

# BIOMEDICAL ENGINEERING

The M.S. and the Ph.D. in Biomedical Engineering are jointly offered between the Health Science Center and The University of Texas at San Antonio (UTSA). The primary objective of this program is to broadly train students in the principles of biomedical engineering so they are well prepared to participate in the development of new approaches for the diagnosis and treatment of human diseases.

As the program is multidisciplinary, the curriculum is designed to provide a synergistic combination of formal courses, seminars, teaching opportunities, interactions with clinicians, and individualized biomedical engineering research experiences in the laboratories of the biomedical engineering faculty. All students are required to take core courses in the areas of Biomaterials, Biomechanics, Bioelectronics/Imaging and Biology, Physiology, as well as Responsible Conduct of Patient-Oriented Clinical Research, and Experimental Design and Data Analysis. In addition to the basic core curriculum, students are required to take additional coursework in the area of specialization. Students have access to the bioengineering and biosciences laboratories at both the Health Science Center and UTSA. This provides a unique opportunity to have learning experiences in medical, dental, bioscience, and engineering environments.

## BIME Courses

### **BIME 5091. Independent Study. 0.5-3 Credit Hours.**

This course will be arranged through BME faculty. Topic and mode of study are agreed upon by student and instructor. Semester hours are variable and credit hours will be determined by topic. The course is offered all terms. The course may be repeated for credit when topics vary. Prerequisites: Graduate student standing and consent of instructor.

### **BIME 6003. Introduction To Clinical Practices. 1 Credit Hour.**

This course will provide an introduction to clinical medicine for the graduate biomedical engineering students. It will provide the opportunity for the student to gain a working knowledge of engineering aspects as it relates to clinical practice. A variety of specialties will be presented. The students will also have the opportunity to observe surgery to gain additional insight. Integration with the medical industry will be made at the end. Prerequisites: open to Biomedical Engineering graduate students.

### **BIME 6004. Biology For Bioengineers. 3 Credit Hours.**

This course provides a broad background in biological concepts with specific attention given to biological processes important in bioengineering. Topics will include biochemistry, genetics, molecular biology, cell biology, and physiology. Applications will emphasize understanding cellular processes important in bioengineering, such as gene therapy and tissue repair and regeneration. Prerequisites: permission of the instructor Open for Cross Enrollment on Space Available basis.

### **BIME 6006. Human Physiology for Bioengineers. 3 Credit Hours.**

The objective of this course is to introduce students to human physiology with emphasis on physical principles, guiding rules, and quantitative approaches. The course will focus on cellular function and physiological processes as applied to human systems including cardiovascular, respiratory, musculoskeletal, nervous, digestive, renal, reproductive and endocrine. An undergraduate biology course or an equivalent to it is required prior to registering for this course. Open for Cross Enrollment on Space Available basis.

### **BIME 6071. Supervised Teaching. 1 Credit Hour.**

Supervised teaching of undergraduate, graduate, medical/dental students, or clinical residents will be required for at least one semester. For example, students may be required to lecture at undergraduate courses at UTSA, or lecture to orthopaedic/dental residents about implants and materials at the HSC. The exact nature of the teaching will be determined based on each student's program of study. Prerequisites: admitted to candidacy and consent of the supervising professor, program director, and COGS chair.

### **BIME 6090. Seminar. 1 Credit Hour.**

Students will have the opportunity to hear presentations from outside speakers, BME faculty, and peers. Prerequisites: Graduate (Ph.D.) student standing; required of all students during fall and spring semesters while pursuing doctoral studies.

### **BIME 6097. Research. 1-12 Credit Hours.**

This course consists of independent, original research under the direction of a faculty advisor.

### **BIME 6098. Thesis. 1-12 Credit Hours.**

Registration for at least one term is required of M.S. candidates. Prerequisite: admission to candidacy for Master of Science degree.

### **BIME 7099. Dissertation. 1-12 Credit Hours.**

Registration for at least two semesters (12 SCH) after they have been admitted to candidacy for the doctoral degree is required for Ph.D. candidates. Prerequisite: admission to candidacy for Doctor of Philosophy degree in Biomedical Engineering, and consent of supervising professor, program director, and COGS chair.

## CSBL Courses

### **CSBL 3005. Advanced Anatomy. Credit Hours.**

Selected students will participate in lectures, detailed dissections, presentations, and teaching of Pre-Matriculation students in the gross anatomy laboratory. A special project or readings in the surgical anatomy literature will be assigned. This elective is considered to be a full-time commitment (40 hours per week). Students are expected to 1) attend all lectures given in the Pre-Matriculation program, 2) to teach in all scheduled laboratory sessions, 3) to prepare and present prosections, 4) to help prepare a laboratory examination, 5) to write and present a literature review on an original topic of interest to the student related to the region of the body being studied.

### **CSBL 4000. Special Topic. 4 Credit Hours.**

This is a self-designed course created by both the student and the department to cover a specific topic. A Course Approval Form must be completed along with documentation of the designed course description.

### **CSBL 4001. Anatomy of the Newborn. 4 Credit Hours.**

Detailed gross dissection and study of newborn specimen with special emphasis on developmental origins as well as features and relationships differing from the adult; combined with library study of developmental malformations. Course fees: Lab fee \$30.

### **CSBL 4002. Regional Anatomy. 4 Credit Hours.**

Anatomy associated with one of the usual medical or surgical specialties, such as gastroenterology, neurology, orthopedics, obstetrics and gynecology, etc. Activities include detailed dissection, presentation of dissected material, assigned readings, and individual project. Course fees: Lab fee \$ 30.

### **CSBL 4004. Selected Research Project. 4 Credit Hours.**

Individual research projects to be arranged between the student and faculty members with whom he/she wishes to work.

**CSBL 4005. Advanced Anatomy. 4 Credit Hours.**

Selected students are required to participate in lectures, detailed dissections, presentations of prosected material, and teaching in the first year medical gross anatomy laboratory. Special projects, activities, and assigned readings in the surgical anatomy and history of anatomy literature. Course fees: Lab fee \$30.

**CSBL 4017. Advanced Neuroanatomy. 4 Credit Hours.**

Selected students will be assigned a special project and readings in the neuro anatomical literature. Course Fees: Lab fee \$30.

**CSBL 4024. History of Anatomy In Situ: Reawakening & Development of Anatomy in the 14th - 18th Century Italy. 4 Credit Hours.**

An in-depth study of the awakening and development of anatomy in 14th - 18th century Italy, visiting the sites where this occurred in Padua, Bologna, and Florence. The course consists of one week of didactic lectures and discussion prior to two weeks in Italy visiting anatomical museums and two of the oldest universities in the world, and ending with a week of student presentations based on a paper focusing on a historical, social, or scientific issue arising during this period in the Italian medical schools and currently relevant to the students' chosen field of medicine.

**CSBL 4025. Anatomy Mentored Teaching. 4 Credit Hours.**

The Mentored Teaching Elective allows 3rd and 4th year medical students to serve as teaching assistants for the spring CSBL 5022 Inter-professional Human Gross Anatomy course. CSBL 5022 serves students in the occupational therapy, physical therapy, physician assistant and biomedical engineering programs, and students in the Masters of Anatomy graduate program. Teaching assistants will serve as instructors for laboratory dissections which cover the central and peripheral nervous systems, vertebral column and back, the upper and lower limbs, head and neck, body wall, thorax, abdomen, pelvis, and perineum. Other teaching assistant duties include preparation of prosection specimens for teaching and demonstration, lab practical exam setup and grading, and preparation and presentation of a brief topical review relevant to anatomy. Applicants should have attained a minimum grade of B in Language of Medicine and in Musculoskeletal/Dermatology and exhibit the highest standards of professionalism. Enrollment is by permission of the Undergraduate Medical Education Office and by the course directors.

**CSBL 5007. Methods In Cell Biology. 1 Credit Hour.**

Through a combination of lectures and demonstrations, the instructors will introduce students to techniques which are currently being used in cellular biology laboratories. The emphasis will be on the applications themselves, their uses, limitations, and the necessary controls. The following topic areas will be covered: imaging and microscopy, immunological techniques, bioinformatics (DNA and protein), rodent anatomy and histology, cytogenetics, and in vitro cell growth and transfection.

**CSBL 5012. Physician Assistant Gross Anatomy. 5 Credit Hours.**

This course will cover the basic principles of human anatomy. Lectures are correlated with laboratory sessions in which students will learn human gross anatomy of the adult through the study of cadaver prosections, bones, models, atlas drawings and radiographs. Emphasis will be placed on basic systems anatomy as they apply to the physician's assistant. Course Fees: Gross Anatomy fee \$30.00.

**CSBL 5013. Gross Anatomy. 6 Credit Hours.**

This course will teach structural and functional anatomy of the normal human body. Lectures will serve as introductory information for the laboratory dissections to follow and to clarify the interactions of the various anatomical components to accomplish the function of the body. The course will cover the central and peripheral nervous systems, vertebral column and back, head and neck, body wall, thorax, abdomen, pelvis, and perineum, and the upper and lower limbs. Special emphasis will be placed on the laboratory experience in which the learner will perform a detailed dissection of the entire human body in order to achieve an understanding of the three-dimensional relationships and thus the interactive function of the body. These dissections will be supplemented by the study of prosected specimens, models skeletons, and other demonstration materials. Course fees: Lab fee \$30 Human Materials fee \$865.

**CSBL 5015. History Of Anatomy. 2.5 Credit Hours.**

The history of anatomy course is designed to acquaint medical, dental, and graduate students with the history of medicine and especially with the physicians and scientists who made essential discoveries in human anatomy. Using a biographical approach, the course is presented as a seminar with lectures, assigned readings and student presentations.

**CSBL 5016. Dental Gross Anatomy. 6 Credit Hours.**

The focus of this course is the structure of the human body, with emphasis on the functional anatomy of the trunk, neck, head, and nervous system. Regional dissection of a human cadaver, by groups of students, is supplemented by individual study of prosections, models, skeletons, and other demonstration materials and is guided by lectures, conferences, and films. The first part of the course, which deals with the anatomy of the thorax and abdomen, presents a general overview of the functional architecture of most major body systems. The emphasis is on principles of structure, to allow development of a holistic understanding of human biology, both normal and pathological. The latter half of the course is devoted to study of the head and neck; greater emphasis will be placed on anatomical relationships with obvious reference to clinical dentistry. Course Fees: Human materials fee: \$865 Lab fee: \$30.

**CSBL 5019. Gross Human Anatomy For Graduate Students. 6 Credit Hours.**

This course will teach structural and functional anatomy of the normal human body. Lectures will serve as introductory information for the laboratory dissections to follow and to clarify the interactions of the various anatomical components to accomplish the function of the body. The course will cover the central and peripheral nervous systems, vertebral column and back, head and neck, body wall, thorax, abdomen, pelvis and perineum, and the upper and lower limbs. Special emphasis will be placed on the laboratory experience in which the learner will perform a detailed dissection of the entire human body in order to achieve an understanding of the three-dimensional relationships and thus the interactive function of the body. These dissections will be supplemented by the study of prosected specimens, models skeletons, and other demonstration materials. Permission of course director if required to enroll. Course fees: Human materials fee \$ 865 Lab fee \$30.

**CSBL 5020. Dental Neuroscience. 1.5 Credit Hour.**

This course will present the student with the basics of neuroanatomy underlying somatosensory perception, special senses, orofacial reflexes, and common neurological disorders. The emphasis will be on neuroanatomical pathways relevant to the head and neck, especially those mediated by the trigeminal system. The course also will include consideration of motor pathways and the special senses, disorders of which will necessarily influence treatment plans developed by future dental practitioners. Acquisition of a basic understanding of the neuroanatomical pathways discussed in lectures will be reinforced by laboratory sessions with representative images of brain and spinal cord sections.

**CSBL 5022. Inter-professional Human Gross Anatomy. 5.5 Credit Hours.**

This courses will teach structural and functional anatomy of the normal human body. Lectures will serve as introductory information for the laboratory dissections to follow and to clarify the interactions of the various anatomical components to accomplish the function of the body. The course will cover the central and peripheral nervous systems, vertebral column and back, the upper and lower limbs, head and neck, body wall, thorax, abdomen, pelvis, and perineum. Special emphasis will be placed on the laboratory experience in which the learner will perform a detailed dissection of the entire human body in order to achieve an understanding of the three-dimensional relationships and thus the interactive function of the body. The dissections will allow the student to understand the anatomical basis for disease and dysfunction in organ systems and their applications to clinical practice. They will be supplemented by the study of prosected specimens where possible, models skeletons, and other demonstration materials.

**CSBL 5023. Development. 1 Credit Hour.**

The course provides a survey of concepts in developmental biology (induction, cell-cell interactions, morphogen gradients, morphogenetic movements, transcription regulation, organogenesis) using experimental examples from both invertebrate and vertebrate embryos. The first set of lectures will focus on gametogenesis, fertilization, and early developmental events, such as cleavage, midblastula transition, gastrulation, and axis formation. The second set of lectures will explore the fates of germ layers in the contexts of cell type-specific differentiation and cell-cell interactions during organogenesis.

**CSBL 5024. Genomics. 1 Credit Hour.**

This course covers historical aspects of the Genomic project and high throughput methods (microarray, SAGE, proteomics, etc.) to perform global analysis of gene expression; the course also provides an overview of new biological fields such as systems biology, functional genomics, and comparative genomics. The students will have the opportunity to become familiarized with tools, methods, databases, and approaches used to extract biological information from global analyses. Hands-on training on biological databases and classes covering examples of the use of genomics to answer questions related to cancer and diseases is an important part of the course, helping the students to visualize how genomics can be used in their own research projects.

**CSBL 5025. Genetics. 1 Credit Hour.**

This course is designed to provide an overview of genetic research. Topics to be covered include: cytogenetics, mitochondrial genetics, cancer genetics, linkage analysis, complex traits, population genetics, animal models, sex determination, and epigenetics.

**CSBL 5026. Stem Cell Biology. 1 Credit Hour.**

This course is an up-to-date overview on current topics in stem cell biology. It is intended for the (future) basic scientist who is interested in studying the regulatory mechanisms of stem cells as well as for the (future) clinician who is interested in how stem cell biology will continue to impact patient care. Topics that will be discussed are: (1) basic biology and stem cells, including embryonic stem cells, adult stem cells, stem cells in different tissues and model systems; (2) microenvironment-mediated; (3) epigenetic regulators of stem cells; (4) stem cells in medicine, including regenerative medicine, cancer and aging; and (5) ethics.

**CSBL 5030. Basic Histology. 1 Credit Hour.**

This course is designed to provide students in the Anatomical Sciences track of the M.S. degree program an introduction to microscopic cell structures and relevant functions followed by study of the four basic human tissues (epithelial, connective, muscle and nervous tissues). In addition, a few specialized tissues (blood cells, bone, cartilage and lymphoid tissues) will be examined in depth to develop skill in understanding function in relation to viewing microscopic anatomical features. Overall, this course is meant to provide a foundation for the understanding of the microscopic architecture of the organ systems of the body and the role these play in normal activity and disease processes. Lectures, independent study (self-directed learning), and laboratory experiences will be used in teaching the fundamentals of human histology.

**CSBL 5032. Dental Histology. 5 Credit Hours.**

Through lectures, demonstrations, and laboratory work, students in this course will be given the opportunity to study the microscopic structure of the basic tissues and organs of the human body, followed by details of the embryologic development and microscopic structure of the various organs of the oral cavity. Current concepts in cellular biology are presented during the portion of the course in which they are most relevant. The general purpose of this course is to give students the opportunity to become acquainted with the basic embryology, cytology, and histology of normal human tissues and organs, thereby providing a foundation of knowledge for the understanding of normal activity and disease processes. Course Fees: Included in general lab fee. \$48 microscope fee for the Freshman year includes this course.

**CSBL 5033. Brain Health Journal Club. 1 Credit Hour.**

A journal club with an emphasis on brain health. The scope of the journal club is broad, with topics ranging from molecular mechanisms to the impact of injuries on behavior. Brain injuries ranging from stroke, spinal cord injury and traumatic brain injury (TBI) to age-associated neurodegeneration will be emphasized. Scientific articles on relevant or state-of-the-art techniques will also be encouraged. On a rotating basis, participants will be expected to present to the group either a paper of interest and relevance to their work or an update on their ongoing research or some combination of the two. PowerPoint slides are discouraged in favor of a chalk talk when presenting to the group.

**CSBL 5060. Advanced Histology. 2 Credit Hours.**

This course, designed for students enrolled in the Anatomical Sciences track of the MS degree program in Cell Systems & Anatomy, will examine the microscopic architecture of organs and their higher level organization into systems performing specific functions. Topics covered will include the integumentary, cardiovascular, respiratory, gastrointestinal, endocrine, urinary and male and female reproductive systems. The goal of this course is to enable students acquire knowledge of normal histological structure of organs and organ systems using light and electron microscopy, thereby providing a strong basis for the sound understanding of cell and tissue morphology in health and disease. The course will include lecture, laboratory and self-directed student learning. A prerequisite for this course is Basic Histology.

**CSBL 5074. Introduction to Research. 0.5 Credit Hours.**

This course is required of all MS students in the Anatomy Track in Cellular & Structural Biology and is available to the Biotechnology Track students. Students will have the opportunity to learn about the research interests of faculty in the program. This course will introduce students to the research strategies and help them identify a mentor and committee members.

**CSBL 5077. Scientific Writing. 2 Credit Hours.**

This course will provide students with the opportunity to develop skills in scientific writing and the presentation of research results. It will emphasize learning-by-doing-and-re-doing. Students will be required to write something every week. The capstone project for students will be to write a grant proposal and defend it in front of the class. One hour per week will be devoted to lecture and critique of published work; the other hour will consist of critique and revision of student writing by other students, as well as by the course director. Topics to be covered include: (1) fundamentals of writing clearly, (2) principles of revision, (3) effective presentation of data, (4) fundamentals of oral presentation, (5) writing/presenting to the appropriate audience, (6) how to write background/introductory sections, (7) how to write materials and methods, (8) how to write the discussion section, and (9) how to constructively critique one's own and others writing.

**CSBL 5083. Practical Optical Microscopy. 1 Credit Hour.**

This course will be a one-hour elective for graduate students consisting of eight (8) one-hour lectures plus eight (8) one-hour laboratories. The course focuses on the practical aspects of using optical microscopes. The objectives are to teach students the fundamental principles of optical microscopy and to provide them with hands-on experience using the optical instrumentation in the Institutional Imaging Core.

**CSBL 5089. Graduate Colloquium. 2 Credit Hours.**

This course is designed to provide graduate students with training in evaluating the scientific literature and in presentation of research in a seminar or journal club format. The course will focus on critical thinking, including evaluation of existing literature, interpretation of experimental results, and comparison of alternative models and interpretations. These tools are essential both for oral presentations and for writing grant proposals and manuscripts. Emphasis will be placed on evaluation of the science, organization of the manuscript, and on oral presentation skills.

**CSBL 5091. Special Topics. 1-9 Credit Hours.**

No description available.

**CSBL 5095. Experimental Design And Data Analysis. 3 Credit Hours.**

The purpose of the course is to provide an introduction to experimental design and statistical analysis. The emphasis of the course will be on the selection and application of proper tests of statistical significance. Practical experience will be provided in the use of both parametric and nonparametric methods of statistical evaluation. Among the topics to be covered are: data reduction, types of distributions, hypothesis testing, scales of measurement, chi square analysis, the special case of the comparison of two groups; analysis of variance; a posteriori multiple comparisons tests, tests of the assumptions of parametric analyses, advanced forms of the analysis of variance, linear regression, and correlation analysis. This course involves the use of statistical software; therefore, access to a laptop or a computer with web access for classes and examinations is required.

**CSBL 6015. Selective Topics In Oncology: Gynecological Cancers. 2 Credit Hours.**

This advanced elective course for the Cancer Biology Track provides a unique learning experience intended to prepare students in the emerging research areas of gynecological cancers for designing research experiments using pre-clinical and clinical research materials. The entire course comprises a small-group format in which students interact closely with a group of faculty who has active research or clinical programs focusing on molecular, clinical, and therapeutic areas of gynecological cancers.

**CSBL 6021. Animal Models. 3 Credit Hours.**

The relevant biology, applicability, and practical use of a number of animal models to biomedical research is covered. Invertebrate (e.g., *C. elegans*) and vertebrate (e.g., fish and rodents) model systems are included in the course. Strengths and weaknesses of each organism that render them particularly valuable as animal models are emphasized. Experimental approaches and tools that are utilized in conjunction with each animal model are rigorously examined. The course is taught from primary scientific literature using classic historical publications and recent publications.

**CSBL 6040. Gross Anatomy Mentored Teach. 1 Credit Hour.**

The Gross Anatomy Mentored Teaching Elective allow students in the Integrated Biomedical Sciences Program, School of Health Professions, and other qualified students to serve as preceptors for the spring CSBL 5022 Interprofessional Human Gross Anatomy course. CSBL 5022 serves students in the occupational therapy, physical therapy, physician assistant and biomedical engineering programs, and students in the Masters of Anatomy graduate program. Preceptors will serve as instructors for laboratory dissections which cover the central and peripheral nervous systems, vertebral column and back, the upper and lower limbs, head and neck, body wall, thorax, abdomen, pelvis, and perineum. Other preceptor duties include preparation of prosection specimens for teaching and demonstration, lab practical exam setup and grading, and preparation and presentation of a brief topical review relevant to anatomy. Students enrolling in this elective must have taken an approved human gross anatomy course (as determined and agreed upon by the course directors) with a minimum final grade of B within the previous five years.

**CSBL 6048. Biology of Aging. 4 Credit Hours.**

Biology of Aging is the core course of the Biology of Aging Track. The course consists of two modules: Aging and Longevity Mechanisms and Molecular and Cellular Mechanisms of Aging. The purpose of this course is to provide students with the most up-to-date information on the current understanding of the aging process. This advanced interdisciplinary graduate course provides experimental understanding of the interrelated areas of aging and age-related diseases. Faculty from several departments will be involved in teaching this course, which will cover the molecular and cell biology of aging, model systems used for aging studies, age-related changes in organs and tissues, and age-related diseases.

**CSBL 6049. Cellular and Molecular Mechanisms of Aging. 2 Credit Hours.**

This course provides up-to-date information on the current understanding of cellular and molecular mechanisms that contribute to aging. The focus is on investigation of specific mechanisms of aging including oxidative stress, nutrient sensing signaling pathways, stem cells and senescence, and genome stability. Experimental design and analysis, including pros and cons of approaches used to gain knowledge and how to appropriately interpret data, will be discussed throughout the course. The relationship between age-related changes in function and potential contributions age associated diseases will be examined via recently published research.

**CSBL 6050. Aging and Longevity Mechanisms. 2 Credit Hours.**

This module will focus on and evaluate several approaches used to modulate longevity and how these are used to discover the genetic, physiological and intracellular foundation of aging processes. The course will consist of interactive lectures complemented by guided reading of currently research papers. Students will be taught to hone critical reading skills and develop testable hypotheses to carry research forward. Topics will include: Genetics of Aging, Exceptional Longevity, Pharmacological Interventions, Calorie Restriction, Healthspan and Pathology of Aging.

**CSBL 6058. Neurobiology Of Aging. 2 Credit Hours.**

The nervous systems of many species, including humans, show obvious declines in function as a result of increasing age. In addition to the gradual decline observed in neural function, it is clear that increasing age also results in increased susceptibility of the nervous system to degenerative diseases such as Alzheimer's Disease, Parkinson's Disease, and Amyotrophic Lateral Sclerosis. This course will focus on recent findings and topics related to the underlying pathology of aging in the nervous system and the relationship of aging to neurodegenerative disease.

**CSBL 6059. Stem Cells & Regenerative Medicine. 1 Credit Hour.**

The fields of stem cells and regenerative medicine are rapidly evolving and have great potential to change the way medicine is practiced. This course will encompass topics from basics of tissue specific stem cell biology to pre-clinical animal models, strategies and progress in regenerative medicine. We will discuss some of the most current research being done in regenerative medicine from stem cell transplantation to biomaterials. Prerequisite: INTD 5000.

**CSBL 6060. Anatomical Sciences Thesis. 1-8 Credit Hours.**

Designed as an alternative to a "bench research"- based thesis, this longitudinal course for the Anatomical Sciences track in the Masters Program will culminate in the production of a thesis ideally suitable for adaption as a scholarly publication in a peer-reviewed journal. The thesis should focus on assessment of an unanswered and important question on a relevant and approved subject, involve in-depth research and demonstrate critical thinking on the part of the student. A student in the Anatomical Sciences Track will meet with the Course Director during the spring semester of his/her first year in the program to begin to identify a research area and specific topic(s) for his/her thesis proposal. Areas of focus include (but are not limited to) the following: 1) Clinical Anatomy - anatomy related to medical procedures and/or training of health professionals; 2) Anatomical Variations - comparative research utilizing human cadavers in the gross anatomy laboratories or comparative research in animal models; 3) Anatomical Sciences Education - education research on anatomy teaching methods and approaches to teaching anatomy to health professions students; 4) History of Anatomy - research on the development of human anatomical studies, comparative anatomy concepts, anatomy education, or involving other applications of the humanities to anatomical sciences (e.g. medical illustration, literature, music); 5) Human and rodent micro-anatomy /histology; or 6) Anatomical aspects of a biomedical research endeavor.

**CSBL 6064. Genes & Development. 4 Credit Hours.**

Genes and Development is the core course of the Genetics, Genomics, and Development Track. The course consists of four modules: genetics, genomics, developmental biology, and stem cell biology. Basic concepts in genetics such as cytogenetics, mitochondrial genetics, cancer genetics, linkage analysis, complex traits, population genetics, animal models, sex determination, and epigenetics will be presented. The genomics section will include historical aspects of the genome project and high throughput analysis. The students are introduced to new techniques in global analysis as well as have hands-on experience. The developmental biology section provides a survey of concepts in developmental biology (induction, cell-cell interactions, morphogen gradients, morphogenetic movements, transcriptional regulation, organogenesis) using experimental examples from both invertebrate and vertebrate embryos. The stem cell biology section includes the following topics: basic biology of stem cells, including embryonic stem cells, adult stem cells, stem cells in different tissues and model systems; microenvironment-mediated and epigenetic regulators of stem cells; stem cells in medicine, including regenerative medicine, cancer, and aging; and ethics. Required for the Genetics, Genomics & Development Track.

**CSBL 6068. Cancer Biology Core 1; An Introductory course. 1 Credit Hour.**

This course introduces the key features of cancer biology. In particular this course will provide initial insight into the clinical presentation and the cellular processes involved in cancer biology. In addition will be an initial presentation of molecular oncology. Topics examined include oncogenes, tumor suppressor genes, apoptosis, control of cell cycle regulation, and control of cellular growth and proliferation. Required for Cancer Biology Discipline. Prerequisites: INTD 5007 (or INTD 6007 and INTD 6009).

**CSBL 6069. Cancer Biology Core 2; Advanced Cancer Biology. 2.5 Credit Hours.**

This course is designed to provide a detailed representation of cancer biology, from progression, standard of care and molecular alterations that drive recent diagnoses and therapeutic strategies. In addition, this course will offer an overview on special populations affected by cancers and models used in the investigation of cancer. Included are basic experimental methods, mouse models, ex vivo systems, molecular profiling and clinical trials. The conceptual notions on clinical trials of cancer drugs and the process of development of novel therapeutic drugs in cancer will be discussed. Required for Cancer Biology Discipline. Prerequisites: INTD 5007 (or INTD 6007 and INTD 6009) and CSBL 6068.

**CSBL 6070. Cancer Biology Preceptorial. 0.5 Credit Hours.**

This is a discussion-based course to help unify our cancer biology students. The idea is to work in a small team based manner for students to disseminate knowledge that they are obtaining by participating in advanced courses of different topics by presenting the topic, methods and relevance to cancer biology to their peers. The intent is that participating students will discuss the topic in detail to understand how it might be useful to cancer biology research, in effect an active learning process. The goal is to provide an integrated multidisciplinary view on cancer research. Prerequisites: CSBL 6068 and CSBL 6069.

**CSBL 6071. Supervised Teaching. 1-12 Credit Hours.**

This course consists of participation in the teaching program of the first-year medical, dental, or health professions curriculum. Semester hours vary depending on the time spent in teaching.

**CSBL 6072. Presentation Skills. 0.5 Credit Hours.**

This course is designed to provide graduate students in the CSB masters program the opportunity to develop their skills in oral presentation. The course will focus on critical thinking, clear and concise presentation of research endeavors, and communicating science to the public, to students, and to other scientists. The course will meet for 1 hour every other week and is intended for MS students in their second year of study. Part I (Fall Semester) will focus on general scientific presentation skills.

**CSBL 6073. Selective Topics In Oncology: Gynecological Cancers. 2 Credit Hours.**

This is an advanced elective course for the Cancer Biology Track. The course is a unique learning experience in preparing students in the emerging research areas of gynecological cancers for designing research experiments using preclinical and clinical research materials. The entire course is a small-group format in which student interact closely with a group of faculty who have active research or clinical programs focusing on molecular, clinical, and therapeutic areas of gynecological cancers.

**CSBL 6074. Molecular Aspects Of Epigenetics. 2 Credit Hours.**

The purpose of this course is to develop an understanding of the molecular aspects of epigenetics. This advanced course will be a unique learning experience that prepares the student to evaluate and design new research in the areas of epigenetic processes including imprinting, gene silencing, X chromosome inactivation, position effect, reprogramming, and the process of tumorigenesis. This module concerns epigenetic mechanisms. Topics include: DNA methylation, histone modifications, epigenetics and stem cells, cancer epigenetics, RNA interference and epigenetics, bioinformatics and epigenetics, and translational epigenetics. This course will include a didactic program and student discussion. For the student discussion module, faculty and students will jointly discuss key publications that serve to bridge the gap between the student's prior understanding of the field and the state of the art in that area.

**CSBL 6075. Cancer Biology Enrichments Course. 0.5 Credit Hours.**

This course is a series of enrichment presentations to the students, either in lecture format, visit to labs or attendance of a conference. The goal is to give secondary reinforcements of the didactic components of the core courses on cancer biology. Required for Cancer Biology Discipline.

**CSBL 6090. Seminar. 1-9 Credit Hours.**

Attendance and participation in the regularly scheduled department seminar series is required each semester the course is offered. The activities included in the seminar course are attendance at invited seminars, journal club, and the student presentations including student annual progress and final dissertation and thesis presentations.

**CSBL 6094. Advanced Neuroanatomy. 0.5 Credit Hours.**

This course in neuroanatomy is offered to graduate students seeking to advance their knowledge beyond the fundamental level. The course consists of reading from more advanced texts and current anatomical literature as well as dissection of deep white matter tracts within the cortex. The student must also complete a 20-page paper on a neuroanatomical topic.

**CSBL 6095. Functional Genomic Data Analysis. 2 Credit Hours.**

This course covers basics of genomic data analysis. Focus is on general computational methods, their biomedical basis, and how to evaluate analysis results. Qualitative algorithm descriptions are expected. Prerequisites: CSBL 5095 or Equivalent.

**CSBL 6097. Research. 1-12 Credit Hours.**

This course consists of independent, original research under the direction of a faculty advisor.

**CSBL 6098. Thesis. 1-12 Credit Hours.**

This course consists of instruction in the preparation of the thesis. Registration for at least one term is required of M.S. candidates. Admission to candidacy for Master of Science degree is required.

**CSBL 6165. Medical Genetics. 3 Credit Hours.**

This course provides an introduction to the basic concepts of medical genetics and current areas of medical genetic research. The course reviews basic genetic concepts including the principles of Mendelian and nontraditional inheritance, cytogenetics, molecular genetics, quantitative and population genetics, and discuss important medical aspects of genetic counseling and pedigree analysis, dysmorphology, cancer genetics and counseling for inherited cancers, developmental genetics, prenatal diagnosis, newborn screening, and pharmacogenetics. Diagnosis and current research toward treatment and cure of common genetic disorders affecting metabolism, reproduction, the endocrine system, the functioning of the eye and the nervous system are discussed. An important aspect of the course will be a discussion of ethical issues in medical genetics. A basic background in genetics, cell biology, and biochemistry is assumed. Prerequisites: A basic background in genetics, cell biology, and biochemistry.

**CSBL 7014. Anatomy 1. 5 Credit Hours.**

This course provides the basic principles of human anatomy. Students have the opportunity to learn human anatomy as it relates to function through the study of bones, cadaver prosections, models, atlas drawings and photographs, and their own bodies. Concentration is on osteology, radiology, arthrology, neuromuscular, vascular, and basic systems anatomy as they apply to physical therapy. Course fees: Lab Assistance fee \$10 per hour Gross Anatomy Lab fee \$30.

**CSBL 7099. Dissertation. 0.5-12 Credit Hours.**

Registration for at least one term is required of Ph.D. candidates. Prerequisites: admission to candidacy for Doctor of Philosophy degree.

**CSBL 8010. Anatomy 2. 2 Credit Hours.**

This course reinforces principles of human anatomy studied in CSBL 7014. Students study human anatomy as it relates to function through cadaver dissection. Concentration is on osteology, radiology, arthrology, neuromuscular, vascular, and basic systems anatomy as they apply to physical therapy. Course fees: Lab Assistance fee \$10 per hour Gross Anatomy Lab fee \$30 Human Materials fee \$865.

**INTD Courses****INTD 1091. Independent Study. 4 Credit Hours.**

Students will work directly with a faculty advisor or assistant dean to develop an independent plan of study.

**INTD 3001. International Elective. Credit Hours.**

Students will work with the course director and Assistant Director of Global Health to identify an appropriate international elective site, using established sites/programs or one that the student discovers on their own. All rotations must be vetted and approved by the course director and will adhere to a community service-learning model that is a structured educational experience combining community service with preparation and reflection. Students are expected to help shape the learning experience around community-identified needs and advance insight related to the context in which service is provided, the connection between service and academic coursework, and students' roles as citizens and professionals. Students will spend 4 weeks living and working at an international service site. Sites may allow for a range of experiences, such as participating in patient care, conducting clinical or public health research, and/or participating in a language immersion program. There may also be opportunities for patient education and emphasis on efforts of local empowerment, aiming to build up the communities in a sustainable way. Regardless of the focus, all sites must be supervised by qualified health care providers. Students are encouraged to integrate themselves into the health care delivery system, to explore community needs that they could address, and when possible, to strive to make an impact through community education, home visits, and research. Reflection essays serve as a way to process experiences, including clinical cases, new perspectives gained, and analysis of health care disparities, and strategies for the overcoming poverty-related health problems. Students are encouraged to share their experiences upon return through a formal presentation.

**INTD 3002. School of Medicine Research Elective. Credit Hours.**

Students will participate in basic or clinical research projects under the supervision of university faculty. The goal of this elective is to immerse students in a rich research environment and provide an opportunity to work with research mentors to fully engage in the research process from writing the proposal to collecting the data to disseminating research results. This elective is open to students who already have an established working relationship with a faculty member and who wish time to continue their work, students who wish to establish a new project, and for students who are in the MD-MPH degree program and MD with Distinction in Research Program. Interested students must contact the course director prior to the enrollment date to express interest in the elective and receive further instructions on the application process for the research and identification/ confirmation of the faculty mentor.

**INTD 3030. Clinical Foundations. 3 Credit Hours.**

The purposes of this course are to 1) Prepare students to excel as learners in clinical settings by providing foundations for clinical skills including finding information, presenting cases, charting, writing orders, completing other paperwork, and clinical reasoning including basic EKG and radiograph interpretation; 2) Assist students in developing new skills expected of third-year clerks including lab skills (phlebotomy, ABG, blood cultures, hemocult cards), IV insertion, PPD placement, sterile gowning/ gloving, basic suturing, nasogastric tube placement, O2 management, and Basic Cardiac Life Support; and 3) Prepare students for their new roles in clinical settings, where they encounter patient care responsibilities along with patient privacy and ethical issues. Successful completion of the first two years of Medical School and approval of the director of the MD/PhD program are required.

**INTD 3058. Hospice and Palliative Medicine. Credit Hours.**

This rotation offers clinical experience in Hospice and Palliative Medicine (HPM). Palliative care provides treatment for seriously ill hospitalized and ambulatory patients and focuses on symptom management, enhancement of function, physical comfort, quality of life, psychosocial support, and communication about the goals of medical care for the patients as well as their families.

**INTD 3091. Independent Study. 9 Credit Hours.**

Students will work directly with a faculty advisor or assistant dean to develop an independent plan of study.

**INTD 4007. Interprofessional Community Service Learning. 2 Credit Hours.**

This is an innovative interdisciplinary service learning (CSL) course offered in partnership with the UT School of Pharmacy, PHR 270S, to allow medical students to integrate meaningful community service with instruction, preparation, and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities. This course will provide the opportunity for students to examine social justice and social determinant of health issues and apply these principles in a structured serviced learning practicum. The student-led service learning project will address the social and health needs of a community partner and will be conducted with the partner agency in a culturally competent manner. Through online learning modules, readings, and discussion; monthly class sessions; a group service learning project; and a structured service learning practicum, this course combines community service with preparation and reflection to foster civic responsibility in the health professions. Open for Cross Enrollment on Space Available basis.

**INTD 4008. Interprofessional Care in HIV. 0.5 Credit Hours.**

Students will have the opportunity to learn how to function as a member of an interprofessional team in HIV case management. The objective is for students to become familiar with issues of patient safety, health literacy, medication reconciliation, and interprofessional teamwork in HIV care. This is an elective didactic course. This is an elective didactic course.

**INTD 4009. Interprofessional Care in HIV. 2 Credit Hours.**

Students will have the opportunity to learn how to function as a member of an interprofessional team in HIV case management, and become familiar with issues of: patient safety, health literacy, medication reconciliation, treatment guidelines, and interprofessional teamwork in HIV care.

**INTD 4015. Humanism in Medicine Fellowship. 2 Credit Hours.**

This is a longitudinal 4th-year elective to support and nourish the inherent altruism of our students. This elective will bring together like-minded students and faculty who have a passion for caring for the medically underserved in their communities. The students will take a leadership role in managing and directing the student-run clinics at the Alpha Home, SMM Transitional Living and Learning Center, Haven for Hope, Travis Park Dermatology (under faculty supervision). Clinical experiences will be at these clinics. This elective will include a few evening seminars throughout the year in which students and faculty meet to discuss social justice, how to start a free clinic, homelessness and topics chosen by the students. Every student will complete a project of their choice over the year.

**INTD 4018. Independent Elective in Ethics. 2 Credit Hours.**

In this longitudinal course, students will be required to undertake an independent study into a specific issue in medical ethics or medical humanities. Students will be required to read on research methods in medical ethics as well as literature in their issue of interest, and then to propose and conduct an original study project, a literature review, a position paper, or an ethical analysis of a particular topic or case. Students will be expected to write an academically rigorous final research report of 10 to 15 pages. Students will be encouraged to produce a final paper that can be submitted for publication in a peer-reviewed bioethics or medical humanities journal. Students will be required to meet with the instructor and/or chosen faculty advisor over the course for assistance, guidance, and discussion. (Center for Medical Humanities and Ethics).

**INTD 4019. Clinical Ethics. 2 Credit Hours.**

Students in this two-week course will have the opportunity to focus on work in clinical ethics consultation. The student will be required to participate in rounds as an ethicist, do in-depth reading on clinical ethics consultation, observe clinical ethics consults, attend ethics committee meetings, and provide an educational seminar to hospital staff on an issue of ethical significance.

**INTD 4025. Healthcare Practice and Policy Elective. 0.5 Credit Hours.**

The Healthcare Practice Elective is an introductory-level, discussion-based, eight-hour course targeted to fourth-year medical students. The course focuses generally on practice and policy issues of payment methodologies, cost-effectiveness, and access to care.

**INTD 4030. Preparing for Global Health Work. 2 Credit Hours.**

This is a 2-week multidisciplinary course for 4th-year medical students who are planning future global health experiences, arising in response to enormous interest in international medicine, with increasing numbers of students choosing to spend time overseas during medical school. This preparatory course aims to provide a foundation of practical knowledge in global health to optimize the students' overseas experiences, facilitate their adaptation to working in different cultural settings, and maximize their impact in the communities where they serve. Topics include chronic and infectious disease, parasite infection, prioritizing community resources, health disparities, ethical dilemmas, cultural awareness, and professionalism. Course material is presented through a variety of approaches, including lectures, small-group case discussions, laboratory sessions, and online learning modules.

**INTD 4045. Patient Notes- Enrichment Elective. Credit Hours.**

It is an interactive, inter-professional course that engages students in music listening sessions to teach students active listening skills. Through various forms of music, students will learn how to actively listen for specific details to gain insight on meaning, become comfortable with ambiguity and interpretation, and develop pattern recognition skills to quickly recognize deviation. Students will also develop stronger methodology for writing patients notes through conceptual practice of SOAP format notes for music pieces. Taught jointly by UTHSCSA faculty and professional musicians, this strategy of applying practical skills to an abstract concept such as music will refine these skills for students in clinical settings. Specifically, this course aims to improve interpersonal communication skills, and organizational note writing. This is also an opportunity for students to practice problems solving with other healthcare professionals.

**INTD 4048. Art Rounds. 2 Credit Hours.**

This is an interactive, interprofessional course that takes students to the McNay Art Museum to learn physical observation skills. Studies demonstrate that increased observational skills translate to improved physical examination skills. Using artwork as patients, students will have the opportunity to learn how to observe details and how to interpret images based on available evidence. Taught jointly by Health Science Center faculty and McNay museum educators, students will have the opportunity to develop and hone their observation, problem solving, and assessment skills. They will also observe, interpret, and give case reports on the original works of art to teach them the skill of verbalizing descriptions of what is seen, and not to accept assumptions made with a first impression. Open for Cross Enrollment on Space Available basis.

**INTD 4058. Hospice and Palliative Medicine Elective. 4 Credit Hours.**

This rotation offers clinical experience in Hospice and Palliative Medicine (HPM). Palliative care provides treatment for seriously ill hospitalized and ambulatory patients and focuses on symptom management, enhancement of function, physical comfort, quality of life, psychosocial support, and communication about the goals of medical care for the patients as well as their families.

**INTD 4103. Communication Skills. 0.5 Credit Hours.**

To introduce fourth year medical students to the principles of conducting public interviews, presentations and effectively disseminating information to the communities they will serve.

**INTD 4104. Improving Patient Outcomes. 0.5 Credit Hours.**

This course is designed to increase a student's knowledge of and skills in identifying systemic problems with health care delivery and patient safety, collecting and analyzing data, generating solutions, presenting results and evaluating peers. The course objectives include facilitating systems thinking, exposing students to the ACGME general competencies (with emphasis on practice-based learning and improvement and systems-based practice), increasing understanding of health care economics and working in teams.

**INTD 4105. Medical Jurisprudence. 0.5 Credit Hours.**

The course will center on the Texas Medical Practice Act and applicable federal laws.

**INTD 4106. Practical Ethics For Healers. 0.5 Credit Hours.**

The course is the capstone of the four-year longitudinal curriculum in humanities and ethics. The goals are to reflect upon 1) physician's values, attitudes, and their intersection with cultural values and attitudes; 2) the historical and moral traditions of medicine in the context of society, politics, spirituality, and the health care system; and 3) the personal identity of a doctor. Open for Cross Enrollment on Space Available basis.



**INTD 4107. The Skin Around Us: A View of Skin Disease from a Humanities Perspective. 4 Credit Hours.**

This elective is for fourth year medical students with a special interest in learning about skin diseases through a humanities perspective. Throughout the four week course, students will attend daily clinics, create a project and write an essay on activities encountered during the elective. The students will also complete brief writing assignments each week after watching videos, movies, and/or reading books.

**INTD 4110. Getting Ready to Teach During Your Residency Program. 0.5 Credit Hours.**

The goal of this 8-hour course is to help senior medical students, who will be residents in a few months, develop teaching skills that will enhance the quality of their interactions with students. The course will be conducted in an interactive workshop format to allow participants to practice important teaching skills for residents. These include 1) orienting and priming students to their responsibilities and roles and accepting the personal role of teacher and role model, 2) giving feedback to improve student performance, 3) helping students to improve their patient presentations-the use of questioning, and 4) coaching procedural and technical skills. The participants will practice these skills and receive feedback from their course peers and instructors based on the guidelines for clinical teachers in action with students and provide critiques. Large and small group discussions and role plays will be used to reinforce teaching principles.

**INTD 4201. Getting Ready To Teach During Your Residency-RAHC. 0.5 Credit Hours.**

The goal of this course is to help senior medical students, who will be residents in a few months, develop teaching skills that will enhance the quality of their interactions with medical students. The course addresses four important residents' teaching skills: (1), teaching learners with different learning styles, (2) providing constructive feedback, (3), teaching at the bedside, and (4) teaching psychomotor procedures.

**INTD 4205. Veritas Mentors in Medicine Longitudinal Elective. 2 Credit Hours.**

This is longitudinal elective and the course work requirements will be for 2 week credit and must be complete by March 1st. Evaluation of MiM performance will include feedback from faculty mentors and students.

**INTD 4210. School of Medicine Research Elective Level 1. 4 Credit Hours.**

Medical research is multidisciplinary and broad in scope. Students will participate in basic, clinical research, quality improvement, or patient safety research projects under the supervision of faculty in the Health Science Center. The goal of this elective is to immerse students in a rich scholarly environment and provide an opportunity to work with research/faculty mentors to fully engage in a scholarly research process from writing the proposal to collecting the data to disseminating results. This elective is open to students who already have an established working relationship with a faculty member and who wish time to continue their work, students who wish to establish a new project, and for students who are in the MD-MPH degree program and MD with Distinction in Research Program. Interested students must submit a research elective application which includes the faculty mentor the student will work, to the office of UME, no later than 12 weeks before the research elective is to begin. Applications will be reviewed and confirmed or declined no later than 8 weeks prior to the proposed start date of the elective. Students will be able to 1) Formulate a research question and identify a research methodology to answer that question; 2) understand research ethics and apply an ethical approach to research design, implementation, and dissemination 3) design a research study and gather quality data; 4) apply and interpret basic biostatistics relevant to the individual research project; 5) write scientific reports. The supervising faculty member will evaluate the performance of the student using a standard, research specific, medical student evaluation form. Students will receive a Pass or Fail summative grade at the conclusion of the 4 week elective. Faculty will be expected to give the student formative feedback after two weeks to assist the student in meeting all expectations to pass the elective.

**INTD 4211. School of Medicine Research Elective Level 2. 4 Credit Hours.**

Medical research is multidisciplinary and broad in scope. Students will participate in basic, clinical research, quality improvement, or patient safety research projects under the supervision of faculty in the Health Science Center. The goal of this elective is to immerse students in a rich scholarly environment and provide an opportunity to work with research/faculty mentors to fully engage in a scholarly research process from writing the proposal to collecting the data to disseminating results. This elective is open to students who already have an established working relationship with a faculty member and reflects their increasing experience with the research process. INTD 4210 Level 1 elective or evidence of past experience knowledge and/or skills is a prerequisite. The expectation is that enrolled students will continue with research experiences begun in INTD 4210 Level 1 including students pursuing the MD-MPH degree and MD with Distinction in Research. Interested students must submit a research elective application which includes the faculty mentor the student will work, to the office of UME, no later than 12 weeks before the research elective is to begin. Applications will be reviewed and confirmed or declined no later than 8 weeks prior to the proposed start date of the elective.

**INTD 4212. School of Medicine Research Elective Level 3. 4 Credit Hours.**

Medical research is multidisciplinary and broad in scope. Students will participate in basic, clinical research, quality improvement, or patient safety research projects under the supervision of faculty in the Health Science Center. The goal of this elective is to immerse students in a rich scholarly environment and provide an opportunity to work with research/faculty mentors to fully engage in a scholarly research process from writing the proposal to collecting the data to disseminating results. Students enrolled in this course will have prior experience with research and ongoing research activities. As such, this elective is open to students who already have an established working relationship with a faculty member and reflects their increasing experience with the research process. INTD 4211 Level 2 electives is a prerequisite. As with INTD 4211 Level 2, the expectation is that enrolled students will continue with research experiences begun in INTD 4210 Level 1 and INTD 4211 Level 2 including students pursuing the MD-MPH degree and MD with Distinction in Research or produce evidence of past experience knowledge and/or skills which are deemed equivalent to these prerequisites. Interested students must submit a research elective application which includes the faculty mentor the student will work, to the office of UME, no later than 12 weeks before the research elective is to begin. Applications will be reviewed and confirmed or declined no later than 8 weeks prior to the proposed start date of the elective. Students will be able to formulate a research question and identify a research methodology to answer that question; understand research ethics and apply an ethical approach to research design, implementation, and dissemination; design a research study and gather quality data; apply and interpret basic biostatistics relevant to the individual research project; write scientific reports. The supervising faculty member will evaluate the performance of the student using a standard, research specific, medical student evaluation form. Students will receive a Pass or Fail summative grade at the conclusion of the 4 week elective. Faculty will be expected to give the student formative feedback after two weeks to assist the student in meeting all expectations to pass the elective.

**INTD 5005. Core Course 1: Biochemistry. 2 Credit Hours.**

Topics to be covered include: protein structure; properties of enzymes; structure, biosynthesis, and function of lipids; pathways and regulation of carbohydrate metabolism and biosynthesis and regulation of amino acids, nucleotides, and related compounds. Prerequisites: consent of instructor.

**INTD 5007. Advanced Cellular And Molecular Biology. 4 Credit Hours.**

This course provides an in-depth learning experience that instructs students on the fundamentals of molecular biology and cell biology as well as prepares the student to evaluate and design new research in the cutting-edge areas of modern molecular biology and cell biology. The course combines a didactic program of lectures along with a small group discussion format in which students interact closely with a group of faculty who have active research programs. The course focuses on active areas of research in molecular biology: Chromatin structure, DNA Transcription, DNA Replication and Repair, Recombination, RNA processing and regulation, Protein processing, targeting and degradation and in cell biology: Cell Signaling and Communication, Cell Growth, and Cell Death. Each week, the faculty provide students with didactic lectures on a current research area. Students and faculty will then jointly discuss key publications that serve to bridge the gap between the fundamental underpinnings of the field and the state of the art in that area.

**INTD 5013. Perio/Pros/Endo/Orth Interdisciplinary Course 1. 1 Credit Hour.**

A seminar that brings together the residents and graduate staff from the periodontic, prosthodontic, endodontic and orthodontic postdoctoral programs to share clinically relevant multidisciplinary information. Patient diagnostic evaluations and treatment plans are evaluated in an interactive environment. Selected topics involving new advancements are presented and discussed.

**INTD 5020. Dental Biomed Core 1. 4 Credit Hours.**

The Biomedical Core Course will provide a multidisciplinary approach to basic science instruction as it relates to the clinical practice of dentistry. Both basic science and clinical science faculty will participate to provide a sound base of material required by each program. Individual programs will supplement the Biomedical Core Course in the basic science areas particular to that discipline. This combination of core instruction with individual supplementation should provide the advanced education student the appropriate background in biomedical science.

**INTD 5021. Dental Biomed Core 2. 1 Credit Hour.**

This course is a continuation of MSDS 5020 Dental Biomedical Core Course 1.

**INTD 5023. Research Ethics. 1 Credit Hour.**

The goal of this course is to provide the Master's student an opportunity to gain the essential standards necessary for training and education approved by the National Institute of Health. This course links to the web-based NIH Clinical Research Training On-Line Course <http://www.cc.nih.gov/training/training/crt/infor.html> for Principal Investigators that is required for all individuals conducting research. This course is open to current Health Science Center students. Open for Cross Enrollment on Space Available basis.

**INTD 5030. Introduction To Patient Care. 5 Credit Hours.**

The first component of this course is an informatics module so that students become familiar with their new computers and are trained on specific software. In the second and overlapping component, students are assigned to a variety of small-group rotations in a clinical setting to prepare them for patient-care activities. In the first semester, the students are required to become certified in basic life support. They also are required to rotate through a clinic orientation that is followed by a rotation as an assistant in the General Practice Groups. They are expected to follow proper infection control protocol and utilize some basic assisting skills. They also are required to rotate through a head and neck exam activity, followed with a patient activity in the second semester. Second semester activities also include intraoral radiography technique, a clinic component of their periodontics, and school-based prevention courses, a sealant lab and clinic, and radiographic interpretation. Students are evaluated primarily on professional development expectations.

**INTD 5035. University Teaching Excellence Course. 2 Credit Hours.**

The course is designed for post-doctoral fellows, senior graduate students, faculty members, research staff and residents who are interested in a career in teaching and desire to acquire knowledge about learning processes and to develop educational planning, teaching and assessment skills to enhance their teaching toolkit. UTEC participants practice key skills needed for success in college-level teaching, working individually and in teams to accomplish course objectives. Classes will be supplemented by readings, worksheets and self-assessment inventories. Although the course will provide instruction in contemporary pedagogic techniques, it primarily emphasizes teaching science courses for undergraduates on campuses at predominantly undergraduate institutions (PUIs), rather than teaching graduate students and medical / dental students at the health science center (HSC) or other academic HSCs. Course instructors include faculty from the Schools of Medicine, Dentistry and Nursing at UTHSCSA as well as visiting faculty from local PUIs, St. Mary's University and Our Lady of the Lake University. UTEC has been offered for two consecutive fall semesters now (2015 and 2016). It is sponsored by the San Antonio Biomedical Education and Research (SABER) Program that is supported by an Institutional Research and Academic Career Development Award (IRACDA) from the National Institute of General Medical Sciences of the NIH (PHS grant, K12 GM11726).

**INTD 5040. Fundamentals Of Neuroscience I: Molecular, Cellular, & Developmental Neuroscience. 2 Credit Hours.**

This course is intended to introduce students to a broad survey of the basics of molecular, cellular and developmental neuroscience. The course is organized into a series of three modules: biochemical and cellular properties of nervous system cells, development of neuronal systems, and neurotransmission and neuromodulation, which covers the fundamentals of these three areas. Current topics and concepts are discussed in discussion sessions that include student participation. Two components; Neuroscience students register for both PHYL 5041 and INTD 5040.

**INTD 5043. Fundamentals Of Neuroscience 2: Systems Neuroscience. 3 Credit Hours.**

This course, the second component of our broad survey of the basics of neuroscience, begins at the level of the neural circuit, and guides the students through an understanding of increasingly complex levels of organization and function in the brain. Topics include neurotransmitter systems, sensory and motor function, motivated behavior, regulation and integration of autonomic, behavioral, and emotional responses in the limbic system, higher order cognitive processes, and the neurobiological basis underlying some important psychiatric disorders and their treatment.

**INTD 5046. Metaanalysis In Cognitive Neuroimaging. 2.5 Credit Hours.**

The objective of this course is to familiarize students with human functional brain imaging methods, experimental designs, statistical analyses, inferential strategies, and content. Students are guided through a literature-based research project that culminates in a quantitative metaanalysis of a set of studies using similar tasks.

**INTD 5047. Neuroanatomy. 2 Credit Hours.**

The purpose of this course is to provide students with a practical working knowledge of the structure of both the peripheral and central nervous system. The emphasis will be on the organization of the human brain, although the brains of other species may also be included if appropriate for a specific brain region. The course will look at each of the individual components of the central nervous system in some depth but will also emphasize the complex integration of these various components into a functional brain. The topics covered in the course are specifically designed to mesh in time with those covered in Fundamentals of Neuroscience 2 describing the function of these areas. For this reason, it would be best if these two courses were taken concomitantly. The course will be didactic with digital images, models, and wet specimens included in the course.

**INTD 5051. Research Methodology and Evidence-Based Practice. 2 Credit Hours.**

This course is designed to introduce dental residents and faculty to critical thinking, research methodology, and evidence-based practice skills.

**INTD 5064. Applied Statistics for Health Care Practitioners. 3 Credit Hours.**

This online course focuses on the application of descriptive and inferential statistics in research studies. Students are expected to gain knowledge and skills that will enable them to understand, interpret, and evaluate statistical results; work with a consultant statistician; and use software to enter, analyze, and summarize data. Course requirements include homework assignments, online discussions and/or chats, and periodic projects.

**INTD 5066. Laughter is the Best Medicine: An Interdisciplinary Elective about Humor, Healing, and Healthcare. 1 Credit Hour.**

This class is a serious look at humor! The physiological and psychological benefits of humor, as well as its therapeutic use with patient interactions, will be explored. Students will learn how to develop and improve their personal use of humor to combat burn out, through techniques to enhance coping skills and stress reduction. Student participation and interaction is integral to the content delivery.

**INTD 5067. Introduction To Bioinformatics And Computational Biology. 2 Credit Hours.**

The course will be taught by faculty from Biochemistry, Cellular & Structural Biology, CCRI, Periodontics, and faculty from UTSA. The course will be an introduction to methods and tools for working with DNA sequences and protein families, learning basic Unix networking, overview of numerical modeling, systems biology approaches to complex diseases, gene expression analysis, bioinformatics in clinical research, statistical tools for complex datasets, proteomics, structural methods for protein biology, cheminformatics, molecular modeling, and mathematical model building.

**INTD 5074. Topics In Translational Medical Product Development. 1 Credit Hour.**

It is crucial to understand the intricate process of translating basic research into market driven products, navigate the complex pathways of intellectual property management and the regulatory affairs of agencies such as the FDA. This course will offer students in biomedical sciences the opportunity to integrate industry-relevant training and experience with their basic science education. The course will explore the marketing and regulatory process by which a biomedical product is developed and brought to commercialization.

**INTD 5075. Complementary Healthcare for the Clinician. Credit Hours.**

The goal of this elective is to introduce future doctors to practices outside of the classical medical school curriculum that promote an evidence-based approach to wellness. This is so that the medical students of the UTHSC School of Medicine are informed about the reality, evidence and rumor surrounding a variety of commonly used alternative and supplementary healthcare practices. The of this class is not to make the student an expert in areas such as acupuncture or yoga, but to be well informed of the role of such practices as it relates to patient treatment and wellness. To this end, all the classes will have a practical component which will allow the students to experience the alternative modalities in a structured setting.

**INTD 5081. Topics In Cardiovascular Research. 1 Credit Hour.**

This course is designed to familiarize students with the current literature related to cardiovascular disease. Each week a different research topic selected from the recent literature is presented and discussed. Students are expected to attend and participate in the discussions. In addition, students are required to prepare and present once during the semester. A list of previous and current course presentations will be available online.

**INTD 5082. Responsible Conduct of Research. 1.5 Credit Hour.**

This foundational course introduces students to core ethical content necessary for responsible research conduct. Through interactive seminars, students will learn about (1) scientists as responsible members of society (contemporary ethical issues in biomedical research and environmental/social impacts of research), (2) policies for research with human subjects and vertebrate animals, (3) collaborative research, (4) conflicts of interest (personal, professional, financial), (5) data acquisition and laboratory tools (management, sharing, ownership), (6) responsible authorship and publication, (7) mentor/trainee responsibilities and relationships, (8) peer review, and (9) research misconduct (forms of misconduct and management policies).

**INTD 5091. Special Topics. 1-4 Credit Hours.**

This is a placeholder course, for which graduate students may register, if they are unable to select a specific track core course at the time of registration. Tracks are: Biology of Aging, Cancer Biology; Cell and Molecular Biology; Genetics, Genomics, & Development; Membrane Biology & Cell Signaling; Metabolism & Metabolic Disorders; Microbiology & Immunology; Molecular Biophysics & Biochemistry; Molecular, Cellular, & Integrative Physiology; Neuroscience; and Pharmacology. The course may be repeated for credit.

**INTD 5094. Independent Study. 1-4 Credit Hours.**

This elective allows for detailed in-depth study in a specific area of study. The area and mode of study are to be agreed upon by the student and instructor. The course may be repeated for credit when the area of study varies. Clock hours are to be arranged. Prerequisites: Graduate standing and consent of instructor.

**INTD 6002. Ethics In Research. 0.5 Credit Hours.**

This course covers topics relevant to ethics in scientific research. The course is taught on a case-study basis, dealing with real and hypothetical situations relevant to the conduct of scientific research. Topics discussed will include, but will not be limited to: data management, peer review, recognizing scientific misconduct, authorship, and The University of Texas regulations relevant to human and animal research. This course is required of all doctoral graduate students.

**INTD 6007. Advanced Cell Biology. 2 Credit Hours.**

This course provides an in-depth learning experience that instructs students on the fundamentals of cell biology as well as prepares the student to evaluate and design new research in the cutting-edge areas of modern cell biology. The course combines a didactic program of lectures along with a small-group discussion format in which students interact closely with a group of faculty who have active research programs. The course focuses on active areas of research in cell biology: Cell Signaling and Communication, Cell Growth, and Cell Death. Each week, the faculty the jointly discuss key publications that serve the bridge the gap between the fundamental underpinnings of the field and the state of the art in that area. Students and faculty will then jointly discuss key publications that serve to bridge the gap between the fundamental underpinnings of the field and the state of the art in that area.

**INTD 6008. Mitochondria & Apoptosis. 1 Credit Hour.**

This course will focus in depth on Mitochondria and Apoptosis. Topics will include: Mitochondria and Respiration; Mitochondria and Reactive Oxygen Species; Mitochondria and Apoptosis. It will provide an opportunity for a unique learning experience where the student can prepare to evaluate and design new research in the cutting-edge areas of modern cell biology and molecular biology. Instead of a didactic program of lectures, the entire course comprises a small-group format in which students interact closely with a group of faculty who have active research programs. Each week, faculty will provide students with a brief overview of the research area. Students and faculty will then jointly discuss key publications that serve to bridge the gap between the student's prior understanding of the field and the state of the art in that area.

**INTD 6009. Advanced Molecular Biology. 2 Credit Hours.**

This course will provide an in-depth learning experience on the fundamentals of molecular biology as well as prepare the student to evaluate and design new research in the cutting-edge areas of modern molecular biology. The course combines a didactic program of lectures along with a small- group discussion format in which students interact closely with a group of faculty who have active research programs. The course focuses on active areas of research in molecular biology: Chromatin structure, Transcription, DNA Replication and Repair, Recombination, RNA processing and regulation, Protein processing, targeting and degradation. Each week, the faculty provide students with didactic lectures on a current research area. Students and faculty then jointly discuss Key publications that serve to bridge the gap between the fundamental underpinnings of the field and the state of the art in that area.

**INTD 6010. Evidence Based Dentistry. 1 Credit Hour.**

Designed to help students establish an "evidence-based practice" the course will provide students the opportunity to learn the skills necessary to evaluate and select new dental products and clinical procedures. This requires an ability to read and evaluate various sources of knowledge, including articles published in the dental and medical literature, advertisements, Internet sources, and continuing education programs. Lectures and readings are designed to provide a basic understanding of clinical research, epidemiology, and statistical procedures such that dental journal articles and other sources of knowledge can be critically evaluated. The long-range goal is to prepare the student to think critically and to make sound judgments regarding the acceptance of new knowledge, products, and procedures in private practice.

**INTD 6011. Introduction To Science Of Teaching. 1 Credit Hour.**

This course will provide insight into the basic skills of learning and teaching. Faculty from the Academic Center for Excellence in Teaching and the Graduate School will provide the opportunity to learn the skills, strategies, and experiences for a future in academia and teaching. Topics include lecture presentations on why scientists choose to teach, planning a student learning experience in addition to developing a lecture syllabus, curriculum and teaching portfolio and philosophy. The course is recommended for Supervised Teaching Course INTD 6071.

**INTD 6014. Perio/Pros/Endo/Orth Interdisciplinary Course 2. 1 Credit Hour.**

This seminar brings together the residents and graduate staff from the periodontic, prosthodontic, endodontic and orthodontic postdoctoral programs to share clinically relevant multidisciplinary information. Patient diagnostic evaluations and treatment plans are evaluated in an interactive environment. Selected topics involving new advancements are presented and discussed.

**INTD 6019. Pharmacotherapeutics. 1 Credit Hour.**

This course is designed to review general principles of pharmacology; current and accepted pharmacotherapy for the medical management of pain, infection, and selected systemic diseases; and associated adverse drug events. It is based on the top 200 drugs dispensed by U.S. community pharmacies for the prevention, diagnosis, and/or treatment of disease with special reference to dentistry.

**INTD 6033. Cell Signaling Mechanisms. 2 Credit Hours.**

This course covers the molecular mechanisms of action of various extracellular mediators including hormones, neurotransmitters, growth factors, cytokines, etc., and cell signaling events. Several areas will be discussed including: (1) mechanisms of mediator synthesis; (2) interaction of mediators with specific receptors; (3) modulation by mediators of various second messenger systems including cyclic nucleotides, inositol phospholipids, calcium, protein phosphorylation, ion flux, etc.; and (4) intra- and intercellular mechanism for regulating mediator action. Open for Cross Enrollment on Space Available basis.

**INTD 6040. Resident Lecture Series in Psychiatric Disorders and Psychopharmacology I. 1 Credit Hour.**

This is an interdisciplinary advanced elective in which students attend 17 lectures from the Psychiatry Year One Residents' lecture series. These lectures focus on the psychopathology, epidemiology, and pharmacological treatments for illnesses such as schizophrenia, anxiety disorders, trauma related disorders, eating disorders, and sleep disorders.

**INTD 6041. Basic Science Resident Lecture Series In Neurology. 1.5 Credit Hour.**

This is an interdisciplinary advanced elective in which students attend 20 lectures, selected from the full offering of daily one-hour lectures comprising the Neurology Residents' Basic Sciences lecture series. These lectures cover a range of topics, such as Epilepsy, Movement Disorders, the Thalamus, Parkinson's Disease, Alzheimer's Disease, Stroke, Sleep, etc., all given from a clinical perspective. In addition, graduate students will have the opportunity to observe or participate in at least two enrichment activities related topically to the lectures they attend, which may include such settings as case presentations, diagnostic training sessions, or clinical observations, again selected from the list of offerings included in the "Neurology Residents" series.

**INTD 6043. Structure & Function Of Membrane Proteins. 2 Credit Hours.**

This is a course targeted at students within any of the Graduate Tracks. The objective is to provide a broad view, allowing for in depth consideration in selected areas, of the structure and diverse functions of proteins within a membrane environment. Specific topics covered will include: ion selective channels, large membrane pores, membrane transporters, membrane pumps, and membrane receptors. The format of the course will be didactic lecture followed by student presentations of relevant topics. Open for Cross Enrollment on Space Available basis.

**INTD 6045. Clinical Practicum In Neuroscience. 1 Credit Hour.**

This course will provide students with a brief, but intense and very focused exposure to clinical practice in a relevant area of their choosing, designed and coordinated to best match their interests in close individual collaboration with a clinical mentor in one of the participating components: Neurosurgery, Neurology, Psychiatry, or Endodontics. Representative activities could include participation in case presentation and treatment planning, attending rounds with physicians and residents, direct observation of clinical procedures, patient interviews, follow-up care and outcome review. Potential venues may include inpatient psychiatric ward, sleep clinic, epilepsy clinic, stroke clinic, neurosurgical theater and surgical ICU. In consultation with the course director, students will first select one of the following sub-sections, then design their individually tailored clinical practicum experience with the coordinator for that section.

**INTD 6046. Resident Lecture Series in Psychiatric Disorders and Psychopharmacology II. 1 Credit Hour.**

This is an interdisciplinary advanced elective in which students attend lectures, selected from the full offering of weekly two-hour lectures comprising the Psychiatry Year One Residents' lecture series. These lectures cover a range of topics, such as Substance Abuse, Depression, Bipolar Disorder, etc., all given from a clinical perspective.

**INTD 6070. Teaching Excellence And Academic Skills (Texas). 1 Credit Hour.**

This course, designed to assist graduate students and faculty in acquiring teaching skills, is composed of four modules, each covering a range of topics from lecture and clinical teaching to instructional development to assessing student achievement.

**INTD 6088. Clinic Introduction. 4.5 Credit Hours.**

The informatics module, one component of this course, is a continuation from the first-year module. Students continue training on a higher level of computer use. The clinic component of the course is a series of small-group rotations for distinct clinic modules including patient assessment, periodontics, caries detection, preventive methods, sealants, pulp testing, local anesthesia, oral surgery, radiographic technique recertification, radiographic interpretation, digital photography, constructing a stabilizing appliance, patient education, infant exam, and opportunities for assisting in various clinics with the Dental School at external sites. At the end of the sophomore year, students will have had the opportunity to become well acquainted with the clinic environment and techniques for initial patient visits scheduled for the summer clinic. Professional development expectations are emphasized in the overall evaluation.

**INTD 6097. Research. 0.5-12 Credit Hours.**

This course is intended for first-year IMG students only. Students will be required to attend a minimum of 10 departmental (any) seminars during the semester and submit a 100-150 word synopsis of each seminar within two weeks of the seminar.

**INTD 6115. Perio/Pros/Endo/Ortho Interdisciplinary Course 3. 1 Credit Hour.**

This is a seminar that brings together the residents and graduate staff from the periodontic, prosthodontic, endodontic and orthodontics postdoctoral programs to share clinically relevant multidisciplinary information. Patient diagnostic evaluations and treatment plans are evaluated in an interactive environment. Selected topics involving new advancements are presented and discussed.

**INTD 7002. Neurobiology Of Learning And Memory. 1 Credit Hour.**

This course will focus on recent findings and topics related to the underlying aspects of the neural basis of learning and memory. Students will have the opportunity to learn about: molecular basis of memory formation, consolidation and retrieval, memory and emotion, associative learning, memory and amnesia, and recognition memory and the medial temporal lobe. The lectures will be interactive and driven by discussions of key journal articles. Each week the first hour will be reserved for lecturing and the second hour will be reserved for a discussion of a journal article.

**INTD 7003. Elective in International Medicine. 4 Credit Hours.**

This elective serves as a vehicle for students to participate in international medicine rotations. Students will work with a faculty sponsor to identify a program, either a pre-established site or a site discovered by the student which requires faculty approval. This elective includes: 1) The Center for Medical Humanities and Ethics International Scholars Program in India, a competitive program requiring a separate application through the department of Medicine, 2) Shoulder to Shoulder program in Latin America, which requires a separate application process and some cost (airfare and small project fee), and is available October, January, and April, 3) Programs in Nicaragua, Mexico, Panama, and Guatemala, and 4) Other sites available through online directory: <http://www.globalhealth-cc.org/GHEC/Resources/GHonline.htm>. All rotations share a commitment to service learning - medical education and self-reflection that arises out of service to needy populations. Students spend up to 4 weeks (or possibly longer) living in an international site and participating in the care of patients, under the supervision of local and visiting health care providers. The clinical settings and caseload will vary based on the location. There may be opportunities for patient education and emphasis on efforts of local empowerment, aiming to build up the communities in a sustainable way. Students will be expected to integrate themselves into the health care delivery system, and when possible, to strive to make an impact through community education and home visits. For certain Latin American sites, fluency in Spanish is a prerequisite. Students are encouraged to seek similar service learning experiences with underprivileged populations in San Antonio and Border communities prior to or after the rotation. End of rotation "reflection essays" are required and will serve to process student experiences.

**INTD 7005. Indian Health Care Preceptorship. 4 Credit Hours.**

This elective offers the opportunity for an experience in the health care of Native Americans, coordinated through the Indian Health Service. Most experiences involve both inpatient and outpatient care under direct supervision of board certified family physicians or internists. Educational activities such as conferences, teaching rounds, etc., may vary from site to site. All clinical sites are located outside the state of Texas, including sites in New Mexico, Arizona and Alaska. Early application is recommended. Students completing appropriate application forms may be reimbursed for transportation costs and provided room and board by the Indian Health Service.

**INTD 7007. Literature and Medicine. 2 Credit Hours.**

In this course you are required to read short stories, poems, and a book of nonfiction. While many of the stories or poems directly address medical or ethical issues, the primary purpose is not to enhance your store of knowledge in these areas, but to promote your appreciation of these works through discussions with other students (online via Blackboard and in class) and with authors and lecturers. Your own contributions to the course - not just the insights you've gained as medical students but the wisdom you bring to the class as human beings - will be critical to its success. We hope that the readings will help you prepare for and process your clinical experiences, furthering your development as a person as well as physician. There will be no "right" or "wrong" answers in this course; rather, our goal is to encourage thoughtful and serious responses to the readings and a lively and fulfilling conversation about them and the issues they raise. Students from Christian Medical College in Vellore, India, will join in our discussion online. MSIV students will receive two credits for completion of this longitudinal elective. All students are expected to participate in class discussions. Grades are earned by reading assignments, attendance at class meetings, and posting primary and secondary responses to posted discussion questions. Open for Cross Enrollment on Space Available basis.

**INTD 7020. Clinical Patient Management. 5 Credit Hours.**

This course is designed to help students develop skills in clinical behavioral dentistry through small group discussions, lectures, and routine patient treatment by application of the principles of coordinating patient care; communicating effectively with colleagues, staff, and faculty; and managing time, records, and environment. The students are required to manage their comprehensive care patients in the Junior Clinic following the principles presented in this course.

**INTD 7074. Topics In Translational Medical Product Development. 1 Credit Hour.**

It is crucial to understand the intricate process of translating basic research into market driven products, navigate the complex pathways of intellectual property management and the regulatory affairs of agencies such as the FDA. This course will offer students in biomedical sciences the opportunity to integrate industry-relevant training and experience with their basic science education. The course will explore the marketing and regulatory process by which a biomedical product is developed and brought to commercialization.

**INTD 7091. Independent Studies. 1-9 Credit Hours.**

Students will have the opportunity to use this course to study for the National Board, Part II examination, according to their own need. This course also will serve as a framework for a student returning from a leave of absence or from other protracted time away from classes or clinic. At the conclusion of the course, the enrolled student must demonstrate knowledge and/or skills and/or values consistent with the expectations for entering the level of course study from which the student left. An individualized course of study will be developed once the student is enrolled.

**PHYL Courses****PHYL 3014. Research in Endocrinology of Aging. Credit Hours.**

The course consists of student participation in research on glucocorticoid-induced gene expression during aging and food restriction.

**PHYL 3016. Ion Channel Research. Credit Hours.**

The course includes student participation in ongoing basic research on the molecular mechanisms of signaling pathways acting on ion channels. Techniques may include patch-clamp, electrophysiology, molecular biology and biochemistry.

**PHYL 4000. Special Topic. 1-42 Credit Hours.**

This is a self-designed course created by both the student and the department to cover a specific topic. A Course Approval Form must be completed along with documentation of the designed course description.

**PHYL 4012. Molecular Endocrinology Research. 4 Credit Hours.**

The course consists of student participation in research on glucocorticoid-induced gene expression during aging and food restriction.

**PHYL 4016. Ion Channel Research. 4 Credit Hours.**

The course includes student participation in ongoing basic research on the molecular mechanisms of signaling pathways acting on ion channels. Techniques may include patch-clamp, electrophysiology, molecular biology and biochemistry.

**PHYL 5013. Dental Physiology. 6.5 Credit Hours.**

Lecture instruction in the basic concepts of cell and organ function and in the integrated function of mammalian organ systems is presented. The physiology of the nervous system is included. (Students may elect to substitute CSBL 5019 - Gross Human Anatomy for Graduate Students for this course.)

**PHYL 5017. Discovery Of Physiological Principles 3. 2 Credit Hours.**

This course consists of laboratory demonstrations and experiments in areas covered in Organ Systems Physiology 2 and acquisition of skills for analyzing and communicating the results of laboratory research. Corequisites: PHYL 5025.

**PHYL 5025. Organ Systems Physiology 2. 4 Credit Hours.**

This course is a continuation of the study, begun in Organ System Physiology 1, of the mechanisms that produce and control the functions of the body's organ system. Prerequisites: PHYL 5011, PHYL 5014, PHYL 5021, and PHYL 5024.

**PHYL 5041. Excitable Membranes. 1 Credit Hour.**

This course addresses fundamental mechanisms of cell excitability in neurons and other excitable tissues. The format is a combination of lectures, readings, discussions, a laboratory demonstration, and online simulations (where available). Examples of the latter include activities to simulate the resting membrane potential and action potentials. The module will emphasize contemporary issues in the scientific literature as well as translational science where dysfunction in ion channels underlie common disorders such as Alzheimer's Disease, Myasthenia Gravis, Cystic Fibrosis, Long QT Syndrome, and Epilepsy to name just a few. PHYL 5041 is a co-requisite for Fundamentals of Neuroscience I as it is the first module of that course, but it also can be taken as a standalone one-hour course.

**PHYL 5042. Cardiovascular Physiology. 1 Credit Hour.**

This course explores the physiological mechanisms by which the cardiovascular system carries out its principle function. Mechanisms that produce and regulate cardiac pumping, organ blood flow, capillary fluid and solute exchange, and arterial blood pressure are examined. The nature and importance of various local, neural, and hormonal mechanisms are emphasized. Integrated control of cardiovascular function in situations requiring cardiovascular adjustments (e.g., exercise, blood pressure alterations) are also covered. Students may take the full series but are only required to take three out of the four courses (PHYL 5041, 5042, 5043, and 5044).

**PHYL 5043. Respiratory & Renal Physiology. 1 Credit Hour.**

This course covers the physiology of respiratory and renal function in the human body. Our focus is on basic mechanisms of function, role in body homeostasis, as well as dysfunction of both systems associated with pulmonary and renal disease. Two sessions are set aside for discussion around significant advances in each field. One or more recently published articles will serve as the focus for each of these discussions sessions. Students may take the full series but are only required to take three out of the four courses (PHYL 5041, 5042, 5043, and 5044).

**PHYL 5044. Metabolism/Hormones/GI System. 1 Credit Hour.**

The course serves to expose students to the current state of knowledge in the field of endocrinology and metabolism, including reproductive physiology, and the related topics of the physiology of the digestive tract. Three sessions are assigned to advanced topics. In these three sessions students will engage in a discussion format centered around one recent important publication. The lecturer will lead the discussion with the aim of showing how the topics the students have been exposed to integrate one with another, providing the context for present-day discoveries.

**PHYL 5045. Mammalian Physiology. 4 Credit Hours.**

The course begins with fundamental processes that govern membrane transport, membrane potential, and excitation-contraction coupling. The course then proceeds to coverage of organ system function including cardiovascular, respiratory, renal, gastrointestinal and endocrine/metabolic physiology. Lecture material is enhanced by supplemental discussion of research literature encompassing molecular biology, integrative function, and pathophysiological implications. Students may take the full course but are only required to take three out of the four modules (PHYL 5041, 5042, 5043, and 5044).

**PHYL 6020. Regulation of Glucose Metabolism. 3 Credit Hours.**

The normal regulation of glucose metabolism will be reviewed integrating whole body, organ, cellular, and molecular control mechanisms. Dysregulation of these control mechanisms in diabetes and other common metabolic disorders such as obesity and the metabolic syndrome will be examined in detail. State-of-the-art in vivo and in vitro techniques essential for the study of normal and deranged glucose homeostasis will be discussed in depth. Diabetic microvascular (nephropathy, retinopathy, neuropathy) and macrovascular complications and their relationship to impaired glucose metabolism will be reviewed. Lastly, pharmacologic therapy of diabetes and its associated complications will be discussed.

**PHYL 6071. Supervised Teaching. 1 Credit Hour.**

A student enrolled in this course is expected to participate in the teaching program of the Department.

**PHYL 6090. Seminar. 1 Credit Hour.**

The course is comprised of research presentations by Physiology graduate students. This course is required of all students each semester.

**PHYL 6091. Selected Topics Of Physiology. 2 Credit Hours.**

Students must take a least two courses selected from among the offerings in:(1) Cardiovascular; (2) Cell Biology in Neural Science; (3) Endocrine and Metabolism; (4) Molecular Physiology; and (5) Ion Channels in Disease. Courses that may be substituted for one of these selections: (1) INTD 5040 - Fundamentals of Neuroscience I: Molecular, Cellular, and Developmental Neuroscience; (2) INTD 5043 - Fundamentals of Neuroscience II: Systems Neuroscience; (3) CSBL 6048 - Biology of Aging; and (4) CSBL 6058 - Neurobiology of Aging. Not all selected topics are offered each semester. Please discuss this with the Academic Coordinator for more details. Substituted courses in conflict with Physiology course schedule will require approval from COGS.

**PHYL 6097. Research. 1-12 Credit Hours.**

If a track chooses to give a seminar course, the specific course requirements will be determined by the track. The sub-designations for each track are: (1)Biology of Aging; (2) Cancer Biology; (3) Cell & Molecular Biology; (4) Genetics, Genomics & Development; (5) Membrane Biology & Cell Signaling; (6) Metabolism & Metabolic Disorders; (7) Microbiology & Immunology; (8)Molecular Biophysics & Biochemistry; (9) Molecular, Cellular, & Integrative Physiology; (10) Neuroscience; and (11) Pharmacology.

**PHYL 6098. Thesis. 1-12 Credit Hours.**

Registration for at least one term is required of M.S. candidates. Prerequisite: admission to candidacy for Master of Science degree.

**PHYL 6291. Seminar 2. 1 Credit Hour.**

Presentation and discussion of recent research advances by outside scientists.

**PHYL 7000. Off Campus. 1-42 Credit Hours.**

All off campus rotations must be approved by the designated faculty member prior to the beginning of the rotation (at least one week before the course begins). Credit will not be given for any rotation that has not been approved in advance. Required paperwork includes: "Course Approval" form, a written letter or email for acceptance form the physician preceptor with the start and end dates of the course/rotation, and a course description of your learning objectives and responsibilities during the rotation. Forms must include a complete address and telephone number for the off campus location or residence address for the student while at the off campus site. Forms will not be approved after the rotation has already begun. Contact the department for assistance with enrolling in this course.

**PHYL 7099. Dissertation. 1-12 Credit Hours.**

Registration for at least two terms is required of Ph.D. candidates. Prerequisites: admission to candidacy for the Ph.D. degree.

**RADI Courses****RADI 4001. General Diagnostic Radiology. 4 Credit Hours.**

This course is designed as an introduction to diagnostic radiology. The primary goals of the course are directed toward introducing the student to the different diagnostic imaging modalities available and teaching the student to select the appropriate radiologic examinations for different clinical problems. Students will have the opportunity to receive a working knowledge of diagnostic radiology through lectures, individual projects, reading assignments, participation in subspecialty rotations, teaching conferences, and study of the American College of Radiology teaching file.

**RADI 4006. Pediatric Radiology. 4 Credit Hours.**

By being with the pediatric radiologist on a one-on-one basis through most of the working day, the student will have the opportunity to gain some insight as to the radiologist's role as a clinician, consultant, and teacher; and acquire some knowledge of general pediatrics, neonatology, urology, orthopaedics, and other specialties. The student may attend Diagnostic Radiology Lectures.

**RADI 4007. Review Of Radiology for the Intern. 0.5 Credit Hours.**

This is a refresher course in Clinical Diagnostic Radiology. In a large group format, a Radiology faculty member will review with the participants the basics of evaluating the chest X-ray, chest CT, abdominal CT, spinal, head, and pediatric cases. In addition, time will be spent on reviewing the appropriate studies to order for the work-up of various clinical scenarios.

**RADI 4020. Mammography- A Multidisciplinary Approach. 4 Credit Hours.**

This elective is intended to educate students in the subject of mammography with a multidisciplinary approach. Students will be allowed to spend 2 days each week in medical oncology, surgical oncology, or radiation therapy. Students will primarily be assigned to the mammography section of radiology, learning what criteria are used to detect breast cancer and participating in the work-up of lesions and witnessing biopsies. In addition, they will attend tumor board once a week that is multidisciplinary one day per week will set aside for library student and the students will be asked to research a topic or participate in a project regarding mammography. We intend that this elective will thoroughly educate those who are interested in mammography and help them understand how our specialty is integrated with many other disciplines.

**RADI 4202. General Diagnostic Radiology. 4 Credit Hours.**

By being with the pediatric radiologist on a one-on-one basis through most of the working day, the student will have the opportunity to gain some insight as to the radiologist's role as a clinician, consultant, and teacher; and acquire some knowledge of general pediatrics, neonatology, urology, orthopaedics, and other specialties. The student may attend Diagnostic Radiology Lectures.

**RADI 5001. Basic Radiation Safety. 1 Credit Hour.**

This course provides the student with the opportunity to gain a conceptual understanding of the radiation protection principles involved in the research, diagnostic, and therapeutic uses of radiation sources. This course will cover the safe receipt, use, storage, and disposal of radiation sources in the biomedical research setting. The contents of this course fulfill HSC training requirements in order to use radioactive materials on campus. Successful participants will earn three HSC safety certificates of completion: Basic Radiation Safety Training, Basic Laser Safety Training, and Basic Laboratory Safety Training.

**RADI 5005. Fundamentals Of Radiation Dosimetry. 3 Credit Hours.**

The aim of this course is to introduce the students to the fundamentals of radiation dosimetry, including dosimetry quantities, interactions with matter, cavity theory and calibration protocols. More specifically, the topics that will be covered during this course are the following: 1) Introduction/Ionizing Radiation, 2) Quantities for describing interactions, 3) Exponential attenuation, 4) Charged particle and radiation equilibria, 5) Absorbed dose in radioactive media, 6) Radioactive decay, 7) X-ray interactions with matter, 8) Charged particle interactions with matter, 9) Cavity theory, 10) Dosimetry Fundamentals, and 11) Calibration protocols.

**RADI 5007. Statistics in the Radiological Sciences. 2 Credit Hours.**

An overview of biomedical statistics methods and basic applications to experimental design with special emphasis given to those methods used in radiation detection, image analysis, and evaluations of diagnostic efficacy. Students will learn the theory behind these methods and apply them to actual and simulated problems in the Radiological Sciences using the R statistical programming environment.

**RADI 5010. Medical Biophysics. 3 Credit Hours.**

This course is an introduction to the basic principles of biophysics as applied to medicine and biology. Emphasis will be placed on non-imaging topics of medical biophysics such as mechanics, thermodynamics, diffusion, electrical conduction, biomagnetism, and light spectroscopy.

**RADI 5011. Radiation And Nuclear Physics. 3 Credit Hours.**

This course reviews nuclear structure, interactions of radiation with matter, and the statistical nature of radiation. The course covers gas, scintillation, and solid-state detector technologies and their applications, including spectroscopy.



**RADI 5015. Physics Of Diagnostic Imaging 1. 3 Credit Hours.**

This course introduces the student to the basic principles and radiological practice using noninvasive imaging systems. Topics include production of x-rays, interaction of radiation with matter, and the physics of imaging using computed tomography, ultrasound, and magnetic resonance. Prerequisites: consent of instructor.

**RADI 5018. Physics Measurements In Imaging Lab. 2 Credit Hours.**

This is a laboratory course focusing on performance of measurements used in quality assurance (QA), system characterization, and acceptance testing of medical imagers. Corequisites: RADI 5015.

**RADI 5020. Principles of Health Physics 1. 3 Credit Hours.**

This course covers the basic principles of protection dealing with the major forms of ionizing radiation.

**RADI 5025. Molecular Oncology & Radiobiology. 1.5-3 Credit Hours.**

This course is an overview of the physics and chemistry of radiation biology; the biological effects of ionizing and non-ionizing radiations and hyperthermia at the cellular and tissue levels and whole body and late effects.

**RADI 5030. Neuroscience Imaging Laboratory. 1 Credit Hour.**

Students are assigned to rotate in 6 laboratories at the RIC: MRI, PET, TMS, ERP, animal imaging, and optical imaging. In each lab, students will have the opportunity for hands-on experience on subject preparation, data acquisition, and processing.

**RADI 5050. Human Neuroelectrophysiology. 3 Credit Hours.**

A detailed study of the electrophysiological basis of human behavior, with an emphasis on event-related brain potentials associated with cognitive function, perception, and action. See instructor for prerequisite coursework.

**RADI 5090. Sem Radiological Science. 1-9 Credit Hours.**

Each student is required to register a minimum of two terms if following an M.S. degree plan or four terms if following a Ph.D. plan. Seminars will review current findings in the field.

**RADI 6012. Phys Nuclear Medi Imaging. 3 Credit Hours.**

This course is a study of physical principles of planar, SPECT, and PET radionuclide imaging; instrument theory; dosimetry; computer uses; and safety considerations. Prerequisites: RADI 5011.

**RADI 6014. Physics Of Dental Imaging. 2 Credit Hours.**

This course is a survey of imaging procedures used in modern dentistry with an emphasis on the clinical objectives and physical principles underlying intraoral, panoramic, cephalometric, and digital dental radiography. Prerequisites: consent of instructor.

**RADI 6015. Physics Measurements in Imaging 2. 3 Credit Hours.**

Students will become study and work with advanced methods for evaluating the performance of clinical imaging systems, including x-ray imaging, fluoroscopy, mammography, ultrasound, x-ray CT and MRI. Testing will follow procedures described in publications of the AAPM and ACR and used to achieve compliance with the regulations and recommendations the DSA, MQSA, ACR, NRC, MIPPA and State of Texas' Radiation Control Program. Students will study the procedures and then use "best practices" to perform the tests in a clinical setting. Methods for evaluating nuclear medicine equipment shall also be reviewed and carried out, but in a less intensive manner. Prerequisites: RADI 5015, RADI 6049, RADI 6012, RADI 6016.

**RADI 6016. Physics of Diagnostic Imaging 2. 3 Credit Hours.**

This course includes theory and applications of various forms of electronic imaging systems; advanced diagnostic imaging principles involving mathematical image analysis, digital image processing, digital image display, and concepts of electronic imaging. Prerequisites: consent of instructor.

**RADI 6017. Neuroimaging Methods. 3 Credit Hours.**

This course will deal extensively with several noninvasive brain imaging techniques to study the functional organization of the human and animal brains. Methods covered include positron-emission tomography (PET), event-related potentials, magneto-encephalography, optical imaging, voltage and calcium imaging, autoradiography, as well as transcranial magnetic stimulation. The course will only touch upon anatomical and functional MRI as well as high field MRI, as students will receive exhaustive MRI training from other classes. Course format will include both lectures on the several methods and seminars in which recent technical advances in the field are discussed. Prerequisites: consent of instructor.

**RADI 6018. Foundations Of Neuroscience Imaging. 3 Credit Hours.**

This course will explore several advanced topics in cognitive neuroimaging techniques. Examples of such topics include strategies to study the functional and/or anatomical organization of the human brain and paradigms used for studying a variety of brain functions. Students interested in functional MRI as well as DTI will have an opportunity to gain extensive knowledge and experience.

**RADI 6019. Pulse Sequence Programming For MRI. 3 Credit Hours.**

This course is an introduction to the basic principles of image processing as applied to digital radiography, computed tomography, ultrasound imaging, and magnetic resonance images. Prerequisites: RADI 6016.

**RADI 6020. Advanced Topics In Cognitive Neuroscience. 3 Credit Hours.**

This course will explore several advanced topics in cognitive neuroscience. It includes exhaustive study of a brain function in normal and in disease states. Brain functions include but are not limited to sensation, perception, action, language, motion, and cognition.

**RADI 6021. Prin/Health Physics 2. 3 Credit Hours.****RADI 6022. Programming Medical for Physics. 1 Credit Hour.**

The purpose of the course is to demonstrate to students the usefulness of programming for medical physics. The Matlab programming language is chosen because it enables rapid coding and data visualization. Students will first be taught basic programming techniques. Then, they will be shown specific examples of these techniques being applied to medical physics. Finally, they will create a final program, which performs a task of the student's choosing and utilizes several concepts from the course. Students will be graded based on their attendance and programming projects. Must have familiarity with the field of medical physics.

**RADI 6023. Introduction To Clinical Medical Physics Practice. 1-9 Credit Hours.**

This course allows students to observe professional medical physicists in a clinical setting and learn the roles of various other medical professionals in the Radiology and Radiation Oncology medical clinic. Students participate in simple tasks related to medical physics data and are shown how to evaluate data to provide reports and tables. Students are also trained in basic safety and ethical issues in clinical medicine and the professional conduct of the medical physicist, following the guidelines established in AAPM Report 109. This material is intended to cover ethical issues in clinical medicine and in the professional conduct of the medical physicist. The term ethics is used here in the sense of a permissible standard of conduct for members of profession. While different people may have different opinions of what is ethical professions always have certain ethical standards or codes of conduct that are compiled in written form and are generally by practitioners. In addition to becoming familiar with written codes of conduct, the student shall be introduced to commonly encountered situations in which a choice of actions is available, some of which would be considered unethical and some of which be considered ethical, according to current standards of care of practice. These would include more specific issues that arise with respect to recent patient privacy concerns and legislation specific to the Health Insurance Portability and Accountability Act (HIPAA) and compliance both in clinical practice and research. A case-based approach in a seminar setting with class participation is utilized. This allows the student to put him or herself in the place of an individual who faces an ethical dilemma and to explore variations of the case that is presented. Other faculty members are also encouraged to attend, to offer comments, and to relate situations that they encountered either first- or secondhand.

**RADI 6024. Radiological Anatomy & Physiology. 3 Credit Hours.**

This course will provide students with an opportunity to learn anatomy, physiology, and commonly used medical terminology as it relates to radiologic imaging. Anatomic and physiologic features will be illustrated with radiologic images in formats commonly encountered in clinical radiology. By the end of the course, students are expected to be familiar with basic medical terminology and have a good understanding of medical anatomy, physiology, and some basic pathology as related to specific organs for which radiologic images are commonly applied.

**RADI 6025. Therapy Clinical Rotation 1. 12 Credit Hours.**

The first clinical rotation is designed to give an introduction and an overview of all the clinical processes and the basic safety training. In detail the student will cover the following topics: employee orientation, radiation oncology orientation, HIPAA training, introduction to radiation protection, introduction to nursing and introduction to simulation, introduction to LINACs, LINAC QA and warm up, monitor unit calculations, electronic medical records orientation, regulations and professional recommendations.

**RADI 6026. Clinical Therapy Rotation 2. 12 Credit Hours.**

In the second semester of the clinical rotation, the students will cover the following topics: on board MV and kV imaging, ExacTrac design, function and daily, monthly QA, Linac Annual QA and the RPC process, TBI and TSE, IMRT planning, LDR planning and the COMS eye plaque process, patient safety, and learn shielding techniques for CT, kV imaging, LINAC and isotopes.

**RADI 6027. Imaging Physics Clinical Rotation 1. 12 Credit Hours.**

The first clinical rotation is designed to give an introduction and an overview of all the clinical processes and the basic safety training. In detail the student will cover the following topics: employee orientation, clinical radiology department orientation, HIPAA & MIPPA training, introduction to safety in the radiology clinic, introduction to general radiography, introduction to hard copy devices and image displays, electronic medical records orientation, introduction to ultrasounds imaging, introduction to mammography, regulations and professional recommendations.

**RADI 6030. Physics Of Radiotherapy. 3 Credit Hours.**

Theory, design, and operation of radiation-producing equipment used in radiation therapy are introduced. Exposure and absorbed dose calculations, patient dosimetry, treatment planning, and use of computers in radiation therapy are covered.

**RADI 6031. Physics Measurements In Radiotherapy I. 3 Credit Hours.**

Performance of measurements on radiation therapy equipment used to determine therapy treatment parameters is the opportunity for study in this course.

**RADI 6032. Therapy Clinical Rotation 3. 12 Credit Hours.**

In the third semester of the clinical rotation, the students will cover the following topics: treatment plan checks, weekly chart checks, brachytherapy planning and QA, LINAC design, SRS Treatment Planning (SRS) and daily, monthly and annual QA, participation in all aspects of SBRT treatment and treatment planning QA.

**RADI 6033. Advanced Radiotherapy Physics. 3 Credit Hours.**

This course includes the coverage of advanced radiation therapy special topics: intensity modulated radiation therapy, advanced brachytherapy, and radiation therapy shielding.

**RADI 6034. Therapy Clinical Rotation 4. 12 Credit Hours.**

In the fourth semester of the clinical rotation, the students will cover the following topics: medical dosimetry rotation, ultrasound, PET, MRI, SPECT imaging in radiotherapy and acceptance and commissioning of major equipment.

**RADI 6035. Physics Measurements In Radiotherapy 2. 3 Credit Hours.**

In this course students will have the opportunity to gain further didactic and hands-on familiarity with radiation therapy measurement equipment (ion chambers, films, TLDs, water tanks, profilers, etc.) and learn daily clinical practices. Students will have the opportunity to learn the roles of a radiation oncology team, the generation of radiation therapy treatment plans, patient quality assurance, and advanced, specialized radiation therapy techniques. Learning can be accomplished through attendance of didactic lectures, homework assignments, presentations of class projects, and a comprehensive oral exam. Prerequisites: RADI 5005, RADI 6030, and RADI 6031.

**RADI 6038. Methods in Dosimetry & Shielding Design. 2.5 Credit Hours.**

The goal of the course is to teach students the guidelines established by the American Association of Physicists in Medicine (AAPM) and the National Council of Radiation Protection (NCRP) relating to patient dosimetry and shielding design of radiological facilities. Students will be responsible to read, comprehend, and learn the selected Task Group reports. Students will be evaluated of their knowledge by weekly quizzes and a final oral evaluation held at the end of the course. Successful completion of the course will be accomplished when the student is knowledgeable and understands the recommendations for a practicing clinical physicist. Learning is accomplished through attendance of weekly lectures, assignments (presentation of assigned reports and guidelines), and class discussion.

**RADI 6039. Imaging Physics Clinical Rotation 2. 12 Credit Hours.**

In the second semester of the clinical rotation, topics covered include safety in the radiological clinic, nuclear medicine and MRI, introduction to fluoroscopy, computed tomography, magnetic resonance imaging, nuclear medicine and regulations, professionalism and ethics.

**RADI 6040. Imag Physics Clin Rotation 3. 12 Credit Hours.**

The third clinical rotation will include safety in radiology clinic, advanced general radiography, advanced breast imaging and image-guided stereotactic breast biopsy, dental radiography and cone beam CT, dual-energy x-ray absorptiometry (DEXA), advanced fluoroscopic imaging and special procedures, intermediate nuclear medicine and regulations, professionalism and ethics.

**RADI 6042. Non-Ionizing Radiation Biology. 1-9 Credit Hours.**

This course is an overview of the biological and known or potential health effects of non-ionizing radiation, with attention to radio frequency radiation in the microwave range, extremely low frequency (ELF) field exposures, LASER emissions, and ultraviolet (UV) light exposure.

**RADI 6043. Imaging Physics Clinical Rotation 4. 12 Credit Hours.**

The fourth clinical rotation will include safety in radiology clinic, imaging informatics, advanced imaging informatics, advanced magnetic resonance imaging, advanced nuclear medicine physics, regulations, professionalism and ethics.

**RADI 6049. Intro To Magnetic Resonance. 2 Credit Hours.**

This course presents the basics of the practice of magnetic resonance as the experimentalist or clinician first meets them. The approach begins with images, equipment, and scanning protocols. The student will have the opportunity to face issues pertinent to practice with theoretical background added as experience grows. Through this approach, key ideas are introduced in an intuitive style that is faithful to the underlying physics.

**RADI 6050. Magnetic Resonance Imaging. 2 Credit Hours.**

This course explores the physics of magnetic resonance image formation through discussion of imaging problems, reviews of current research topics with an emphasis on quantitative methods using MRI, and hands-on experience in MRI laboratories. Prerequisites: RADI 6049.

**RADI 6051. Statistical Parametric Mapping. 3 Credit Hours.**

Course content includes principles of NMR Spectroscopy as applied to the resolution of molecular structural problems in chemistry, biology, and medicine; and principles and methods for designing BOLD contrast MRI experiments and evaluating fMRI data.

**RADI 6060. Biophotonics and Optical Imaging. 3 Credit Hours.**

Optical methodologies for imaging, diagnosis, and therapy are rapidly advancing in biology and medicine. This course will review basic elements of optics and optical sources, especially lasers and light-emitting solid state devices, in the context of biomedical applications. Dosimetry, tissue optics, and the principles of laser-tissue interaction will be considered in depth. Current medical uses of lasers will be surveyed, along with their scientific and technical foundations. The course will conclude with several case studies of research areas that are currently hot topics in biomedical optics.

**RADI 6062. Cognitive Neuroscience. 3 Credit Hours.**

Cognitive Neuroscience deals with the neural basis of cognition and behavior, including considerations of perception, attention, motor control, language, learning, memory, executive function, spatial cognition, emotion, and social cognition. It also presents discussions on neurocognitive development and the evolution of the human brain. Unlike courses in basic neuroscience, this course has a more human focus, presenting in-depth discussions of neuroimaging techniques and literature. In addition, it focuses on psychological models of cognitive function derived from psychological experimentation, human lesion studies, and computational modeling. Cognitive Neuroscience presents an integrated view of the psychology and neurobiology of human cognition and behavior. By the end of the semester, students will have had the opportunity to: (1) become highly familiar with the structure of the human nervous system; (2) become conversant about the physical basis and limitations of neuroimaging techniques; (3) become familiar with the principal brain areas thought to be involved in a host of human cognitive competencies and behaviors, including perception, action, emotion, and language; and (4) understand how psychological theory and neural theory come together to form the foundation of cognitive neuroscience.

**RADI 6071. Supervised Teaching. 1-12 Credit Hours.**

This course is a presentation of lectures and supervised teaching under the direction of faculty.

**RADI 6091. Special Topics. 1-12 Credit Hours.**

This course covers topics of special interest which may include emerging and new modalities in radiological sciences relating to x-ray, nuclear, or magnetic imaging.

**RADI 6097. Research. 1-12 Credit Hours.**

This course is supervised research under the guidance of a faculty member.

**RADI 6098. Thesis. 1-12 Credit Hours.**

Registration for at least two terms is required for M.S. candidates. Prerequisites: admission to candidacy for the Master of Science degree.

**RADI 7000. Off Campus. 4 Credit Hours.**

All off campus rotations must be approved by the designated faculty member prior to the beginning of the rotation (at least one week before the course begins). Credit will not be given for any rotation that has not been approved in advance. Required paperwork includes: "Course Approval" form, a written letter or email for acceptance form the physician preceptor with the start and end dates of the course/rotation, and a course description of your learning objectives and responsibilities during the rotation. Forms must include a complete address and telephone number for the off campus location or residence address for the student while at the off campus site. Forms will not be approved after the rotation has already begun. Contact the department for assistance with enrolling in this course.

**RADI 7005. Treatment Planning Techniques In Radiation Therapy. 3 Credit Hours.**

The goal of the course is to provide an overview of the physics and clinical elements that contribute to the development of computerized treatment plans in radiation therapy. The commissioning and acceptance testing of a planning system will be discussed and demonstrated in several planning platforms. Anatomy specific treatment planning will be described, including imaging of the specific disease, as well as contouring and plan development. Multiple plans will be generated for each site using different planning modalities, such as 2D, 3D, and IMRT.

**RADI 7006. Treatment Planning Techniques in Radiotherapy 2. 3 Credit Hours.**

This course is a continuation of RADI 7005. It presents an in-depth study of multidisciplinary treatment of the cancer patient from the clinician's viewpoint. Students are required to master concepts specific to site-specific disease including: histopathology, etiologic and epidemiology factors, detection and diagnosis, tumor stage and grade, routes of metastases, dose fractionation and prognostic factors. This course is designed to approach each cancer type by anatomic system, addressing treatment factors with increasing degrees of complexity. Assigned exercises organized by treatment site and procedure type will be carried out under the direct supervision of an assigned advisor. These will be both simulated and real case assignments. The course is taught as a didactic course with applied planning. Didactic instruction will be provided by medical residents while practical planning instruction will be applied by a medical dosimetrist.

**RADI 7010. Motor Learning And Brain Imaging. 3 Credit Hours.**

This course is designed for the advanced student (doctoral or postdoctoral) to obtain a comprehensive overview of the field of motor learning from behavioral and brain imaging perspectives. Topic coverage will include general motor learning and speech motor learning (with reference to treatment of motor speech disorders). The course will be structured in a seminar format. The course will explore measurement methods and issues in motor learning and the neural substrates of learning in intact and disordered subject groups.

**RADI 7099. Dissertation. 1-12 Credit Hours.**

Registration for at least one term is required for Ph.D. candidates.  
Prerequisites: admission to candidacy for Doctor of Philosophy degree.