

MEDICAL PHYSICS

(PG DEGREE STANDARD)

UNIT I - BASICS OF RADIOLOGICAL PHYSICS:

Atomic Structure - Nuclear Transformation - Radioactivity and radioactive decay successive disintegration and equilibrium conditions - Interaction of Radiation with matter; electromagnetic radiation, charged particles and neutrons - Radiation attenuation coefficients - Radiation dosimetric concepts, quantities and units - cavity theories - Principles of Radiation detection and measurements - Radiation dosimeters and Radiation monitors.

UNIT II - RADIATION THERAPY PHYSICS:

Radiotherapy with sealed and unsealed radionuclide – Mechanism of Telecobalt and linear accelerators (LINAC) – Physics of Modern radiotherapy machines - 3D CRT, IMRT, SRS & SRT, IGRT, cyber knife and Proton Beam therapy - Radiation Dosimetry protocol (TRS 398), Calibration of teletherapy equipments - Quality Assurance of Radiotherapy machines - Treatment Planning System (TPS) in radiation therapy & Quality assurance of TPS.

UNIT III - PHYSICS OF BRACHYTHERAPY:

Introduction to Brachytherapy radionuclide and their properties - Production and construction of sealed – LDR, MDR and HDR Brachytherapy sources, their specification & calibration - reference Exposure rate - reference air kerma rate and air kerma strength - source calibration using an In-air set-up and calibration using a well type ionization chamber - source calibration using solid phantoms- source dosimetry - Interstitial, Intracavitary, intraluminal and pulsed brachytherapy - Monte Carlo Based source dosimetry - Quality assurance of brachytherapy equipments.

UNIT IV - BIOLOGICAL EFFECTS OF RADIATION:

Physics of radiation absorption - Cancer biology - Cell survival curves - Fractionation in Radiation therapy- dose rate effect - Oxygen Enhancement Ratio (OER) - Relative Biological Effectiveness (RBE) – Linear Energy Transfer (LET) - Molecular mechanism of DNA & chromosomal damage and repair – 4 R's of Radiobiology - Bioeffect models; Time Dose Fractionation (TDF) and Extrapolated Response Dose (ERD) - Hyperthermia - Radioprotectors - Effects of radiation on embryo and fetus - Acute radiation syndrome.

UNIT V - RADIATION HAZARD EVALUATION AND CONTROL:

Basic concepts of Radiation protection standards - philosophy behind radiation protection - External radiation protection - ICRP recommendations - Radiation dose limits - system of radiological protection - Equivalent dose, effective dose, committed dose - radiation exposures - Evaluation of external and internal radiation hazards and control - ALI-DAC- MPBB - planning and shielding calculations - radioactive waste disposal - Radiation emergencies, medical management and legislation.

UNIT VI - DIAGNOSTIC RADIATION PHYSICS:

Basic Physics of diagnostic radiology – Production of X-rays - diagnostic X-ray tube & its electrical circuits- X-ray tube rating - X-ray film, properties & Processing - Intensifying screens - Factors affecting radiographic imaging - fluoroscopy - Tomography - Various diagnostic X-ray tubes and shields – Computer Tomography (CT) and its generations - Quality assurance of diagnostic equipments - Digital subtraction angiography (DSA).

UNIT VII - PHYSICS OF NUCLEAR MEDICINE:

Scintillation counters - Different types of collimators - Gamma camera - single head and dual head scanners - Emission tomography - Single photon emission computed tomography (SPECT) - Positron emission tomography (PET) - Production of radioisotopes for nuclear medicine procedure – Technetium generator – Radiopharmaceuticals and their clinical applications.

UNIT VIII - PHYSICS OF ULTRASOUND & IMAGING:

Production & properties of ultrasound - propagation of ultrasound through body tissue - Acoustic impedance and acoustical characteristics in human body - ultrasound dosimetry - piezoelectric transducers - ultrasound scanning modes - Ultrasound cardiography (UCG) – Doppler effect - Double doppler shift – doppler systems - ultrasonic tomography - applications of ultrasound in medicine.

UNIT IX - LASERS IN MEDICINE AND THERMOGRAPHY:

Theory and production of medical lasers - Laser Tissue interaction mechanism – Applications of lasers in Dermatology, Oncology, Ophthalmology - Application of ultrafast pulsed lasers in Medicine - laser blood flow meter. Hazards of lasers and their safety measures - Various types of electromagnetic radiations; UV, Visible, IR, their sources and detectors - Optical properties of tissues – Medical Applications of IR radiations in diagnosis and therapy.

UNIT X - MRI AND BIO MEDICAL INSTRUMENTATION :

Basic principles of Magnetic resonance imaging (MRI) – Larmor frequency - Resonance - Slice selection - localization within slices – Mechanism of relaxation (T1 and T2) - contrast agents – MRI system - Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) - physiological assist devices - pacemaker – defibrillators - heart lung machine - diathermy units – Dialysis units; Hemo & peritoneal dialysis - Blood cell counter.