**Faculty of Allied Health Sciences**
Bachelor of Science (Semester-II)
In Effect from Academic Year 2024-25

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| **Branch Name:** | B.Sc RIT |
| **Program Code:** | AS102 |
| **Course Title:** | Radiological Physics |
| **Course Code:** | 1AS1020201 |
| **Pre-requisite Course:** | |

## Course Objectives:

This course is aimed at making the student understand the principles of medical physics and radiological equipments as applicable to health care and practice them in their respective speciality. Know how to use various radiological and electronic instruments to record and interpret the overall wellbeing of the human system.

## Teaching and Examination Scheme:

| Teaching Scheme (Hours per week) | | | | Evaluation Scheme (Marks) | | | | |
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| | | | | Theory (Marks) | | Practical (Marks) | | |
| Lecture (L) | Tutorial (T) | Practical (P) | Credit | University Assessment | Continuous Assessment | University Assessment | Continuous Assessment | Total (Marks) |
| 03 | - | 02 | 04 | 50 | 50 | 25 | 25 | 150 |

## Course Contents:

| Unit No | Topic | Total Hours |
|---|---|---|
| I | **BASIC PHYSICS**<br>Basic concepts: Units and measurements-Force, work, power and energy-Temperature and heat-SI units of above parameters. Atomic structure-atom model- Nucleus-electronic configuration-periodic table-Isotopes-Ionization-excitation- Binding energy-electron volt-Electromagnetic radiation-Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum.<br>Electricity and magnetism, capacitors ohms law. | 15 |
| | **SOUND**<br>1. The nature and propagation of sound wave (the characteristics of sound, wave theory), speed of sound in a material medium, intensity of sound, the decibel, Interference of sound waves, beats, diffraction.<br>2. Doppler's effect, Ultrasonic wave, production of ultrasonic waves (piezo- electric effect) in ultra sonography.<br>3. Use of principle of Doppler's effect in Diagnostic Radiology (e.g. Echo, blood flow measurement). | |

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| **II** | **BASIC RADIOLOGICAL PHYSICS**<br>1. X-rays: Discovery of x-rays-X-ray production and properties: Bremsstrahlung Radiation-Characteristics X-Rays, factors affecting X-ray emission spectra, X- ray quality and quantity, HVL measurements, heel effect, soft and hard X- Rays, added and inherent filtration, reflection and transmission targets.<br>2. **Interaction of ionizing radiation with matter**-Types of interactions of X-and gamma radiation, Photoelectric Compton, Pair production, annihilation, radiation. Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient- coherent scattering photonuclear disintegration Particle interactions. Interactions of X rays and Gamma rays in the body; fat-soft tissue-bone- contrast media-total attenuation coefficient-relative clinical importance. Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number. | **15** |
| **III** | **X-Ray equipment & units:**<br>1. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X- ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing)cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-rays-factors influencing them.<br>2. Grid controlled and high-speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation. Interlocking and X-ray tube overload protection. Heat dissipation methods, tube rating, heat units, operating conditions.<br>3. Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits- | **15** |

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| | high frequency generators-falling load generators, Capacitors discharge and grid control systems. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing)cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulations and rotating tubes-line focus principle-space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-rays-factors influencing them.<br>4. Grid controlled and high-speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation. Inter locking and X-ray tube overload protection. Heat dissipation methods, tube rating, heat units, operating conditions.<br>5. Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Capacitors discharge and grid control systems. | |
| **IV** | **Generators**:<br>X-ray generator circuits: Vacuum tube diodes-semi-conductor diodes- transistor-Rectification-half and full wave-self rectification-X-ray generator; filament circuit-kilo Voltage circuit-single phase generator- three phase generator-constant potential generator-Fuses, switches and interlocks-Exposures witching and timers-HT cables-earthing. Physical quantity, its unit and measurement: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit (HU). | **15** |
| **V** | **Radiation Quantities and Units:**<br>Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose- electronic equilibrium-rad, gray, conversion factor for roentgen to rad-quality factor-dose equivalent rem, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose. | **15** |

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| | **Conventional Radiological Equipment**<br>Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x-ray tube ; construction, working, methods of cooling the anode, rating chart and cooling chart; rotating anode x-ray tube : construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical con side ration in choice of focus, anode heel effect, grid controlled x-ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristic spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum. | |

**Practicals**

| Unit No | Topic | Total Hours |
|---|---|---|
| **I** | Radiation dose measurement and dorsimetry. | **9.6** |
| **II** | Calibration and maintenance of X-ray equipments. | **9.6** |
| **III** | X-ray beam alignment test | **9.6** |
| **IV** | Determination of magnification by changing Source to Image Distance | **9.6** |
| **V** | Determination of magnification by changing Object to Image Distance | **9.6** |

**Text Books/ Reference Books:**


1. Textbook of radiology for residents and technicians – Satish K Bhargava- 5th edition
2. Handbook of Medical Radiography latest edition by C Ram Mohan
3. Radiographic positioning Niranjan Baghel


**Course Learning Outcomes (CLO):**

The student should be able to perform limb X-rays independently, assist in specialized radiological procedures, understand darkroom processes, carry out image processing, and identify radiological equipment.