Medical Physics Program at Duke University

Potential future course offerings (depending on student interest and faculty availability)

MP 252. Health physics seminar (1 c.h.). Weekly seminar on various topics pertaining to health physics. The seminar provides students exposure to operational and current issues in Radiation Safety and opportunity to interact with professionals in the Triangle area and beyond.

MP 312. Radiobiology (2 c.h.). Effects of ionizing radiation on biological material from molecular interactions, through sub-cellular and cellular levels of organization, to the response of tissues, organs and the whole body. Includes the application of radiation biology in oncology and the biological aspects of environmental radiation exposure.

MP 314. Internal and external dosimetry (3 c.h.). This course provides foundations for internal and external dosimetry methods, experience in using available software packages, overviews of internal and external organ dose estimation methods in nuclear medicine and diagnostic radiology, and overviews of issues pertaining to occupational dose monitoring.

MP 315. Non-ionizing radiation bioeffects and applications (3 c.h.). This course reviews the interactions, biological effects, and medical applications of non-ionizing electromagnetic radiation, and discusses the uses, hazards, safety precautions, and formal exposure limits associated with each section of the electromagnetic spectrum.

MP 316. Advanced radiation detection and dosimetry (3 c.h.). Provide and overview of radiation detection methods for charged particles, photons and neutrons. Understand underlying principles of each method, including its advantages and disadvantages for specific applications. Illustrate general concepts by specific examples of detectors, measurement techniques and signal processing.

MP 324. 3D treatment planning/ IMRT (3 c.h.). Modern techniques in 3-dimensional and inverse treatment planning, Monte Carlo methods and beam optimization will be discussed.

MP 325. Special topics in cancer treatment (3 c.h.) The course discusses special treatment modalities for cancer therapy including hyperthermia treatment and nuclear oncology. Topics relating to Hyperthermia including thermal biology, methods of heating, heat transport theory, and implementing the program into the clinic will be discussed. Nuclear oncology covers the use of radionuclides in cancer treatment, including radiolabeled monoclonal antibodies, and the use of beta and alpha emitters.

MP 326. Monte Carlo methods in medical physics (3 c.h.). Provide an introduction to the use of the Monte Carlo method in radiation transport. The acquired knowledge will be applicable to dosimetry problems, detector simulations or shielding calculations. Demonstrate setup and solutions of sample problems using MCNP or other MC codes.

MP 333. Medical image processing and display (3 c.h.). A course covering basic medical imaging processing methods (e.g., 2D, 3D FF, Filtering, MTF), image reconstruction (e.g., FBP, iterative), image corrections and enhancements (e.g., scatter, attenuation), image registration, quantitative image analysis, statistical processing methods including Monte Carlo methods, display methods and technology, and 3D visualization. The course includes a 1 c.h. computer-based lab component.

MP 334. PACS and hospital informatics (3 c.h.). The course covers topics in modern medical informatics systems of Picture Archiving and Communication System (PACS), Radiology Information System (RIS), and Hospital Information System (HIS). Topics covered include the hardware and software components of these systems, DICOM and HL-7 protocols, database structure, data storage and distribution, and web applications.

MP 335. Advanced digital imaging applications (3 c.h.). The course covers advanced topics in diagnostic imaging and emerging technologies. They include methods for depth discrimination (e.g., bi-plane and tomosynthesis), methods for tissue discrimination (e.g., dual-energy and contrast imaging), advanced image processing, and computer aided detection and diagnosis.

MP 336. Magnetic resonance imaging (3 c.h.). This course will cover the hardware, methods and medical uses of magnetic resonance imaging (MRI) and spectroscopy (MRS). The emphasis will be on 1.5 Tesla human imaging, but aspects of higher and lower magnetic field strengths will be examined as appropriate. Topics: Basic concepts of NMR (spins, gyromagnetic ratio, chemical shift, T1, T2, liquids and protein solutions, tissue), Magnets, Gradients, RF Coils, Pulse sequence concepts and the k-space view of MRI/MRS, basic pulse sequences, Fast imaging, special contrast imaging (diffusion, FLAIR), flow imaging (including perfusion), contrast agents, spectroscopy, task-activation MRI, image artifacts, quality assurance.

MP 342. Radionuclide and radiotracer production (3 c.h.). Production of radionuclides for imaging and therapy. Cyclotron and target principles, operation, and maintenance. Reactor-produced radionuclides. Radiochemistry. Production of PET tracers. Tracer kinetic modeling. Quantitating physiological parameters.

MP 345. Special topics in functional and molecular imaging (3 c.h.). The course discusses the fundamentals of functional and molecular imaging methods, recent advances, and new methodologies. The modalities considered include NM imaging, fMRI, contrast CT, contrast US, etc.

MP 351. Special topics in clinical research (1 c.h.). A seminar series, web-based course covering topics pertaining to clinical research. Issues discussed include human subject experimentation, animal experimentations, patient privacy, scientific ethics and fraud, plagiarism and copyright, researching in a patient-oriented environment.

MP 358. Clinical problem solving (3 c.h.). A course offered as a practical introduction to MP instrumentation or practice. The student will be paired with a faculty engineer or physicist and a practicing clinician for a semester project focused on some current clinical physics question. As an example, working with the technical and clinical mentors the student will design a research project that will explore via phantom evaluation, simulation, or software modeling the impact of the choice of imaging parameters on clinical imaging. Clinical imaging protocols will be evaluated to determine where the medical physicist/biomedical engineer can provide useful insight in translating technical understanding to clinical protocols. The course will require a scholarly report which will be posted on the Imaging Physics web site for future reference.