

**BHARATHIAR UNIVERSITY : COIMBATORE 46**  
*Under The CENTRE FOR COLLABORATION OF INDUSTRY AND INSTITUTION*  
***CCII COLLABORATIVE PROGRAMME***

**P G DIPLOMA IN RADIOLOGICAL IMAGING TECHNOLOGY**

**SCHEME OF EXAMINATION**

**For the students admitted from the academic year 2013 -2014 batch and onwards**

**SEMESTER I**

<b>Paper</b>	<b>Subject</b>	<b>Marks</b>
<b>1</b>	<b>Basic Concept of Physics</b>	<b>100</b>
<b>2</b>	<b>Anatomy and Physiology</b>	<b>100</b>
<b>3</b>	<b>Applied Imaging Technology - I</b>	<b>100</b>
<b>4</b>	<b>Physics in Medicine</b>	<b>100</b>
<b>5</b>	<b>Practical - Basic Concept of Physics</b>	<b>100</b>
<b>6</b>	<b>Practical - Anatomy and Physiology</b>	<b>100</b>
<b>7</b>	<b>Practical Applied Imaging Technology - I</b>	<b>100</b>
<b>8</b>	<b>Practical - Physics in Medicine</b>	<b>100</b>

**SEMESTER II**

<b>1</b>	<b>Applied Imaging Technology - II</b>	<b>100</b>
<b>2</b>	<b>Applied Imaging Technology - III</b>	<b>100</b>
<b>3</b>	<b>Institutional Training</b>	<b>100</b>
<b>4</b>	<b>Practical - Applied Imaging Technology – II ( Physics of MRI &amp; NMR)</b>	<b>100</b>
<b>5</b>	<b>Practical - Applied Imaging Technology – III Physics of computed tomography)</b>	<b>100</b>

	<b>Total</b>	<b>1300</b>
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**SEMESTER I****PAPER – I****BASIC CONCEPT OF PHYSICS (90 hrs)****UNIT I – DOSIMETRY AND RADIATION BIOLOGY**

**Radiation units** – Exposure, Coulombs/ Kg .Air karmma – gray ,absorbed dose –gray , absorbed dose –gray equivalent dose –sievert .Effective dose – sievert.

**Interaction mechanisms** - Ionization, excitation free radicals, Introduction to concept of linear energy transfer (LET).

**UNIT II- Interactions**

Interactions of charged particles, interaction of electromagnetic radiations.Neutron interactions.Introduction to thermography and microwave equipment and interactions.Optical Intraction ,Ultra sound intractions.

**UNIT III – Basic concepts of electromagnetic radiation**

Electromagnetic waves, Relationships between frequency and wavelength .The electromagnetic spectrum, sources of electromagnetic radiation. Risks from occupational exposure –public, occupational exposure of pregnant women. Diagnostic references levels (DRL)

**UNIT IV – Basic of NMR and MRI**

Basic Nuclear Magnetic Resonance (NMR) ,nuclear magnetic moments effect of external magnetic field. Nuclear precession. Equilibrium magnetization, significance of Radio frequency (RF) pulse and (NMR) and microwave (EPR) Equipment .Resonance and larmorfrequency .Free induction Decay (FID).

**UNIT- V**

Radiation detectors, Radiation protection –biological aspects. Measurement of detriment.ICRP frame work of radiological protection.

## **PAPER II**

### **ANATOMY AND PHYSIOLOGY (90 hrs)**

#### **UNIT – I**

##### **I.The human body as a whole**

Definitions .subdivision of Anatomy .Terms of locations and positions, Fundamental planes. Vertebrate structure of man, Organizations of the body cells, Tissues.

##### **II.Anatomy of Nervous system**

Central nervous system, Spinal cord anatomy

#### **UNIT –II**

##### **Anatomy of circulatory system**

Heart size, locations, coverings, chambers blood supply, nerve supply and the blood vessel. names of arteries and veins.

##### **Anatomy of Respiratory system**

Organs of respiratory system

Respiratory portions –Pleurae and lungs , Brief knowledge of parts and positions.

#### **UNIT –III**

##### **Anatomy of Digestive system**

Components of digestive system, Mouth ,Tongue ,Tooth ,Salivary glands ,Liver ,Biliary apparatus ,pancreas –positions and their brief functions.

#### **UNIT –IV**

##### **Anatomy of excretory system and reproductive system**

Kidneys – Ureters ,Urinary bladder , Urethra

Male reproductive system –Testis ,Duct system

Female reproductive system –Ovaries ,Duct system and accessory glands

#### **UNIT-V**

##### **Anatomy of Endocrine system**

Name of all the glands and their positions, hormones and their functions –Pituitary, thyroid, para thyroid, adrenal gland and gonads, islets of pancreas.

**PAPER – III****APPLIED IMAGING TECHNOLOGY – I (PHYSICS OF DIAGNOSTIC****TOOLS –X-RAY ) ( 90 hrs)****UNIT-I**

Introduction to diagnostic radiology I and II. Introduction to diagnostic radiology III. Digital Radiology –I .Digital radiology II and III.

**UNIT –II;-production of X-ray**

Bremsstrahlung and characteristics radiation .The X-ray spectrum .The intensity of X-ray Beams.X-ray tubes.

X-ray generators .Transformers, X-ray Generator types. Effect of waveform on Radiation output. Exposure switches and Timing.

**UNIT III****INTRACTIONS BETWEEN X-RAY AND MATTER.**

Attenuation .Interaction process. Relative importance of different types of interactions.Scatter radiation .Contrast media.Filtration.Grids and Air gap technique.

**UNIT – IV****Screen /Film systems**

Luminescent screens – General principals ,absorption of quantum detection efficiency (QUE). Conversion efficiency.

Physical characteristics of X-ray film and film processing .Structure of X-ray film. Latent image formation by light or X-ray .Automatic film processing.

**UNIT –V****IMAGE QUALITY IN RADIOLOGY**

Radiographic or image contrast .Radiographic Mottle (noise),Blur .Modulation transfer function.Geometry of the Radiographic Image .Mammography –an introduction and description.

**PAPER – IV****PHYSICS IN MEDICINE ( 90 hrs)****UNIT – I****NUCLEAR MEDICINE**

In vitro and in vivo testing ,gamma rays for imaging ,radio pharmaceuticals ;-preparation and quality control ,chemistry and radio pharmacology of radio nuclides gamma camera,SPECT ,PET.

**UNIT – II****Ultrasound in medicine.**

Ultrasound imaging, generation and detection of ultrasound, ultrasound propagation choice of frequency, A-scan ,B-scan ,M-mode imaging and echo cardiography .Use of Doppler technique for blood flow etc.

**UNIT –III****Neuroelectrics and Neuromagnetics**

Basic electrophysiology ,genetics of electric and magnetic signals technique for measurement and imaging of EEG,ECG,MEG and MCG.Fluoroscopy and image intensifier.

**UNIT – IV****Bioeffects and safety of**

X-ray NMR .MRI and Ultrasound

Special procedures: IVP ,Barium studies,MCU and H.S.G basic nursing.

**UNIT-V**

Terminology ; anatomical terminology, positioning terminology and projection terminology.

Image sharpness -: Geometric unsharpness ,movement unsharpness ,absorption unsharpness and photographic unsharpness.

High K.V.technique ,Magnification.

Practicals (90hrs): Basic observation in the lab and as well as basic quality required to work in the lab.

**SEMESTER II****PAPER – V****APPLIED IMAGING TECHNOLOGY –II ( PHYSICS OF MRI AND NMR)****UNIT – I BASIC CONCEPTS:**

Introduction to MRI and NMR .Physics of proton NMR.Probing chemical structure, chemical shielding (NMR). The g-value ( EPR) through –bond J coupling and through space dipole – dipole coupling (NMR).

**UNIT –II- NMR**

Chemical shift ,Relaxation –general mechanisms ,Longitudinal (  $T_1$ ) relaxation time.Transverse (  $T_2$ ) relaxation time effect of field in homogenetics . $T_2^*$  standard sequence ;ultra fast sequences.

Pulse sequence ;Inversion recovery and STIR .Spin –echo .Gradient sequences,MR Anangiography.

**UNIT – III –MRI**

Imaging technique ; Gradient Magnetic fields.The Fourier transform and the FID.2D-Fourier transform reconstruction methods .Inter leaved Multislice Imaging .3D –Fourier Transform reconstruction methods .Fast imaging techniques.

**UNIT- IV MRI -2**

Imaging Quality .Effects of flow .Instrumentation .Safety and contra –indications .MRI in practice .One –dimensional imaging; frequency encoding using magnetic field gradients. two-dimensional imaging; phase encoding ;slice selection (3D to 2D) gradient echoes.

**UNIT-V**

Introduction to in Vivo MR-Spectroscopy ,Single –Voxel MRS,Introduction to spectroscopic Imaging (CSI).Processing MRS data.Flow and Angiography advanced pulse sequence and technique .Clinical applications of MRI.

**PAPER –VI****Applied Imaging Technology –III (Physics of Compound Tomography) (90 hrs)****UNIT- I Basic Concepts of CT Scan**

Introduction to CT scan. Computer data. Medical imaging terminology ,Principles of CT scan .Stimulation and virtual stimulation ,Classical X-ray tomography ,Principles of sectional imaging,scanner configurations, mechanical features.

**UNIT – II**

CT and conformal planning ,hand planning .tissue compensations ,algorithms for computing dose distribution in patients for photon and electron beams, including convention methods and Monte Carlo simulation.

**UNIT –III**

CT- Instrumentation, Imaging processing for computed tomography, geometry –parallel, fan beam geometry ,cone –beam geometry ,line integrals and projection datasets.CT- characteristics of common structure.

**UNIT – IV**

Spiral and helical computed Tomography .Multislice spiral computed tomography ,2D Fourier reconstruction ,convolution and back projection ,design performance of filters in CBP technique,digital filters,CT image display.windowing ,CT numbers ,angular sampling requirements .

**UNIT – V**

Radiation dose.dose –spatial resolution –density resolution trade off,partial –volume and beam hardening effects.Clinical applications of Computed Tomography and in radiotherapy planning.

**PAPER VII (Semester I and II)****PRACTICALS****1. POSITIONING RADIOGRAPHY AND TECHNIQUES****2. DARK ROOM TECHNIQUE**

- a. Washing
- b. Developing
- c. Drying
- d. Disposing the waste

**3. STORING AND RECORD ROOM**

**On lab training for entire semester.**

**Reference books for PG Diploma in Radiological Imaging Technology**

## Medical physics Text Book

1. E.G.A Aird ; An Introduction to Medical Physics ( Heineman 1985 )
2. Brown and Smallwood – Medical Physics and Physiological Measurement ( Blackwell 1981)
3. J.S.Carruth and A.L.Mckenzie ; Medical Lasers (Adam Hilger Ltd)
4. D.W.Hill ; Physics Appiled to Anaesthesia (Butterworth)
5. R.P.Parker , P.H .Smith and D.M Taylor ; Basic Science of Nuclear Medicine .Covers Basic radiation physics and Biology , Measurement and Instrumentation , Chemistry ,radio pharmacy . A good Introduction to Physics in Nuclear Medicine.
6. Christensen’s Physics of Diagnostic radiology
7. K.Thayalan : Basic Radiological Physics

**Books On Specific Medical Physics Applications**

1. R.L.Kathrne – Radiation Protection 1985
2. S.Webb (Ed) , The Physics of Medical Imaging ,Hilger
3. P.P.Dendy and B.Heaton ,Physics of Diagnostic Radiology , IOPP
4. E.Krestel Imaging System for Medical Diagnostics , Clinical Nuclear Medicine , Chapman and Hall .
5. WR Hendee radiation Therapy Physics ,Mosby
6. G.Steele , Basic Clinical Radiobiology – Arnold
7. M.H. Levitt ,Spin Dyanamics .Basic Principals of Nuclear Magnetic Resonance Spectroscopy , Wiley

**Prescribed References**

1. Heggie JCP, Liddell NA & Maher KP , 2001. Appiled Imaging Technology , 4<sup>th</sup> Edition ( St.Vincent ‘s Hospital – Melbourne )
2. Bushberg JT , Seibert JA , Leidholdt EM & BOONE JM 2002, The Essential Physics of Medical Imaging. 2<sup>nd</sup> Edition ( Lippincott Williams & Wilkins ; Philadelphia ) – the first Chapter of which provides an excellent introduction to the subject