technologies. 2001 Current Topics in Astronomy and Astrophysics (3) S Prereq.: consent of instructor. Topics of current interest in astronomy; recent topics include extraterrestrial intelligence, black holes, exploration of the solar system. 4221, 4222 Introduction to Astrophysics (3,3) S Prereq.: PHYS 2021 or 2031 or consent of instructor. Essentials of observational astronomy, solar system, stars, stellar systems; results and problems of modern astrophysical research. 4261 Modern Observational Techniques (3) V Prereq.: ASTR 2201 or 2202 or consent of instructor. Instrumentation and techniques of modern observational astronomy; telescope design and use; observational techniques; results and problems of modern astrophysical research.

4250 Special Topics in Observational Astronomy (3) V May be taken twice for credit when topics vary. One topic scheduled each time course is offered; current topics include astronomical spectroscopy and astronomical photometry.

4997 Problems in Astronomy (1-3) Prereq.: consent of instructor. May be taken for a max. of 3 sem. hrs. of credit. Individual reading and theoretical and/or experimental work on advanced problems.

6101 Astronomy for Teachers (4) Su, V For teachers and students in the College of Education. Cannot be taken for degree credit by physics majors. General astronomy including the solar system, stellar astronomy, and stellar systems. 6108 Astronomy Laboratory for Teachers (1-3) Su V For in-service teachers and graduate students in the College of Education. May not be taken for credit by physics majors. May be taken for a max. of 2 hrs. of credit or 2 hrs. lab. Visual observation techniques including the use of star charts and globe; visual and photographic observation of celestial objects; stellar and nebulae using small reflectors as well as large telescopes through multimedia technology.

7441, 7742 Stellar Astrophysics (3,3) F,S ASTR 7741 is prerequisite for 7742. Also offered as PHYS 7741, 7742. Application of physical principles to study of stars; spectroscopy, stellar atmospheres, stellar structure, and stellar evolution.

7751, 7752 Galactic Astrophysics (3,3) F,S ASTR 7751 is prerequisite for 7752. Also offered as PHYS 7751, 7752. Application of physical principles to study of galaxies; interstellar medium, galactic structure and stellar motions, galaxies, antennae.

7777 Seminar in Astronomy and Astrophysics (1-6) V May be taken for a max. of 6 sem. hrs. of credit. Also offered as PHYS 7777.

7783 Topics in Astronomy and Astrophysics (3) V May be taken for a max. of 6 hrs. of credit. Also offered as PHYS 7783.

### BASIC SCIENCES • BASC

#### 2010 Inquiry Approaches to Math and Science Teaching (1) Introduction to the theory and practice of inquiry-based math and science instruction; design and execution of lesson plans in elementary education; guidance of this instructor and mentoring elementary school teacher.

2011 Inquiry-Based Math and Science Lesson Design (1) Prereq.: BIOL 2222. Sun, stars, and stellar systems; geospatial information science; guiding this instructor and mentoring elementary school teacher.

6001 Topics in Biological Science for Elementary School Teachers (3) Su only May be taken for a max. of 12 hrs. of credit when topics vary.

6002 Topics in Biological Science for Elementary School Teachers (3) Prereq.: 8 sem. hrs. of introductory biology. May be taken for a max. of 9 hrs. of credit when topics vary.

6083 Topics in Environmental Science for Elementary School Teachers (3) Su only May be taken for a max. of 9 hrs. of credit when topics vary.

7000 Methods in Teaching in College Life Science Laboratories (1) F Pass-fail grading. Philosophy and practice of life science laboratory education at the college level.

### BIOLOGICAL ENGINEERING • BE

1250 Introduction to Engineering Methods (2) F 6 hrs. lab. Fundamentals of engineering design; presentation of an engineering design; graphical expression of engineering design using computer-aided drafting software.

1252 Biology in Engineering (2) S Prereq.: credit or registration in BIOL 2201. 1 hr. lecture; 3 hrs. lab. Effect of variability on biological systems; presentation of an engineering problem solving and design; engineering design; engineering report writing; oral report presentation; laboratory and design; and engineering research.

2307 Elements of Landscape Construction (3) F,S Prereq.: MATH 1015 or 1022. 2 hrs. lecture; 3 hrs. lab. Theory and use of tape, level, transit, plane table, and compass; principles of area and volume calculations, land slope, drainage grades, landfill design, and site analysis. 2350 Experimental Methods for Engineers (2) S Prereq.: BE 2352. 2 hrs. lecture; 3 hrs. lab. Introduction to experimental methods and instrumentation for engineering applications; measurement of temperature, pressure, flow, strain, and vibration in biological systems; measurement of physical properties, measurement of design specification, creating a detailed design to address a technical problem that the team chose in BE 3290. Activities include developing measurable design objectives and a product design specification, creating multiple design solutions, evaluating design solutions, and communicating a detailed design.

4290 Senior Engineering Design Laboratory (2) S Prereq.: BE 4290. 6 hrs. lab. Engineering design principles used to complete the project set forth in the design solution submitted in BE 4290; design project completion.

4363 Biocompatibility & Surface Modification of Materials (3) V Prereq.: BE 4390. Biocompatibility of materials, theoretical aspects, and design and surface modification technology. A design project will be included.

4364 Food and Bioprocess Engineering (3) V Prereq.: BE 2352; credit or registration in BE 3340. 2 hrs. lecture; 3 hrs. lab. Design and analysis of systems for processing biobased and biomaterials; with emphasis on separation, biotechnology, fluid flow, thermodynamics, and transport phenomena in food and bioprocessing; unit operations, including mixing, drying, extraction, and process control.

### 4341 Biological Reactor Systems Design (3) S Prereq.: BE 3131. Principles and applications of microbial and biochemical principles used in design of biological reactors for biotransformation; metabolic output and cellular production; design of batch and continuous flow reactors utilizing microbial kinetic models; attached and suspended growth systems and eucaryotic and microbial cells.

4342 Sugar Process Engineering (3) Prereq.: EE 2950, CE 2200 or ME 3834 or CHE 3101, ME 2334 or 3333 or CHE 3172. Processes used in the manufacture of raw and refined sugar; application of scientific and engineering principles to unit operations of evaporation, crystallization, extraction, solids handling and drying, centrifuging, clarification, and concentration of sugar processing and control strategies; detailed process design of heat transfer equipment, fluid flow systems including non-Newtonian flow and heat transfer analysis; chemical and control analysis; energy transfer in engineering design and analysis; principle of mass transfer.

4344 Mobile Fluid Power Control (3) Prereq.: ME 3834 or CHE 3172. 2 hrs. lecture; 1 hr. lab. Design of hydraulic systems and basic components; power steering, hydrostatic transmissions, electrohydraulic servo-valves, manual and automatic control applications.

4362 Agricultural Precision Systems (3) S 2 hrs. lecture; 3 hrs. lab. Principles and applications of geospatial technologies supporting precision agriculture/forestry and planning for natural resource data management.

4363 Aquacultural Engineering (3) F Prereq.: senior standing. Engineering principles applied to agricultural and fishing systems; water chemistry; fluid mechanics; aquacultural pumping plants; fish pond design; recirculating aquaculture systems; water filtration; disinfection; aeration and deaerating.

4364 Natural Resource Engineering (3) V Prereq.: CE 2200 or their equivalent. 2 hrs. lecture; 2 hrs. lab. Principles and applications of geospatial systems and practices in control systems, including open channels, vegetated waterways, terraces, water control structures, spillways, reservoirs, and engineering/artifact field methods.

4989 Independent Study in Biological Engineering (1-4) F,S,Su Prereq.: senior standing. Written engineering report required. May be taken for a max. of 6 sem. hrs. of credit when topics vary. Biological engineering practice; library research, experimental and/or theoretical investigation.

5004 Advanced Natural Resource Engineering (3) V Prereq.: BE 4393. Advanced topics in statistical hydrology, flood theory, evaporation/transport, transport of pollutants, drainage, irrigation, erosion, sediment transport, and sedimentation applied to rural fields and watersheds.

5006 Agricultural Systems Engineering (3) V Prereq.: BE 4292 or equivalent. 2 hrs. lecture; 2 hrs. lab. Approaches to engineering problems in agriculture: queueing theory; modeling and simulation; linear programming; decision support systems, and electrical properties.

5400 Advanced Food Engineering and Biotechnology (3) V Prereq.: BE 4540. Design and modeling of food and biobased systems; applications of thermodynamic principles and transport phenomena with emphasis on numerical techniques in the design, analysis, and optimization of food systems. Research topics in food engineering and food biotechnology.

5750 Advanced Instrumentation and Control for Biological Systems (3) V Prereq.: BE 2352. 2 hrs. lecture; 3 hrs. lab. Theory of measurement and feedback integrated with applied design work with biological systems; focus areas include precision farming, environmental applications, bioprocess,
and biomedical measurement and control concepts.
3752 Advanced Transport Phenomena in Biological Engineering (3) Prereq.: BIOL 4215, CHEM 3260. Advanced study of heat and mass transfer in biological materials and systems; mathemat- ics describing active and passive cellular transport; erephysiology of transport; study of oxygen and mass flow in nonideal, heterogenous systems, including kinetic and thermodynamic considerations.
3761 Laboratory Systems for Agricultural Waste Treatment (3) V Prereq.: BE 4341. Design of biological reactor systems for treatment of agricultural wastes; utilizing and designing biological and physical processes for suspended- and attached-growth cultures; characterization of agricultural wastes and wastewaters; consideration of nutrient recovery, pathogen survival, odor reduction, and by-product recovery goals.
3781 Advanced Aquacultural Engineering (3) V Prereq.: BE 4341. Advanced topics in aquacultural aeration, oxygenation, disinfection of aquacultural systems, and animal wastewater characterization; integration with traditional agricultural production.
7500 Seminar (1-3 hr.) Consent of instructor. May be taken for a max. of 6 sem. hrs. of credit. Individual research on problems in the biological sciences.
4001 1207 HONORS: Biology Laboratory for Science Majors (3) Prereq.: BIOL 1201 and 1207 or 1208 and consent of instructor. 3 hrs. lecture; 3 hrs. lab. Credit will not be given for both this course and BIOL 1202 and 1209. Similar content as BIOL 1202 and 1209 with special emphasis on selected topics for qualified students.
2063 General Biology Laboratory (3) Prereq.: BIOL 1202, 1209 and CHEM 1202. 3 hrs. lecture; 3 hrs. lab. Credit will not be given for both this course and BIOL 1011 or 1012. Structure and function of organisms and their rela- tionship to people and the environment.
2083 The Elements of Biochemistry (3) F Prereq.: CHEM 1202 or equivalent. Preparation for students majoring in a biological science. Nature and physiological uses of natural substances of interest to education, agriculture, and home economics.
2153 Principles of Genetics (4) F Prereq.: BIOL 1202, 1209, and enrollment in CHEM 1202. Fundamental laws of heredity. Basic concepts of human physiology, genetics, and techniques of the various organisms.
2380 Introduction to Research in Biological Sciences (1) Prereq.: 6 sem. hrs. of biological sciences and consent of the instructor. Pass-fail grading. Introduction to research with faculty in the Department of Biological Sciences.
2502 Summer Research (1-3 hrs.) Consent of instructor. Prereq.: BIOL 1201, 1208, and 4 hrs. of additional biological sciences with laboratory. 2 hrs. lecture; 6 hrs. lab/field work. Diversity, ecology, and evolution of microorganisms, viruses, and exuberant reptiles, birds, and mammals; emphasis on Louisiana species.
2510 Introduction to Marine Zoology (4) F Prereq.: BIOL 1202 and 1209 and consent of instructor. 12 hrs. Lab. Five weeks at Louisiana Universities’ Marine Consortium (LUMCON). For degrees in biological science this counts only as an approved type of course work in the laboratory vany of marine animals, particularly those of the Louisiana Gulf Coast; classification, morphology, physiology, and ecology.
2900 Careers in Life Sciences (1) Prereq.: credit or registration in BIOL 1202, open to Biological Sciences, Biochemistry and Microbiology majors only. A one week workshop outside class is required. Career opportunities in all fields of the biological sciences.
3001 Science Teaching in Secondary School I: The Localfa (1) Prereq., analysis of coastal, and laboratory vany of marine animals, particularly those of the Louisiana Gulf Coast; classification, morphology, physiology, and ecology.
3002 Science Teaching in Secondary School II: Technology in Science Education (1) Prereq.: registration in EDJC 3002 or equivalent and credit in EDJC 3001 and CHEM 3001, or CHEM 3002, or PHYS 3001. Also offered as CHEM 3002 and PHYS 3001. Technology in the integration of technology in the classroom, student teacher, cooperating teacher, and laboratory vany of marine animals, particularly those of the Louisiana Gulf Coast; classification, morphology, physiology, and ecology.
3041 Evolution Laboratory (1) Prereq.: credit or concur- rent enrollment in BIOL 3040. Lab. to accompany lecture BIOL 3040.
3080 Introductory Plant Physiology (4) Prereq.: BIOL 1202 and 1209; CHEM 2002, 2261, or 2461. 3 hrs. lecture; 3 hrs. lab. Also offered as PLH 3060. Life processes of plants emphasizing growth and development, metabolism, transport, and water relations.
3090 Cell Biology (3) Prereq.: BIOL 2153 and CHEM 2262. Molecular description of cell structure and function. See ENTM 3090.
3116 Microbiology Laboratory (3) F Prereq.: BIOL 2051. 6 hrs. lab. Laboratory course illustrating experimental microbiology in ecology, taxonomy, physiology, and genetics.
3152 Comparative Anatomy of the Vertebrates (4) F Prereq.: BIOL 2153. BIOL 3090 recommended. 2 hrs. lecture; 6 hrs. lab. Macroevolution, biomechanics, and functional anatomy of vertebrates; lab dissection of selected vertebrates. See ENTM 3152.
3153 Developmental Zoology (4) Prereq.: BIOL 3090. 3 hrs. lecture; 3 hrs. lab. Combination of classical descriptive embryology and contemporary experimental theories focusing on the diversity of development in vertebrates and invertebrates.
3900 Undergraduate Seminar in Biological Sciences (1-3) V Prereq.: BIOL 1011 or 1012. Preparation for independent laboratory or library research written on selected topics in biological sciences.
3999 Undergraduate Research in Biological Sciences (1-3) F,S,Prereq.: Permission of department. May be taken for a max. of 6 sem. hrs. of credit. Individual research on problems in the biological sciences.