGEBRA I (3) LEC. 3. Pr. MATH 3100. "C" or better in MATH 3100. Groups, Groups of Permutations, isomorphisms and homomorphisms; Cyclic Groups, Quotient Groups, The Fundamental Homomorphism Theorem.

MATH 5320 INTRODUCTION TO ABSTRACT ALGEBRA II (3) LEC. 3. Pr. MATH 5310. Theory of rings and fields, Ideals and Homomorphisms, Quotient Rings, Rings of Polynomials, Extensions of Fields, Galois Theory.

MATH 5330 COMPUTATIONAL ALGEBRA (3) LEC. 3. Pr. MATH 5310. Introduction to computation in multivariate polynomial rings and finite fields. Topics include Groebner bases, Buchberger's Algorithm, kinematic/robotics problems, symbolic manipulation software.

MATH 5350 INTRODUCTION TO ALGEBRAIC GEOMETRY (3) LEC. 3. Pr. MATH 5320. LEC. 3. Pr. "C" or better in Math 5320. Affine varieties, Hilbert's Nullstellensatz, the Ideal-Variety Correspondence, irreducibility, polynomial and rational functions, projective varieties, Bezout's Theorem, dimension theory.

MATH 5370 LINEAR ALGEBRA (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Introduction to the theoretical foundations of Linear Algebra including vector spaces, basis, dimension, linear transformations, fundamental subspaces, matrix representations, eigenvalues, eigenspaces.

MATH 5380 INTERMEDIATE EUCLIDEAN GEOMETRY I (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Fundamental concepts and theorems of Euclidean geometry, introduction to higher dimensions. Regular polygons and polyhedra, symmetry groups, convexity, geometric extremum problems. Geometric transformations and their invariants.

MATH 5390 INTERMEDIATE EUCLIDEAN GEOMETRY II (3) LEC. 3. Pr. MATH 5380. Planar graphs and Euler's theorem. The symmetry group of a set, homotheties and similitudes, path, arcs and length of curves, advanced theorems on the circle.

MATH 5460 PERTURBATION METHODS (3) LEC. 3. Pr. MATH 2650. Analytical solutions of nonlinear problems, ODEs, PDEs, multiple scales, and transcendental equations in engineering, mathematics, and physics using both regular and singular perturbation methods.

MATH 5500 INTRODUCTION TO TOPOLOGY (3) LEC. 3. Pr. MATH 3100. C or better in MATH 3100. Metric spaces, topological spaces, continuity, compactness, connectedness, product and quotient spaces and local properties.

MATH 5630 INTRODUCTION TO NUMERICAL ANALYSIS I (3) LEC. 3. Pr. MATH 2650. Programming ability. Numerical solution of equations, polynomial approximation, numerical differentiation and integration, numerical solutions of ordinary differential equations, error analysis. Written programs using algorithms. Programming ability.

MATH 5640 INTRODUCTION TO NUMERICAL ANALYSIS II (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Programming ability. Numerical solutions of systems of linear equations, numerical computation of eigenvalues and eigen vectors, error analysis. Written programs using the algorithms.

MATH 5650 THEORY OF NONLINEAR OPTIMIZATION (3) LEC. 3. Pr. MATH 2650 and (MATH 2660 or MATH 2667). Kuhn-Tucker conditions, quadratic programming, search methods and gradient methods, Lagrangean and penalty function methods.

MATH 5670 PROBABILITY AND STOCHASTIC PROCESSES I (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Random variables, discrete and absolutely continuous distributions. Poisson process, expectation and conditional expectation. Moment generating functions, limit distributions. Emphasis on probabilistic reasoning and problem solving. Credit will not be given for both MATH 5670 and STAT 5670.

MATH 5680 PROBABILITY AND STOCHASTIC PROCESSES II (3) LEC. 3. Pr. MATH 5670 or STAT 5670. Multivariate distributions. Central Limit Theorem, Laplace transforms, convolutions, simulation, renewal processes, Continuous-time Markov Chains, Markov renewal and semi-regenerative processes, Brownian motion and diffusion. Credit will not be given for both MATH 5680 and STAT 5680.

MATH 5710 LINEAR OPTIMIZATION (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Theory and algorithms for standard linear optimization problems. Simplex algorithm and duality, shortest paths, network flows, min-cost flows and circulations, out-of-kilter method, assignments and matchings.

MATH 5730 ENUMERATION (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Using generating functions and Polya theory to do sophisticated counting. Permutations and combinations, inclusion-exclusion, partitions, recurrence relations, group actions, Polya theory with applications.

MATH 5750 INTRODUCTION TO GRAPH THEORY (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Algorithmic and theoretical aspects of graph theory: matchings, colorings, scheduling problems, Hamilton cycles. Euler tours, spanning trees, network reliability, connectivity, extremal graphs, planar graphs, disjoint paths.

MATH 5770 COMBINATORIAL DESIGNS (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627 or MATH 1720. Latin squares, mutually orthogonal latin squares, orthogonal and perpendicular arrays, Steiner triple systems, block designs, difference sets and finite geometries.

MATH 5800 ACTUARIAL MATHEMATICS I (3) LEC. 3. Pr. MATH 2790 and STAT 3600. A development of theoretical basis of survival models, life table, life insurance benefits, annuities, premium calculation and policy values primarily intended as preparation for part of the Society of Actuaries Exam FAM.

MATH 5810 ACTUARIAL MATHEMATICS II (4) LEC. 4. Pr. MATH 5800. This course develops the knowledge of theoretical basis to traditional and modern contingent payment models and the application of those models to insurance and other financial risks. It is primarily intended as preparation for the Society of Actuaries Exam ALTAM.

MATH 5840 FOUNDATIONS OF NUMBER THEORY FOR SECONDARY SCHOOL TEACHERS (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Divisibility, Diophantine equations, congruencies.

MATH 5850 NUMERICAL ANALYSIS FOR SECONDARY TEACHERS (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. The numerical solutions of selected problems arising in calculus and algebra along with the programming techniques. Computer familiarity.

MATH 5860 FOUNDATIONS OF NON-EUCLIDEAN GEOMETRY FOR SECONDARY SCHOOL TEACHERS (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. B.L. geometry, hyperbolic geometry, absolute geometry, parallel postulates.

MATH 5870 FINANCIAL MATHEMATICS (3) LEC. 3. Pr. (MATH 1610 or MATH 1613 or MATH 1617) and (MATH 1620 or MATH 1623 or MATH 1627) and MATH 2650 and STAT 3600. Options and spreads, pricing of such options in accordance with the Black-Scholes Equation, and the binomial pricing model.

MATH 5970 SPECIAL TOPICS (1-3) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 3 credit hours.

MATH 6000 MATHEMATICAL MODELING: CONTINUOUS (3) LEC. 3. Introduction to mathematical models and related techniques. Includes general principles involving continuous deterministic problems and a detailed, specific term-project. Programming ability.

MATH 6010 VECTOR CALCULUS (3) LEC. 3. Pr. (MATH 2630 or MATH 2637) and (MATH 2660 or MATH 2667). Departmental approval. Vector-valued functions, vector fields. Gradient, divergence, curl. Integral theorems: Green's Theorem, Stoke's Theorem, Gauss' Theorem. Tensors and differential forms. Applications.

MATH 6030 COMPLEX VARIABLES WITH APPLICATIONS I (3) LEC. 3. Complex functions and their elementary mapping properties; contour integration and residues; Laurent series; applications to real integrals. MATH 6030-6040 are appropriate for students of engineering or science.

MATH 6050 MATRIX THEORY AND APPLICATIONS (3) LEC. 3. Canonical forms, determinants, linear equations, eigenvalue problems.

MATH 6060 ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS (3) LEC. 3. First and second order linear partial differential equations with emphasis on the method of eigenfunction expansions.

MATH 6110 NUMBER THEORY (3) LEC. 3. Greatest common divisor, unique factorization, linear Diophantine equations. Modular arithmetic, Chinese remainder theorem, polynomial congruences. Quadratic residues, Legendre/Jacoby symbols, quadratic reciprocity. Primes. Moebius inversion. Sums of squares. Units and the integers mod n.

MATH 6120 INFORMATION THEORY (3) LEC. 3. Information and entropy, information rate optimization and channel capacity, variable-length codes, data compression (Kraft-McMillan inequality, Huffman's algorithm), maximum likelihood decoding, Shannon's Noisy Channel Theorem.

MATH 6140 DATA COMPRESSION (3) LEC. 3. Lossless compression methods, including static, dynamic, and higher order Huffman and arithmetic encoding, interval and recency rank encoding, and dictionary methods; lossy transform methods (JPEG).

MATH 6150 ALGEBRAIC CODING THEORY (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Linear codes, Hamming and Golay codes, BCH codes, cyclic codes. Random error detection and correction. Burst-error correction. Decoding algorithms. Credit will not be given for both MATH 5150 and MATH 6150/6156.

MATH 6170 FINITE EXTREMAL SET THEORY (3) LEC. 3. Pr. (MATH 2660 or MATH 2667) and (MATH 3100 or MATH 3710). Finite posets and their Hasse diagrams. Sequences and the Erdos-Szekeres Theorem. Chains and antichains, Dilworth's Theorem. Set systems in the hypercube, Sperner's Lemma and the LYM inequality. Intersecting families, the Erdos-Ko-Rado Theorem. Isoperimetric inequalities in the hypercube. Additional topics related to recent research. Includes paper reading and presentation component. Graduate version of MATH 5170.

MATH 6180 CRYPTOGRAPHY (3) LEC. 3. Classical cryptosystems, the Data Encryption Standard, one-way functions and relevant number theoretic problems (factoring, primality testing, discrete logarithm problem), RSA and other public key cryptosystems.

MATH 6200 ANALYSIS I (3) LEC. 3. or equivalent course, subject to departmental approval. Real numbers, infima and suprema; sequences and series of real numbers, convergence and limits, Cauchy sequences and completeness; topology of the real line, Bolzano-Weierstrass and Heine-Borel theorems; real-valued functions of a real variable, continuity and uniform continuity; intermediate#value and extreme-value theorems. Emphasis on proofs.

MATH 6210 ANALYSIS II (3) LEC. 3. Pr. MATH 6200. Sequences and series of functions, modes of convergence, power series, elementary functions; derivatives and power series, elementary functions; derivatives and antiderivatives, the mean-value theorem; Riemann integration and the Fundamental Theorem of Calculus; R^n and abstract spaces, functions of several variables. Emphasis on proofs.

MATH 6310 INTRODUCTION TO ABSTRACT ALGEBRA I (3) LEC. 3. Departmental approval. Groups, Groups of Permutations, isomorphisms and homomorphisms; Cyclic Groups, Quotient Groups, The Fundamental Homomorphism Theorem.

MATH 6320 INTRODUCTION TO ABSTRACT ALGEBRA II (3) LEC. 3. Pr. MATH 6310. Theory of rings and fields, Ideals and Homomorphisms, Quotient Rings, Rings of Polynomials, Extensions of Fields, and Galois Theory.

MATH 6330 COMPUTATIONAL ALGEBRA (3) LEC. 3. Pr. MATH 6310. Introduction to computation in multivariate polynomial rings and finite fields. Topics include Groebner bases, Buchberger's Algorithm, kinematic/robotics problems, and symbolic manipulation software.

MATH 6350 INTRODUCTION TO ALGEBRAIC GEOMETRY (3) LEC. 3. Pr. MATH 5320. LEC. 3. Pr. "C" or better in Math 5320. Affine varieties, Hilbert's Nullstellensatz, the Ideal-Variety Correspondence, irreducibility, polynomial and rational functions, projective varieties, Bezout's Theorem, dimension theory.

MATH 6370 LINEAR ALGEBRA (3) LEC. 3. Introduction to the theoretical foundations of Linear Algebra Algebra including vector spaces, basis, dimension, linear transformations, fundamental subspaces matrix representations, eigenvalues, eigenspaces.

MATH 6380 INTERMEDIATE EUCLIDEAN GEOMETRY I (3) LEC. 3. Fundamental concepts and theorems of Euclidean geometry, introduction to higher dimensions. Regular polygons and polyhedra, symmetry groups, convexity, geometric extremum problems. Geometric transformations and their invariants.

MATH 6390 INTERMEDIATE EUCLIDEAN GEOMETRY II (3) LEC. 3. Pr. MATH 6380. Planar graphs and Euler's theorem. The symmetry group of a set, homotheties and similitudes, path, arcs and length of curves, and advanced theorems on the circle.

MATH 6460 PERTURBATION METHODS (3) LEC. 3. Pr. MATH 2660 or MATH 2667. Departmental approval. Analytical solutions of nonlinear problems, ODES, PDEs, multiple scales, and transcendental equations in engineering, mathematics, and physics using both regular and singular perturbation methods. May count either AERO/MATH 5460 or AERO/MATH 6460.

MATH 6500 INTRODUCTION TO TOPOLOGY (3) LEC. 3. Departmental approval. Metric spaces, topological spaces, continuity, compactness, connectedness, product and quotient spaces and local properties.

MATH 6630 INTRODUCTION TO NUMERICAL ANALYSIS I (3) LEC. 3. Numerical solution of equations, polynomial approximation, numerical differentiation and integration, numerical solutions of ordinary differential equations, error analysis. Written programs using algorithms. Programming ability.

MATH 6640 INTRODUCTION TO NUMERICAL ANALYSIS II (3) LEC. 3. Numerical solutions of systems of linear equations, numerical computation of eigenvalues and eigenvectors, error analysis. Written programs using the algorithms. Programming ability.

MATH 6650 THEORY OF NONLINEAR OPTIMIZATION (3) LEC. 3. Kuhn-Tucker conditions, quadratic programming, search methods and gradient methods, Lagrangean and penalty function methods.

MATH 6670 PROBABILITY AND STOCHASTIC PROCESSES I (3) LEC. 3. Random variables, discrete and absolutely continuous distributions. Poisson process, expectation and conditional expectation. Moment generating functions, limit distributions. Emphasis on probabilistic reasoning and problem solving. Credit will not be given for both MATH 6670 and STAT 6670.

MATH 6680 PROBABILITY AND STOCHASTIC PROCESSES II (3) LEC. 3. Pr. MATH 6670 or MATH 6676 or STAT 6670 or STAT 6676. Multivariate distributions. Central Limit Theorem, Laplace transforms, convolutions, simulation, renewal processes, Continuous-time Markov Chains, Markov renewal and semi- regenerative processes, Brownian motion and diffusion. Credit will not be given for both MATH 6680 and STAT 6680.

MATH 6710 LINEAR OPTIMIZATION (3) LEC. 3. Theory and algorithms for standard linear optimization problems. Simplex algorithm and duality, shortest paths, network flows, min-cost flows and circulations, out-of-kilter method, assignments and matchings.

MATH 6730 ENUMERATION (3) LEC. 3. Using generating functions and Polya theory to do sophisticated counting. Permutations and combinations, inclusion-exclusion, partitions, recurrence relations, group actions, Polya theory with applications.

MATH 6750 INTRODUCTION TO GRAPH THEORY (3) LEC. 3. Algorithmic and theoretical aspects of graph theory: matchings, colorings, scheduling problems, Hamilton cycles. Euler tours, spanning trees, network reliability, connectivity, extremal graphs, planar graphs, disjoint paths.

MATH 6770 COMBINATORIAL DESIGNS (3) LEC. 3. Latin squares, mutually orthogonal latin squares, orthogonal and perpendicular arrays, Steiner triple systems, block designs, difference sets and finite geometries.

MATH 6800 ACTUARIAL MATHEMATICS I (3) LEC. 3. Departmental approval. A development of theoretical basis of survival models, life table, life insurance benefits, annuities, premium calculation and policy values primarily intended as preparation for part of the Society of Actuaries Exam FAM.

MATH 6810 ACTUARIAL MATHEMATICS II (4) LEC. 4. Pr. MATH 6800. This course develops the knowledge of theoretical basis to traditional and modern contingent payment models and the application of those models to insurance and other financial risks. It is primarily intended as preparation for the Society of Actuaries Exam ALTAM.

MATH 6840 NUMBER SYSTEMS AND ALGEBRA FOR TEACHERS (3) LEC. 3. Pr. MATH 3100. Connections of advanced college-level mathematics with the secondary mathematics curriculum, focusing on number systems, algebra, and functions, to develop mathematical knowledge relevant to teaching. Includes appropriate uses of technology and non-routine mathematics problem solving. Admission to a program in Secondary Mathematics Education or department approval required.

MATH 6850 FUNCTIONS AND MATHEMATICAL MODELING FOR TEACHERS (3) LEC. 3. Pr. MATH 2650 or MATH 2660 or MATH 2667. Connections of advanced college-level mathematics with the secondary mathematics curriculum, focusing on functions and mathematical modeling, to develop mathematical knowledge relevant to teaching. Includes appropriate uses of technology and non-routine mathematics problem solving. Admission to a program in Secondary Mathematics Education or department approval required.

MATH 6860 GEOMETRY FOR TEACHERS (3) LEC. 3. Pr. MATH 2660 or MATH 2667 or MATH 3100. Connect advanced college-level mathematics with the secondary mathematics curriculum, focusing on geometry, to develop mathematical knowledge relevant to teaching. The contents include axiomatic systems of geometry, transformational geometry, and similarity. Appropriate technology and mathematics problem solving skills will be introduced. Admission to a program in Secondary Mathematics Education or department approval required.

MATH 6870 FINANCIAL MATHEMATICS (3) LEC. 3. Pr. (MATH 1610 or MATH 1613 or MATH 1617) and (MATH 1620 or MATH 1623 or MATH 1627) and MATH 2650 and STAT 3600. Options and spreads, pricing of such options in accordance with the Black-Scholes Equation, and the binomial pricing model.

MATH 6970 SPECIAL TOPICS (1-3) DSL. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 3 credit hours.

MATH 7000 APPLIED MATHEMATICS I (3) LEC. 3. Departmental approval. Linear spaces, matrices, eigenvalues, least squares solutions to linear systems, Hilbert spaces, orthogonal expansions, integral equations, compact operators, Green's functions for boundary value problems, eigenfunction expansions.

MATH 7010 APPLIED MATHEMATICS II (3) LEC. 3. Pr. MATH 7000 or MATH 7006. Calculus of variations, asymptotic expansions, Spectral theory, Fourier transform, Partial differential equations, transform methods and eigenfunction expansions, vibrations, diffusion processes, equilibrium states, Green's functions, boundary layer problems.

MATH 7110 DISCRETE GEOMETRY AND CONVEXITY I (3) LEC. 3. Departmental approval. Geometric objects and configurations with discrete symmetry groups. Regular polygons and polyhedra. Regular arrangements. Plane tilings and patterns.

MATH 7120 DISCRETE GEOMETRY AND CONVEXITY II (3) LEC. 3. Pr. MATH 7110. Convexity and related geometric extremum problems. Packing and covering. Arrangements of extreme density.

MATH 7140 INTRODUCTION TO MODEL THEORY (3) LEC. 3. Departmental approval. First-order languages, Satisfaction. Consequences. The completeness and compactness theorems, models constructed from constants. Elementary substructures and embeddings, Lowenheim-Skolem-Tarskj theorems. Ultraproducts and ultrapowers.

MATH 7150 AXIOMATIC SET THEORY I (3) LEC. 3. Departmental approval. Introduction to modern set theory. The axioms of ZFC, ordinals and cardinals, closed unbounded sets, the constructible universe L, Martin's Axiom.

MATH 7160 AXIOMATIC SET THEORY II (3) LEC. 3. Pr. MATH 7150. Introduction to forcing, independence results, iterated forcing, consistency of Martin's Axiom.

MATH 7180 ALGORITHMIC ALGEBRA I (3) LEC. 3. Departmental approval. Fundamental aspects of algorithmic algebra. Noetherian rings. Theory of Groebner bases. Hilbert Nullstellensatz. Elimination theory. Applications to graph theory and algebraic geometry.

MATH 7190 ALGORITHMIC ALGEBRA II (3) LEC. 3. Pr. MATH 7180. Modules. Groebner bases for modules and syzygy computations. Improved Buchberger's algorithm. Computation of Ext. Groebner bases over rings. Primary decomposition of ideals. Dimension theory.

MATH 7200 REAL ANALYSIS I (3) LEC. 3. Departmental approval. Sigma algebras, measures, measurable functions, integratability, properties of Lebesgue measure, density, Lusin's theorem, Egeroff's theorem, product measures, Fubini's theorem. Limit theorems involving pointwise convergence and integration.

MATH 7210 REAL ANALYSIS II (3) LEC. 3. Pr. MATH 7200. L-p spaces, completeness, duals. Weak convergence, norm convergence, pointwise convergence, convergence in measure. Signed and complex measures. Absolute continuity, Lebesgue decomposition. Measure theory, Lebesgue integration, introductory functional analysis.

MATH 7230 FUNCTIONS OF A COMPLEX VARIABLE I (3) LEC. 3. Departmental approval. Complex numbers, analytic functions, derivatives, Cauchy integral theorem and formulae, Taylor and Laurent series, analytic continuation, residues, maximum principles, Riemann surfaces.

MATH 7240 FUNCTIONS OF A COMPLEX VARIABLE II (3) LEC. 3. Pr. MATH 7230. Conformal mappings, families of analytic functions and harmonic analysis.

MATH 7280 ADVANCED THEORY OF ORDINARY DIFFERENTIAL EQUATIONS I (3) LEC. 3. Departmental approval. Existence and continuation theorems for ordinary differential equations, continuity and differentiability with respect to initial conditions, linear systems, differential inequalities, Sturm theory.

MATH 7290 ADVANCED THEORY OF ORDINARY DIFFERENTIAL EQUATIONS II (3) LEC. 3. Pr. MATH 7280. Stability theory, periodic solutions, boundary value problems, disconjugacy of linear equations, Green's functions, upper and lower solutions, a priori bounds methods, current research.

MATH 7310 ALGEBRA I (3) LEC. 3. Departmental approval. Groups, Lagrange's Theorem, normal subgroups, factor groups, Isomorphism and Correspondence Theorems. Symmetric groups, alternating groups, free groups, torsion groups. Introduction to rings, correspondence theorems.

MATH 7320 ALGEBRA II (3) LEC. 3. Pr. MATH 7310. Rings, modules, vector spaces, and semi-simple modules. Commutative rings; prime and primary ideals, PIDs are UFD, factorizations in integral domains, field extensions, the Galois Correspondence Theorem.

MATH 7340 RING THEORY (3) LEC. 3. Pr. MATH 7320. Topics on: commutative rings (Cohen-Seidenberg theorems, Krull Intersection Theorem, Dedekind domains), or noncommutative rings (projective modules over Artinian algebras, representation type, Noether-Skolem Theorem, division algebras).

MATH 7350 ALGEBRAIC GEOMETRY (3) LEC. 3. Pr. MATH 7320 and P/C MATH 7500. Pr. ``C" or better in Math 7320 and Math 7500. Affine and projective varieties, the Ideal-Variety Correspondence, morphisms and rational maps of varieties, Bezout's Theorem, sheaves, schemes, divisors, sheaf cohomology.

MATH 7360 LIE ALGEBRA (3) LEC. 3. General introduction of Lie algebras including their structures and classifications of semisimple Lie algebras.

MATH 7370 MATRICES I (3) LEC. 3. Departmental approval. Jordan form, functions of a matrix, spectral theorem, singular values, norms, quadratic forms, field of values, inertia; topics of current interest.

MATH 7380 MATRICES II (3) LEC. 3. Pr. MATH 7370. Matrix stability and inertia, inequalities for matrix eigenvalues and singular values, The Kronecker and Hadamard matrix products, the exponential and logarithm matrix map; topics of current interest.

MATH 7390 MULTILINEAR ALGEBRA (3) LEC. 3. Pr. MATH 5370 or MATH 6370. Multilinear algebra, symmetry class of tensors, induced operators, generalized matrix functions, and current research topics.

MATH 7400 FUNCTIONAL ANALYSIS I (3) LEC. 3. Pr. MATH 7210. Departmental approval. Bounded linear transformations and functionals on Banach and Hilbert spaces, weak topologies, linear operators, adjoints, compact operators. Banach algebras, spectral theory, Gelfand transform.

MATH 7410 FUNCTIONAL ANALYSIS II (3) LEC. 3. Pr. MATH 7400. C*-algebras, Hermitian, self adjoint elements, functional calculus for commutative algebras. Normal operators on Hilbert space, spectral theorem, applications, symmetric and self-adjoint operators, normal operators, the spectral theorem.

MATH 7440 PARTIAL DIFFERENTIAL EQUATIONS I (3) LEC. 3. Departmental approval. Second order linear elliptic and hyperbolic equations stressing non-linear and numerical problems, characteristic domains of dependence, energy integrals, finite difference schemes, Sobolev spaces, maximum principle.

MATH 7450 PARTIAL DIFFERENTIAL EQUATIONS II (3) LEC. 3. Pr. MATH 7440. Parabolic and hyperbolic equations, stressing numerical problems, characteristics, domains of dependence, energy integrals, reaction-diffusion problems, Navier-Stokes equations, fixed-point and Galerkin methods.

MATH 7460 ADVANCED PERTURBATION METHODS (3) LEC. 3. Departmental approval. Solutions of nonlinear problems and integrals using WKB, Rayleigh-Janzen, Generalized Scales, Latta, van der Pol, Watson, Laplace, Adomian, homotopy, Pade, Liouville-Green and Burmann transformations. May count either AERO 7460/7466 or MATH 7460/7466.

MATH 7500 TOPOLOGY I (3) LEC. 3. Departmental approval. Separation and countability axioms, covering properties, completeness, connectedness, metric spaces and metrizability, product and quotient spaces, function spaces.

MATH 7510 TOPOLOGY II (3) LEC. 3. Pr. MATH 7500. Homotopy, elementary properties of retracts, fundamental groups, covering spaces, computations of fundamental groups.

MATH 7530 CONTINUUM THEORY I (3) LEC. 3. Pr. MATH 7510. Departmental approval. Topics such as inverse limits, decompositions, hyperspaces, special mappings, topological structures from the pathological (indecomposable continua), to the straightforward (Peano continua).

MATH 7540 CONTINUUM THEORY II (3) LEC. 3. Pr. MATH 7530. Topics in continuum theory such as confluent mappings, epsilon mappings, chains, to-the-boundary theorems, relationship to inverse limits, advanced topics.

MATH 7550 SET THEORETIC TOPOLOGY I (3) LEC. 3. Pr. MATH 7510. Departmental approval. Compactifications, covering properties, metrization theorems and generalized metrizable spaces, topological groups.

MATH 7560 SET THEORETIC TOPOLOGY II (3) LEC. 3. Pr. MATH 7550. Topological Groups, Cardinal invariants, use of set-theoretic axioms such as Martin's Axiom, independence results, advanced topics.

MATH 7600 ADVANCED NUMERICAL MATRIX ANALYSIS (3) LEC. 3. Departmental approval. Topics selected from: discretization matrices, sparse matrices, QR-algorithm, symmetric eigenvalue problems, singular value decomposition, pseudo-inverses, simplex method, matrix algorithms for vector computers.

MATH 7610 NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS I (3) LEC. 3. Pr. MATH 2650 and (MATH 2660 or MATH 2667) and (MATH 5630 or MATH 6630) and (MATH 5640 or MATH 6640). Finite difference methods for ordinary and partial differential equations.

MATH 7630 NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS II (3) LEC. 3. Pr. MATH 7610. Finite element methods for partial differential equations.

MATH 7700 GRAPH THEORY (3) LEC. 3. Algorithmic, enumerative and theoretical aspects of graph theory: matchings and factors, colorings, Hamiltonicity, connectivity, trees, extremal graphs, planarity. May count either MATH 6750 or MATH 7700.

MATH 7710 COMPUTATIONAL GEOMETRY (3) LEC. 3. Departmental approval. Design and time-complexity of computer algorithms for geometry problems studying the geometric ideas needed for computer-aided design, computer graphics and robotics.

MATH 7720 INTRODUCTION TO CODING THEORY (3) LEC. 3. Introduction to methods and algorithms for reliable communications through error control coding. BCH, Reed- Solomon, Reed-muller codes, convolutional codes, Berlekamp-Massey, Viterbi, and iterated decoding algorithms.

MATH 7730 ADVANCED TOPICS IN CODING THEORY (3) LEC. 3. Pr. MATH 7720. Departmental approval. Structure and theoretical properties of codes and related algorithms. Relations to other combinatorial and algebraic objects stressed.

MATH 7740 ADVANCED COMBINATORIAL DESIGNS (3) LEC. 3. Topics of current interest and research in combinatorial design theory. Areas included: latin squares, embeddings, Wilson's constructions, quadruple systems, Hadamard designs, graph designs, orthogonal arrays.

MATH 7750 ADVANCED TOPICS IN GRAPH THEORY (3) LEC. 3. Pr. MATH 6750 or MATH 7700. Topics of current interest and recent research in graph theory. May include edge colorings, algebraic graph theory, network flows, factor theory.

MATH 7760 INTRODUCTION TO ALGEBRAIC TOPOLOGY I (3) LEC. 3. Pr. MATH 7510. Departmental approval. Homology of chain complexes, the axioms of homology and their verification, computations of homology groups.

MATH 7770 INTRODUCTION TO ALGEBRAIC TOPOLOGY II (3) LEC. 3. Pr. MATH 7760. Homology with coefficients and universal coefficient theorem theorems, Cohomology and universal coefficient theorems, homology of products of spaces, cup and cap products, duality in manifolds.

MATH 7780 ADVANCED ALGEBRAIC TOPOLOGY I (3) LEC. 3. Departmental approval. Advanced topics in homology, cohomology, and duality with relations to and further study of homotopy theory. Applications to and further study of manifolds and geometric topology.

MATH 7790 ADVANCED ALGEBRAIC TOPOLOGY II (3) LEC. 3. Pr. MATH 7780. Continuation of MATH 7780; advanced topics in homology, cohomology, and duality with relations to and further study of homotopy theory. Applications to and further study of manifolds and geometric topology.

MATH 7800 PROBABILITY I (3) LEC. 3. Pr., a full year of undergraduate mathematical analysis at a level commensurate with MATH 5200/5210. Measure-theoretic foundations, independence, conditioning, martingales, Markov property, stationarity, random walks, Markov chains, Poisson processes.

MATH 7810 PROBABILITY II (3) LEC. 3. Pr. MATH 7800. Classical and modern topics in stochastic processes (Markov chains, Poisson process, Brownian motion). Applications and stochastic models (queues, stationary processes, population dynamics, finances). Credit will not be given for both MATH 7810 and STAT 7810.

MATH 7820 APPLIED STOCHASTIC PROCESSES I (3) LEC. 3. Classical and modern topics in stochastic processes (Markov processes, Random Walks, Martingales, Brownian motion). Introduction to stochastic integrals and differential equations. Applications (queues, population dynamics, chaos, finances). Credit will not be given for both MATH 7820 and STAT 7820.

MATH 7830 APPLIED STOCHASTIC PROCESSES II (3) LEC. 3. Classical and modern topics in stochastic processes (Markov processes, Random Walks, Martingales, Brownian motion). Introduction to stochastic integrals and differential equations. Applications (queues, population dynamics, chaos finances).

MATH 7870 REAL FUNCTIONS AND DESCRIPTIVE SET THEORY I (3) LEC. 3. Pr. MATH 7210 or MATH 7500. Borel classification of sets, the Baire classification of real functions. Derivatives and approximately continuous functions. The Lebesegue density topology.

MATH 7880 REAL FUNCTIONS AND DESCRIPTIVE SET THEORY II (3) LEC. 3. Pr. MATH 7870. Analytic and coanalytic sets. Lebesegue measurable, universally measurable and Marczewski measurable sets and functions. Baire properties. Singular sets. Category analogs to real analysis.

MATH 7950 SEMINAR (1-3) SEM. SU. Course may be repeated for a maximum of 6 credit hours.

MATH 7960 SPECIAL PROBLEMS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 10 credit hours.

MATH 7970 SPECIAL TOPICS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated with change in topics.

MATH 7980 RESEARCH AND SPECIAL PROJECT IN APPLIED MATHEMATICS (1-10) RES. SU. Departmental approval. For students working on the Master of Applied Mathematics degree with concentration in numerical analysis. Course may be repeated for a maximum of 10 credit hours.

MATH 7990 RESEARCH AND THESIS (1-10) MST. Course may be repeated with change in topics.

MATH 8310 HOMOLOGICAL ALGEBRA I (3) LEC. 3. Pr. MATH 7320. Departmental approval. Homology and cohomology. Hom and Tensor functors; the adjoint isomorphisms, injective/projective modules, flat modules, the classification of certain rings using homological tools.

MATH 8330 INTRODUCTION TO LIE GROUPS (3) LEC. 3. Pr. MATH 7310 or MATH 7370. Introduce Lie groups via matrix groups. Topics include exponential map, Lie algebras, classical groups, structures and classifications, manifolds, representations.

MATH 8960 SPECIAL PROBLEMS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 15 credit hours.

MATH 8970 SPECIAL TOPICS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 15 credit hours.

MATH 8990 RESEARCH AND DISSERTATION (1-10) DSR. Course may be repeated with change in topics.

Physics Courses

PHYS 1000 FOUNDATIONS OF PHYSICS (4) LEC. 3. LAB. 2. Science Core. Newton's Laws, momentum and energy, solids, liquids, gases, plasma, thermodynamics, electricity, magnetism, light, atomic and nuclear physics. Students who have previous credit in any higher-numbered physics course may not receive credit.

PHYS 1001 FOUNDATIONS OF PHYSICS LABORATORY (1) LAB. 2. Coreq. PHYS 1003. Core-curriculum laboratory course in physics focusing on practical applications and hands-on experience. Topics include: Newton's Laws, momentum and energy, solids, liquids, gases, plasma, thermodynamics, electricity, magnetism, light, atomic and nuclear physics.

PHYS 1100 PHYSICS ORIENTATION (1) LEC/SEM. SU. The course will provide incoming Physics majors with an orientation to the Physics program and will develop critical thinking and professional skills that complement academic and research training. Students will be exposed to aspects of physics research through a broad range of topical discussions with the instructor, other faculty and/or outside speakers.

PHYS 1150 ASTRONOMY (4) LEC. 3. LAB. 3. Science Core. Open to non-science majors. Earth, the solar system, stars, neutron stars, black holes, supernova, galaxies, the expanding universe, and modern cosmological theories.

PHYS 1400 PHYSICS FOR AVIATORS (4) LEC. 3. LAB. 3. Pr. (MATH 1130 or MATH 1150 or MATH 1610 or MATH 1617) and SCMH 1010. Departmental approval. The course provides students with an overview of introductory physics topics such as kinematics, laws of motion, conservation laws, thermodynamics, waves, basic electrical circuits, magnetic fields, and optics essential as a foundation of aviation. The course will specifically utilize examples and problems related to aviation.

PHYS 1500 GENERAL PHYSICS I (4) LEC. 3. LAB. 3. Pr. MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or P/C MATH 1610 or P/C MATH 1613 or P/C MATH 1617 or P/C MATH 1620 or P/C MATH 1623 or P/C MATH 1627 or P/C MATH 1710 or P/C MATH 1720 or P/C MATH 2630 or P/C MATH 2637. Science Core. Introduction to Newton's Laws, gravitation and cosmology, concept of conservation laws, solids and fluids, thermodynamics. Math at level of MATH 1130 or higher is expected. Credit will not be given for both PHYS 1500 and PHYS 1600 or PHYS 1607.

PHYS 1510 GENERAL PHYSICS II (4) LEC. 3. LAB. 3. Pr. PHYS 1500 or PHYS 1600 or PHYS 1607. Science Core. Electricity and magnetism, AC circuits, waves, nuclear physics, radioactivity and particle physics. Physics at the level of PHYS 1500 or higher is expected. Credit will not be given for both PHYS 1510 and PHYS 1610 or PHYS 1617.

PHYS 1600 ENGINEERING PHYSICS I (4) LEC. 3. LAB. 3. Pr. MATH 1610 or MATH 1613 or MATH 1617 or P/C MATH 1620 or P/C MATH 1623 or P/C MATH 1627 or P/C MATH 2630 or P/C MATH 2637. Science Core. Introduction to Newton's Laws, gravitation, cosmology, conservation of energy, momentum and angular momentum, special relativity, and fluids using introductory calculus. Math at the level of MATH 1610 or higher is required as a prerequisite. Credit will not be given for both PHYS 1500 and PHYS 1600 or PHYS 1607.

PHYS 1607 HONORS PHYSICS I (4) LEC. 3. LAB. 3. Pr. Honors College. Science Core. Honors version of PHYS 1600. Membership in the Honors College or Departmental approval required. Recommended for Physics majors. Math at the level of MATH 1610 or higher is required as a prerequisite. Credit will not be given for both PHYS 1500 and PHYS 1600 or PHYS 1607.

PHYS 1610 ENGINEERING PHYSICS II (4) LEC. 3. LAB. 3. Pr. (PHYS 1600 or PHYS 1607) and (MATH 1620 or MATH 1623 or MATH 1627). Science Core. Thermodynamics, electricity and magnetism, simple AC circuits, waves, and geometric optics. Physics at the level of PHYS 1600 or higher is expected. Math at the level of MATH 1620 or higher is required as a prerequisite. Credit will not be given for both PHYS 1510 and PHYS 1610 or PHYS 1617.

PHYS 1617 HONORS PHYSICS II (4) LEC. 3. LAB. 3. Pr. Honors College. MATH 1620 and PHYS 1600 or PHYS 1607. Science Core. Honors version of PHYS 1610. Membership in the Honors College or Departmental approval required. Recommended for Physics majors. Math at the level of MATH 1620 or higher is required as a prerequisite. Physics at the level of PHYS 1600 or higher is expected. Credit will not be given for both PHYS 1510 and PHYS 1610 or PHYS 1617.

PHYS 2100 INTERMEDIATE MECHANICS (3) LEC. 3. Pr. (PHYS 1610 or PHYS 1617) and (P/C MATH 2630 or P/C MATH 2637 or P/C MATH 2633). Principles and applications of Newtonian mechanics, noninertial reference frames, harmonic motion, central forces, rigid bodies, introduction to Lagrangian and Hamiltonian mechanics.

PHYS 2200 INTRODUCTORY QUANTUM PHYSICS AND RELATIVITY (3) LEC. 3. Pr. PHYS 1617 or PHYS 1610. Observational foundations of quantum physics, relativity and developments of several branches of physics up to their present frontiers.

PHYS 2300 PHYSICS LABORATORY SKILLS (3) LEC. 1. LAB. 5. Pr. PHYS 1617 or PHYS 1610. The measurement process and its unavoidable uncertainties; standard laboratory instruments; data analysis techniques and tools.

PHYS 2400 MATHEMATICAL AND COMPUTATIONAL METHODS OF PHYSICS (3) LEC. 3. Pr. (MATH 2630 or MATH 2637) and (PHYS 1610 or PHYS 1617). This course introduces students of physics and related fields to mathematical tools and techniques that are needed later in the physics curriculum. Topics include complex numbers, linear algebra, linear and partial differential equations, Fourier series and integrals, and vector calculus with physical application. Students will be introduced to the Python-based computational toolkits to aid in their problem solving.

PHYS 3100 INTERMEDIATE ELECTRICITY AND MAGNETISM (3) LEC. 3. Pr. (PHYS 1617 or PHYS 1610) and (MATH 2630 or MATH 2637 or MATH 2730). Electrostatics, Magnetostatics, Laplace's equation, boundary-value problems, multipole expansions, dielectric and magnetic materials. Faraday's law, AC circuits, and Maxwell's equations.

PHYS 3200 STATISTICAL THERMODYNAMICS (3) LEC. 3. Pr. PHYS 2200. The basic laws of thermodynamics, kinetic theory, and statistical mechanics including entropy, the partition function, free energy, and the quantum statistics of Fermions and Bosons.

PHYS 3500 PHYSICS OF THE WORLD AROUND US (3) LEC. 3. Interdisciplinary topic e.g. Biophysics, Astrophysics, Physics of Weather, Physics of Music, or Environmental Physics. Course may be repeated for a maximum of 12 credit hours.

PHYS 3610 APPLICATIONS OF MODERN PHYSICS (3) LEC. 3. Pr. PHYS 2200. Survey of contemporary subdisciplines in physics and technology that are based on the principles of quantum mechanics such as atomic/molecular physics, statistical mechanics, condensed matter/material science, astrophysics, nuclear physics, and elementary particle physics.

PHYS 3620 OBSERVATIONAL ASTRONOMY (3) LEC. 3. Pr. PHYS 1600 and (MATH 1620 or MATH 1627). This course will introduce students to astronomy from an observational perspective. Students will first learn about astronomical images and data analysis and discuss the physics of the solar system, stars, galaxies, and the universe. As part of the course, students will collect and analyze astronomical data using departmental telescopes and access publicly available data from facilities to demonstrate astrophysical principles.

PHYS 4100 FUNDAMENTALS OF QUANTUM MECHANICS (3) LEC. 3. Pr. PHYS 2200 and MATH 2650. Schrodinger equation, stationary and time-dependent solutions, spin and the exclusion principle, perturbation theory, scattering and resonances, the interpretation of quantum mechanics.

PHYS 4200 FUNDAMENTAL EXPERIMENTS IN PHYSICS (3) LEC. 1. LAB. 5. Pr. PHYS 2300. Experiments that demonstrate the fundamental ideas and facts of physics. Data will be collected, analyzed, interpreted and reported in comprehensive lab reports.

PHYS 4930 DIRECTED STUDIES IN PHYSICS (1-5) IND. Departmental approval. Student will study a topic of interest under the direction of a faculty member. Course may be repeated for a maximum of 10 credit hours.

PHYS 4967 HONORS SPECIAL PROBLEMS (1-3) IND. Pr. Honors College. Departmental approval.. Course may be repeated for a maximum of 6 credit hours.

PHYS 4980 UNDERGRADUATE RESEARCH IN PHYSICS (1-5) IND. Departmental approval. Student will work under the direction of a faculty member on a problem of mutual interest. Course may be repeated for a maximum of 10 credit hours.

PHYS 4997 HONORS THESIS (1-6) IND. Pr. Honors College. Departmental approval.. Course may be repeated for a maximum of 6 credit hours.

PHYS 5100 APPLICATIONS OF QUANTUM MECHANICS (3) LEC. 3. Pr. PHYS 4100. Quantum mechanics applied to atomic physics, solid state physics, nuclear physics, particle physics, electrodynamics, and cosmology.

PHYS 5200 TEACHING AND LEARNING OF STEM (3) LEC. 3. This course will provide students with a basic knowledge of the relevant research in cognitive psychology and learning science and the ability to apply that knowledge to enhance their ability to learn and teach science, particularly at the undergraduate level. This course will involve readings, discussion, and application of the ideas through the creation of learning activities. It is suitable for advanced undergraduates and graduate students with some science background.

PHYS 5300 OPTICS (3) LEC. 2. LAB. 2. Pr. PHYS 1617 or PHYS 1610. An overview of optics to include geometrical optics, electromagnetic waves, interference of light, diffraction of light, optical detectors, instrumentation and displays.

PHYS 5500 FUNDAMENTALS OF PHYSICS (3) LEC. 3. A subject such as Wave Mechanics, Mathematical Physics, Nonlinear Dynamics, Optics, Nuclear Physics, Elementary Particles, Relativity, or Electrodynamics. Course may be repeated for a maximum of 9 credit hours.

PHYS 5600 FRONTIERS OF PHYSICS (3) LEC. 3. A subject from the research areas in the Department such as Solid State, Atomic, Plasma, Space, or Computational Physics will be selected by the lecturer. Course may be repeated for a maximum of 9 credit hours.

PHYS 5610 INTRODUCTION TO SOLID STATE PHYSICS (3) LEC. 3. Lattice vibrations, band description of electronic states in metals, semiconductors and insulators, and magnetic, superconducting and defect properties of solids.

PHYS 5620 SURVEY OF PLASMA PHYSICS (3) LEC. 3. Pr. PHYS 3100. Single particle motions: fluid description of a plasma; plasma waves and oscillations; kinetic description, diffusion, and resistivity; non-linear effects.

PHYS 5900 PHYSICS TEACHING SEMINAR (1) LEC. 1. LAB. 0. SU. Introduction to issues, resources and best practices related to the teaching of physics. Physics undergraduate student or instructor approval required.

PHYS 6100 APPLICATIONS OF QUANTUM MECHANICS (3) LEC. 3. Quantum mechanics applied to atomic physics, solid state physics, nuclear physics, particle physics, electrodynamics, and cosmology.

PHYS 6200 TEACHING AND LEARNING OF STEM (3) LEC. 3. This course will provide students with a basic knowledge of the relevant research in cognitive psychology and science education and the ability to apply that knowledge to enhance their ability to learn and teach science, particularly at the undergraduate level. The course will involve readings, discussion, and application of the ideas through the creation of learning activities. It is suitable for advanced undergraduates and graduate students with some science background. Prerequisite: B.S. in a STEM discipline or 20+ credit hours of STEM coursework.

PHYS 6300 OPTICS (3) LEC. 2. LAB. 2. An overview of optics to include geometrical optics, electromagnetic waves, interference of light, diffraction of light, optical detectors, instrumentation and displays.

PHYS 6500 FUNDAMENTALS OF PHYSICS (3) LEC. 3. A subject such as Wave Mechanics, Mathematical Physics, Nonlinear Dynamics, Optics, Nuclear Physics, Elementary Particles, Relativity, or Electrodynamics. Course may be repeated for a maximum of 9 credit hours.

PHYS 6600 FRONTIERS OF PHYSICS (3) LEC. 3. A subject from the research areas in the Department such as Solid State, Atomic, Plasma, Space, or Computational Physics will be selected by the lecturer. Course may be repeated for a maximum of 9 credit hours.

PHYS 6610 INTRODUCTION TO SOLID STATE PHYSICS (3) LEC. 3. Lattice vibrations, band description of electronic states in metals, semiconductors and insulators, and magnetic, superconducting and defect properties of solids.

PHYS 6620 SURVEY OF PLASMA PHYSICS (3) LEC. 3. Single particle motions: fluid description of a plasma; plasma waves and oscillations; kinetic description, diffusion, and resistivity; non-linear effects.

PHYS 6900 PHYSICS TEACHING SEMINAR (1) LEC. 1. LAB. 0. SU. Graduate Students in Physics or Departmental Approval. Introduction to issues, resources and best practices related to the teaching of physics.

PHYS 7100 CLASSICAL MECHANICS (3) LEC. 3. Lagrangian and Hamiltonian formulations of mechanics, canonical transforms. Hamilton-Jacobi theories, action angle variables, rigid rotators, normal modes, and mechanics of continuous media.

PHYS 7200 ELECTRICITY AND MAGNETISM I (3) LEC. 3. Electrostatics, special function expansions, magnetostatics, linear media and Maxwell's equations.

PHYS 7250 ELECTRICITY AND MAGNETISM II (3) LEC. 3. Time dependent Maxwell theory, wave propagation and dispersion, diffraction, scattering, radiation, relativistic covariance and applications.

PHYS 7300 QUANTUM MECHANICS I (3) LEC. 3. Schrodinger wave equation, discrete and continuous spectra, matrix formulation, perturbation theory.

PHYS 7350 QUANTUM MECHANICS II (3) LEC. 3. Time-dependent approximation methods, relativistic wave equations, and second quantization.

PHYS 7400 STATISTICAL PHYSICS (3) LEC. 3. Thermodynamic quantities, equilibrium ensembles for classical and quantum systems, fluctuations, phase transitions and critical phenomena.

PHYS 7850 GRADUATE PHYSICS RESEARCH SEMINAR (1) LEC. 1. LAB. 0. SU. This course is designed to develop and expand incoming graduate student's knowledge and experience with state-of-the-art research as it is done in the Auburn University Department of Physics.

PHYS 7900 DIRECTED STUDIES (1-5) IND. SU. Student will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 6 credit hours.

PHYS 7930 DIRECTED STUDIES (1-5) IND. Student will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 6 credit hours.

PHYS 7950 PHYSICS COLLOQUIUM (1) SEM. SU. Offers a series of talks presented by invited speakers on broad fields of physics. Check with graduate advisor for credit allowed. Course may be repeated for a maximum of 6 credit hours.

PHYS 7970 SPECIAL TOPICS IN PHYSICS (1-5) SEM. Seminar or lecture series in a rapidly advancing specialty of physics. Course may be repeated for a maximum of 6 credit hours.

PHYS 7990 RESEARCH AND THESIS (1-10) MST. May be repeated as often as is appropriate. Course may be repeated with change in topics.

PHYS 8100 RELATIVISTIC QUANTUM MECHANICS (3) LEC. 3. Dirac equation, 1D barrier scattering, 3D central potentials, S-matrix theory, Feynman diagrams, quantum electrodynamics, renormalization, tree and loop level problems.

PHYS 8200 INTRODUCTION TO ATOMIC PHYSICS (3) LEC. 3. Hydrogen atom, Hartree-Fock theory, radiative transitions, photoionization, autoionization, electron-atom scattering.

PHYS 8600 PLASMA PHYSICS (3) LEC. 3. A detailed study of plasma physics including particle orbit theory, magnetohydrodynamics, plasma waves and transport phenomena.

PHYS 8700 SOLID STATE PHYSICS (3) LEC. 3. Atomic and electronic structures of solids and the associated electical, optical and transport properties.

PHYS 8900 DIRECTED STUDIES (1-5) IND. SU. Students will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 10 credit hours.

PHYS 8930 DIRECTED STUDIES IN ADVANCED PHYSICS (1-5) IND. Student will work with a faculty member to study a topic of interest. Course may be repeated for a maximum of 10 credit hours.

PHYS 8970 SPECIAL TOPICS IN ADVANCED PHYSICS (1-5) LEC. Departmental approval. Topic at the forefront of physics research will be chosen by the lecturer. Course may be repeated for a maximum of 10 credit hours.

PHYS 8990 RESEARCH AND DISSERTATION (1-10) DSR. May be repeated as often as is appropriate. Course may be repeated with change in topics.

Sciences Math Courses

SCMH 1010 CONCEPTS OF SCIENCE (4) LEC. 3. LAB. 2. Interdisciplinary course which presents major scientific concepts in physical and biological sciences. After taking SCMH 1010, students can complete core science requirement series by taking BIOL 1010, CHEM 1010, GEOL 1100, PHYS 1000, or PHYS 1150. Science Core. May count either SCMH 1010 or SCHM 1013 or SCHM 1017.

SCMH 1017 HONORS CONCEPTS OF SCIENCE (4) LEC. 3. LAB. 2. Pr. Honors College. Interdisciplinary course for Honors students which presents major scientific concepts in physical and biological sciences. After taking SCMH 1017, students can complete core science requirement series by taking BIOL 1010, CHEM 1010, GEOL 1100, GEOL 1107, PHYS 1000, or PHYS 1150. Science core. Credit will not be given for both SCMH 1017 and SCMH 1010.

SCMH 1100 COSAM ORIENTATION (1) LEC. 1. Introduction to the College of Sciences and Mathematics and its resources, exploration of STEM careers, orientation to campus resources and facilities, and assistance with academics and transition to Auburn.

SCMH 1890 PRE-HEALTH PROFESSIONS ORIENTATION (1) LEC. 1. SU. Orientation and guidance tailored for non-freshmen and transfer students planning to seek admission into health professions schools and programs such as dentistry, medicine, optometry, pharmacy, physician assistant, and physical therapy.

SCMH 1897 HONORS PRE-HEALTH PROFESSIONS ORIENTATION (1) LEC. 1. SU. Pr. Honors College. Orientation and guidance tailored for non-freshmen and transfer students planning to seek admission into health professions schools and programs such as dentistry, medicine, optometry, pharmacy, physician assistant, and physical therapy.

SCMH 1950 COSAM MAJOR AND CAREER EXPLORATION (1) LEC. 1. SU. Introduction to majors offered by the College of Sciences and Mathematics, motivation and skills for academic success, departmental resources and facilities, and exploration of careers in Sciences and Mathematics.

SCMH 3810 PRE-PHYSICAL THERAPY PRACTICUM (1) PRA. 2. SU. Departmental approval. Direct observation of physical therapists at an approved facility in the Auburn-Opelika area.

SCMH 3890 PRE-MEDICAL PRECEPTORSHIP (1) LAB. 2. SU. Departmental approval. Direct observation and interaction with physicians at East Medical Center and in individual medical offices.

SCMH 4920 SCIENCES AND MATHEMATICS INTERNSHIP (1-4) DSL. 8-16. SU. Practical on-the-job training in some area related to Sciences and Mathematics. Course may be repeated for a maximum of 6 credit hours.

SCMH 4980 SCIENCES AND MATHEMATICS UNDERGRADUATE RESEARCH (1-5) IND/RES. Departmental approval. Directed research in an area of specialty within Sciences and Mathematics and interdisciplinary fields. Course may be repeated for a maximum of 6 credit hours.

SCMH 5010 CLINICAL APPLICATIONS I (3) LEC. 2. A study of the clinical/personal issues facing primary care physicians in the rural community. Must be enrolled in the Rural Medicine Program.

SCMH 5020 CLINICAL APPLICATIONS II (3) LEC. 2, CLN/LEC. 1. Pr. SCMH 5010. A continuation of SCMH 5010.

SCMH 5940 GLOBAL STUDY/TRAVEL IN SCIENCES AND MATHEMATICS (1-12) AAB. Departmental approval. Application required. Students international study travel on topics relevant to Sciences and Mathematics. Course may be repeated for a maximum of 12 credit hours.

Statistics Courses

STAT 1010 DATA EPISTEMOLOGY (3) LEC. 3. This course will provide the basic tools to understand, interpret and reason with data in order to critically think about data-driven knowledge. Acquiring notions of logical reasoning and data literacy, the students will know how to analyze and ask the correct questions regarding data collection, representation and interpretation.

STAT 2010 STATISTICS FOR SOCIAL AND BEHAVIOR SCIENCES (4) LEC. 3. LAB. 2. Pr. MATH 1100 or MATH 1120 or MATH 1123 or MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or MATH 1610 or MATH 1613 or MATH 1617. Introduction to basic principles of statistical reasoning and statistical procedures used in data analysis in the social and behavioral sciences.

STAT 2017 HONORS STATISTICS FOR SOCIAL AND BEHAVIORAL SCIENCES (4) LEC. 3. LAB. 2. Pr. Honors College. Introduction to statistical data analysis, statistical packages, and APA-style statistical reporting use in research in Psychology and other social and behavioral sciences.

STAT 2510 STATISTICS FOR BIOLOGICAL AND HEALTH SCIENCES (3) LEC. 3. Pr. MATH 1100 or MATH 1120 or MATH 1123 or MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or MATH 1610 or MATH 1613 or MATH 1617 or MATH 1680 or MATH 1683. Introduction to statistical concepts, reasoning and methods used in data analysis, descriptive statistics, sampling distributions, statistical inference, confidence intervals, regression or correlation, contingency tables. Students who have previous credit in any higher-numbered math course may not receive credit.

STAT 2600 BUSINESS ANALYTICS I (3) LEC. 3. Pr. MATH 1680 or MATH 1683 or P/C COMP 1000 or COMP 1003. Introduction to analytics in business including use of data to make business decisions, basic predictive business modeling, and communication of analytical results. Minimum 2.0 overall cumulative undergraduate GPA.

STAT 2610 STATISTICS FOR BUSINESS AND ECONOMICS (3) LEC. 3. Pr. MATH 1690. Introduction to statistical analysis, theory, and interpretation used in business and economics.

STAT 2710 STATISTICAL COMPUTING (1) LEC. 1. Pr. (P/C STAT 2010 or P/C STAT 2017) and (P/C STAT 2510 or STAT 2513) and P/C STAT 2610 and P/C STAT 3010. Introduction to basic statistical computing programs and methods..

STAT 3010 STATISTICS FOR ENGINEERS AND SCIENTISTS (3) LEC. 3. Pr. MATH 1610 or MATH 1613 or MATH 1617 or MATH 1710. Introduction to statistical methods and analysis used in engineering and science.

STAT 3600 PROBABILITY AND STATISTICS I (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627 or MATH 1720. Calculus-based introduction to probability and statistics with an emphasis on practical problem-solving.

STAT 3610 PROBABILITY AND STATISTICS II (3) LEC. 3. Pr. STAT 3600. Departmental approval. Continuation of STAT 3600.

STAT 3611 PROBABILITY AND STATISTICS II LABORATORY (1) LAB. 2. Departmental approval. Coreq. STAT 3610. The application of statistical techniques from STAT 3610.

STAT 4000 INTRODUCTION TO DATA SCIENCE (3) LEC. 3. Pr. STAT 2010 or STAT 2017 or STAT 2510 or STAT 2513 or STAT 2600 or STAT 3010 or STAT 3600 or STAT 3603. Departmental approval. This course will provide an entry level introduction to the field of data science. The course will cover the essential statistical and computational tools including programming and analytical models, as well as teamwork, communication, and critical thinking.

STAT 4610 APPLIED REGRESSION ANALYSIS (3) LEC. 3. Pr. STAT 3610 or STAT 3010. Least squares estimation, hypothesis testing and confidence interval estimation in regression; simple, polynomial and multiple linear regression; residual and lack-of-fit analysis; use of dummy variables; multiple and partial correlation analysis; model building algorithms and model comparisons; transformations.

STAT 4620 APPLIED NONPARAMETRIC STATISTICS (3) LEC. 3. Review of elementary probability; goodness-of-fit tests; for singles and several location parameters; tests for scale parameters; distribution tests; measures of association; bootstrap and permutation tests.

STAT 4630 APPLIED TIME-SERIES ANALYSIS (3) LEC. 3. ARIMA models: the autoregressive process, the moving average process, and the ARMA process; forecasting, errors and confidence intervals, updating forecast models; estimation; model building and assessment; applications in econometrics.

STAT 4650 INTRODUCTION TO BAYESIAN STATISTICS (3) LEC. 3. LAB. 0. Pr. STAT 3610. This course will develop an introduction to the Bayesian thinking and the Fundamental Concepts in Bayesian Statistics.

STAT 4970 SPECIAL TOPICS IN STATISTICS (1-3) LEC. Departmental approval. Special topics designed to meet the needs and interest of students. Course may be repeated for a maximum of 6 credit hours.

STAT 4980 UNDERGRADUATE RESEARCH IN STATISTICS AND DATA SCIENCE (1-3) IND/RES. Directed research in Statistics and Data Science. Departmental Approval. Course may be repeated for a maximum of 3 credit hours.

STAT 5000 INTERMEDIATE STATISTICAL METHODS FOR DATA SCIENCE (3) LEC. 3. Pr. STAT 3610 or STAT 3010. C Grade or better in STAT3610 or STAT3010 or equivalent. Principles of probability and statistics, multiple testing and bootstrapping, parametric and nonparametric regression, generalized linear models, time dependent data with a focus on Data Science.

STAT 5110 SAS PROGRAMMING AND APPLICATIONS (3) LEC. 3. Pr. STAT 3010 or STAT 3610. Emphasis is placed on using SAS routines to obtain statistical analyses for common statistical methods and interpreting output.

STAT 5210 R PROGRAMMING FOR DATA SCIENCE (3) LEC. 3, LEC. 3. Pr. STAT 2510 or STAT 3010 or STAT 3610. Fundamental concepts on R programming language and popular R packages. Topics include basic syntax, R objects, control flow, file input and output, building R packages, data manipulation, visualization, interface to C, parallel computing, building web apps.

STAT 5330 DATA BASED DECISION MAKING USING SIX SIGMA (3) LEC. 3. Pr. STAT 3610 and INSY 4330. Departmental approval. Covers statistical tools needed for implementation of "Six Sigma", "Learn Six Sigma" and "Design for Six Sigma". Credit will not be given for both STAT 5330 and STAT 6330/ 6336.

STAT 5600 PROBABILITY AND STATISTICS FOR DATA SCIENCE (3) LEC. 3. Pr. STAT 3610 or STAT 3010 or MATH 1620. Grade of C or better in STAT 3610 or STAT 3010 and Grade of C or better in MATH 1620 or equivalent. Basic probability theory, random variables, multivariate random variables, expectation, random processes, times series, convergence of random processes, Markov chains, maximum likelihood estimation, Bayesian statistics, hypothesis testing, prediction, sampling and resampling methods, multivariate statistics.

STAT 5610 FUNDAMENTALS OF STATISTICAL INFERENCE I (3) LEC. 3. Pr. STAT 3600 and STAT 3610. Probability and independence; discrete and continuous distributions, random variable, moments; joint, marginal, conditional distributions; exponential families; bivariate transformations, covariance and correlation; multivariate distributions, sums of random variables, sampling distributions for normal data, order statistics; convergence of random variables, principles of data reduction; the likelihood principle.

STAT 5620 FUNDAMENTALS OF STATISTICAL INFERENCE II (3) LEC. 3. Pr. STAT 5610. Properties of random samples; generating a random sample; point and interval estimation; hypothesis testing; Analysis of Variance: one-way ANOVA, multi-way ANOVA and ANCOVA; linear regression, multiple regression and GLM methods, logistic regression.

STAT 5630 SAMPLE SURVEY, DESIGN AND ANALYSIS (3) LEC. 3. Pr. STAT 3600. Departmental approval. Estimation of means, proportions, finite populations, stratified sampling, systematic sampling ratio estimations.

STAT 5650 STATISTICAL LEARNING (3) LEC. 3. Pr. STAT 5000. or equivalent. Introduction to modern methods and algorithms in Statistics. Topics include common supervised and unsupervised learning methods such as linear regression, logistic regression, regularization, non-parametric regression, model assessment and selection, neural network, support vector machines, principal components analysis.

STAT 5670 PROBABILITY AND STOCHASTIC PROCESSES I (3) LEC. 3. Pr. MATH 2630 or MATH 2637. Random variables, discrete and absolutely continuous distributions. Poisson process, expectation and conditional expectation. Moment generating functions, limit distributions. Emphasis on probabilistic reasoning and problem solving. Credit will not be given for both STAT 5670 and MATH 5670.

STAT 5680 PROBABILITY AND STOCHASTIC PROCESSES II (3) LEC. 3. Pr. STAT 5670 or MATH 5670. Multivariate distributions, Central Limit Theorem, Laplace transforms, convolutions, simulations, renewal processes Continuous-time Markov chains, Markov renewal and semi-regenerative processes, Brownian motion and diffusion. Credit will not be given for both STAT 5680 and MATH 5680.

STAT 5690 CHAOTIC AND RANDOM PHENOMENA (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Statistics and modeling of random phenomena in connection to computational complexity, data analysis, processes of chance and chaotic nonlinear systems. Credit will not be given for both STAT 5690 and MATH 5690.

STAT 6000 INTERMEDIATE STATISTICAL METHODS FOR DATA SCIENCE (3) LEC. 3. Pr. STAT 3610 or STAT 3010. C Grade or better in STAT 3610 or STAT 3010 or equivalent. Principles of probability and statistics, multiple testing and bootstrapping, parametric and nonparametric regression, generalized linear models, time-dependent data.

STAT 6110 SAS PROGRAMMING AND APPLICATIONS (3) LEC. 3. Pr. STAT 3010 or STAT 3610 or P/C STAT 7000. Emphasis is placed on using SAS routines to obtain statistical analyses for common statistical methods and interpreting output.

STAT 6210 R PROGRAMMING FOR DATA SCIENCE (3) LEC. 3. Pr. STAT 2510 or STAT 3010 or STAT 3610. Fundamental concepts on R programming language and popular R packages. Topics include basic syntax, R objects, control flow, file input and output, building R packages, data manipulation, visualization, interface to C, parallel computing, building web apps.

STAT 6330 DATA BASED DECISION MAKING USING SIX SIGMA (3) LEC. 3. Pr. STAT 3610 and INSY 4330. Departmental approval. Covers statistical tools needed for implementation of "Six Sigma", "Learn Six Sigma" and "Design for Six Sigma". Credit will not be given for both STAT 5330 and STAT 6330/ 6336.

STAT 6600 PROBABILITY AND STATISTICS FOR DATA SCIENCE (3) LEC. 3. Pr. STAT 3610 or STAT 3010 and (MATH 1620 or MATH 1623 or MATH 1627). Grade of C or better in STAT 3610 or STAT 3010 and Grade of C or better in MATH 1620 or equivalent. Basic probability theory, random variables, multivariate random variables, expectation, random processes, times series, convergence of random processes, Markov chains, Maximum Likelihood Estimation, Bayesian statistics, hypothesis testing, prediction, Sampling and Resampling methods, multivariate statistics.

STAT 6610 FUNDAMENTALS OF STATISTICAL INFERENCE I (3) LEC. 3. Pr. STAT 3600 and STAT 3610. This class is first of a two-semester sequence in probability and statistics taught at a calculus-based level. Students should gain an understanding of probability and random variables in order to have the foundation to conduct statistical inference in STAT 5620/6620.

STAT 6620 FUNDAMENTALS OF STATISTICAL INFERENCE II (3) LEC. 3. Pr. STAT 6610. This class is second of a two-semester sequence in probability and statistics taught at a calculus-based level. Students should gain an understanding of inference for the practice of statistics.

STAT 6630 SAMPLE SURVEY, DESIGN AND ANALYSIS (3) LEC. 3. Pr. STAT 3600. Departmental approval. Estimation of means, proportions, finite populations, stratified sampling systematic sampling ratio estimations.

STAT 6650 STATISTICAL LEARNING (3) LEC. 3. Pr. STAT 6000. or equivalent. Introduction to modern methods and algorithms in Statistics. Topics include common supervised and unsupervised learning methods such as linear regression, logistic regression, regularization, non-parametric regression, model assessment and selection, neural network, support vector machines, principal components analysis.

STAT 6670 PROBABILITY AND STOCHASTIC PROCESSES I (3) LEC. 3. Pr. MATH 2630 or MATH 2637. Random variables, discrete and absolutely continuous distributions. Poisson process, expectation and conditional expectation. Moment generating functions, limit distributions. Emphasis on probabilistic reasoning and problem solving. Credit will not be given for both STAT and MATH 6670.

STAT 6680 PROBABILITY AND STOCHASTIC PROCESSES II (3) LEC. 3. Pr. MATH 6670 or MATH 6676 or STAT 6670 or STAT 6676. Multivariate distributions, Central Limit Theorem, Laplace transforms, convolutions, simulations, renewal processes Continuous-time Markov chains, Markov renewal and semi-regenerative processes, Brownian motion and diffusion. Credit will not be given for both STAT 6680 and MATH 6680.

STAT 6690 CHAOTIC AND RANDOM PHENOMENA (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Statistics and modeling of random phenomena in connection to computational complexity, data analysis, processes of chance and chaotic nonlinear systems. Credit will not be given for both STAT 6690 and MATH 6690.

STAT 6830 STATISTICS AND PROBABILITY FOR TEACHERS (3) LEC. 3. Pr. STAT 3010 or STAT 3600 or STAT 3603. Connections of advanced college-level mathematics with the secondary mathematics curriculum, focusing on statistics and probability, to develop mathematical knowledge relevant to teaching. Includes appropriate uses of technology and non-routine mathematics problem solving. Admission to a program in Secondary Mathematics Education or department approval required.

STAT 7000 EXPERIMENTAL STATISTICS I (4) LEC. 4. Departmental approval. Paired and independent sample t-tests, ANOVA, F-tests, contrasts, tests for trends, multiple comparisons, CR and RCB designs of experiments, regression.

STAT 7010 EXPERIMENTAL STATISTICS II (3) LEC. 3. Pr. STAT 7000. Advanced topics in experimental design: writing linear models for experiment-expected mean squares, variance components, nested designs, Latin Square Designs, split plot designs, ANOVA and multiple regression.

STAT 7020 REGRESSION ANALYSIS (3) LEC. 3. Pr. STAT 7000. Departmental approval. Introduction to the method of least squares as it applies to regression and analysis of variance. Simple linear regression, multiple regression, model selection and diagnostics.

STAT 7030 CATEGORICAL DATA ANALYSIS (3) LEC. 3. Pr. STAT 3600 or MATH 3600 or STAT 7000. Departmental approval. Methods for analysis or categorical response data. Topics include Chi-square tests, Likelihood Ratio tests, Logistic Regression, and Loglinear Modeling.

STAT 7040 BIOSTATISTICS (3) LEC. 3. Pr. STAT 7000. Departmental approval. Epidemiology, biometry, methods of survival analysis.

STAT 7100 STATISTICAL ANALYSIS OF SURVEY, AGGREGATE AND LARGE DATA SOURCES (3) LEC. 3. Pr. STAT 2010 or STAT 2017. Departmental approval. Techniques commonly used in multivariate statistical analysis of data sources such as surveys, archival records, and other large data sets. Credit will not be given for STAT 7100 and SOCY 7100.

STAT 7250 PRACTICAL DATA ANALYSIS AND COMPUTATION FOR THE LIFE SCIENCES (3) LEC. 2. LAB. 1. Pr. STAT 7020 or WILD 7150. Data from the life sciences and advanced statistical techniques for data analyses and computaMon are brought together through a cross-fertilization of graduate students in the life sciences, statistics, and mathematics. Focus on production of publication-quality research on student-identified projects.

STAT 7270 EXPERIMENTAL DESIGN IN PSYCHOLOGY (4) LEC. 4. Pr. STAT 7000 and STAT 7020. Introduction to the analysis of data collected under differential experimental designs. Credit will not be given for both STAT 7270 and PSYC 7270.

STAT 7300 ADVANCED ENGINEERING STATISTICS I (3) LEC. 3. Pr. STAT 3610. Departmental approval. Advanced concepts of experimental design including blocking, regression approach to analysis of variance, fractional factorials in base-2, and base-3 designs. Emphasis throughout is on improving industrial products and processes. Credit will not be given for both STAT 7300 and INSY 7300.

STAT 7310 ADVANCED ENGINEERING STATISTICS II (3) LEC. 3. Pr. STAT 7300 or STAT 7306 or INSY 7300 or INSY 7306. Fractional factorial experimentation applied for the purpose of process and quality improvement and optimization, introduction to analysis of covariance, multiple regression analysis, and response surface analysis. Credit will not be given for both STAT 7310 and INSY 7310.

STAT 7600 STATISTICAL THEORY AND METHODS I (3) LEC. 3. Pr. STAT 3600. Departmental approval. Random variables, probability theory, random variables, probability distributions, sampling distributions, convergence.

STAT 7610 STATISTICAL THEORY AND METHODS II (3) LEC. 3. Pr. STAT 7600. Likelihood ratio, regression, ANOVA, categorical data, non-parametric methods, decision theory.

STAT 7620 NONPARAMETRIC STATISTICS (3) LEC. 3. Pr. STAT 3600. Departmental approval. Distribution-free methods of statistical inference. Sign, Wilcoxon signed-rank, and Mann-Whitney tests for location, the Chi-Square and Kolmogorov-Smirnov tests for goodness-of-fit. Measures of association.

STAT 7630 BAYESIAN STATISTICS (3) LEC. 3. LAB. 0. Pr. STAT 3600 or STAT 3610. This course will develop an understanding of Bayesian principles and methodologies and cover the modeling and computation required to perform advanced data analysis from the Bayesian perspective.

STAT 7650 COMPUTATIONAL STATISTICS (3) LEC. 3. Pr. STAT 7020 and STAT 7610. This course covers the theory and practice of common algorithms used for simulation, computing, and optimization in Statistics.

STAT 7670 APPLIED LONGITUDINAL DATA ANALYSIS (3) LEC. 3. To introduce students to statistical models and methods for the analysis of longitudinal date, i.e. data collected repeatedly on individuals (humans, animals, etc) over time (or other conditions).

STAT 7700 GENERALIZED LINEAR MODELS (3) LEC. 3. Pr. STAT 7600. Departmental approval. Exponential families and links functions, model fitting, likelihood methods, residual diagnostics, count data, estimating equations.

STAT 7780 SURVIVAL ANALYSIS (3) LEC. 3. Pr. STAT 7000. Departmental approval. Kaplan-Meier estimator, log-rank tests, Cox proportional hazard model, fully parametric models.

STAT 7800 LINEAR MODELS (3) LEC. 3. Pr. STAT 7610 and MATH 2660. Departmental approval. A rigorous development of some of the important topics of applied statistics: the multivariate normal distribution analysis of variance, regression, aspects of experimental design.

STAT 7810 MODERN STOCHASTIC PROCESSES I (3) LEC. 3. Pr. (MATH 6670 or MATH 6676 or STAT 6670 or STAT 6676) and MATH 6210. Classical and Modern Topics in stochastic processes (Markov chains, Poisson process, Brownian motion). Applications and stochastic models (queues, stationary processes, population dynamics, finances). Credit will not be given for both STAT 7810 and MATH 7810.

STAT 7820 APPLIED STOCHASTIC PROCESSES I (3) LEC. 3. Pr. MATH 7810 or MATH 7816 or STAT 7810 or STAT 7816. Classical and modern topics in stochastic processes (Markov processes, Random Walks, Martingales, Brownian motion.) Introduction to stochastic integrals and differential equations. Applications (queues, population dynamics, chaos finances). Credit will not be given for both STAT 7820 and MATH 7820.

STAT 7830 APPLIED STOCHASTIC PROCESSES II (3) LEC. 3. Pr. STAT 7810 or STAT 7816.

STAT 7840 APPLIED MULTIVARIATE STATISTICAL ANALYSIS (3) LEC. 3. Pr. STAT 7000. Multivariate normal distribution, Hotelling's T2, MANOVA, discriminate analysis, principal components.

STAT 7850 THEORY OF STATISTICAL INFERENCE (3) LEC. 3. Pr. STAT 7610. Central limit theorem, Convergence, M-estimate, Statistical functional, U-statistics

STAT 7860 APPLIED TIME SERIES ANALYSIS (3) LEC. 3. Pr. STAT 3610. Departmental approval. Autoregressive and moving average models, differencing, estimation and forecasting, spectral theory.

STAT 7930 STATISTICAL CONSULTING PRACTICUM (3) PRA. 3. Pr. STAT 7000 and STAT 7010 and STAT 7020. This is a course in applied statistics, providing training in statistical consulting. Applications of commonly encountered statistical methods are explored in the consulting environment. Written and oral communication skills are emphasized, and ethical aspects of consulting are introduced. This course provides students with an opportunity to gain practical experience in consulting through various projects with clients, through the AU Statistical Consulting Center.

STAT 7940 CAPSTONE PROJECT (3) LEC. 3. Discuss various topics while working on an industry-level project. Students will complete a semester-long project under the supervision of instructors.

STAT 7950 SEMINAR (1) SEM. SU. Exploration of statistical concepts, fostering active learning through presentations, guest lectures, discussions, and student-led research presentations. Course may be repeated for a maximum of 2 credit hours.

STAT 7960 SPECIAL PROBLEMS IN STATISTICS (1-10) RES. Credit will not be given for both MATH 7960 and STAT 7960. Course may be repeated for a maximum of 10 credit hours.

STAT 7970 SPECIAL TOPICS (1-3) LEC. Departmental approval. Special topics designed to meet the needs and interests of students. Course may be repeated for a maximum of 6 credit hours.

STAT 7980 SPECIAL PROJECT (3) LEC. 3. SU. Departmental approval. Non-thesis project in Statistics for Master's degree in Statistics (non-thesis option).

STAT 7990 RESEARCH AND THESIS (1-10) DSR. Research for Master's thesis in Statistics. Course may be repeated with change in topic.

STAT 8400 ADVANCED QUANTITATIVE METHODS FOR MANAGEMENT I (3) LEC. 3. Pr. STAT 7000. or approved equivalent. Study of the application of linear regression analysis to business research. First advanced course in applied linear statistics models.

STAT 8410 ADVANCED QUANTITATIVE METHODS MANAGEMENT II (3) LEC. 3. or approved equivalent. Introduction to multivariate techniques in business research. Study of the theory and applications of ANOVA, ANCOVA, MANOVA, MANCOVE, Discriminate Analysis & Polytomous Logistic Regression.

STAT 8420 ADVANCED QUANTITATIVE METHODS FOR MANAGEMENT III (3) LEC. 3. Pr. STAT 7100 and STAT 8400 and STAT 8410. or approved equivalent. Third course in statistical modeling. Emphasis on applications of Principal Components Analysis, and Structural Equation Modeling to management research.

STAT 8990 RESEARCH AND DISSERTATION (1-10) LEC. 1-10. Individual doctoral dissertation research. May be repeated for credit. Course may be repeated with change in topics. Course may be repeated for a maximum of 30 credit hours.