BIOLOGY (BIOL)

BIOL 1220. Biology of Sex & Death. 4 Credit Hours.
Students learn biology through the lens of the formation and collapse of biological systems, organized around questions pertaining to life, sex, and death.

BIOL 1510. Biological Principles. 4 Credit Hours.
An introduction to the basic principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships.

BIOL 1510R. BIOL 1510 Recitation. 0 Credit Hours.
A recitation period for BIOL 1510, an introduction to the basic principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, evolution, and ecological relationships.

BIOL 1511. Honors Biological Principles. 4 Credit Hours.
An advanced introduction to the principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships.

BIOL 1520. Introduction to Organismal Biology. 4 Credit Hours.
An introduction to biology at the organ and organismal levels, with emphasis on physiological processes and integration of growth and development.

BIOL 1521. Honors Introduction to Organismal Biology. 4 Credit Hours.
Introduction to biology at the organ and organismal levels, with emphasis on biodiversity, physiological processes, and integration of growth, reproduction and development.

BIOL 1XXX. Biology Elective. 1-21 Credit Hours.

BIOL 2100. Island Biogeography of New Zealand. 3 Credit Hours.
Introduction to theory of island biogeography focused on New Zealand's geological history and unique biota.

BIOL 2335. General Ecology. 3 Credit Hours.
Introduction to ecological processes at individual, population, and community levels that occur in plant, animal, and microbial taxa, and their relevance to current environmental problems.

BIOL 2336. General Ecology Laboratory. 1 Credit Hour.
The companion laboratory for BIOL 2335 (Ecology). This course stresses understanding ecological concepts through a combination of lab and field experiments, and computer simulations.

BIOL 2337. Honors Ecology. 3 Credit Hours.
A problem-based learning course in ecology. Student teams will do research and solve challenges typically faced by ecologists and environmental scientists.

BIOL 2338. Honors Ecology Laboratory. 1 Credit Hour.
Companion course to Honors Ecology. Student teams will explore solutions to ecological challenges using experiments and mathematical models.

BIOL 2344. Genetics. 3 Credit Hours.
Mendelian and molecular genetics; principles of inheritance, gene structure and function, foundations of recombinant DNA technology, genetic basis of variation and evolution.

BIOL 2345. Genetics Laboratory. 1 Credit Hour.
A laboratory course in the fundamental techniques of genetic analysis.

BIOL 2344. Honors Genetics. 3 Credit Hours.
A comprehensive genetics course incorporating discussions of primary literature. Topics include molecular genetics and gene action, transfer systems and mapping, cytological, quantitative and population genetics. Credit not allowed for both BIOL 2354 and BIOL 2344.

BIOL 2355. Honors Genetics Laboratory. 1 Credit Hour.
Hands-on introduction to practical techniques, critical thinking, and important concepts in genetics. Students carry out laboratory experiments that explore transmission, population, and molecular genetics.

BIOL 2695. Undergraduate Internship(Undergraduate Internship for Academic Credit). 1-21 Credit Hours.
Biology Undergraduate Internship for credit freshmen and sophomores, by permit only. The internship experience must be at a unit or agency approved by the School of Biology.

BIOL 2698. Undergraduate Research Assistantship. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

BIOL 2699. Undergraduate Research. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

BIOL 2801. Special Topics. 1 Credit Hour.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2802. Special Topics. 2 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2803. Special Topics. 3 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2804. Special Topics. 4 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2805. Special Topics. 5 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological sciences.

BIOL 2901. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 2902. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 2903. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 2904. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 2905. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 2XXX. Biology Elective. 1-21 Credit Hours.

BIOL 3100. Ecology and Evolution: An Australian Perspective. 3 Credit Hours.
Evolution and ecology of Australian ecosystems, including rainforests, open woodlands, coastal habitats; conservation of endangered ecosystems. Earns Biology technical credit. Research project required.
Biology (BIOL)

BIOL 3300. Tropical Ecology. 3 Credit Hours.
Ecological processes in the tropics including community organizations, biotic interactions, biodiversity, coevolution. Students perform research projects in rain forest, cloud forest, and seashore.

BIOL 3380. Introductory Microbiology. 3 Credit Hours.
Basic biology of bacteria, fungi, algae, and viruses, with emphasis on bacteriology.

BIOL 3381. Introductory Microbiology Laboratory. 1 Credit Hour.
Fundamental laboratory techniques in microbiology.

BIOL 3450. Cell and Molecular Biology. 3 Credit Hours.
An introduction to the structure and function of cells and their organelles with emphasis on eucaryotic cellular and molecular processes. Credit not allowed for both BIOL 3450 and BIOL 3340.

BIOL 3451. Cell and Molecular Biology Lab. 1 Credit Hour.
An introduction to experimental methods of cell and molecular biology research that will cover some fundamental topics of cell biology. Credit not allowed for both BIOL 3451 and BIOL 3341.

BIOL 3600. Introduction to Evolutionary Biology. 3 Credit Hours.
Comprehensive introduction to evolutionary biology. Includes focus on processes (natural selection, genetic drift) and resulting patterns (genome organization, phylogeny) illustrated with prokaryote and eukaryote examples.

BIOL 3754. Laboratory in Human Anatomy. 1 Credit Hour.
A detailed hands-on study of human structure using high-resolution models, specialized specimens and dissection of selected mammalian organs and tissues.

BIOL 3756. Laboratory in Human Physiology. 1 Credit Hour.
A laboratory application of concepts in Physiology, providing hands-on experience focusing on primarily on non-invasive human experiments supplemented with in vitro tissue experiments.

BIOL 3813. Special Topics. 3 Credit Hours.
Topics of current interest not covered in other courses in the department.

BIOL 3XXX. Biology Elective. 1-21 Credit Hours.

BIOL 4012. Protein Biology. 3 Credit Hours.
Biological view of proteins, including protein biosynthesis, processing, modification, folding, trafficking, interactions, degradation, natural and directed evolution, assembly diseases, amyloids, prions and protein-based inheritance.

BIOL 4015. Cancer Biology and Biotechnology. 3 Credit Hours.
This course covers basic concepts of cancer biology and new technologies that are being developed to understand, detect, treat, and prevent cancer. Credit not allowed for both BIOL 4015 and BIOL 7015.

BIOL 4150. Genomics and Applied Bioinformatics. 3 Credit Hours.
Retrieval and analysis of biological sequence, gene expression, and proteomics data from public databases and other sources; applying standard bioinformatics tools to investigate biological questions. Credit not allowed for both BIOL 4150 and BIOL 6150.

BIOL 4225. Molecular Evolution. 3 Credit Hours.
Evolutionary processes at molecular level, organizations of genomes and genetic systems. Students will read and present up-to-date research articles in various topics in molecular evolution.

BIOL 4340. Medical Microbiology. 3 Credit Hours.
Advanced study of bacteria, protozoa, fungi, and viruses that cause human diseases; emphasis on epidemiology, mechanisms of disease causation, prevention, and treatment.

BIOL 4401. Experimental Design and Statistical Methods in Biology. 3 Credit Hours.
Introductory course on experimental design, hypothesis testing and basic statistical techniques commonly applied in biological research. Exercises based on computer statistical software packages.

BIOL 4410. Microbial Ecology. 3 Credit Hours.
Advanced studies of microbial ecosystems, the specific roles of bacteria in maintaining ecological balance, and the evolution of the ecosystem in response to changing environments.

BIOL 4417. Marine Ecology. 3 Credit Hours.
An overview of the physical forces and biotic interactions structuring marine communities and of the major threats to these communities. Credit not allowed for both BIOL 4417 and BIOL 6417.

BIOL 4418. Microbial Physiology. 3 Credit Hours.
Study of the physiology of growth and metabolic activities of microorganisms.

BIOL 4428. Population Dynamics. 3 Credit Hours.
Students will examine the ecological factors that affect dynamics, regulation, and evolution of natural populations, emphasizing the connections with mathematical models, genetics, and ecology. Credit will not be awarded for both BIOL 4428 and BIOL 6428.

BIOL 4460. Communicating Biological Research. 1 Credit Hour.
Students learn to convey the importance of research findings in the biological sciences and to critically evaluate research results through discussions and scientific presentations. Credit will not be awarded for both BIOL 4450 and BIOL 4460.

BIOL 4464. Developmental Biology. 3 Credit Hours.
Investigations of cell differentiation and development using the tools of molecular genetics and cell biology.

BIOL 4471. Behavioral Biology. 3 Credit Hours.
An introduction to the study of the principles of behavior of all kinds of organisms, from microbes to mammals.

BIOL 4545. Genetics of Complex Human Traits and Diseases. 3 Credit Hours.
Introduction to the genetics and evolution of complex human traits, focusing on contemporary approaches to understanding susceptibility to malignant, metabolic, immune and psychological diseases.

BIOL 4570. Immunology and Immunochemistry. 3 Credit Hours.
A survey of modern immunology and its applications.

BIOL 4590. Research Project Lab. 3 Credit Hours.
Experience in designing, implementing, and communicating a biology research project, and practical training in modern approaches for biological research.

BIOL 4607. Molecular Biology of Microbes: Disease, Nature, and Biotechnology. 3 Credit Hours.
Molecular genetics of bacteria with an emphasis on experimental approaches, regulatory mechanisms in disease-causing and environmental bacteria, and biotechnology applications derived from microbes. Credit not awarded for both BIOL 4607 and BIOL 4608 or BIOL 4607 and BIOL 6608 or BIOL 4607 and BIOL 6607.

BIOL 4651. Foundations of Bioethics. 3 Credit Hours.
This course examines important bioethical issues in research, policy, medicine, and the environment in light of ethical theory and the process of scientific inquiry. Credit not awarded for both BIOL 4651 and BIOL 4650.
BIOL 4690. Independent Research Project. 3 Credit Hours.
Independent research with proposal and manuscript writing, conducted with the guidance of a faculty member.

BIOL 4694. Intern Assistantship (Undergraduate Internship for Pay). 1-21 Credit Hours.
Biology Undergraduate Internship for pay for juniors and seniors, by permit only. The internship experience must be at a unit or agency approved by the School of Biology.

BIOL 4695. Undergraduate Internship (Undergraduate Internship for Academic Credit). 1-21 Credit Hours.
Biology Undergraduate Internship for credit for juniors and seniors, by permit only. The internship experience must be at a unit or agency approved by the School of Biology.

BIOL 4696. Biology Undergraduate Teaching Assistantship. 3 Credit Hours.
Biology teaching carried out under the guidance of a faculty member. Credit not allowed for both BIOL 4696 and BIOL 4697.

BIOL 4697. Biology Undergraduate Teaching Experience. 3 Credit Hours.
An introduction to teaching biology for undergraduate teaching assistants, with a focus on effective teaching active engagement of students, and development of innovative classroom activities. Credit not allowed for both BIOL 4696 and BIOL 4697.

BIOL 4698. Undergraduate Research Assistantship. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

BIOL 4699. Undergraduate Research. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

BIOL 4740. Biologically Inspired Design. 3 Credit Hours.
We examine evolutionary adaptation as a source for engineering design inspiration, utilizing principles of scaling, adaptability, and robust multifunctionality that characterize biological systems. Credit not allowed for both BIOL 4740 and (ISYE 4740 or PTFE 4740 or MSE 4740 or ME 4740).

BIOL 4744. Microbial Symbiosis & Microbiomes. 3 Credit Hours.
This course explores how symbiotic interactions with microbes affect the biology of other organisms, focusing extensively on the beneficial microbes native to the human body.

BIOL 4746. Signaling Molecules. 3 Credit Hours.
The diversity of chemical signals between organisms and their structural specifications will be presented along with chemical and biological methods for isolating signaling molecules.

BIOL 4801. Special Topics. 1 Credit Hour.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.

BIOL 4803. Special Topics. 3 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.

BIOL 4804. Special Topics. 4 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.

BIOL 4805. Special Topics. 5 Credit Hours.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.

BIOL 4813. Special Topics. 3 Credit Hours.
Special Topics in BIOS.

BIOL 4823. Special Topics. 3 Credit Hours.
Special Topics in BIOS.

BIOL 4833. Special Topics. 3 Credit Hours.
Special Topics in BIOS.

BIOL 4901. Special Problems. 1-21 Credit Hours.
Research problem in biology under supervision of a faculty member. To be offered any term with credit to be arranged. Seven hours (four hours technical electives + three hours free elective) are the maximum credits allowed toward the Bachelor of Science in Biology degree.

BIOL 4902. Special Problems. 1-21 Credit Hours.
Research problem in biology under supervision of a faculty member. To be offered any quarter with credit to be arranged. Seven hours (four hours technical electives + three hours free electives) are the maximum credits allowed toward the Bachelor of Science in Biology degree.

BIOL 4903. Special Problems. 1-21 Credit Hours.
Research problem in biology under supervision of a faculty member. To be offered any quarter with credit to be arranged. Seven hours (four hours technical electives + three hours free electives) are the maximum credits allowed toward the Bachelor of Science in Biology degree.

BIOL 4904. Special Problems. 1-21 Credit Hours.
Research problem in biology under supervision of a faculty member. To be offered any quarter with credit to be arranged. Seven hours (four hours technical electives + three hours free electives) are the maximum credits allowed toward the Bachelor of Science in Biology degree.

BIOL 4905. Special Problems. 1-21 Credit Hours.
Special problem in biology under supervision of a faculty member. To be offered any quarter with credit to be arranged. Seven hours (four hours technical electives + three hours free electives) are the maximum credits allowed toward the Bachelor of Science in Biology degree.

BIOL 4910. Honors Undergraduate Research Thesis. 3 Credit Hours.
Writing and submission of an Undergraduate Research Thesis describing research accomplishments with a Georgia Tech faculty member. For a thesis conducted without a Biological Sciences faculty member, the instructor of record and a second reader from the School must both approve the thesis contains sufficient biological content.

BIOL 4XXX. Biology Elective. 1-21 Credit Hours.

BIOL 6150. Genomics and Applied Bioinformatics. 3 Credit Hours.
Retrieval and analysis of biological sequence, gene expression, and proteomics data from public databases and other sources; applying standard bioinformatics tools to investigate biological questions. Credit not allowed for both BIOL 6150 and BIOL 4150.

BIOL 6221. Biological Oceanography. 3 Credit Hours.
An introduction to the major biological processes in the ocean, including primary production, elemental cycling, food webs, and fisheries.

BIOL 6410. Microbial Ecology. 3 Credit Hours.
Advanced studies of microbial ecosystems, the specific roles of bacteria in maintaining ecological balance, and the evolution of the ecosystem in response to changing environments.

BIOL 6417. Marine Ecology. 3 Credit Hours.
An overview of the ecological and evolutionary patterns, processes, and mechanisms affecting the organization, structure, and function of a broad variety of marine communities. Credit not allowed for both BIOL 6417 and BIOL 4417.

BIOL 6418. Microbial Physiology. 3 Credit Hours.
Study of the physiology of growth and metabolic activities of microorganisms.
BIOL 6428. Population Dynamics. 3 Credit Hours.
Students will examine the ecological factors that affect dynamics, regulation, and evolution of natural populations, emphasizing the connections with mathematical models, genetics, and ecology. Credit will not be awarded for both BIOL 6428 and BIOL 4428.

BIOL 6478. Methods in Molecular Biophysics. 3 Credit Hours.
An introduction to biophysical methods that are employed to study biological macromolecules and their interaction to gain understanding of how they function. Credit not allowed for both BIOL 4478 and BIOL 6478.

BIOL 6505. Programming in Biological and Health Sciences. 3 Credit Hours.
This course introduces students to the basics of coding, applied to fundamental biological and medical questions.

BIOL 6570. Immunology. 4 Credit Hours.
A survey of modern immunology and its applications, with emphasis on immunological methods used in molecular and cell biological research.

BIOL 6600. Evolution. 3 Credit Hours.
An introduction to evolutionary patterns and processes, including the history of life, phylogenetics, population genetics, quantitative genetics, molecular evolution, and other important topics in evolutionary biology.

BIOL 6607. Molecular Biology of Microbes: Disease, Nature, and Biotechnology. 3 Credit Hours.
Molecular genetics of bacteria with an emphasis on experimental approaches, regulatory mechanisms in disease-causing and environmental bacteria, and biotechnology applications derived from microbes. Credit will not be awarded for both BIOL 6607 and BIOL 4607, BIOL 4608, or BIOL 6608.

BIOL 6611. Advanced Microbial Physiology. 3 Credit Hours.
Advanced studies of selected aspects of the physiology of prokaryotic and eukaryotic microorganisms.

BIOL 6620. Aquatic Chemical Ecology. 3 Credit Hours.
The course focuses on understanding the chemical mechanisms of aquatic signaling and the cascading effects on population regulation, community organization, and ecosystem function. Credit not allowed for both BIOL 6620 and BIOL 4620.

BIOL 6720. Environmental Microbial Genomics. 3 Credit Hours.
To introduce advanced concepts and principles of contemporary environmental microbiological research and associated bioinformatics techniques through representative examples from recent literature.

BIOL 6750. Foundations of Quantitative Biosciences. 4 Credit Hours.
Introduction to quantitative methods and logic that enable key advances in understanding living systems, spanning molecules, cells, organisms, and biomes.

BIOL 6756. Discovery of Signaling Molecules. 3 Credit Hours.
The diversity of chemical signals between organisms and their structural specificities will be presented along with chemical and biological methods for isolating signaling molecules. Crosslisted with CEE 6756 and CHEM 6756.

BIOL 6765. Geomicrobiology. 3 Credit Hours.
Interactions between microorganisms and the geosphere, microbial energetics and genetics; geochemical controls on microbial diversity and activity. Crosslisted with EAS 6765.

BIOL 6XXX. Biology Elective. 1-21 Credit Hours.

BIOL 7000. Master's Thesis. 1-21 Credit Hours.

BIOL 7001. Foundations in Molecular and Cell Biology. 4 Credit Hours.
The goal of this course is to provide new students with fundamental knowledge in the general areas of prokaryotic and eukaryotic molecular biology, biochemistry, structural biology, and bioinformatics.

BIOL 7010. Advanced Cell Biology. 3 Credit Hours.
Current topics in eukaryotic cell biology including membrane functions, intracellular sorting and compartmentalization, cell signaling, cell cycle, cytoskeleton, cell adhesion, motility, and current experimental approaches.

BIOL 7015. Cancer Biology and Technology. 3 Credit Hours.
This course covers the major concepts of cancer biology as well as state-of-the-art technologies that are being applied to cancer research, detection and treatment. Credit not allowed for both BIOL 7015 and BIOL 4015.

BIOL 7111. Molecular Evolution. 3 Credit Hours.
Evolutionary processes at the molecular level, organizations of genomes and genetic systems. Students will read and present up-to-date research articles in various topics in molecular evolution.

BIOL 7200. Programming for Bioinformatics. 3 Credit Hours.
This active-learning, project-based course provides a rigorous introduction to scientific computing for bioinformatics, including Linux utilities, shell scripting and bioinformatics programming.

BIOL 7210. Computational Genomics. 3 Credit Hours.
In this active learning class, students will learn to convert sequence information into knowledge through the use of computational genomics tools, applications and databases.

BIOL 7914. Advances in Bacteriology. 2 Credit Hours.
Topics of current interest in the physiology and ecology of bacteria and applications to practical problems.

BIOL 7923. Advances in Ecology. 2 Credit Hours.
Topics of current interest in the general areas of population growth and limitation, and the structure and stability of ecosystems.

BIOL 7924. Advances in Environmental Biology. 2 Credit Hours.
Topics of current interest in environmental biology.

BIOL 7963. Advances in Molecular Biology. 2 Credit Hours.
Topics of current interest in molecular biology.

BIOL 7964. Advances in Genetics. 2 Credit Hours.
Topics of current interest in genetics.

BIOL 8002. Seminar. 1 Credit Hour.
Weekly seminars on current research presented by various scientists in the field of biology.

BIOL 8003. Seminar. 1 Credit Hour.
Weekly seminars on current research presented by various scientists in the field of biology.

BIOL 8106. Tools of Science Seminar. 2 Credit Hours.
This course addresses issues important to all successful scientists and engineers such as: research ethics; collaborations between industry, academics, and government; women and minorities in science; balancing research, teaching and service; writing, editing, and reviewing, presentations; job interviews; time management; speaking to the public and media; and scientific and university politics.
BIOL 8510. Epigenetics, Stem Cells, and Development. 3 Credit Hours.
This course will introduce the basic concepts and mechanisms in epigenetics, covering topics ranging from stem cell reprogramming, organismal development, social behaviors, to human diseases.

BIOL 8515. Community Ecology. 3 Credit Hours.
An advanced ecology course that covers classic and contemporary concepts, patterns, and processes in the field of community ecology.

BIOL 8530. Human Evolutionary Genomics. 3 Credit Hours.
An advanced course where students will discuss primary literature and use computational tools to investigate how evolution has shaped global patterns of human genetic variation.

BIOL 8550. Origin of complex life: from cells to societies. 3 Credit Hours.
This course examines the evolutionary origins of complex life. We will examine the history of life on Earth and evolutionary process through which complexity arises.

BIOL 8560. RNA Biology and Biotechnology. 3 Credit Hours.
The purpose of this course is to introduce students (graduate and upper level undergraduate) to the fundamental concepts of RNA biology and to state-of-the-art biotechnologies that use RNA for medical and industrial applications.

BIOL 8744. Microbial Symbiosis & Microbiomes. 3 Credit Hours.
This course explores how symbiotic interactions with microbes affect the biology of other organisms, focusing extensively on the beneficial microbes native to the human body.

BIOL 8801. Special Topics. 1 Credit Hour.
New graduate lecture courses in areas of current interest.

BIOL 8802. Special Topics. 2 Credit Hours.
New graduate lecture courses in areas of current interest.

BIOL 8803. Special Topics. 3 Credit Hours.
New graduate lecture courses in areas of current interest.

BIOL 8804. Special Topics. 4 Credit Hours.
New graduate lecture courses in areas of current interest.

BIOL 8805. Special Topics. 5 Credit Hours.
New graduate lecture courses in areas of current interest.

BIOL 8813. Special Topics. 3 Credit Hours.
Special Topics in Biology.

BIOL 8814. Special Topics. 4 Credit Hours.
Special Topics in Biology (lecture + supervised lab).

BIOL 8823. Special Topics. 3 Credit Hours.

BIOL 8833. Special Topics. 3 Credit Hours.
Special Topics in Biological Sciences.

BIOL 8901. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 8902. Special Problems. 1-21 Credit Hours.
Research problems in biology under the supervision of a faculty member.

BIOL 8997. Teaching Assistantship. 1-9 Credit Hours.
For graduate students holding a teaching assistantship.

BIOL 8998. Research Assistantship. 1-9 Credit Hours.
For graduate students holding research assistantships.

BIOL 9000. Doctoral Thesis. 1-21 Credit Hours.