

# Swami Rama Himalayan University

## Ph.D. Syllabus for Entrance Examination

### Medical Physics

#### Unit I

Production and properties of X-rays, structure and types of X-ray tubes, insulation and cooling of X-ray tubes, filament and high voltage transformers and circuits, half and full wave rectifiers, three phase and constant potential generators, automatic brightness control, automatic exposure control, measurement of kV and mA, timers, image intensifiers, flat panels and close circuit TV systems. General Properties of alpha, beta and gamma rays, Laws of radioactivity, Artificial Radioactivity, Particle Accelerators – Van De Graff generator, Cyclotron, Betatron, Linear Accelerator, Klystron and Magnetron, Travelling and Standing wave Acceleration. Interactions of radiation with matter.

#### Unit II

Radiation quantities and units, linear and mass attenuation coefficients, charge particle equilibrium, ion chambers-parallel plate, cylindrical and spherical, Bragg-Gray-cavity theory, beam quality index. Diodes, MOSFET, Operation amplifier and their characteristics, theory and design of a condenser type ion chambers and thimble chambers, proportional and GM counters, Scintillation and semiconductor detectors, radiographic and radiochromic films, thermoluminescent dosimeters (TLD), optically stimulated luminescence dosimeters (OSLD), pocket dosimeters, farmer dosimeters, well type chamber, radiation field analyzer and water phantom dosimetry system, gamma zone monitor, contamination monitor, personal monitoring dosimeters.

#### Unit III

Construction and working of a tele-cobalt unit and a medical linear accelerator, output calibration of Co-60 gamma rays, high energy X-rays and electron beams, CT and virtual simulation, central axis dosimetric parameters, beam modifying and shaping devices, energy specification and depth dose characteristics of electron beams, QA in radiation therapy. Definitions and classification of brachytherapy techniques- surface mould, intracavitary, interstitial and intraluminal techniques, properties of commonly used brachytherapy sources, dose rate considerations and classification of brachytherapy techniques, Paterson Parker and Manchester doses systems, afterloading techniques, ISO requirements and QA of brachytherapy sources.

#### Unit IV

Conventional radiography and fluoroscopy techniques, filters and collimators, devices and methods to reduce scatter, image quality, digital and computed radiography, mammography and computed tomography, magnetic resonance imaging and medical ultrasound equipment, QA of conventional radiography system and CT equipment. Techniques and instruments in radionuclide imaging- radionuclide generator and their operational principles, gamma camera and its system components, physics and instrumentation of positron emission tomography and single photon emission computed tomography, image quality parameters and quality control in nuclear medicine.

#### Unit V

Anatomy and physiology as applied to radiodiagnosis and radiotherapy, action of radiation in living cells, survival curve and its parameters, target theory, LET, RBE, dose rate and dose fractionation, somatic and genetic effects of ionizing radiation, physical and biological factors affecting cell survival, 5 R's of radiobiology, dose fractionation and linear quadratic model. ICRP principles of radiation protection, ALARA, dose limits, equivalent dose and effective dose, effect of distance, time and shielding on dose, personal and area monitoring, categories of exposures- occupational, public and medical exposure, safety in handling of radionuclides and disposal of radioactive waste, radiation legislation and radiation protection rules.