

# AS to BS in Medical Dosimetry

## Core Curriculum Course Descriptions

### **MD301 RADIATION DOSIMETRY**

This course focuses on introducing radiation terminology used in radiation dosimetry. Fundamental dose calculation theories are reviewed and an emphasis is placed on clinical and radiation safety related dosimetry techniques.

### **MD302 RADIATION BIOLOGY**

This course focuses on introducing fundamental radiation biology concepts. Emphasis is placed on radiation interactions, cell damage, cell survival curves, cell sensitivity and response, factors affecting cell response, tissue kinetics, effects on the fetus, biological models, and radiobiological risk assessment.

### **MD303 DIAGNOSTIC RADIOLOGY**

This course focuses on introducing fundamental physics in the medical imaging profession. Fundamental concepts are applied to the system design of each imaging component presented. A special emphasis is placed on the implementation and application of each diagnostic imaging modality.

### **MD304 BRACHYTHERAPY**

This course focuses on introducing fundamental radiation physics and safety of brachytherapy. Special emphasis is placed on both LDR and HDR brachytherapy.

### **MD305 RADIATION ONCOLOGY I**

This course focuses on applying the fundamental radiation oncology physics concepts to external beam radiation therapy. An emphasis is placed on understanding basic dosimetry quantities, dose calculation parameters, dose calculations, monitor unit calculations, instrumentation, and radiation generating equipment.

### **MD310 TREATMENT PLANNING I**

This course focuses on the didactic component and clinical component of treatment planning preparation and isodose distribution. The concepts and factors affecting preparation and planning are reviewed and evaluated.

### **MD311 TREATMENT PLANNING II**

This course focuses on 3D treatment planning for the following body sites: Lung, Prostate, Breast, and Head/Neck. Emphasis is placed on: Patient Positioning & Immobilization, Imaging, 3D Geometry Definition, Treatment Planning System Functionality, Treatment Planning, Dose Verification, Plan Verification, and Terminology.

**MD320            CLINICAL ROTATION I**

This is a clinically oriented course with a focus on simulation, treatment planning techniques, and plan evaluation.

**MD321            CLINICAL ROTATION II**

This is a clinically oriented course with a focus on simulation, treatment planning techniques, and plan evaluation.

**MD405            RADIATION ONCOLOGY II**

This course builds upon the fundamental ideas developed in Radiation Oncology I. A wide range of specialized topics are covered. The intent is to familiarize the student with a broad swath of special procedures encountered in radiation oncology, and to provide in-depth understanding of the most common of these special procedures. The course also covers the process of machine acceptance and commissioning, the use of this data by the operator of the treatment planning system, and how the system then uses that data to calculate doses from therapy devices. Emphasis throughout this course is placed on quality control and quality assurance.

**MD410            TREATMENT PLANNING III**

This course focuses on 3D treatment planning for the following treatment modalities: IMRT, SRS, and SRT. Emphasis is placed on: Patient Positioning & Immobilization, Imaging, 3D Geometry Definition, Treatment Planning System Functionality, Treatment Planning, Dose Verification, Plan Verification, and Terminology.

**MD411            TREATMENT PLANNING IV**

This course focuses on 3D treatment planning for the following treatment modalities: IORT, Electron Arc, TBI X-ray, and TBE-Electron. Emphasis is placed on: Patient Positioning & Immobilization, Imaging, 3D Geometry Definition, Treatment Planning System Functionality, Treatment Planning, Dose Verification, Plan Verification, and Terminology.

**MD420            CLINICAL ROTATION III**

This is a clinically oriented course with a focus on simulation, treatment planning techniques, and plan evaluation.

**MD421            CLINICAL ROTATION IV**

This is a clinically oriented course with a focus on simulation, treatment planning techniques, and plan evaluation.

**MHP510 HEALTH PHYSICS AND RADIATION SAFETY**

This course focuses on introducing physical principles of radioisotopes and imaging systems used in medicine and biology. Imaging systems are discussed at length with a focus on applying universal imaging concepts such as contrast and resolution to the Anger camera, PET and SPECT scanners. Radiochemical therapy and other radiopharmaceuticals are discussed. Health physics and quality control issues pertinent to nuclear medicine physics are addressed.

**MP590 MEDICAL AND PROFESSIONAL ETHICS**

This course focuses areas that require an understanding of medical ethics. Emphasis will be placed on Patient Data, Patient Records, Publications, Presentations, General Professional Conduct, Medical Malpractice, and Research.

Elective Curriculum Course Descriptions

**MD398 INDEPENDENT STUDY**

Independent study courses are generally designed to allow a student to pursue one of their academic or research interests outside of the standard curriculum offered by the school. You will arrange with your selected instructor a schedule, goals, and assessment milestones.

**MATH201 CALCULUS I**

This course is the first in a series of two designed to familiarize the student with the calculus. This particular course covers the fundamentals of calculus: the derivative and integral. It also covers a selection of topics to prepare the student for the second course in the series.

**BIOL301 HUMAN ANATOMY AND PHYSIOLOGY**

This course is intended to provide the student with an overview of human anatomy and physiology in the framework of organ systems. The course is aimed at an audience of non-physician medical professionals, and as part of that end the anatomical component of the course emphasizes cross-sectional anatomy as seen on planar and cross-sectional medical imaging such as CT, PET, and MRI images.

**PHY201 GENERAL PHYSICS I**

This is an introductory course designed specifically for the student who has not taken a calculus-based general physics course, but is preparing for a career in medical physics. The combination of General Physics I and II will be adequate preparation for later upper-level physics courses. The course is designed to develop the ability to think as a physicist, rather than to survey physical science. To this end, the course will deal with the mechanics of particles and rigid bodies, the mechanics of fluids, and thermodynamics. These topics represent an increasing complexity.

**PHY202          GENERAL PHYSICS II**

This is the sequel to General Physics I. A student prepared in the calculus and vector analysis can take this course before General Physics I, but both courses must be taken. The course includes a historical introduction to electromagnetic fields following a detailed treatment of the concepts and laws. Gauss, Oersted's, and Ampere's Laws, and Maxwell's displacement current are central. Energy of the fields and storage elements in circuit theory and practical circuit analysis are treated. Electromagnetic (radio and light) waves are introduced.

**PHY301          MODERN PHYSICS**

This course serves as a transition from the general, historical physics principles covered in a general physics course and the more modern concepts of quantum mechanics, solid state physics, and relativity that are pertinent to the study of modern-day physics. A range of topics are covered in an introductory fashion so that students are familiarized with the background material they will need to succeed in upper-level physics courses.

**PHY401          ELECTRICITY AND MAGNETISM**

This is an advanced treatment of the material in General Physics II. There is a mathematical introduction to the vector calculus and the solution of differential equations. The student, however, should be familiar with the calculus and vector analysis. The course is designed to develop first Maxwell's electromagnetic field equations from the classic experiments that led to them. The motion of charges, waves, and wave energies and momenta are then developed. Einstein's special theory of relativity ties fields and particle motion together.

**PHY403          FUNDAMENTALS OF NUCLEAR PHYSICS**

A strong foundation in nuclear physics is a fundamental component of any physicist's tool chest. This is especially true of the medical physicist whose bread and butter is radiation science. In this course, the student is introduced to a broad swath of topics in nuclear physics. First, quantum mechanics are treated briefly to the depth necessary for the rest of the material. Nuclear properties essential to understanding the rest of the course are covered. General principles of radioactive decay are discussed, followed by in-depth discussions of alpha, beta, and gamma decays. The last planned topic is neutron physics, although the chapter on nuclear reactions will be covered if there is time.

**PHY405          THERMODYNAMICS**

This course introduces the student to the basic concepts and laws of thermodynamics. A mathematical introduction is included in the course, although the student must be familiar with the calculus. With the aim of making the approach as simple as possible the thermodynamic potentials (internal energy, enthalpy, Helmholtz energy, and Gibbs energy) are introduced as soon as possible and the remainder of the course built upon them. The molecular picture of matter, statistical mechanics, irreversibility, entropy production, chemical thermodynamics, reaction kinetics, and transition state theory are treated. The course ends with a treatment of phase transitions.

**PHY407          QUANTUM MACHANICS**

This is an introduction to quantum mechanics and the language of the Dirac vectors, on which modern treatments are based. The course begins with an introduction to Dirac vectors and transformations based on the requirements of what experiment tells us. Familiarity will develop as we encounter momentum, angular momentum, and atoms. The course ends with a treatment of atoms and spectra.

**PHY409          ANALYTICAL MECHANICS**

This is an introduction to modern mechanical treatment of the motion of particles and rigid bodies. The course is based on Lagrange and Hamiltonian mechanics the basic principles of which are developed at the beginning of the course. The student should have an understanding of the calculus. The course is designed for learning by application. Each topic is introduced as briefly as possible and then the student will engage the application.