GURU KASHI UNIVERSITY

B.VOC. in Medical Imaging Technology

Session 2025-26

Faculty of Health and Allied Sciences

Graduates Attributes

The programme B.Voc. in Medical Imaging Technology imparts to students an in-depth understanding of radiological sciences and equips them with the skills to perform essential patient care procedures. Graduates develop competence in operating modern imaging equipment, ensuring patient safety, applying radiation protection measures, and assisting in diagnostic and interventional procedures. They also gain attributes of professionalism, ethical responsibility, critical thinking, and effective communication, enabling them to work efficiently as part of a healthcare team.

Programme Learning Outcomes: After Completion Of this Course Gradates will able to:

- Apply foundational knowledge of anatomy, physiology, and imaging sciences to support accurate diagnostic procedures in diverse clinical settings.
- Operate and manage medical imaging equipment such as X-ray, CT, MRI, and ultrasound with competence, safety, and adherence to radiation protection principles.
- Demonstrate patient care skills including preparation, positioning, communication, and monitoring, ensuring comfort and safety throughout imaging procedures.
- Interpret and analyze imaging data under professional guidance to assist physicians in diagnosis, treatment planning, and follow-up care.
- Exhibit professional ethics, teamwork, and continuous learning abilities to contribute effectively to healthcare delivery and adapt to technological advancements in medical imaging.

Programme Structure

Semester 1st										
S. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Cr.**	**Int**	**Ext**	**Total Marks**
1	BIG101	Anatomy & Physiology – I	Core Based	2	0	0	2	15	35	50
2	BIG102	Fundamentals of Medical Imaging	Core Based	2	0	0	2	15	35	50
3	BIG103	Radiation Physics	Core Based	2	0	0	2	15	35	50
4	BIG104	Medical Terminology & Communication	Core Based	2	0	0	2	15	35	50
5	BIG105	Entrepreneurship Setup & Lauch	Skill Based	0	0	4	2	15	35	50
6	BIG106	Anatomy & Physiology – I Practical	Skill Based	0	0	4	2	15	35	50
7	BIG107	Fundamentals of Medical Imaging Practical	Skill Based	0	0	4	2	15	35	50
8	BIG108	Radiation Physics Practical	Skill Based	0	0	4	2	15	35	50
9	BIG109	Medical Terminology & Communication Practical	Skill Based	0	0	4	2	15	35	50
10	BIG110	Communication and Soft Skills	Compulsory Foundation	2	0	0	2	15	35	50
11	BIG111	Human Rights and Duties	Multi-Disciplinary	3	0	0	3	25	50	75

Total	**13**	**0**	**20**	**23**	**175**	**400**	**575**

Semester 2nd										
S. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Cr.**	**Int**	**Ext**	**Total Marks**
1	BIG201	Anatomy & Physiology – II	Core Based	2	0	0	2	15	35	50
2	BIG202	Radiological Equipment – I (X-ray)	Core Based	2	0	0	2	15	35	50
3	BIG203	Patient Care & Safety in Imaging	Core Based	2	0	0	2	15	35	50
4	BIG204	Radiographic Positioning – I	Core Based	2	0	0	2	15	35	50
5	BIG205	Pathology & Microbiology for Imaging	Core Based	2	0	0	2	15	35	50
6	BIG206	Anatomy & Physiology – II Practical	Skill Based	0	0	4	2	15	35	50
7	BIG207	Radiological Equipment – I (X-ray) Practical	Skill Based	0	0	4	2	15	35	50
8	BIG208	Patient Care & Safety in Imaging Practical	Skill Based	0	0	4	2	15	35	50
9	BIG209	Radiographic Positioning – I Practical	Skill Based	0	0	4	2	15	35	50
10	BIG210	Pathology & Microbiology for Imaging Practical	Skill Based	0	0	4	2	15	35	50
11	BIG211	Environmental Sciences	Compulsory Foundation	2	0	0	2	15	35	50
12	BIG212	First Aid	Value Added	2	0	0	2	15	35	50

			Courses							
Total				**14**	**0**	**20**	**24**	**180**	**420**	**600**

Semester 3rd										
S. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Cr.**	**Int**	**Ext**	**Total Marks**
1	BIG301	Cross Sectional Anatomy	Core Based	2	0	0	2	15	35	50
2	BIG302	Radiological Equipment – II (CT)	Core Based	2	0	0	2	15	35	50
3	BIG303	Radiographic Positioning – II	Core Based	2	0	0	2	15	35	50
4	BIG304	Contrast Media & Special Procedures	Core Based	2	0	0	2	15	35	50
5	BIG305	CT protocol	Core Based	2	0	0	2	15	35	50
6	BIG306	Cross Sectional Anatomy Practical	Skill Based	0	0	4	2	15	35	50
7	BIG307	Radiological Equipment – II (CT) Practical	Skill Based	0	0	4	2	15	35	50
8	BIG308	Radiographic Positioning – II Practical	Skill Based	0	0	4	2	15	35	50
9	BIG309	Contrast Media & Special Procedures Practical	Skill Based	0	0	4	2	15	35	50
10	BIG310	CT protocol Practical	Skill Based	0	0	4	2	15	35	50
11	BIG311	Community Health & Primary Care	Compulsory Foundation	3	0	0	3	25	50	75
Total				**13**	**0**	**20**	**23**	**175**	**400**	**575**

Semester 4th										
S. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Cr.**	**Int**	**Ext**	**Total Marks**
1	BIG401	Radiological Equipment – III (MRI)	Core Based	2	0	0	2	15	35	50
2	BIG402	Nuclear Medicine & PET Imaging	Core Based	2	0	0	2	15	35	50
3	BIG403	Radiobiology & Radiation Protection	Core Based	2	0	0	2	15	35	50
4	BIG404	Radiographic Positioning – III	Core Based	2	0	0	2	15	35	50
5	BIG405	MRI Protocol	Core Based	2	0	0	2	15	35	50
6	BIG406	Quality Control in Radiology	Core Based	2	0	0	2	15	35	50
7	BIG407	Radiological Equipment – III (MRI) Practical	Skill Based	0	0	4	2	15	35	50
8	BIG408	Nuclear Medicine & PET Imaging Practical	Skill Based	0	0	4	2	15	35	50
9	BIG409	Radiobiology & Radiation Protection Practical	Skill Based	0	0	4	2	15	35	50
10	BIG410	Radiographic Positioning – III Practical	Skill Based	0	0	4	2	15	35	50
11	BIG411	MRI Protocol Practical	Skill Based	0	0	4	2	15	35	50
12	BIG412	Quality Control in Radiology Practical	Skill Based	0	0	4	2	15	35	50
Total				**12**	**0**	**24**	**24**	**180**	**420**	**600**

Semester 5th										
S. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Cr.**	**Int**	**Ext**	**Total Marks**
1	BIG501	Advanced Imaging Techniques	Core Based	2	0	0	2	15	35	50
2	BIG502	Interventional Radiology	Core Based	2	0	0	2	15	35	50
3	BIG503	Ultrasound Technology & Doppler	Core Based	2	0	0	2	15	35	50
4	BIG504	PACS & Digital Imaging Systems	Core Based	2	0	0	2	15	35	50
5	BIG505	Medical Ethics & Legal Issues	Multidisciplinary	3	0	0	3	25	50	75
6	BIG506	Research Methodology & Biostatistics	Core Based	2	0	0	2	15	35	50
7	BIG507	Advanced Imaging Techniques Practical	Skill Based	0	0	4	2	15	35	50
8	BIG508	Interventional Radiology Practical	Skill Based	0	0	4	2	15	35	50
9	BIG509	Ultrasound Technology & Doppler Practical	Skill Based	0	0	4	2	15	35	50
10	BIG510	PACS & Digital Imaging Systems Practical	Skill Based	0	0	4	2	15	35	50
11	BIG511	Research Methodology & Biostatistics Practical	Skill Based	0	0	4	2	15	35	50
Total				**13**	**0**	**20**	**23**	**175**	**400**	**575**

Semester 6th										
S. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Cr.**	**Int**	**Ext**	**Total Marks**
1	BIG601	Internship	Skill Based	0	0	40	20	150	350	500
Total				**0**	**0**	**40**	**20**	**150**	**350**	**500**
Grand Total				**65**	**0**	**144**	**137**	**1035**	**2390**	**3425**

Semester 1st

Course Title: Anatomy & Physiology – I	L	T	P	Cr
Course Code: BIG101	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the basic structure and functions of the human body.
2. Identify major organs and organ systems along with their physiological roles.
3. Describe fundamental anatomical terms and planes used in medical sciences.
4. Correlate anatomical structures with their physiological mechanisms.
5. Apply basic anatomical and physiological knowledge to clinical and paramedical practices.

Course Contents

UNIT I: Introduction to Anatomy and Physiology (10 Hours)

- Definition and scope of anatomy and physiology
- Levels of structural organization in the human body
- Anatomical terminology, body planes, positions, and cavities
- Basic concepts of homeostasis

UNIT II: Skeletal and Muscular System (10 Hours)

- Structure and classification of bones
- Major bones and joints of the human body
- Overview of the axial and appendicular skeleton
- Types of muscles, structure of skeletal muscle
- Physiology of muscle contraction and muscle tone

UNIT III: Cardiovascular and Respiratory System (5 Hours)

- Structure of the heart and major blood vessels

- Circulation of blood: systemic, pulmonary, and portal circulation
- Composition and functions of blood
- Structure and functions of respiratory organs
- Mechanism of breathing and regulation of respiration

UNIT IV: Digestive and Excretory System (5 Hours)

- Structure and functions of digestive organs
- Physiology of digestion and absorption
- Structure of kidney and nephron
- Physiology of urine formation and fluid balance

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *TORTORA GJ, DERRICKSON BH. Principles of Anatomy and Physiology. 15th ed. Hoboken: Wiley; 2017.*
- *MARIEB EN, HOEHN K. Human Anatomy & Physiology. 11th ed. Pearson; 2018.*
- *ROSS MH, WOHLTMANN H, ROMRELL LJ. Histology: A Text and Atlas. 7th ed. Philadelphia: Wolters Kluwer; 2015.*
- *HALL JE. Guyton and Hall Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier; 2021.*
- *DRAKE RL, VOGL W, MITCHELL AWM. Gray's Anatomy for Students. 4th ed. Philadelphia: Elsevier; 2019.*

Course Title: Fundamentals of Medical Imaging	L	T	P	Cr
Course Code: BIG102	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the basic principles of medical imaging modalities.
2. Explain the production and properties of X-rays and their role in diagnostic imaging.
3. Describe the fundamentals of radiography, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound.
4. Recognize the applications and limitations of different imaging techniques.
5. Correlate imaging methods with clinical practice in healthcare.

Course Contents

UNIT I: Introduction to Medical Imaging (10 Hours)

- Definition, scope, and importance of medical imaging
- History and evolution of imaging technologies
- Basic physics of radiation: ionizing vs. non-ionizing radiation
- Electromagnetic spectrum and its relevance in imaging

UNIT II: X-ray Imaging and Computed Tomography (10 Hours)

- Discovery and properties of X-rays
- Components of an X-ray machine and image formation
- Radiographic projections and contrast media basics
- Introduction to CT scan: principle, components, image reconstruction
- Clinical applications of X-ray and CT imaging

UNIT III: Magnetic Resonance Imaging (5 Hours)

- Basic principles of MRI: nuclear magnetic resonance, relaxation times
- Components of MRI system
- Safety considerations in MRI
- Applications and limitations

UNIT IV: Ultrasound and Emerging Imaging Modalities (5 Hours)

- Principles of ultrasound imaging (sound waves, transducers, Doppler effect)
- Clinical applications of ultrasound in diagnosis
- Introduction to nuclear medicine and PET imaging (overview)
- Future trends in imaging technology

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *WEBB S, ed. The Physics of Medical Imaging. Boca Raton: CRC Press; 2017.*
- *CARLTON RR, ADLER AM. Principles of Radiographic Imaging: An Art and a Science. 6th ed. Boston: Cengage Learning; 2019.*
- *WESTBROOK C, KATT CK, HANNAH A. MRI in Practice. 5th ed. Wiley-Blackwell; 2019.*
- *HALL EJ, GIACCIA AJ. Radiobiology for the Radiologist. 8th ed. Philadelphia: Wolters Kluwer; 2019.*

Course Title: Radiation Physics	L	T	P	Cr
Course Code: BIG103	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the fundamental principles of atomic structure and radiation physics.
2. Differentiate between ionizing and non-ionizing radiation.
3. Describe the mechanisms of X-ray production and their properties.
4. Explain the interaction of radiation with matter.
5. Recognize the units of radiation measurement and their applications in medical imaging.
6. Correlate radiation physics concepts with safety in diagnostic radiology.

Course Contents

UNIT I: Basics of Atomic and Nuclear Physics (10 Hours)

- Structure of atom, subatomic particles, and energy levels
- Radioactivity: types of radioactive decay (α, β, γ)
- Half-life and decay constant
- Nuclear fission, fusion, and their relevance in medicine

UNIT II: Production and Properties of X-rays (10 Hours)

- Discovery of X-rays and basic principles
- X-ray tube construction (cathode, anode, filtration, collimation)
- Continuous and characteristic spectra
- Properties of X-rays: penetration, ionization, fluorescence, photographic effect
- Factors affecting X-ray beam quality and quantity (kVp, mA, exposure time, distance)

UNIT III: Interaction of Radiation with Matter (5 Hours)

- Mechanisms of interaction: photoelectric effect, Compton scattering, pair production
- Attenuation, linear attenuation coefficient, half-value layer (HVL)

- Importance of tissue density and atomic number

UNIT IV: Radiation Quantities and Units (5 Hours)

- Exposure, absorbed dose, equivalent dose, effective dose
- Units: roentgen, gray, sievert, becquerel, curie
- Introduction to dosimeters and radiation monitoring devices
- Concept of ALARA (As Low As Reasonably Achievable)

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *HALL EJ, GIACCIA AJ. Radiobiology for the Radiologist. 8th ed. Philadelphia: Wolters Kluwer; 2019.*
- *ATTIX FH. Introduction to Radiological Physics and Radiation Dosimetry. 2nd ed. Weinheim: Wiley-VCH; 2008.*
- *KHAN FM, GERBI BJ. The Physics of Radiation Therapy. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2019.*
- *HORENSTEIN MN. Physics for Diagnostic Radiology. 4th ed. Boca Raton: CRC Press; 2020.*

Course Title: Medical Terminology & Communication	L	T	P	Cr
Course Code: BIG104	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the origins, structure, and formation of medical terms.
2. Interpret medical terminology commonly used in healthcare and medical imaging.
3. Accurately use medical abbreviations, prefixes, suffixes, and root words.
4. Communicate effectively with healthcare professionals and patients using appropriate terminology.
5. Develop confidence in writing reports, case notes, and patient records.

Course Contents

UNIT I: Introduction to Medical Terminology (10 Hours)

- Basics of medical terminology: origin (Greek & Latin roots)
- Word building: prefixes, suffixes, root words, and combining forms
- Rules for plural formation and pronunciation
- Commonly used medical abbreviations and acronyms

UNIT II: Terminology of Body Systems (10 Hours)

- Anatomical terms related to major organ systems: skeletal, muscular, cardiovascular, respiratory, digestive, urinary, nervous, endocrine, and reproductive
- Medical terms for common diseases and conditions
- Terminology related to diagnostic and therapeutic procedures

UNIT III: Medical Communication Skills (5 Hours)

- Essentials of healthcare communication
- Writing patient case notes and reports
- Use of terminology in prescriptions, radiology reports, and discharge summaries
- Importance of accuracy and clarity in communication

UNIT IV: Professional and Patient-centered Communication (5 Hours)

- Doctor patient communication skills
- Breaking down medical terms for patient understanding
- Telephone and electronic communication in healthcare
- Cultural sensitivity and empathy in communication

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *CHABNER DE. The Language of Medicine. 12th ed. St. Louis: Elsevier; 2021.*
- *SMITH JJ, PILESPY M. Medical Terminology for Health Professions. 9th ed. Boston: Cengage Learning; 2020.*
- *MOSELEY A. Medical Terminology: A Short Course. 9th ed. St. Louis: Elsevier; 2022.*
- *EHRLICH A, SCHROEDER C. Medical Terminology for Health Careers. 8th ed. Cengage Learning; 2018.*
- *KUMAR P, CLARK M. Kumar & Clark's Clinical Medicine. 10th ed. Philadelphia: Elsevier; 2020.*

Course Title: Entrepreneurship Setup & Lauch	L	T	P	Cr.
Course Code: BIG105	0	0	4	2

Introduction: This semester lays the foundation for the learner to understand what entrepreneurship is, beyond just starting a business. It introduces key ideas like problem-solving, value creation, and self-awareness. The learner will begin exploring basic business concepts while discovering their own interests and strengths.

Learners Objective: After Completion of this course, the learner will be able to:

1. Understand the core concepts of entrepreneurship through relatable, real-life examples.
2. Begin to see themselves as problem-solvers and creators.
3. Learn about business paths and choose one to try based on interest or local fit.
4. Launch a micro-hustle (online or offline) to earn their first income.
5. Build confidence and self-belief by doing.

Outcome: By the end of this semester, learners will start a simple business activity, earn their first income, and build belief in their ability to do business.

Guiding Principles/Approach: This syllabus is built on principles of experiential learning, growth mindset development, and identity-first learning. Drawing from learning science and behavior design, the course shifts students from passive learning to active doing, where they try out small business activities in real contexts. The design helps students not just learn entrepreneurship, but begin to see themselves as entrepreneurs. Emphasis is placed on small wins, peer collaboration, and locally relevant opportunities to ensure learning feels achievable and connected to their realities. The curriculum focuses on conceptual understanding without heavy theory, combining

practical action, reflection, and collaboration. By making progress visible and success feel possible, it plants the seeds of self-reliance, initiative, and long-term motivation.

Semester Syllabus:

Format: 12 weeks, 4 hours/week | 2 credits

Revenue Target: ₹10,000

Week	Learning Goal	Measurable Outcome
1	Understand what entrepreneurship is and who can be an entrepreneur	Students define entrepreneurship in their own words and list 2 entrepreneurs from their local area or community
2	Connect personal identity to entrepreneurship (strengths, interests, struggles)	Students create a "value map" showing how a skill/interest/problem from their life could become a business opportunity
3	Learn about 5 business paths: content creation, dropshipping, cloud kitchen/food business, gig economy and local services	Students explore 1–2 examples from each domain and share one they're most curious to try and why
4	Choose a path and generate a basic business idea	Students write down a clear offer (what, for whom, why) and one way to reach their customer
5	Take first real action: message, post, pitch, or sell	Students reach out to or serve 1 real potential customer and record what happened
6	Reflect on first attempt and share with peers	Students share their result, a challenge faced, and one idea to improve next time

7	Improve and try again: aim for first ₹100	Students apply a change, try again, and aim to make their first ₹100 or get meaningful response
8	Learn how to identify and understand your target customer	Students talk to 2 potential customers or observe them and list 3 insights about their needs
9	Learn how to serve your target audience better	Students improve one part of their offer (product, delivery, messaging, or interaction) based on customer feedback or need
10	Explore core entrepreneurial values (resilience, honesty, effort)	Students reflect on 1 value they're building and show it in a business task or peer story
11	Focus on earning and staying consistent	Students complete a second earning task and track their consistency (e.g., same product or message for 3 days)
12	Reflect on earnings, grit, and how to keep going	Students record total earnings, one resilience moment, and one support system or habit they'll continue with

Weekly Component:

Component	Duration	Description
Learning Module	~1.5 hrs	• Introduces key concepts in a simple and engaging way • Includes, examples, and 1–2 interactive discussions or quizzes

Action Lab	~2 hrs	• Hands-on task on the weekly concept • Includes step-by-step guidance, templates, and worksheets • Ends with a submission (e.g., video, reflection, or proof of action)
Resources	Self-paced	• Supplementary videos, short readings, real- life stories, and tools to deepen understanding at their own pace

Evaluation Criteria

Evaluation Component	**Description**	**Weightage**
Weekly Task Completion	Timely submission of weekly tasks including reflections, activities, quizzes etc.	40%
Target Completion	Performance-based evaluation on hitting **revenue or profit targets** (e.g., generating ₹10,000 revenue)	30%
Final Project	A comprehensive project based on the semester's theme	30%

Course Title: Anatomy & Physiology – I Practical	L	T	P	Cr.
Course Code: BIG106	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify major bones, muscles, and organs of the human body.
2. Demonstrate the use of anatomical models, charts, and specimens.
3. Perform basic physiological experiments related to blood, cardiovascular, and respiratory systems.
4. Correlate theoretical knowledge with practical understanding of human structure and functions.
5. Develop hands-on skills required for paramedical and allied health sciences.

Course Content

List of Practicals / Experiments (60 Hours)

- Introduction to laboratory safety and handling of specimens/models.
- Study of human skeleton: identification of major bones (axial and appendicular).
- Demonstration of types of joints and their movements.
- Identification of major muscles using charts and models.
- Study of circulatory system:
  - Structure of heart (using models/specimens).
  - Identification of major blood vessels.
- Measurement of pulse rate and blood pressure.
- Estimation of hemoglobin concentration.
- Determination of blood group (ABO and Rh typing).
- Preparation of blood smear and identification of blood cells.
- Counting of red blood cells (RBC) using hemocytometer.
- Counting of white blood cells (WBC) using hemocytometer.
- Demonstration of respiratory system using models/specimens.

- Measurement of respiratory rate and vital capacity (using spirometer, if available).
- Study of digestive system using charts and models.
- Study of urinary system using charts and models.

Suggested Readings

- *CHAITOW L, DE LANY J. Clinical Anatomy and Physiology for Healthcare Professionals. 3rd ed. Elsevier; 2018.*
- *TORTORA GJ, DERRICKSON BH. Principles of Anatomy and Physiology. 15th ed. Wiley; 2017.*
- *MARIEB EN, SMITH LA. Human Anatomy & Physiology Laboratory Manual. 13th ed. Pearson; 2021.*
- *HALL JE. Guyton and Hall Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier; 2021.*
- *ROSS MH, PAWLINA W. Histology: A Text and Atlas. 8th ed. Wolters Kluwer; 2020.*

Course Title: Fundamentals of Medical Imaging Practical	L	T	P	Cr.
Course Code: BIG107	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate basic handling of X-ray, CT, MRI, and ultrasound equipment (introductory level).
2. Apply knowledge of imaging physics to understand image formation and quality.
3. Identify radiographic projections and recognize normal anatomical structures.
4. Understand the importance of patient preparation, positioning, and safety measures in imaging.
5. Observe and interpret basic imaging procedures under supervision.
6. Follow standard radiation protection and infection control practices in imaging departments.

Course Content

List of Practicals / Experiments (60 Hours)

- Introduction to imaging department: layout, safety protocols, and workflow.
- Familiarization with X-ray machine components (tube, console, control panel, bucky).
- Demonstration of X-ray film, cassettes, CR/DR systems.
- Practice of patient positioning for common radiographic views (chest PA, hand, foot, skull, abdomen).
- Demonstration of contrast media and their uses in imaging.
- Visit/demonstration of CT scanner: console, gantry, patient table.
- Introduction to CT imaging protocols (head, chest, abdomen) – observation.
- Demonstration of MRI machine (safety zones, coils, console).
- Observation of MRI brain and spine studies – basic orientation.

- Demonstration of ultrasound equipment and transducers.
- Observation of abdominal ultrasound and obstetric scans.
- Introduction to fluoroscopy and its clinical applications.
- Observation of image processing steps (film developing or digital processing).
- Basics of radiation protection: lead aprons, shields, dosimeters, safe distance.
- Case discussions: identification of normal anatomy on X-ray, CT, and ultrasound images.

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *CARLTON RR, ADLER AM. Principles of Radiographic Imaging: An Art and a Science. 6th ed. Boston: Cengage Learning; 2019.*
- *WESTBROOK C, KATT CK, HANNAH A. MRI in Practice. 5th ed. Wiley-Blackwell; 2019.*
- *WEBB S, ed. The Physics of Medical Imaging. Boca Raton: CRC Press; 2017.*
- *DRAKE RL, VOGL W, MITCHELL AWM. Gray's Anatomy for Students. 4th ed. Philadelphia: Elsevier; 2019.*

Course Title: Radiation Physics Practical	L	T	P	Cr.
Course Code: BIG108	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate fundamental experiments related to radiation physics.
2. Measure radiation intensity and understand the inverse square law.
3. Determine attenuation of X-rays in different materials and calculate half-value layer (HVL).
4. Familiarize with radiation detectors and dosimeters.
5. Apply radiation protection principles in a laboratory/clinical setting.
6. Correlate theoretical principles of radiation physics with practical applications in imaging.

Course Content

List of Practicals / Experiments (60 Hours)

- Introduction to radiation laboratory: safety rules and handling of radiation equipment.
- Familiarization with X-ray unit and control panel.
- Measurement of radiation intensity using a survey meter/dosimeter.
- Verification of inverse square law of radiation.
- Study of the effect of tube voltage (kVp) and current (mA) on X-ray output.
- Measurement of exposure time and its effect on image density.
- Determination of half-value layer (HVL) for aluminum/lead filters.
- Attenuation of X-rays through different materials (bone, soft tissue equivalent, lead).
- Introduction to radiation detectors: ionization chamber, TLD, GM counter (demonstration/observation).
- Demonstration of scatter radiation and protective shielding.
- Familiarization with personal dosimetry devices (film badge, TLD badge, pocket dosimeter).

- Demonstration of radiation leakage testing in X-ray tube housing.
- Practice of ALARA principles in the lab environment.
- Visit to diagnostic radiology department to observe radiation protection practices.
- Case-based discussion on radiation accidents and safety measures.

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *ATTIX FH. Introduction to Radiological Physics and Radiation Dosimetry. 2nd ed. Weinheim: Wiley-VCH; 2008.*
- *KHAN FM, GERBI BJ. The Physics of Radiation Therapy. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2019.*
- *HALL EJ, GIACCIA AJ. Radiobiology for the Radiologist. 8th ed. Philadelphia: Wolters Kluwer; 2019.*
- *MARTINSEN ACT, GULLIKSSON M, TYLER JM. Radiation Physics and Dosimetry for Medical Imaging. 1st ed. Boca Raton: CRC Press; 2019.*

Course Title: Medical Terminology & Communication Practical	L	T	P	Cr.
Course Code: BIG109	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply medical prefixes, suffixes, and root words in constructing and interpreting terms.
2. Accurately use medical abbreviations in healthcare documentation.
3. Demonstrate effective communication skills with patients, peers, and healthcare professionals.
4. Prepare patient case notes, reports, and discharge summaries.
5. Practice role-plays for doctor–patient and interprofessional communication.
6. Develop confidence in oral presentations, group discussions, and interview situations.

Course Content

List of Practicals / Activities (60 Hours)

- Introduction to medical terminology: exercises on word-building (prefix, suffix, root).
- Practice of common medical abbreviations in prescriptions and case sheets.
- Writing simple case notes and patient histories.
- Writing discharge summaries and referral notes.
- Practice in reading and interpreting doctors' orders and radiology reports.
- Role-play: doctor–patient communication (history taking, explaining procedures).
- Role-play: interprofessional communication (nurse–doctor, technician–doctor).
- Communication with patients: explaining diagnoses in simple terms.

- Group discussion on healthcare scenarios.
- Mock patient interview sessions.
- Preparation and delivery of short oral presentations (health topics).
- Simulation of telephone communication in healthcare settings.
- Practice of professional email and letter writing.
- Debate and case-based discussions on communication barriers.
- Feedback and reflection sessions on communication skills.

Suggested Readings

- *CHABNER DE. The Language of Medicine. 12th ed. St. Louis: Elsevier; 2021.*
- *SMITH JJ, PILESPY M. Medical Terminology for Health Professions. 9th ed. Boston: Cengage Learning; 2020.*
- *MOSELEY A. Medical Terminology: A Short Course. 9th ed. St. Louis: Elsevier; 2022.*
- *KUMAR S, LATA P. Communication Skills. 2nd ed. New Delhi: Oxford University Press; 2018.*
- *BISWAS C. Communication Skills for Professionals. 3rd ed. New Delhi: Pearson; 2019.*

Course Title: Communication and Soft Skills	L	T	P	Cr
Course Code: BIG110	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop effective verbal and non-verbal communication skills.
2. Demonstrate listening, speaking, reading, and writing skills in academic and professional contexts.
3. Apply interpersonal communication and teamwork skills in healthcare and allied settings.
4. Improve confidence in public speaking, presentations, and interviews.
5. Recognize the importance of empathy, etiquette, and professional behavior in patient care and workplace communication.

Course Contents

UNIT I: Fundamentals of Communication (10 Hours)

- Definition, process, and types of communication
- Barriers to effective communication and strategies to overcome them
- Verbal and non-verbal communication (tone, body language, gestures, posture, eye contact)
- Importance of communication in healthcare settings

UNIT II: Language and Professional Communication Skills (10 Hours)

- Listening skills: active listening, barriers to listening
- Speaking skills: pronunciation, fluency, clarity
- Reading comprehension and note-making
- Writing skills: formal letters, emails, reports, and memos
- Professional etiquette and telephone communication

UNIT III: Interpersonal and Team Communication (5 Hours)

- Role of communication in teamwork and collaboration
- Conflict management and negotiation skills
- Empathy and emotional intelligence in patient interaction
- Case studies: doctor–patient, nurse–patient, and interprofessional communication

UNIT IV: Presentation and Career Skills (5 Hours)

- Preparing and delivering oral presentations
- Group discussions and debates
- Interview skills and resume writing basics
- Time management, goal setting, and self-confidence building

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *KAUL A. Effective Business Communication. 2nd ed. New Delhi: PHI Learning; 2015.*
- *BISWAS C. Communication Skills for Professionals. 3rd ed. New Delhi: Pearson; 2019.*
- *MCGRATH E. Basic Managerial Skills for All. 9th ed. New Delhi: PHI Learning; 2017.*
- *LESIKAR RV, PETIT JD, FLATLEY ME. Basic Business Communication. 13th ed. New York: McGraw-Hill; 2017.*
- *KUMAR S, LATA P. Communication Skills. 2nd ed. New Delhi: Oxford University Press; 2018.*

Course Title: Human Rights and Duties	L	T	P	Cr
Course Code: BIG111	3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the concept, origin, and evolution of human rights.
2. Understand the constitutional provisions and legal framework of human rights in India.
3. Recognize the duties and responsibilities of citizens in a democratic society.
4. Appreciate the role of international organizations in promoting and protecting human rights.
5. Apply the knowledge of rights and duties in healthcare, education, and social settings.

Course Contents

UNIT I: Introduction to Human Rights (15 Hours)

- Meaning, nature, and scope of human rights
- Historical evolution: Magna Carta, French Revolution, Universal Declaration of Human Rights (UDHR)
- Classification of rights: civil, political, economic, social, and cultural rights
- Philosophical and moral foundations of human rights

UNIT II: Constitutional Framework in India (10 Hours)

- Fundamental Rights and Directive Principles of State Policy
- Fundamental Duties under Article 51A of the Constitution
- Right to Equality, Right to Freedom, Right against Exploitation, Right to Constitutional Remedies
- Role of judiciary in protecting human rights

UNIT III: National and International Institutions (10 Hours)

- National Human Rights Commission (NHRC) and State Human Rights Commissions
- Role of NGOs and civil society in human rights protection
- United Nations and its specialized agencies (UNHRC, UNICEF, WHO, ILO)
- International Covenants and conventions on human rights

UNIT IV: Human Rights in Practice (10 Hours)

- Human rights and healthcare: patient rights, informed consent, dignity in treatment
- Rights of women, children, minorities, and vulnerable groups
- Human rights violations: causes and remedies
- Duties of citizens in maintaining harmony, protecting environment, and promoting democracy

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- BASU DD. Introduction to the Constitution of India. 25th ed. Gurgaon: LexisNexis; 2021.
- JAYARAMU J. Human Rights. 2nd ed. New Delhi: Atlantic Publishers; 2018.
- NIRMAL BC. Human Rights in India: Historical, Social and Political Perspectives. New Delhi: Oxford University Press; 2019.
- UNITED NATIONS. Universal Declaration of Human Rights. New York: UN; 1948.
- SUBRAMANIAN S. Human Rights: International Challenges. New Delhi: Rawat Publications; 2017.

Semester 2nd

Course Title: Anatomy & Physiology – II	L	T	P	Cr
Course Code: BIG201	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the structure and functions of different organ systems of the human body.
2. Correlate physiological processes with normal health and common clinical conditions.
3. Demonstrate understanding of the integration of systems for maintaining homeostasis.
4. Apply anatomical and physiological knowledge in clinical and paramedical practices.

Course Contents

UNIT–I: Cardiovascular System (10 Hours)

- Structure of heart, layers, chambers, and valves.
- Blood circulation: systemic, pulmonary, and portal circulation.
- Cardiac cycle, heart sounds, blood pressure, pulse, and ECG basics.
- Physiology of cardiac output and regulation.

UNIT–II: Respiratory System (10 Hours)

- Anatomy of respiratory tract and lungs.
- Mechanism of breathing, ventilation, and gas exchange.
- Transport of gases (oxygen and carbon dioxide).
- Regulation of respiration and applied aspects (hypoxia, dyspnea, cyanosis).

UNIT–III: Digestive System (5 Hours)

- Anatomy of alimentary canal and accessory organs.
- Physiology of digestion and absorption of carbohydrates, proteins, and fats.
- Role of liver, pancreas, and gall bladder.

UNIT–IV: Excretory System (5 Hours)

- Anatomy of kidney, nephron, and urinary tract.
- Mechanism of urine formation.
- Regulation of water, electrolytes, and acid–base balance.
- Applied aspects: renal failure, dialysis basics.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *TORTORA GJ, DERRICKSON BH. Principles of Anatomy and Physiology. 15th ed. Hoboken: Wiley; 2017.*
- *MARIEB EN, HOEHN K. Human Anatomy & Physiology. 11th ed. New York: Pearson; 2018.*
- *ROSS MH, PAWLINA W. Histology: A Text and Atlas. 8th ed. Philadelphia: Wolters Kluwer; 2020.*
- *GUYTON AC, HALL JE. Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier; 2021.*
- *DATTA AK. Essentials of Human Anatomy. Vol I–III. 10th ed. Kolkata: Current Books International; 2018.*
- *CHOUDHURY AR. Concise Medical Physiology. 8th ed. Kolkata: New Central Book Agency; 2016.*

Course Title: Radiological Equipment – I (X-ray)	L	T	P	Cr
Course Code: BIG202	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the basic principles and components of X-ray generating equipment.
2. Describe the design, construction, and functioning of X-ray tubes.
3. Understand different types of X-ray generators and their applications.
4. Recognize the function of accessories used in conventional radiography.
5. Apply knowledge of equipment to ensure quality imaging and patient safety.

Course Contents

UNIT–I: Fundamentals of X-ray Production (10 Hours)

- Discovery of X-rays and evolution of equipment.
- Principles of X-ray generation.
- Requirements for X-ray production: source of electrons, acceleration, target.
- Interaction of electrons with target material.

UNIT–II: X-ray Tubes (10 Hours)

- Construction and working of X-ray tube.
- Stationary vs rotating anode tubes.
- Line focus principle and heel effect.
- Tube rating charts, heat units, and cooling methods.
- Special tubes: mammography tubes, CT tubes.

UNIT–III: X-ray Generators (5 Hours)

- Single-phase, three-phase, and high-frequency generators.
- Exposure timers and control panels.
- Rectification circuits.
- Automatic exposure control (AEC).

UNIT–IV: Accessories & Safety (5 Hours)

- Grids, collimators, filters, and beam restrictors.
- X-ray tables, bucky stands, and cassettes.
- Image receptors: film–screen systems, introduction to digital detectors.
- Radiation protection principles in X-ray rooms.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *SEERAM E. Computed Radiography: Principles and Technology. New York: Springer; 2019.*
- *CARROLL QB. Radiography in the Digital Age. 3rd ed. Springfield: Charles C Thomas; 2019.*
- *FAUBER TL. Radiographic Imaging and Exposure. 6th ed. St. Louis: Elsevier; 2020.*
- *JOHNS HE, CUNNINGHAM JR. The Physics of Radiology. 4th ed. Springfield: Charles C Thomas; 1983.*
- *CHERRY SR, SORENSON JA, PHELPS ME. Physics in Nuclear Medicine. 4th ed. Philadelphia: Elsevier; 2012.*

Course Title: Patient Care & Safety in Imaging	L	T	P	Cr
Course Code: BIG203	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles of patient care in diagnostic imaging departments.
2. Demonstrate effective communication and patient preparation for imaging procedures.
3. Apply infection control, aseptic techniques, and biomedical waste management in imaging facilities.
4. Identify radiation hazards and apply safety protocols for patients, staff, and public.
5. Recognize medico-legal, ethical, and psychological considerations in patient handling.

Course Contents

UNIT–I: Fundamentals of Patient Care (10 Hours)

- Introduction to patient care in imaging departments.
- Patient rights, dignity, and confidentiality.
- Professional ethics in radiology practice.
- Effective communication skills: history taking, patient instructions, handling anxious/paediatric/elderly patients.
- Cultural sensitivity and patient comfort.

UNIT–II: Patient Preparation & Positioning (10 Hours)

- Preparation of patients for X-ray, CT, MRI, USG procedures.
- Contrast media: types, routes of administration, indications, contraindications, reactions.
- Informed consent: concept and importance.
- Immobilization devices and positioning aids.

UNIT–III: Infection Control & Emergency Care (5 Hours)

- Infection control measures in imaging facilities.
- Hand hygiene and aseptic techniques.

- Biomedical waste management (specific to imaging departments).
- Basic life support (BLS) and management of contrast reactions.

UNIT–IV: Radiation Protection & Safety (5 Hours)

- Principles of radiation protection (ALARA, justification, optimization, dose limitation).
- Protective devices: aprons, shields, barriers.
- Patient dose reduction strategies.
- Radiation safety for staff and attendants.
- Safety regulations and international guidelines (ICRP, AERB).

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *FAUBER TL. Radiographic Imaging and Exposure. 6th ed. St. Louis: Elsevier; 2020.*
- *TORTORA GJ, DERRICKSON BH. Principles of Anatomy and Physiology. 15th ed. Hoboken: Wiley; 2017.*
- *STEFANAC SJ, NESBIT SP. Patient Care in Radiography with an Introduction to Medical Imaging. 10th ed. St. Louis: Elsevier; 2018.*
- *BRONZINO JD, PETERSON DR. Medical Devices and Human Engineering. 5th ed. Boca Raton: CRC Press; 2019.*
- *INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP). Radiation Protection Principles. Publication 103. Oxford: Pergamon; 2007.*

Course Title: Radiographic Positioning – I	L	T	P	Cr
Course Code: BIG204	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles of radiographic positioning and image evaluation.
2. Demonstrate knowledge of surface anatomy, positioning landmarks, and planes.
3. Describe standard radiographic positions for extremities, chest, and abdomen.
4. Correlate radiographic projections with clinical indications.
5. Apply radiation protection principles during positioning of patients.

Course Contents

UNIT–I: Principles of Radiographic Positioning (10 Hours)

- Introduction to positioning: anatomical planes, body positions, and movement terminology.
- Surface anatomy and positioning landmarks.
- General principles: centering, collimation, source-to-image distance (SID), exposure factors.
- Patient preparation, immobilization, and communication.
- Radiation protection during positioning.

UNIT–II: Radiography of Upper Extremities (10 Hours)

- Hand, fingers, and thumb (PA, oblique, lateral).
- Wrist (PA, oblique, lateral).
- Forearm (AP, lateral).
- Elbow (AP, lateral, obliques).
- Humerus (AP, lateral).
- Shoulder girdle (AP shoulder, lateral scapula, Y-view, clavicle).

UNIT–III: Radiography of Lower Extremities (5 Hours)

- Toes and foot (AP, oblique, lateral).
- Ankle (AP, mortise, lateral).

- Leg (AP, lateral).
- Knee (AP, lateral, oblique).

UNIT–IV: Chest & Abdomen (5 Hours)

- Chest radiography (PA, AP, lateral, decubitus views – indications).
- Abdomen (AP supine, upright, decubitus).
- Special notes: pediatric positioning and portable radiography basics.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *BONTRAGER KL, LAMPIGNANO JP. Textbook of Radiographic Positioning and Related Anatomy. 9th ed. St. Louis: Elsevier; 2020.*
- *CLARK KC, DUTTON AG. Clark's Positioning in Radiography. 13th ed. London: CRC Press; 2015.*
- *MERRILL V, TOLAND CB. Merrill's Atlas of Radiographic Positioning and Procedures. 14th ed. St. Louis: Elsevier; 2019.*
- *FAUBER TL. Radiographic Imaging and Exposure. 6th ed. St. Louis: Elsevier; 2020.*
- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *LORNA KW, STEPHEN JG. Radiography for Medical Imaging Students. 2nd ed. Cambridge: Cambridge University Press; 2017*

Course Title: Pathology & Microbiology for Imaging	L	T	P	Cr
Course Code: BIG205	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the basic pathological processes that alter imaging appearances.
2. Correlate imaging findings with common pathological conditions of various organ systems.
3. Describe the role of microbiology in infectious diseases relevant to diagnostic imaging.
4. Identify imaging manifestations of infections and inflammatory diseases.
5. Apply knowledge of pathology and microbiology in assisting radiologists with diagnosis.

Course Contents

UNIT–I: Fundamentals of Pathology (10 Hours)

- Introduction to pathology and its relevance in imaging.
- Cellular injury, degeneration, necrosis, and apoptosis.
- Inflammation and healing processes.
- Neoplasia: benign vs malignant, imaging correlations.
- Hemodynamic disorders: edema, thrombosis, embolism, infarction.

UNIT–II: Systemic Pathology and Imaging Correlation (10 Hours)

- Respiratory system: pneumonia, tuberculosis, lung cancer.
- Cardiovascular system: atherosclerosis, cardiomegaly, congenital heart diseases.
- Gastrointestinal system: cirrhosis, hepatocellular carcinoma, intestinal obstruction.
- Musculoskeletal system: osteomyelitis, bone tumors, arthritis.
- CNS: stroke, hemorrhage, meningitis, tumors.

UNIT–III: Basics of Microbiology (5 Hours)

- Introduction to microorganisms of medical importance.

- Bacteria, viruses, fungi, and parasites – overview.
- Modes of transmission of infectious diseases.
- Sterilization and disinfection in imaging departments.

UNIT–IV: Infectious Diseases & Imaging (5 Hours)

- Tuberculosis: pulmonary and extrapulmonary imaging findings.
- HIV and opportunistic infections – imaging relevance.
- Pyogenic infections and abscesses.
- Healthcare-associated infections (HAIs) and infection control in radiology.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *ROBBINS SL, COTRAN RS, KUMAR V. Robbins and Cotran Pathologic Basis of Disease. 10th ed. Philadelphia: Elsevier; 2020.*
- *HARSH MOHAN. Textbook of Pathology. 8th ed. New Delhi: Jaypee Brothers; 2019.*
- *MURRAY PR, ROSENTHAL KS, PFALLER MA. Medical Microbiology. 9th ed. Philadelphia: Elsevier; 2020.*
- *DUTTA S. Textbook of Pathology for Allied Health Science Students. 2nd ed. New Delhi: Jaypee Brothers; 2020.*
- *CHAUDHURI AR. Pathology for Radiographers. New Delhi: Jaypee Brothers; 2017.*
- *RASKIN RE, MEYER DJ. Atlas of Infectious Diseases and Pathology in Imaging. Philadelphia: Elsevier; 2018.*

Course Title: Anatomy & Physiology – II Practical	L	T	P	Cr.
Course Code: BIG206	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate practical knowledge of the cardiovascular, respiratory, digestive, and excretory systems.
2. Perform basic physiological experiments related to circulation, respiration, and excretion.
3. Record, analyze, and interpret normal physiological parameters.
4. Apply laboratory techniques in identifying structures, tissues, and physiological functions.
5. Correlate practical findings with theoretical knowledge of anatomy and physiology.

Course Content

List of Practicals / Experiments (60 Hours):

- Study of models/charts of the heart and blood vessels.
- Recording of pulse rate, blood pressure, and interpretation of findings.
- Study of cardiac sounds using stethoscope and preparation of clinical charts.
- Demonstration of ECG recording and interpretation of normal waves.
- Study of respiratory system models and charts.
- Demonstration of lung volumes and capacities using spirometry.
- Effect of exercise on pulse and respiration.
- Study of digestive system models (stomach, liver, pancreas, intestines).
- Test for salivary amylase activity.
- Study of excretory system models (kidney, nephron).
- Urine analysis: physical, chemical (protein, sugar, ketone), and microscopic examination.
- Histological study of cardiovascular, respiratory, digestive, and excretory organs (slides).

- Case-based demonstrations: hypertension, dyspnea, jaundice, renal failure (awareness level).
- Viva-voce and record maintenance of practical work.

Suggested Readings

- *CHAUDHARI SK. Practical Physiology. 3rd ed. New Delhi: CBS Publishers; 2017.*
- *GOPALAKRISHNAN C. Practical Physiology for Undergraduate Students. 2nd ed. New Delhi: Jaypee Brothers; 2019.*
- *BANERJEE PK. Practical Physiology with Viva Voce. 2nd ed. New Delhi: Jaypee Brothers; 2020.*
- *MARIEB EN, HOEHN K. Human Anatomy & Physiology Laboratory Manual. 12th ed. New York: Pearson; 2018.*
- *KESARI H. Textbook of Practical Physiology. 2nd ed. New Delhi: CBS Publishers; 2018.*
- *DATTA AK. Essentials of Human Anatomy (Vol I–III). 10th ed. Kolkata: Current Books International; 2018.*

Course Title: Radiological Equipment – I (X-ray) Practical	L	T	P	Cr.
Course Code: BIG207	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify the components of X-ray equipment and explain their functions.
2. Demonstrate the correct operation and safety checks of an X-ray machine.
3. Handle accessories such as grids, filters, and collimators in clinical practice.
4. Differentiate between types of X-ray generators and their controls.
5. Apply safety measures for patient, operator, and staff during radiographic procedures.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to X-ray room, equipment, and control panel.
- Identification of X-ray tube parts (cathode, anode, housing, filtration).
- Demonstration of stationary vs rotating anode tubes.
- Study of tube rating charts and cooling curves.
- Demonstration of control console: exposure settings (kV, mA, time, mAs).
- Operation of single-phase, three-phase, and high-frequency X-ray generators.
- Familiarization with rectification circuits (demonstration).
- Checking and handling of beam restrictors: collimators, cones, diaphragms.
- Demonstration and use of filters (inherent and added).
- Study of radiographic accessories: X-ray table, bucky stand, cassettes, screens.
- Use of grids: types, purpose, and demonstration of grid cutoff.

- Demonstration of automatic exposure control (AEC) systems.
- Introduction to image receptors: film–screen systems vs CR/DR detectors.
- Radiation protection: lead aprons, shields, barriers, and safe positioning.
- Preventive maintenance and daily safety checks of X-ray machines.
- Record keeping of exposures, quality control logs, and safety protocols.

Suggested Readings

- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *FAUBER TL. Radiographic Imaging and Exposure. 6th ed. St. Louis: Elsevier; 2020.*
- *CARROLL QB. Radiography in the Digital Age. 3rd ed. Springfield: Charles C Thomas; 2019.*
- *SEERAM E. Computed Radiography: Principles and Technology. New York: Springer; 2019.*
- *CLARK KC, DUTTON AG. Clark's Positioning in Radiography. 13th ed. London: CRC Press; 2015.*
- *JOHNS HE, CUNNINGHAM JR. The Physics of Radiology. 4th ed. Springfield: Charles C Thomas; 1983.*

Course Title: Patient Care & Safety in Imaging Practical	L	T	P	Cr.
Course Code: BIG208	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate proper communication and patient preparation before imaging procedures.
2. Apply aseptic techniques, infection control, and biomedical waste management in imaging facilities.
3. Assist in safe patient positioning, immobilization, and contrast media administration.
4. Recognize and respond to medical emergencies, including contrast reactions and CPR.
5. Implement radiation protection measures for patients, staff, and attendants.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to patient care protocols in diagnostic imaging departments.
- Demonstration of patient identification, history taking, and consent procedures.
- Practice of communication skills with anxious, pediatric, and geriatric patients.
- Preparation of patients for X-ray, CT, MRI, and USG procedures.
- Demonstration of patient positioning and immobilization techniques.
- Handling and preparation of contrast media (oral, IV, intrathecal – awareness level).
- Simulation of contrast administration under supervision.
- Recognition and immediate response to contrast reactions.
- Demonstration of aseptic handwashing and use of personal protective equipment (PPE).

- Biomedical waste segregation and disposal practices in imaging departments.
- Infection control drills: cleaning and disinfection of imaging tables, probes, and accessories.
- Basic Life Support (BLS) and CPR practice on mannequins.
- Demonstration of safe patient transfer techniques (wheelchair, stretcher, trolley).
- Radiation protection exercises: proper use of lead aprons, shields, gonad protectors.
- Checking and recording radiation protection devices (TLD badges, lead barriers).
- Maintenance of patient care and safety records/logbook.

Suggested Readings

- *STEFANAC SJ, NESBIT SP. Patient Care in Radiography with an Introduction to Medical Imaging. 10th ed. St. Louis: Elsevier; 2018.*
- *BUSHONG SC. Radiologic Science for Technologists: Physics, Biology, and Protection. 12th ed. St. Louis: Elsevier; 2021.*
- *FAUBER TL. Radiographic Imaging and Exposure. 6th ed. St. Louis: Elsevier; 2020.*
- *LONG BW, ROLLINS JH, SMITH BJ. Merrill's Atlas of Radiographic Positioning and Procedures. 14th ed. St. Louis: Elsevier; 2019.*
- *AMERICAN HEART ASSOCIATION. Basic Life Support Provider Manual. 2020 ed. Dallas: AHA; 2020.*
- *WHO. Radiation Protection and Safety in Medical Uses of Ionizing Radiation. Geneva: WHO; 2018.*

Course Title: Radiographic Positioning – I Practical	L	T	P	Cr.
Course Code: BIG209	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate correct patient positioning for routine radiographic examinations of extremities, chest, and abdomen.
2. Identify anatomical landmarks and apply positioning principles.
3. Select and adjust exposure factors (kV, mA, time, mAs) for optimal image quality.
4. Evaluate radiographic images for positioning accuracy and diagnostic value.
5. Apply patient safety and radiation protection measures during positioning.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to positioning equipment: X-ray table, bucky stand, cassettes, and markers.
- Demonstration of anatomical planes and surface landmarks used in positioning.
- Positioning for fingers, thumb, and hand (PA, oblique, lateral).
- Positioning for wrist (PA, oblique, lateral).
- Positioning for forearm (AP, lateral).
- Positioning for elbow (AP, lateral, obliques).
- Positioning for humerus (AP, lateral).
- Positioning for shoulder girdle (AP shoulder, lateral scapula, Y-view, clavicle).
- Positioning for toes and foot (AP, oblique, lateral).
- Positioning for ankle (AP, mortise, lateral).
- Positioning for leg (AP, lateral).
- Positioning for knee (AP, lateral, oblique).
- Positioning for chest (PA, AP, lateral).

- Positioning for abdomen (AP supine, AP upright, decubitus view).
- Demonstration of pediatric positioning and use of immobilization devices.
- Practice of radiation protection methods during radiographic positioning.
- Image evaluation criteria: analysis of positioning accuracy, collimation, and exposure.
- Maintenance of practical record book and viva-voce.

Suggested Readings

- *BONTRAGER KL, LAMPIGNANO JP. Textbook of Radiographic Positioning and Related Anatomy. 9th ed. St. Louis: Elsevier; 2020.*
- *CLARK KC, DUTTON AG. Clark's Positioning in Radiography. 13th ed. London: CRC Press; 2015.*
- *MERRILL V, TOLAND CB. Merrill's Atlas of Radiographic Positioning and Procedures. 14th ed. St. Louis: Elsevier; 2019.*
- *FAUBER TL. Radiographic Imaging and Exposure. 6th ed. St. Louis: Elsevier; 2020.*
- *LONG BW, ROLLINS JH, SMITH BJ. Radiographic Positioning and Related Anatomy Workbook. 14th ed. St. Louis: Elsevier; 2020.*
- *LORNA KW, STEPHEN JG. Radiography for Medical Imaging Students. 2nd ed. Cambridge: Cambridge University Press; 2017.*

Course Title: Pathology & Microbiology for Imaging Practical	L	T	P	Cr.
Course Code: BIG210	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. **Demonstrate handling, collection, and processing of pathological and microbiological specimens.**
2. **Perform basic hematology and microbiology laboratory techniques relevant to imaging.**
3. **Prepare and interpret common stains (Gram, AFB, H&E).**
4. **Correlate laboratory findings with imaging features of common diseases.**
5. **Apply infection control and biosafety measures in laboratory and imaging setups.**

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to pathology and microbiology laboratory setup.
- Demonstration of specimen collection: blood, urine, sputum, pus.
- Preparation and staining of peripheral blood smear (Leishman/Giemsa).
- Hemoglobin estimation and TLC/DLC demonstration.
- ESR determination and clinical relevance.
- Urine analysis: physical, chemical (protein, sugar), and microscopic examination.
- Preparation of histology slides – fixation, processing, H&E staining (demonstration).
- Gram staining of bacterial samples.
- Acid-fast bacilli (AFB) staining for tuberculosis.
- Culture methods: streak plate technique and colony identification (demonstration).
- Demonstration of fungal identification techniques (KOH mount).

- Handling of biopsy/cytology specimens (radiology–pathology correlation).
- Case demonstrations: pneumonia, TB, osteomyelitis, liver abscess, tumors.
- Biosafety protocols in radiology departments (PPE, hand hygiene, waste disposal).
- Correlation exercises: comparing pathology/microbiology results with radiographic findings.
- Maintenance of laboratory record book and viva-voce.

Suggested Readings

- *HARSH MOHAN. Textbook of Pathology. 8th ed. New Delhi: Jaypee Brothers; 2019.*
- *ROBBINS SL, COTRAN RS, KUMAR V. Robbins and Cotran Pathologic Basis of Disease. 10th ed. Philadelphia: Elsevier; 2020.*
- *DUTTA S. Textbook of Pathology for Allied Health Science Students. 2nd ed. New Delhi: Jaypee Brothers; 2020.*
- *MURRAY PR, ROSENTHAL KS, PFALLER MA. Medical Microbiology. 9th ed. Philadelphia: Elsevier; 2020.*
- *ANANTHANARAYAN R, PANIKER CKJ. Textbook of Microbiology. 10th ed. Hyderabad: Universities Press; 2017.*
- *CHAUDHURI AR. Pathology for Radiographers. New Delhi: Jaypee Brothers; 2017.*

Course Title: Environmental Sciences	L	T	P	Cr
Course Code: BIG211	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the structure and functions of the environment and ecosystems.
2. Identify natural resources and discuss their sustainable use.
3. Understand environmental pollution, its causes, effects, and control measures.
4. Recognize the importance of biodiversity conservation and sustainable development.
5. Apply environmental awareness in healthcare, community health, and professional practice.

Course Contents

UNIT–I: Introduction & Natural Resources (10 Hours)

- Definition, scope, and importance of environmental studies.
- Components of the environment.
- Natural resources: forest, water, mineral, energy, and land resources.
- Role of individuals in conservation of natural resources.

UNIT–II: Ecosystems & Biodiversity (10 Hours)

- Concept of an ecosystem, structure, and function.
- Energy flow and ecological pyramids.
- Types of ecosystems: forest, grassland, desert, aquatic.
- Biodiversity: levels, value, threats, and conservation methods.

UNIT–III: Environmental Pollution (5 Hours)

- Types: air, water, soil, noise, radioactive pollution.
- Causes, effects, and control measures.
- Role of healthcare professionals in pollution awareness.

UNIT–IV: Social Issues & Human Health (5 Hours)

- Sustainable development and climate change.
- Global warming, ozone depletion, acid rain.

- Waste management: biomedical waste, solid waste, e-waste.
- Environmental ethics and public health.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *AGARWAL KC. Environmental Biology. New Delhi: Nidhi Publishers; 2001.*
- *RAO MN, DATAR SV. Wastewater Treatment. Oxford: Oxford & IBH Publishing; 1987.*
- *ODUM EP, BARRETT GW. Fundamentals of Ecology. 5th ed. Belmont: Cengage Learning; 2004.*
- *RAO CS. Environmental Pollution Control Engineering. New Delhi: New Age International; 2006.*
- *SHARMA PD. Ecology and Environment. 10th ed. Meerut: Rastogi Publications; 2019.*
- *KAUSHIK A, KAUSHIK CP. Perspectives in Environmental Studies. 6th ed. New Delhi: New Age International; 2020.*

Course Title: First Aid	L	T	P	Cr
Course Code: BIG212	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the basic principles and importance of first aid in emergency care.
2. Demonstrate immediate and effective response to common medical and surgical emergencies.
3. Perform basic life support (BLS) and cardiopulmonary resuscitation (CPR).
4. Apply safe techniques for wound care, bleeding control, fractures, burns, and poisoning.
5. Recognize when to provide first aid and when to seek advanced medical help.

Course Contents

UNIT–I: Introduction & Basic Principles of First Aid (10 Hours)

- Definition, scope, and objectives of first aid.
- First aid kit: contents and maintenance.
- Principles of patient assessment (DRABC – Danger, Response, Airway, Breathing, Circulation).
- First aid in fainting, shock, seizures, heat stroke, and hypothermia.

UNIT–II: Basic Life Support & CPR (10 Hours)

- Introduction to BLS and chain of survival.
- Cardiopulmonary resuscitation (adult, child, infant).
- Recovery position and airway management techniques.
- First aid for choking (Heimlich maneuver).
- Awareness of automated external defibrillator (AED).

UNIT–III: Wounds, Bleeding, Fractures & Burns (5 Hours)

- Types of wounds and bleeding.
- Control of bleeding (direct pressure, elevation, bandaging, tourniquet – awareness).

- First aid in fractures, sprains, and dislocations.
- First aid in burns, scalds, and electric shock.

UNIT–IV: Poisoning, Bites & Miscellaneous Emergencies (5 Hours)

- First aid in poisoning (ingestion, inhalation, injection, contact).
- Snake bite, dog bite, insect stings.
- First aid in drowning, near-drowning, and road traffic accidents.
- Transport of injured patients and shifting techniques.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- ST JOHN AMBULANCE, BRITISH RED CROSS, ST ANDREW'S FIRST AID. First Aid Manual. 11th ed. London: Dorling Kindersley; 2021.
- AMERICAN RED CROSS. First Aid/CPR/AED Participant's Manual. 2020 ed. Washington DC: American Red Cross; 2020.
- AMERICAN HEART ASSOCIATION. Basic Life Support (BLS) Provider Manual. 2020 ed. Dallas: AHA; 2020.
- KNIGHT B. Immediate First Aid: A Practical Guide. 6th ed. London: Hodder Arnold; 2018.
- TIWARI R. Textbook of First Aid and Emergency Nursing. New Delhi: Jaypee Brothers; 2017.
- ALEXANDER D. First Aid Manual for Nurses. London: Routledge; 2019.

Semester 3rd

Course Title: Cross Sectional Anatomy	L	T	P	Cr
Course Code: BIG301	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the principles and importance of cross-sectional imaging in radiology.
2. Identify normal anatomical structures in axial, coronal, and sagittal planes.
3. Correlate sectional anatomy with CT and MRI imaging techniques.
4. Differentiate major organs, vessels, bones, and soft tissues in various body regions.
5. Apply knowledge of sectional anatomy in clinical and diagnostic radiology practice.

Course Contents

UNIT I: Introduction & Head and Neck (10 Hours)

- Basics of cross-sectional imaging (planes: axial, coronal, sagittal).
- Cross-sectional anatomy of the brain: ventricles, major lobes, basal ganglia, brainstem, cerebellum.
- Cross-sections of orbit, paranasal sinuses, and neck (pharynx, larynx, vessels, glands).

UNIT II: Thorax (10 Hours)

- Cross-sectional anatomy of thoracic wall and mediastinum.
- Heart and great vessels (aorta, pulmonary arteries/veins, vena cava).
- Lungs, bronchi, and pleura.
- Correlation of thoracic cross sections with CT images.

UNIT III: Abdomen (5 Hours)

- Cross-sectional anatomy of liver, gall bladder, spleen, pancreas, kidneys, and adrenal glands.
- Major abdominal vessels (aorta, IVC, portal vein).
- Peritoneal spaces and retroperitoneum.

UNIT IV: Pelvis & Musculoskeletal (5 Hours)

- Cross-sectional anatomy of pelvic organs: urinary bladder, rectum, prostate, uterus, ovaries.
- Bony pelvis, hip joint, and surrounding musculature.
- Basic cross-sections of upper and lower limbs (major muscles, bones, and vessels).

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *Fitzgerald R. Fitzgerald's Clinical Neuroanatomy and Radiology. Saunders.*
- *Marios Loukas, Shane Tubbs. Cross-Sectional Anatomy for Diagnostic Imaging. CRC Press.*
- *Head H, Moore KL, Agur AM. Clinically Oriented Anatomy. Wolters Kluwer.*
- *Halpern EJ. Clinical Imaging: An Atlas of Differential Diagnosis. Saunders.*
- *Kelly PJ. Sectional Anatomy for Imaging Professionals. Elsevier.*

Course Title: Radiological Equipment – II (CT)	L	T	P	Cr
Course Code: BIG302	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the basic principles and evolution of CT technology.
2. Understand the construction and working of CT scanners.
3. Describe image formation, reconstruction techniques, and parameters affecting image quality.
4. Recognize radiation dose considerations and safety in CT.
5. Correlate equipment design with clinical applications

Course Contents

UNIT I: Fundamentals of CT (10 Hours)

- History and evolution of CT technology (1st to latest generations).
- Basic principles of CT imaging.
- CT system components: x-ray tube, detectors, collimators, gantry.
- Patient table and positioning systems.

UNIT II: CT Image Formation & Reconstruction (10 Hours)

- Principles of data acquisition.
- Image reconstruction techniques: back projection, filtered back projection, iterative reconstruction.
- Image display, storage, and PACS integration.
- Factors affecting image quality: spatial resolution, contrast resolution, noise, artifacts.

UNIT III: CT Equipment & Technology (5 Hours)

- Slip ring technology and helical/spiral CT.
- Multislice/multidetector CT (MDCT).
- Dual-source and cone-beam CT systems.
- Contrast injectors and accessories.

UNIT IV: CT Safety & Applications (5 Hours)

- CT radiation dose: CTDI, DLP, effective dose.
- Dose optimization and ALARA principle.
- Common CT applications: brain, chest, abdomen, angiography.
- Quality assurance and maintenance of CT equipment.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. Wolters Kluwer.*
- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*
- *Goldman LW. Principles of CT: Multislice CT. Lippincott Williams & Wilkins.*
- *Hsieh J. Computed Tomography: Principles, Design, Artifacts, and Recent Advances. SPIE Press.*
- *Bushong SC. Radiologic Science for Technologists. Elsevier.*

Course Title: Radiographic Positioning – II	L	T	P	Cr
Course Code: BIG303	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the standard radiographic positioning techniques for different regions of the body.
2. Demonstrate knowledge of anatomical landmarks relevant to radiographic positioning.
3. Select appropriate projections to demonstrate specific anatomical structures.
4. Identify positioning errors and suggest corrective measures.
5. Correlate radiographic positioning with clinical indications and diagnostic requirements.

Course Contents

UNIT I: Radiographic Positioning of Skull & Facial Bones (10 Hours)

- Positioning of skull: AP, lateral, Towne's, Caldwell, Submento-vertical (SMV).
- Facial bones: paranasal sinuses, nasal bones, orbits, zygomatic arches.
- Mandible and temporomandibular joint (TMJ) projections.

UNIT II: Radiographic Positioning of Spine (10 Hours)

- Cervical spine: AP, lateral, oblique, open mouth odontoid view.
- Thoracic spine: AP and lateral views.
- Lumbar spine: AP, lateral, oblique, spot views.
- Sacrum, coccyx, and sacroiliac joint views.

UNIT III: Radiographic Positioning of Abdomen & Pelvis (5 Hours)

- KUB (Kidney, Ureter, Bladder) radiographs.
- Abdomen: supine, erect, and decubitus positions.

- Pelvis and hip joint projections.

UNIT IV: Contrast Studies – Basic (5 Hours)

- Introduction to contrast radiography.
- Barium studies: barium swallow, meal, enema.
- Intravenous urography (IVU/IVP) – basic positioning.
- Hysterosalpingography (HSG) – overview.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *Ballinger PW, Frank ED. Merrill's Atlas of Radiographic Positions and Radiologic Procedures. Mosby Elsevier.*
- *Clark KC. Clark's Positioning in Radiography. CRC Press.*
- *Bontrager KL, Lampignano JP. Textbook of Radiographic Positioning and Related Anatomy. Elsevier.*
- *McQuillen Martensen K. Radiographic Image Analysis. Saunders.*
- *Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. Saunders.*

Course Title: Contrast Media & Special Procedures	L	T	P	Cr
Course Code: BIG304	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the properties, types, and uses of contrast media in diagnostic radiology.
2. Describe the preparation, administration, and adverse reactions of contrast agents.
3. Understand the principles and techniques of common special radiological procedures.
4. Identify the role of contrast studies in enhancing diagnostic accuracy.
5. Apply safety protocols and emergency management in contrast-related complications.

Course Contents

UNIT I: Introduction to Contrast Media (10 Hours)

- Definition, classification, and properties of contrast media.
- Positive vs. negative contrast agents.
- Barium sulfate: properties, indications, contraindications, complications.
- Iodinated contrast media: ionic vs. non-ionic, osmolality, viscosity.

UNIT II: Administration & Reactions (10 Hours)

- Routes of administration: oral, rectal, intravascular, intrathecal, intra-articular.
- Dosage, patient preparation, and after-care.
- Adverse reactions: mild, moderate, severe.
- Prevention and management of contrast reactions.

UNIT III: Gastrointestinal & Urological Procedures (5 Hours)

- Barium swallow, meal, and follow-through.

- Barium enema.
- Intravenous urography (IVU/IVP).
- Retrograde urography and micturating cystourethrogram (MCU).

UNIT IV: Advanced Special Procedures (5 Hours)

- Myelography.
- Hysterosalpingography (HSG).
- Angiography: basic principles and applications.
- Interventional radiology – overview.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *Grainger RG, Allison D. Grainger & Allison's Diagnostic Radiology. Churchill Livingstone.*
- *Bontrager KL, Lampignano JP. Textbook of Radiographic Positioning and Related Anatomy. Elsevier.*
- *Bushong SC. Radiologic Science for Technologists. Elsevier.*
- *Haaga JR, Dogra VS. CT and MRI of the Whole Body. Elsevier.*
- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*

Course Title: CT protocol	L	T	P	Cr
Course Code: BIG305	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles of protocol selection in CT imaging.
2. Identify appropriate patient preparation steps for different CT examinations.
3. Differentiate between non-contrast, contrast-enhanced, and specialized CT protocols.
4. Optimize scan parameters (kVp, mAs, slice thickness, pitch, contrast timing) for diagnostic accuracy.
5. Apply radiation safety and dose reduction strategies in CT protocols.
6. Correlate CT protocols with common clinical indications in different body regions.

Course Contents

UNIT I: Fundamentals of CT Protocols (10 Hours)

- Overview of CT scanning parameters (kVp, mAs, pitch, FOV, reconstruction algorithms).
- Patient positioning and immobilization.
- Contrast vs. non-contrast protocols.
- Radiation dose considerations and ALARA principle in protocol design.

UNIT II: Head & Neck Protocols (10 Hours)

- CT brain: NCCT (trauma, stroke, bleed), CECT (tumor, infection).
- CT PNS (sinuses): indications and technique.
- CT orbit: trauma, tumors, infections.
- CT neck: soft tissue masses, lymphadenopathy.

UNIT III: Thorax & Abdomen Protocols (5 Hours)

- CT chest: HRCT (ILD), CECT chest (tumors, pulmonary embolism).

- CT abdomen: liver, pancreas, kidneys (NCCT, CECT, triphasic liver).
- CT KUB and urography protocols.

UNIT IV: Advanced Protocols & Applications (5 Hours)

- CT angiography: brain, chest, abdomen, peripheral vessels.
- CT colonography and enterography.
- CT perfusion studies – basics.
- Pediatric CT protocols – dose optimization.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*
- *Haaga JR, Dogra VS. CT and MRI of the Whole Body. Elsevier.*
- *Kalra MK, Maher MM, Toth TL, et al. Radiation Dose Optimization in CT. Springer.*
- *Brant WE, Helms CA. Fundamentals of Diagnostic Radiology. Wolters Kluwer.*
- *Hsieh J. Computed Tomography: Principles, Design, Artifacts, and Recent Advances. SPIE Press.*

Course Title: Cross Sectional Anatomy Practical	L	T	P	Cr.
Course Code: BIG306	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify normal anatomical structures on CT and MRI images in axial, coronal, and sagittal planes.
2. Correlate cross-sectional anatomy with surface and gross anatomy.
3. Differentiate between soft tissue, bone, and vascular structures on sectional images.
4. Recognize common anatomical variations in cross-sectional images.
5. Apply anatomical knowledge in clinical case-based radiological practice.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to CT and MRI image viewing (axial, coronal, sagittal planes).
- Identification of major bones and soft tissues in head CT and MRI.
- Recognition of ventricles, lobes of brain, basal ganglia, and brainstem in sectional images.
- Cross-sectional study of orbit, paranasal sinuses, and neck (airways, vessels, glands).
- Identification of thoracic wall, mediastinum, heart, and lungs in CT chest.
- Recognition of liver, gallbladder, spleen, pancreas, kidneys, and adrenal glands on CT abdomen.
- Study of major abdominal vessels (aorta, IVC, portal vein) in sectional images.
- Identification of pelvic organs (urinary bladder, uterus, prostate, ovaries) on CT/MRI pelvis.
- Cross-sectional study of bony pelvis and hip joint.

- Recognition of musculoskeletal cross sections in upper limb (shoulder, arm, forearm).
- Recognition of musculoskeletal cross sections in lower limb (thigh, knee, leg).
- Correlation of anatomical models/specimens with sectional images.
- Demonstration of anatomical variations commonly seen in CT/MRI.
- Case-based image interpretation exercises.
- OSCE-based evaluation: labeling and interpretation of CT/MRI sectional anatomy.

Suggested Readings

- *Marios Loukas, Shane Tubbs. Cross-Sectional Anatomy for Diagnostic Imaging. CRC Press.*
- *Kelly PJ. Sectional Anatomy for Imaging Professionals. Elsevier.*
- *Fitzgerald R. Fitzgerald's Clinical Neuroanatomy and Radiology. Saunders.*
- *Halpern EJ. Clinical Imaging: An Atlas of Differential Diagnosis. Saunders.*
- *Moore KL, Agur AM, Dalley AF. Clinically Oriented Anatomy. Wolters Kluwer.*

Course Title: Radiological Equipment – II (CT) Practical	L	T	P	Cr.
Course Code: BIG307	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify the components of a CT scanner and explain their functions.
2. Demonstrate knowledge of CT system operation and safety checks.
3. Perform basic quality assurance (QA) tests on CT equipment.
4. Understand and apply CT parameters (kVp, mAs, pitch, slice thickness) in practice.
5. Handle patient positioning and immobilization for CT procedures (simulation).
6. Recognize and troubleshoot common CT equipment errors and artifacts.

Course Content

List of Practicals / Experiments (60 Hours):

- Introduction to CT equipment and safety protocols.
- Identification of major CT scanner components: gantry, x-ray tube, detectors, collimators, patient table.
- Demonstration of slip-ring technology and helical scanning principle.
- Patient positioning techniques for head, chest, abdomen, and extremities.
- Use of CT control console: entering scan parameters and protocols.
- Study of CT phantoms for calibration and image quality testing.
- Demonstration of CT dose indices: CTDI, DLP (phantom-based).
- QA test for CT number accuracy and noise measurement.
- QA test for slice thickness and spatial resolution.
- QA test for uniformity and artifact evaluation.
- Contrast injector setup and safety checks (simulation).
- Demonstration of image reconstruction techniques.
- Recognition of common CT artifacts (motion, beam hardening, partial volume).

- Preventive maintenance and daily equipment checks.
- OSCE-style evaluation: equipment identification, phantom scanning, QA interpretation.

Suggested Readings

- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*
- *Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. Wolters Kluwer.*
- *Hsieh J. Computed Tomography: Principles, Design, Artifacts, and Recent Advances. SPIE Press.*
- *Goldman LW. Principles of CT: Multislice CT. Lippincott Williams & Wilkins.*
- *Bushong SC. Radiologic Science for Technologists. Elsevier.*

Course Title: Radiographic Positioning – II Practical	L	T	P	Cr.
Course Code: BIG308	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate standard radiographic positioning techniques for skull, spine, abdomen, pelvis, and contrast studies.
2. Identify anatomical landmarks required for accurate positioning.
3. Select and use appropriate exposure parameters for different projections.
4. Recognize and correct positioning errors in radiographs.
5. Apply patient care, safety, and communication skills during radiographic examinations.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to positioning lab: safety, infection control, and patient preparation.
- Positioning of skull – AP, lateral, Towne's, Caldwell, SMV.
- Positioning of facial bones, paranasal sinuses, nasal bones, orbits, and zygomatic arches.
- Radiography of mandible and temporomandibular joint (TMJ).
- Cervical spine: AP, lateral, oblique, and odontoid view.
- Thoracic spine: AP and lateral projections.
- Lumbar spine: AP, lateral, oblique, and spot views.
- Radiography of sacrum, coccyx, and sacroiliac joints.
- KUB (Kidneys, Ureters, Bladder) radiograph.
- Abdomen: supine, erect, and decubitus positions.
- Pelvis: AP pelvis and hip joint projections.
- Basic contrast study: barium swallow positioning.
- Barium meal and follow-through (simulation of patient preparation and positioning).
- Barium enema: positioning and patient instructions.

- Intravenous urography (IVU/IVP) – basic steps and positioning sequence.
- Hysterosalpingography (HSG) – overview and positioning demonstration.
- Identification of positioning errors and corrective measures through case-based images.
- OSCE-style evaluation: practical performance in positioning, exposure, and image assessment.

Suggested Readings

- *Ballinger PW, Frank ED. Merrill's Atlas of Radiographic Positions and Radiologic Procedures. Mosby Elsevier.*
- *Clark KC. Clark's Positioning in Radiography. CRC Press.*
- *Bontrager KL, Lampignano JP. Textbook of Radiographic Positioning and Related Anatomy. Elsevier.*
- *McQuillen Martensen K. Radiographic Image Analysis. Saunders.*
- *Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. Saunders.*

Course Title: Contrast Media & Special Procedures Practical	L	T	P	Cr.
Course Code: BIG309	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify different types of contrast media and their uses.
2. Demonstrate preparation, dilution, and safe handling of contrast agents.
3. Perform patient preparation steps for contrast-enhanced studies.
4. Demonstrate positioning and procedural steps in common contrast radiographic examinations.
5. Recognize adverse reactions to contrast media and perform basic emergency management (simulation).
6. Correlate contrast procedures with diagnostic outcomes in radiology practice.

Course Content

List of Practicals / Experiments (60 Hours):

- Introduction to contrast media: identification of barium, iodinated, and negative contrast agents.
- Reading and interpreting drug labels (composition, concentration, expiry).
- Preparation and dilution of iodinated contrast media.
- Demonstration of safe contrast injection techniques (simulation).
- Patient preparation for contrast procedures: consent, fasting, hydration.
- Contrast study of esophagus – barium swallow positioning.
- Contrast study of stomach and duodenum – barium meal.
- Small bowel follow-through demonstration.
- Barium enema: patient prep and positioning sequence.
- Intravenous urography (IVU/IVP): contrast preparation and positioning steps.

- Retrograde urography and micturating cystourethrogram (MCU) – procedure overview.
- Myelography: contrast use and positioning (simulation).
- Hysterosalpingography (HSG): patient prep and positioning sequence.
- CT and MRI contrast media demonstration (simulation of administration and monitoring).
- Management of contrast media reactions: anaphylaxis protocol and emergency drug tray.
- OSCE-style evaluation: contrast preparation, patient prep, positioning, and reaction management.

Suggested Readings

- *Grainger RG, Allison D. Grainger & Allison's Diagnostic Radiology. Churchill Livingstone.*
- *Bontrager KL, Lampignano JP. Textbook of Radiographic Positioning and Related Anatomy. Elsevier.*
- *Bushong SC. Radiologic Science for Technologists. Elsevier.*
- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*
- *Haaga JR, Dogra VS. CT and MRI of the Whole Body. Elsevier.*

Course Title: CT protocol Practical	L	T	P	Cr.
Course Code: BIG310	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate correct patient preparation and positioning for various CT protocols.
2. Select appropriate scan parameters (kVp, mAs, pitch, slice thickness, contrast timing) for different clinical indications.
3. Differentiate between non-contrast, contrast-enhanced, and specialized CT protocols.
4. Operate CT console for protocol selection and modification.
5. Apply radiation dose optimization strategies during CT scanning.
6. Correlate protocol choice with clinical conditions and diagnostic requirements.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to CT protocol lab and safety measures.
- Demonstration of patient preparation steps for CT (consent, fasting, hydration, IV access).
- Non-contrast CT brain protocol: trauma, stroke, hemorrhage.
- Contrast-enhanced CT brain: tumors, infections.
- CT PNS (sinus) protocol – patient positioning and scan planning.
- CT orbit protocol – positioning and parameter selection.
- CT neck protocol – lymphadenopathy and mass evaluation.
- CT chest: HRCT protocol for interstitial lung disease.
- CT chest with contrast – pulmonary embolism, tumor staging.
- CT abdomen (liver, pancreas, kidneys) – NCCT and CECT protocols.
- Triphasic CT liver protocol (arterial, portal venous, delayed phases).
- CT KUB/urography protocols.
- CT pelvis protocol – uterus, ovaries, prostate evaluation.

- CT angiography protocols – cerebral, thoracic, abdominal, peripheral vessels.
- Pediatric CT protocols with dose optimization.
- Demonstration of CT perfusion (simulation).
- Practice of CT dose monitoring: CTDI, DLP.
- OSCE-based evaluation: patient prep, protocol selection, and console operation.

Suggested Readings

- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Saunders.*
- *Haaga JR, Dogra VS. CT and MRI of the Whole Body. Elsevier.*
- *Kalra MK, Maher MM, Toth TL, et al. Radiation Dose Optimization in CT. Springer.*
- *Hsieh J. Computed Tomography: Principles, Design, Artifacts, and Recent Advances. SPIE Press.*
- *Brant WE, Helms CA. Fundamentals of Diagnostic Radiology. Wolters Kluwer.*

Course Title: Community Health & Primary Care	L	T	P	Cr
Course Code: BIG311	3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the concept of health, disease, and determinants of health in a community.
2. Describe the structure, organization, and functioning of health care delivery systems in India.
3. Apply the principles and strategies of primary health care in different community settings.
4. Identify common community health problems and explain methods of prevention and control.
5. Utilize health education and promotion techniques for improving community health.

Course Contents

UNIT I: Concepts of Health & Disease (15 Hours)

- Definition and dimensions of health.
- Natural history of disease, levels of prevention.
- Indicators of health and disease burden in India.
- Determinants of health: social, environmental, genetic, behavioral.
- Role of paramedical staff in community health services.

UNIT II: Primary Health Care & Health Delivery System (10 Hours)

- Principles of Primary Health Care (equity, community participation, intersectoral coordination, appropriate technology).
- Organization of health services in India: Sub-centre, PHC, CHC, District hospital.
- National Health Programs – overview (RNTCP/NTEP, RCH, NVBDCP, NRHM/NHM).
- Role of ASHA, ANM, and multipurpose health workers.

UNIT III: Community Health Problems & Control (10 Hours)

- Communicable diseases: TB, malaria, HIV/AIDS, diarrheal diseases, ARI.
- Non-communicable diseases: diabetes, hypertension, cancer, mental health.
- Maternal and child health: antenatal care, immunization, infant and young child feeding.
- Nutrition and related health problems (malnutrition, anemia, obesity).

UNIT IV: Health Promotion & Education (10 Hours)

- Health education: principles, methods, and tools.
- School health services and occupational health.
- Community participation and role of NGOs in health care.
- Record keeping, reporting, and use of health data for planning and evaluation.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer sessions

Suggested Readings

- *Park K. Park's Textbook of Preventive and Social Medicine. Bhanot Publishers.*
- *Mahajan BK, Gupta MC. Textbook of Preventive and Social Medicine. Jaypee Brothers.*
- *Kishore J. National Health Programs of India. Century Publications.*
- *Rao M. Principles of Community Medicine. Orient Blackswan.*
- *WHO. Primary Health Care: Alma Ata Declaration & Beyond. World Health Organization.*

Semester 4th

Course Title: Radiological Equipment – III (MRI)	L	T	P	Cr
Course Code: BIG401	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the principles, components, and functioning of MRI equipment.
2. Explain the role of magnets, gradients, and RF coils in MRI imaging.
3. Differentiate between various MRI sequences and imaging techniques.
4. Describe quality assurance, safety aspects, and maintenance of MRI systems.
5. Apply knowledge of MRI equipment to clinical imaging procedures.

Course Contents

UNIT – I: Fundamentals of MRI Equipment (10 Hours)

- Historical development of MRI.
- Basic principles: nuclear magnetic resonance (NMR).
- Types of magnets: permanent, resistive, and superconducting.
- Components of MRI system: magnet, gradient system, RF coils, computer system.
- Patient handling system.

UNIT – II: Image Formation and Sequences (10 Hours)

- Signal generation and acquisition.
- Pulse sequences: Spin Echo, Gradient Echo, Inversion Recovery, FLAIR, Diffusion, Perfusion.
- k-space concept.
- Parallel imaging and advanced techniques.
- Artifacts in MRI and their correction.

UNIT – III: MRI Safety & Quality Assurance (5 Hours)

- MRI safety: static magnetic field, gradient field, RF field.

- Biological effects and contraindications (implants, pacemakers, metallic foreign bodies).
- Safety zones and MRI compatible equipment.
- Quality assurance tests in MRI.

UNIT – IV: Advances & Applications (5 Hours)

- Functional MRI (fMRI).
- MR Spectroscopy (MRS).
- MR Angiography (MRA).
- Cardiac MRI, Whole-body MRI.
- Future trends: AI-assisted MRI, ultra-high field MRI.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Westbrook C, Roth CK. MRI in Practice. Wiley-Blackwell.*
- *Hashemi RH, Bradley WG, Lisanti CJ. MRI: The Basics. Lippincott Williams & Wilkins.*
- *Elster AD. Questions and Answers in MRI. www.mriquestions.com*
- *Edelman RR, Hesselink JR, Zlatkin MB. Clinical Magnetic Resonance Imaging. Elsevier.*
- *Bushong SC. Magnetic Resonance Imaging: Physical and Biological Principles. Mosby.*
- *Hornak JP. The Basics of MRI. Rochester Institute of Technology (Online resource).*

Course Title: Nuclear Medicine & PET Imaging	L	T	P	Cr
Course Code: BIG402	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles of nuclear medicine and PET imaging.
2. Describe the physics and instrumentation used in nuclear medicine.
3. Understand radiopharmaceuticals, their preparation, and applications.
4. Analyze clinical indications, protocols, and safety aspects in nuclear medicine.
5. Discuss the role of PET in oncology, neurology, and cardiology.

Course Contents

UNIT–I: Fundamentals of Nuclear Medicine (10 Hours)

- Introduction to nuclear medicine.
- Radioactivity: decay, half-life, types of radiation.
- Radionuclide production (reactor, cyclotron).
- Radiation detection and measurement.
- Basic instrumentation: gamma camera, SPECT.

UNIT–II: PET Imaging Principles and Instrumentation (10 Hours)

- Principles of positron emission tomography.
- Annihilation photons and coincidence detection.
- PET detectors and electronics.
- Hybrid imaging: PET/CT and PET/MRI.
- Image reconstruction and quality control.

UNIT–III: Radiopharmaceuticals (5 Hours)

- Types of radiopharmaceuticals (diagnostic and therapeutic).
- Radiopharmaceutical preparation and quality assurance.
- Commonly used tracers: FDG, technetium-99m, iodine-131, gallium-68.
- Pharmacokinetics and biodistribution.

UNIT–IV: Clinical Applications and Safety (5 Hours)

- Applications in oncology, neurology, cardiology, and infection imaging.
- Patient preparation and imaging protocols.
- Radiation safety, ALARA principles, and waste disposal.
- Future trends in nuclear medicine and PET imaging.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer

Suggested Readings

- *Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine. 4th ed. Elsevier; 2012.*
- *Bailey DL, Townsend DW, Valk PE, Maisey MN. Positron Emission Tomography: Basic Sciences. Springer; 2005.*
- *Khan FM. The Physics of Radiation Therapy. 5th ed. Wolters Kluwer; 2014.*
- *Kowalsky RJ, Falen SW. Radiopharmaceuticals in Nuclear Pharmacy and Nuclear Medicine. 3rd ed. American Pharmacists Association; 2011.*
- *Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging. 7th ed. Elsevier; 2019.*

Course Title: Radiobiology & Radiation Protection	L	T	P	Cr
Course Code: BIG403	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the biological effects of ionizing radiation at cellular, tissue, and systemic levels.
2. Explain concepts of radiation dose, dose–response relationships, and radiosensitivity.
3. Apply principles of radiation protection for patients, personnel, and the public.
4. Describe international and national guidelines for radiation safety.
5. Demonstrate knowledge of radiation monitoring, shielding, and ALARA principles in clinical practice.

Course Contents

UNIT – I: Fundamentals of Radiobiology (10 Hours)

- Interaction of ionizing radiation with matter.
- Direct and indirect effects of radiation.
- Radiation damage at molecular and cellular levels (DNA damage, chromosomal aberrations).
- Cell survival curves, target theory.
- Radiosensitivity of different tissues and organs.

UNIT – II: Radiation Effects and Dose Response (10 Hours)

- Acute radiation syndrome.
- Somatic and genetic effects of radiation.
- Stochastic and deterministic effects.
- Radiation carcinogenesis and teratogenesis.
- Dose–response relationships.
- Factors influencing biological response (dose, dose rate, LET, RBE, oxygen effect).

UNIT – III: Principles of Radiation Protection (5 Hours)

- Justification, optimization, and dose limitation.

- ALARA (As Low As Reasonably Achievable).
- Patient protection strategies.
- Personnel protection: time, distance, shielding.
- Radiation monitoring devices (TLD, film badge, pocket dosimeter).

UNIT – IV: Radiation Safety Standards and Regulations (5 Hours)

- International organizations: ICRP, IAEA, NCRP, UNSCEAR.
- National regulatory bodies: AERB guidelines (India context).
- Shielding design for diagnostic radiology facilities.
- Safe handling of radiation equipment.
- Radiation emergencies and preparedness.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Hall EJ, Giaccia AJ. Radiobiology for the Radiologist. Lippincott Williams & Wilkins.*
- *Podgorsak EB. Radiation Physics for Medical Physicists. Springer.*
- *Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. Lippincott Williams & Wilkins.*
- *Khan FM, Gibbons JP. The Physics of Radiation Therapy. Wolters Kluwer.*
- *AERB Safety Code (latest edition). Atomic Energy Regulatory Board, Government of India.*
- *ICRP Publications (International Commission on Radiological Protection).*

Course Title: Radiographic Positioning – III	L	T	P	Cr
Course Code: BIG404	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate knowledge of advanced radiographic positioning techniques.
2. Identify standard projections for skull, facial bones, paranasal sinuses, and special radiographic procedures.
3. Apply correct positioning methods to obtain diagnostic images with minimal errors.
4. Correlate anatomical structures with radiographic appearances.
5. Follow radiation protection principles during advanced positioning.

Course Contents

UNIT–I: Skull Radiography (10 Hours)

- Radiographic anatomy of the skull.
- Positioning techniques: PA, AP, Lateral, Caldwell view, Towne's view, Submentovertical (SMV) view.
- Indications and common errors in skull radiography.

UNIT–II: Facial Bones & Paranasal Sinuses (10 Hours)

- Radiographic anatomy of facial bones.
- Positioning for nasal bones, zygomatic arches, orbits, and mandible.
- Radiographic projections for paranasal sinuses: Waters' view, Caldwell's view, Lateral view, SMV.
- Clinical indications and diagnostic value.

UNIT–III: Special Radiographic Procedures (5 Hours)

- Temporomandibular joint (TMJ) projections.
- Mastoid radiography.
- Radiographic evaluation of cranial base.
- Contrast studies related to head and neck (overview).

UNIT–IV: Positioning Principles & Error Correction (5 Hours)

- Common positioning errors and corrective measures.

- Image evaluation criteria.
- Patient preparation, immobilization techniques.
- Radiation protection and safety guidelines.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer

Suggested Readings

- *Bontrager KL, Lampignano JP. Textbook of Radiographic Positioning and Related Anatomy. 9th ed. Elsevier; 2020.*
- *Ballinger PW, Frank ED. Merrill's Atlas of Radiographic Positions and Radiologic Procedures. 14th ed. Mosby; 2018.*
- *Stewart C, Molyneux R. Radiographic Positioning Guide. Churchill Livingstone; 2016.*
- *Long BW, Rollins JH, Smith BJ. Merrill's Atlas Workbook of Radiographic Positioning. 14th ed. Elsevier; 2018.*
- *Clark's Positioning in Radiography. 13th ed. CRC Press; 2015.*

Course Title: MRI Protocol	L	T	P	Cr
Course Code: BIG405	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the principles and sequence parameters underlying MRI protocols.
2. Select appropriate MRI protocols for different anatomical regions and clinical indications.
3. Optimize imaging parameters for better diagnostic quality while ensuring patient safety.
4. Identify artifacts and adapt protocols to minimize them.
5. Apply knowledge of MRI protocols in neurological, musculoskeletal, cardiovascular, and abdominal imaging.

Course Contents

UNIT – I: Basics of MRI Protocols (10 Hours)

- Introduction to MRI protocols.
- Pulse sequence selection and optimization (Spin Echo, Gradient Echo, Inversion Recovery).
- Sequence parameters: TR, TE, flip angle, slice thickness, matrix size, FOV.
- Patient preparation and positioning for MRI studies.

UNIT – II: Neuro and Spine Protocols (10 Hours)

- Brain MRI: routine and advanced (T1, T2, FLAIR, DWI, Perfusion, MR Spectroscopy, fMRI).
- Pituitary and orbits imaging protocols.
- Spine MRI protocols: cervical, thoracic, lumbar spine.
- MR angiography protocols (circle of Willis, carotid, venous).

UNIT – III: Body Imaging Protocols (5 Hours)

- Thoracic MRI (lung, mediastinum, cardiac MRI).
- Abdominal MRI (liver, pancreas, kidneys).
- Pelvic MRI (prostate, uterus, ovaries).

- MRCP protocol for hepatobiliary imaging.

UNIT – IV: Musculoskeletal and Advanced Protocols (5 Hours)

- Joint imaging (knee, shoulder, hip).
- Whole-body MRI.
- Contrast-enhanced MRI protocols.
- Pediatric MRI protocols.
- Recent advances: diffusion tensor imaging, 3D imaging, ultra-fast sequences.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Westbrook C, Roth CK. MRI in Practice. Wiley-Blackwell.*
- *Hashemi RH, Bradley WG, Lisanti CJ. MRI: The Basics. Lippincott Williams & Wilkins.*
- *Edelman RR, Hesselink JR, Zlatkin MB, Crues JV. Clinical Magnetic Resonance Imaging. Elsevier.*
- *Shellock FG. Reference Manual for Magnetic Resonance Safety, Implants, and Devices. Biomedical Research Publishing Group.*
- *Kanal E, Barkovich AJ, Bell C. ACR Guidance Document on MR Safe Practices. American College of Radiology.*
- *Elster AD. Questions and Answers in MRI. www.mriquestions.com*

Course Title: Quality Control in Radiology	L	T	P	Cr.
Course Code: BIG406	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles of quality assurance (QA) and quality control (QC) in radiology.
2. Identify QC tests for radiographic, fluoroscopic, CT, MRI, and mammography equipment.
3. Perform basic QC procedures and interpret results.
4. Recognize image quality parameters and their clinical significance.
5. Apply radiation safety measures in QC practices.
6. Appreciate the role of regulatory guidelines in maintaining standards of radiology services.

Course Contents

UNIT–I: Introduction to Quality Assurance & Quality Control (10 Hours)

- Concepts of quality assurance (QA) and quality control (QC).
- Importance of QC in diagnostic radiology.
- International and national standards (AAPM, AERB, ICRP, NCRP).
- Components of a quality assurance program.
- Record keeping and documentation.

UNIT–II: Quality Control in X-ray & Fluoroscopy (10 Hours)

- QC tests for X-ray equipment:
  - Tube output consistency, kVp accuracy, timer accuracy, HVL measurement.
  - Collimation, alignment, and focal spot size tests.
- QC in fluoroscopy: image quality checks, exposure rate, resolution, contrast, and field size.
- Phantom studies in X-ray/fluoroscopy QC.

UNIT–III: QC in Advanced Imaging Modalities (5 Hours)

- CT: alignment, slice thickness, CT number accuracy, noise and uniformity, dose index.

- MRI: geometric accuracy, spatial resolution, image uniformity, slice positioning.
- Mammography: ACR guidelines, contrast-detail phantom testing, detector uniformity.

UNIT–IV: QC in Image Quality & Radiation Safety (5 Hours)

- Parameters affecting image quality: contrast, resolution, noise, artifacts.
- Radiation protection aspects in QC testing.
- Acceptance testing, preventive maintenance, and corrective actions.
- Role of radiology technologists in quality control programs.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer

Suggested Readings

- Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. 4th ed. Wolters Kluwer; 2021.
- Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. 4th ed. Elsevier; 2016.
- AAPM Report No. 74. Quality Control in Diagnostic Radiology. American Association of Physicists in Medicine; 2002.
- AERB Safety Code No. AERB/RF-MED/SC-2. Regulations for Radiological Installations. Atomic Energy Regulatory Board, India.
- Huda W, Slone RM. Review of Radiologic Physics. 5th ed. Wolters Kluwer; 2017.

Course Title: Radiological Equipment – III (MRI) Practical	L	T	P	Cr.
Course Code: BIG407	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate knowledge of MRI system components and their functions.
2. Operate MRI console for patient data entry and protocol selection.
3. Perform patient positioning techniques for different anatomical regions.
4. Acquire MRI images using standard and advanced pulse sequences.
5. Identify common image artifacts and perform corrective adjustments.
6. Apply quality assurance and safety protocols in MRI practice.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to MRI equipment and room setup.
- Identification and function of magnet, gradient coils, RF coils, patient table.
- MRI console operations: patient data entry, sequence selection, protocol setup.
- Patient preparation and MRI safety screening.
- Positioning for Brain MRI (routine protocol).
- Positioning for Spine MRI (cervical, thoracic, lumbar).
- Positioning for Knee and Shoulder MRI.
- Performing T1-weighted and T2-weighted imaging.
- Performing FLAIR and STIR sequences.
- Diffusion-weighted imaging (DWI) and ADC mapping.
- Gradient Echo imaging and susceptibility sequences.
- Contrast-enhanced MRI protocols (simulation and practice).
- MR angiography protocol demonstration.
- MRCP protocol practice.

- Identification and correction of common MRI artifacts (motion, aliasing, susceptibility).
- Introduction to advanced protocols: fMRI, MR spectroscopy, whole-body MRI.
- Quality assurance tests in MRI (SNR, geometric accuracy, slice thickness, resolution checks).
- Demonstration of MRI-compatible equipment and accessories.
- Safety procedures during MRI scan (quench procedures, emergency handling).
- Case-based discussions on protocol optimization.

Suggested Readings

- *Westbrook C, Roth CK. MRI in Practice. Wiley-Blackwell.*
- *Hashemi RH, Bradley WG, Lisanti CJ. MRI: The Basics. Lippincott Williams & Wilkins.*
- *Elster AD. Questions and Answers in MRI. www.mriquestions.com*
- *Bushong SC. Magnetic Resonance Imaging: Physical and Biological Principles. Mosby.*
- *Kanal E, Barkovich AJ. ACR Guidance Document on MR Safe Practices. American College of Radiology.*

Course Title: Nuclear Medicine & PET Imaging Practical	L	T	P	Cr.
Course Code: BIG408	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate the basic handling and safety procedures for radionuclides.
2. Perform quality control tests on nuclear medicine instrumentation (gamma camera, PET/CT).
3. Prepare and administer radiopharmaceuticals under supervision.
4. Acquire and process nuclear medicine and PET images.
5. Evaluate image quality and identify common artifacts.
6. Apply radiation protection measures during nuclear medicine procedures.

Course Content

List of Practicals / Experiments (60 Hours):

- Familiarization with nuclear medicine department layout and workflow.
- Safety precautions and use of radiation survey meters.
- Preparation, labeling, and quality control of radiopharmaceuticals (Tc-99m, I-131, FDG).
- Demonstration of radionuclide calibrator and dose calibration.
- Quality control of gamma camera (uniformity, resolution, linearity, sensitivity).
- SPECT acquisition and reconstruction techniques.
- PET/CT scanner orientation: detectors, gantry, and patient positioning.
- FDG-PET patient preparation and uptake protocols.
- Acquisition of PET/CT images in oncology.
- Image reconstruction and processing in PET/CT.
- Identification and analysis of artifacts in nuclear medicine and PET imaging.

- Radiation waste management and disposal procedures.
- Documentation and record-keeping in nuclear medicine QC.
- Case-based practicals: oncology, neurology, and cardiology applications.

Suggested Readings

- *Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine. 4th ed. Elsevier; 2012.*
- *Kowalsky RJ, Falen SW. Radiopharmaceuticals in Nuclear Pharmacy and Nuclear Medicine. 3rd ed. American Pharmacists Association; 2011.*
- *Bailey DL, Townsend DW, Valk PE, Maisey MN. Positron Emission Tomography: Basic Sciences. Springer; 2005.*
- *Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging. 7th ed. Elsevier; 2019.*
- *IAEA. Quality Assurance for PET and Cyclotron Systems. IAEA Human Health Series; 2014.*

Course Title: Radiobiology & Radiation Protection Practical	L	T	P	Cr.
Course Code: BIG409	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate practical knowledge of radiation detection and measurement techniques.
2. Operate radiation monitoring devices (TLDs, film badges, survey meters).
3. Carry out quality assurance and safety checks in diagnostic radiology setups.
4. Apply ALARA principles for patient and staff protection in simulated clinical environments.
5. Understand emergency preparedness and radiation accident management procedures.

Course Content

List of Practicals / Experiments (60 Hours):

- Introduction to radiation detection equipment and their working principles.
- Demonstration of ionization chamber and its calibration.
- Measurement of radiation dose using a Geiger-Müller counter.
- Measurement of background radiation levels in laboratory and clinical settings.
- Study of exposure rate at varying distances (inverse square law demonstration).
- Use of thermoluminescent dosimeters (TLDs) for personnel monitoring.
- Use of film badge dosimeter for cumulative dose assessment.
- Pocket dosimeter handling and interpretation.
- Measurement of scatter radiation around X-ray equipment.
- Shielding evaluation of protective barriers (lead aprons, lead glass, walls).

- Quality control tests on X-ray equipment related to radiation safety.
- Study of radiation protection devices: lead aprons, thyroid shields, gonadal shields.
- Demonstration of controlled and supervised areas in diagnostic radiology.
- Emergency procedures in case of radiation accidents and spills (simulation).
- Familiarization with AERB/NCRP safety guidelines.
- Preparation of radiation safety reports/logbooks.
- Visit to hospital radiology department to observe radiation monitoring practices.
- Case-based discussion on radiation-induced hazards and protection strategies.
- Demonstration of patient protection measures (collimation, filtration, proper exposure factors).
- Simulation exercise: applying ALARA principles in clinical scenarios.

Suggested Readings

- *Hall EJ, Giaccia AJ. Radiobiology for the Radiologist. Lippincott Williams & Wilkins.*
- *Podgorsak EB. Radiation Physics for Medical Physicists. Springer.*
- *Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. Lippincott Williams & Wilkins.*
- *Khan FM, Gibbons JP. The Physics of Radiation Therapy. Wolters Kluwer.*
- *AERB Safety Codes and Regulatory Documents (latest edition).*
- *ICRP Publications on Radiation Protection.*

Course Title: Radiographic Positioning – III Practical	L	T	P	Cr.
Course Code: BIG410	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate correct patient positioning for radiographic examinations of the skull, facial bones, and paranasal sinuses.
2. Perform specialized projections such as SMV, Caldwell, Waters, Towne's, and lateral views.
3. Apply positioning techniques for temporomandibular joint (TMJ), mastoid, and cranial base studies.
4. Evaluate radiographs for positioning accuracy and diagnostic quality.
5. Minimize positioning errors and ensure patient safety with radiation protection measures.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to positioning aids, immobilization devices, and radiation safety in skull radiography.
- Positioning for skull – PA and AP views.
- Positioning for skull – Lateral view.
- Positioning for skull – Caldwell's view (PA axial).
- Positioning for skull – Towne's view (AP axial).
- Positioning for skull – Submentovertical (SMV) view.
- Positioning for facial bones – Parietoacanthial (Waters') view.
- Positioning for facial bones – Caldwell's and Lateral views.
- Positioning for nasal bones – Lateral and Waters' views.
- Positioning for zygomatic arches – SMV and Tangential views.
- Positioning for orbits – Caldwell's and Waters' views.
- Positioning for mandible – PA, oblique, and Towne's views.
- Positioning for paranasal sinuses – Waters', Caldwell's, Lateral, and SMV views.

- Positioning for temporomandibular joints (TMJ) – Open and closed mouth projections.
- Positioning for mastoid radiography.
- Identification and correction of common positioning errors in skull and facial radiography.
- Radiographic critique and evaluation sessions for diagnostic acceptability.

Suggested Readings

- *Bontrager KL, Lampignano JP. Textbook of Radiographic Positioning and Related Anatomy. 9th ed. Elsevier; 2020.*
- *Ballinger PW, Frank ED. Merrill's Atlas of Radiographic Positions and Radiologic Procedures. 14th ed. Mosby; 2018.*
- *Long BW, Rollins JH, Smith BJ. Merrill's Atlas Workbook of Radiographic Positioning. 14th ed. Elsevier; 2018.*
- *Clark's Positioning in Radiography. 13th ed. CRC Press; 2015.*
- *Stewart C, Molyneux R. Radiographic Positioning Guide. Churchill Livingstone; 2016.*

Course Title: MRI Protocol Practical	L	T	P	Cr
Course Code: BIG411	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate patient preparation and positioning for MRI examinations.
2. Perform MRI protocols for different anatomical regions.
3. Select and optimize MRI pulse sequences for diagnostic purposes.
4. Recognize and correct common MRI artifacts during image acquisition.
5. Apply MRI safety protocols in simulated and clinical scenarios.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to MRI console and protocol library.
- Patient preparation and MRI safety screening before scanning.
- Standard Brain MRI protocol (T1, T2, FLAIR, DWI).
- Advanced Brain MRI protocol (Perfusion, MR Spectroscopy, fMRI demonstration).
- MRI protocol for Orbits and Pituitary gland.
- MRI protocol for Cervical spine.
- MRI protocol for Thoracic and Lumbar spine.
- MRI protocol for Knee joint (routine sequences).
- MRI protocol for Shoulder joint.
- MRI protocol for Hip joint.
- Thoracic MRI protocol (heart and mediastinum).
- Cardiac MRI (cine imaging, black-blood, contrast-enhanced).
- Abdominal MRI protocol (liver, pancreas, kidneys).
- MRCP protocol for hepatobiliary system.
- Pelvic MRI protocol (uterus, ovaries, prostate).
- Whole-body MRI protocol.
- MR Angiography protocol (circle of Willis, carotids, abdominal aorta).
- Demonstration of Pediatric MRI protocol adjustments.

- Study of protocol modifications to reduce artifacts (motion, aliasing, susceptibility).
- Case-based discussion: protocol optimization for clinical scenarios.

Suggested Readings

- *Westbrook C, Roth CK. MRI in Practice. Wiley-Blackwell.*
- *Hashemi RH, Bradley WG, Lisanti CJ. MRI: The Basics. Lippincott Williams & Wilkins.*
- *Edelman RR, Hesselink JR, Zlatkin MB, Crues JV. Clinical Magnetic Resonance Imaging. Elsevier.*
- *Shellock FG. Reference Manual for Magnetic Resonance Safety, Implants, and Devices. Biomedical Research Publishing.*
- *Elster AD. Questions and Answers in MRI. www.mriquestions.com*

Course Title: Quality Control in Radiology Practical	L	T	P	Cr
Course Code: BIG412	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Perform basic quality control (QC) tests on diagnostic radiology equipment.
2. Assess the performance of X-ray, fluoroscopy, CT, MRI, and mammography systems using standard QC protocols.
3. Demonstrate the use of phantoms and dosimetric equipment for QC testing.
4. Interpret QC test results and identify deviations from standard values.
5. Apply corrective measures and recommend preventive maintenance.
6. Maintain records and documentation as per QA/QC guidelines.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to QC in diagnostic radiology: safety and regulatory requirements.
- Familiarization with dosimetry equipment: ionization chambers, TLDs, survey meters.
- Tube output constancy test for X-ray machines.
- Measurement of kVp accuracy and reproducibility.
- Timer accuracy and exposure reproducibility tests.
- Half Value Layer (HVL) measurement for beam quality assessment.
- Collimator and beam alignment test.
- Focal spot size evaluation (pinhole camera, star pattern, slit camera methods).
- Linearity of mA/mAs output test.
- QC tests for fluoroscopy: exposure rate, field size, resolution, and image quality.

- QC in CT: CT number accuracy, uniformity, slice thickness, noise, and low-contrast resolution.
- CT Dose Index (CTDI) and phantom-based QC studies.
- QC in MRI: geometric accuracy, spatial resolution, slice position accuracy, signal-to-noise ratio, and image uniformity.
- QC in mammography: phantom imaging, ACR guidelines, detector uniformity, contrast-detail evaluation.
- Image quality evaluation and artifact analysis across modalities.
- Radiation protection surveys and leakage radiation checks.
- Preparation of QC logbooks, documentation, and reporting.

Suggested Readings

- *Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. 4th ed. Wolters Kluwer; 2021.*
- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. 4th ed. Elsevier; 2016.*
- *AAPM Report No. 74. Quality Control in Diagnostic Radiology. American Association of Physicists in Medicine; 2002.*
- *Huda W, Slone RM. Review of Radiologic Physics. 5th ed. Wolters Kluwer; 2017.*
- *AERB Safety Code. Regulations for Radiological Installations. Atomic Energy Regulatory Board, India.*

Semester 5th

Course Title: Advanced Imaging Techniques	L	T	P	Cr
Course Code: BIG501	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles and applications of advanced imaging modalities.
2. Differentiate the advantages and limitations of advanced diagnostic techniques.
3. Interpret imaging findings in specialized investigations.
4. Correlate clinical conditions with appropriate advanced imaging methods.
5. Discuss recent advances and future trends in diagnostic imaging.

Course Contents

UNIT–I (10 Hours)

- Advanced CT Imaging Techniques: HRCT, Dual Energy CT, Perfusion CT.
- Applications in neuroimaging, cardiac imaging, and oncology.

UNIT–II (10 Hours)

- Advanced MRI Techniques: Functional MRI (fMRI), Diffusion Weighted Imaging (DWI), Diffusion Tensor Imaging (DTI), MR Spectroscopy, MR Angiography.
- Applications in brain mapping, musculoskeletal imaging, and tumor characterization.

UNIT–III (5 Hours)

- Hybrid Imaging Techniques: PET-CT, PET-MRI, SPECT-CT.
- Role in oncology, cardiology, and neurology.

UNIT–IV (5 Hours)

- Interventional Imaging Techniques: Image-guided biopsies, ablations, and vascular interventions.

- Recent advances: Artificial Intelligence (AI) in medical imaging, 3D/4D imaging, and radiomics.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Grainger & Allison's Diagnostic Radiology. 7th Edition. Elsevier.*
- *Haaga JR, Dogra VS, Forsting M, et al. CT and MRI of the Whole Body. 6th Edition. Elsevier.*
- *Weissleder R, Pittet MJ. Molecular Imaging: Principles and Practice. People's Medical Publishing House.*
- *Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging. 7th Edition. Elsevier.*
- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. 4th Edition. Elsevier.*
- *Brant WE, Helms CA. Fundamentals of Diagnostic Radiology. 5th Edition. Lippincott Williams & Wilkins.*
- *Recent review articles from journals such as Radiology, European Radiology, and American Journal of Roentgenology (AJR).*

Course Title: Interventional Radiology	L	T	P	Cr
Course Code: BIG502	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles, techniques, and instrumentation used in interventional radiology.
2. Identify indications, contraindications, and complications of common interventional procedures.
3. Differentiate between diagnostic and therapeutic interventions.
4. Correlate clinical conditions with appropriate interventional techniques.
5. Discuss recent advances and ethical considerations in interventional radiology.

Course Contents

UNIT–I (10 Hours)

- Introduction to Interventional Radiology: Definition, scope, and history.
- Imaging guidance methods: Fluoroscopy, CT, Ultrasound, and MRI.
- Basics of vascular access, catheters, guidewires, and contrast agents.

UNIT–II (10 Hours)

- Vascular Interventions:
  - Angiography techniques.
  - Angioplasty and stent placement.
  - Embolization procedures (tumor, GI bleeding, aneurysms).
  - Thrombolysis and thrombectomy.

UNIT–III (5 Hours)

- Non-vascular Interventions:
  - Biopsies (liver, lung, kidney).
  - Drainage procedures (abscess, biliary, pleural).
  - Percutaneous nephrostomy.
  - Gastrostomy and other enteral access procedures.

UNIT–IV (5 Hours)

- Recent advances: Radiofrequency ablation, microwave ablation, cryoablation.
- Role of Artificial Intelligence (AI), robotics, and hybrid operating suites.
- Patient safety, radiation protection, and ethical considerations in interventional practice.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Kandarpa K, Machan L, Durham JD, et al. Handbook of Interventional Radiologic Procedures. 5th Edition. Wolters Kluwer.*
- *Valji K. The Practice of Interventional Radiology with Online Cases. 2nd Edition. Elsevier.*
- *Vogl TJ, Reimer P, Mohammed H. Textbook of Clinical Interventional Radiology. Thieme.*
- *Baert AL, Reekers JA, editors. Interventional Radiology. Springer.*
- *Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging. 7th Edition. Elsevier (for hybrid and molecular interventions).*
- *Recent review articles from journals such as CardioVascular and Interventional Radiology (CVIR), Journal of Vascular and Interventional Radiology (JVIR), and Radiology.*

Course Title: Ultrasound Technology & Doppler	L	T	P	Cr
Course Code: BIG503	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the basic physics and principles of ultrasound imaging.
2. Describe the instrumentation and operation of ultrasound machines.
3. Interpret normal and pathological findings in common ultrasound examinations.
4. Understand the principles and applications of Doppler ultrasound in vascular and cardiac studies.
5. Discuss safety, artifacts, and recent advances in ultrasound technology.

Course Contents

UNIT–I (10 Hours)

- Basics of ultrasound physics: Sound waves, frequency, wavelength, acoustic impedance.
- Interaction of ultrasound with tissues: reflection, refraction, attenuation, absorption, scattering.
- Modes of ultrasound imaging: A-mode, B-mode, M-mode.

UNIT–II (10 Hours)

- Ultrasound equipment: Transducers, beam formation, image display, resolution.
- Artifacts in ultrasound imaging: reverberation, shadowing, enhancement, mirror image.
- Safety and bioeffects of ultrasound.

UNIT–III (5 Hours)

- Doppler ultrasound principles: Continuous wave, pulsed wave, color Doppler, power Doppler.
- Applications in vascular imaging: carotid, peripheral arteries, venous system.
- Hemodynamic assessment using Doppler.

UNIT–IV (5 Hours)

- Clinical applications: abdominal, obstetric, gynecological, musculoskeletal, and cardiac ultrasound.
- Recent advances: elastography, contrast-enhanced ultrasound, 3D/4D ultrasound.
- Emerging trends and role of AI in ultrasound interpretation.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Rumack CM, Levine D, Charboneau JW. Diagnostic Ultrasound. 5th Edition. Elsevier.*
- *Hedrick WR, Hykes DL, Starchman DE. Ultrasound Physics and Instrumentation. 5th Edition. Elsevier.*
- *Curry TS, Dowdey JE, Murry RC. Christensen's Physics of Diagnostic Radiology. 4th Edition. Lippincott Williams & Wilkins.*
- *Allan PL, Baxter GM, Weston MJ. Clinical Ultrasound. 3rd Edition. Churchill Livingstone.*
- *Zwiebel WJ, Pellerito JS. Introduction to Vascular Ultrasonography. 6th Edition. Elsevier.*
- *Recent review articles from Ultrasound in Medicine and Biology, Journal of Ultrasound in Medicine (JUM), and European Journal of Ultrasound.*

Course Title: PACS & Digital Imaging Systems	L	T	P	Cr
Course Code: BIG504	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the principles and components of PACS (Picture Archiving and Communication System).
2. Describe digital imaging concepts, image acquisition, storage, and retrieval.
3. Understand standards such as DICOM and HL7 for medical image communication.
4. Evaluate workflow integration of PACS with HIS/RIS in a healthcare environment.
5. Discuss current trends, cybersecurity, and future directions in digital imaging systems.

Course Contents

UNIT–I (10 Hours)

- Introduction to digital imaging: Analog vs. digital systems.
- Fundamentals of digital image acquisition (CR, DR, CT, MRI, Ultrasound).
- Image quality parameters: resolution, contrast, noise, dynamic range.

UNIT–II (10 Hours)

- PACS architecture: hardware and software components.
- Workflow of PACS: image acquisition, storage, retrieval, display, and distribution.
- Integration with Hospital Information System (HIS) and Radiology Information System (RIS).

UNIT–III (5 Hours)

- Standards and protocols: DICOM, HL7, IHE.
- Image compression: lossless vs. lossy.
- Teleradiology and cloud-based PACS solutions.

UNIT–IV (5 Hours)

- Quality assurance and troubleshooting in PACS.
- Data security, backup, and disaster recovery.
- Recent advances: Artificial Intelligence in PACS, enterprise imaging, mobile device integration.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Huang HK. PACS and Imaging Informatics: Basic Principles and Applications. 2nd Edition. Wiley-Blackwell.*
- *Reiner B, Siegel E, Carrino JA. PACS: A Guide to the Digital Revolution. Springer.*
- *DICOM Standards Committee. Digital Imaging and Communications in Medicine (DICOM) Standard. NEMA.*
- *Dreyer KJ, Mehta A, Thrall JH. PACS: Basic Principles and Applications. Springer.*
- *Branstetter BF. Practical Imaging Informatics: Foundations and Applications for PACS Professionals. Springer.*
- *Articles from Journal of Digital Imaging (JDI) and Radiology.*

Course Title: Medical Ethics & Legal Issues	L	T	P	Cr
Course Code: BIG505	3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the fundamental principles of medical ethics and their application in healthcare practice.
2. Analyze ethical dilemmas and apply ethical decision-making models.
3. Explain the legal framework governing medical practice in India and internationally.
4. Recognize patient rights, responsibilities, and the importance of informed consent.
5. Discuss medico-legal issues in radiology and imaging practice.
6. Appreciate the role of professional conduct, accountability, and confidentiality in healthcare delivery.

Course Contents

UNIT–I (15 Hours)

- Introduction to Medical Ethics: Definition, scope, and importance.
- Principles of biomedical ethics: autonomy, beneficence, non-maleficence, and justice.
- Professional codes of conduct (Indian Medical Council, WHO).
- Ethical issues in patient–doctor relationship, truth-telling, and confidentiality.

UNIT–II (10 Hours)

- Informed consent and patient rights.
- Ethical issues in clinical trials and research.
- Ethical dilemmas in end-of-life care, organ donation, and reproductive medicine.
- Ethics in emerging technologies (genetics, AI in healthcare, telemedicine).

UNIT–III (10 Hours)

- Introduction to Medical Law: Sources, scope, and importance.
- Legal aspects in healthcare delivery: negligence, malpractice, and liability.
- Consumer Protection Act and its implications in healthcare.
- Laws relating to medical records, documentation, and reporting.

UNIT–IV (10 Hours)

- Medico-legal issues in Radiology and Imaging:
  - Radiation safety and patient protection.
  - PCPNDT Act (Pre-Conception and Pre-Natal Diagnostic Techniques Act).
  - Legal implications of medical errors in imaging.
- Role of courts, tribunals, and regulatory bodies in healthcare.
- Recent case studies and judicial decisions in medical law.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Beauchamp TL, Childress JF. Principles of Biomedical Ethics. 8th Edition. Oxford University Press.*
- *Rao NG. Medical Ethics and Law. Jaypee Brothers Medical Publishers.*
- *Singh JP. Law and Medicine. Jaypee Brothers Medical Publishers.*
- *Hope T, Savulescu J, Hendrick J. Medical Ethics and Law: The Core Curriculum. 4th Edition. Churchill Livingstone.*
- *Srivastava AK. Medical Law and Ethics. CBS Publishers.*
- Articles from Indian Journal of Medical Ethics and Journal of Medical Ethics.

Course Title: Research Methodology & Biostatistics	L	T	P	Cr
Course Code: BIG506	2	0	0	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the fundamentals of research methodology and its application in health sciences.
2. Identify research problems, formulate objectives, and design appropriate study methods.
3. Apply principles of sampling, data collection, and data management.
4. Perform basic statistical analyses and interpret results correctly.
5. Critically evaluate scientific literature and prepare research proposals.
6. Appreciate ethical considerations in conducting and publishing research.

Course Contents

UNIT–I (10 Hours)

- Introduction to research: Definition, need, and significance in healthcare.
- Types of research: Qualitative, quantitative, mixed methods.
- Research process: Identifying problems, formulating hypotheses, objectives, and variables.
- Literature review and referencing styles.

UNIT–II (10 Hours)

- Research design: Descriptive, analytical, experimental, observational, cross-sectional, case-control, cohort studies.
- Sampling methods: Probability and non-probability techniques, sample size determination.
- Data collection tools: Questionnaires, interviews, observations, records.
- Reliability and validity of research instruments.

UNIT–III (5 Hours)

- Biostatistics: Introduction and scope in health sciences.
- Data presentation: Tables, charts, and graphs.
- Measures of central tendency (mean, median, mode).
- Measures of variability (range, variance, standard deviation).

UNIT–IV (5 Hours)

- Basic inferential statistics: t-test, chi-square test, correlation, regression (concepts only).
- Introduction to statistical software (SPSS, R, MS Excel).
- Research ethics: Plagiarism, informed consent, authorship, and publication ethics.
- Writing a research proposal and report.

Transaction Modes: Video-based teaching, Collaborative teaching, Case-based teaching, Question–Answer discussions

Suggested Readings

- *Kothari CR. Research Methodology: Methods and Techniques. 4th Edition. New Age International.*
- *Gupta SC, Kapoor VK. Fundamentals of Applied Statistics. Sultan Chand & Sons.*
- *Dawson B, Trapp RG. Basic & Clinical Biostatistics. 5th Edition. McGraw Hill.*
- *Polit DF, Beck CT. Nursing Research: Generating and Assessing Evidence for Nursing Practice. 11th Edition. Wolters Kluwer.*
- *Banerjee A, Chaudhury S. Statistics without Tears: Populations and Samples. Indian Psychiatry Journal.*
- *Recent review articles from Indian Journal of Medical Research and International Journal of Health Sciences.*

Course Title: Advanced Imaging Techniques Practical	L	T	P	Cr.
Course Code: BIG507	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Perform advanced imaging procedures using CT, MRI, and other emerging modalities.
2. Apply image post-processing techniques (MPR, MIP, 3D rendering, fusion imaging).
3. Demonstrate patient positioning and preparation for specialized imaging techniques.
4. Analyze advanced imaging protocols for clinical applications.
5. Understand quality assurance and safety measures in advanced imaging practices.

Course Content

List of Practicals / Experiments (60 Hours):

- Patient positioning for advanced CT examinations (Brain, Chest, Abdomen).
- High-resolution CT (HRCT) technique for lungs.
- CT Angiography protocols – cerebral and peripheral vascular studies.
- Contrast-enhanced CT: patient preparation and administration techniques.
- MRI brain protocols – T1, T2, FLAIR, DWI.
- MRI musculoskeletal imaging: knee and shoulder positioning.
- Functional MRI (fMRI) – principles and demonstration.
- MR Angiography – contrast and non-contrast techniques.
- Diffusion and perfusion MRI – practical application.
- Basics of MR spectroscopy demonstration.
- PET-CT demonstration – patient prep and image acquisition workflow.
- Image post-processing: multiplanar reconstruction (MPR).
- Image post-processing: maximum intensity projection (MIP).
- Image post-processing: 3D volume rendering.

- Fusion imaging (PET/CT, SPECT/CT) – interpretation basics.
- Quality control checks for advanced imaging equipment.
- Radiation safety protocols in CT, PET-CT, and MRI.

Suggested Readings

- *Bushong SC. Magnetic Resonance Imaging: Physical and Biological Principles. Mosby.*
- *Haaga JR, Dogra VS, Forsting M, Gilkeson RC, Ha HK, Sundaram M. CT and MRI of the Whole Body. Elsevier.*
- *Westbrook C, Roth CK. MRI in Practice. Wiley-Blackwell.*
- *Elster AD. Questions & Answers in Magnetic Resonance Imaging. Mosby.*
- *Valk PE, Bailey DL, Townsend DW, Maisey MN. Positron Emission Tomography: Basic Sciences. Springer.*
- *Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Elsevier.*
- *Brant WE, Helms CA. Fundamentals of Diagnostic Radiology. Lippincott Williams & Wilkins.*

Course Title: Interventional Radiology Practical	L	T	P	Cr.
Course Code: BIG508	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate knowledge of aseptic techniques, patient preparation, and monitoring in interventional radiology procedures.
2. Perform and assist in basic image-guided diagnostic and therapeutic procedures.
3. Handle and operate interventional radiology equipment under supervision.
4. Recognize potential complications and apply basic emergency management skills.
5. Maintain documentation and ensure radiation safety protocols during procedures.

Course Content

List of Practicals / Experiments (60 Hours):

- Familiarization with interventional radiology suite and equipment.
- Practice of sterile techniques, gowning, and draping.
- Preparation of contrast media and catheters.
- Patient preparation, positioning, and monitoring in IR procedures.
- Introduction to vascular access techniques (simulation-based practice).
- Image-guided biopsy procedures (demonstration/assisting).
- Drainage procedures: abscess, pleural, and biliary (demonstration/assisting).
- Angiography: technique demonstration and assisting.
- Embolization procedures: principles and assisting role.
- Percutaneous nephrostomy and ureteric stenting.
- Central venous catheter placement and PICC line procedures.
- Management of complications in interventional radiology.
- Radiation protection measures specific to IR suite.

- Documentation and reporting in IR practice.

Suggested Readings

- *Valji K. The Practice of Interventional Radiology, with Online Cases and Video. 2nd ed. Elsevier; 2022.*
- *Kandarpa K, Machan L. Handbook of Interventional Radiologic Procedures. 5th ed. Wolters Kluwer; 2020.*
- *Haskal ZJ, Martin LG. Interventional Radiology: A Survival Guide. 5th ed. Elsevier; 2021.*
- *Kessel D, Robertson I. Interventional Radiology: A Practical Guide. 3rd ed. CRC Press; 2016.*
- *Chaurasia BD. Practical Guide to Interventional Radiology. Jaypee Brothers; latest edition.*

Course Title: Ultrasound Technology & Doppler Practical	L	T	P	Cr.
Course Code: BIG509	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Operate ultrasound equipment and apply basic sonographic techniques.
2. Perform patient positioning and scanning in routine ultrasound examinations.
3. Acquire and interpret normal sonographic appearances of abdominal, pelvic, and obstetric regions.
4. Demonstrate use of color, power, and spectral Doppler in vascular studies.
5. Apply safety standards and quality control measures in ultrasound imaging.

Course Content

List of Practicals / Experiments (60 Hours):

- Orientation to ultrasound machine – controls, probes, and image optimization.
- Patient preparation and positioning for sonographic examinations.
- Scanning techniques for liver, gallbladder, pancreas, spleen, and kidneys.
- Sonography of urinary bladder and prostate.
- Pelvic ultrasound: uterus, ovaries, adnexa.
- First trimester obstetric ultrasound – fetal pole, gestational sac, CRL measurement.
- Second trimester ultrasound – fetal biometry and anomaly screening basics.
- Third trimester ultrasound – growth parameters, AFI, placenta, Doppler assessment.
- Vascular ultrasound – carotid artery Doppler.
- Lower limb venous Doppler – DVT evaluation.

- Upper limb venous Doppler demonstration.
- Peripheral arterial Doppler – lower extremity arterial system.
- Renal artery Doppler – resistive index measurement.
- Portal venous system Doppler demonstration.
- Color Doppler in obstetric ultrasound – umbilical artery, MCA.
- Basics of echocardiography – 2D and Doppler demonstration.
- Quality assurance and safety in ultrasound & Doppler imaging.

Suggested Readings

- *Rumack CM, Levine D, Charboneau JW. Diagnostic Ultrasound. Elsevier.*
- *Curry RA, Tempkin BB. Sonography: Introduction to Normal Structure and Function. Elsevier.*
- *McDicken WN. Diagnostic Ultrasonics: Principles and Use of Instruments. Churchill Livingstone.*
- *Allan PL, Baxter GM, Weston MJ. Clinical Ultrasound. Elsevier.*
- *Baert AL, Knauth M, Sartor K. Ultrasound in Clinical Practice. Springer.*
- *Hagen-Ansert SL. Textbook of Diagnostic Sonography. Mosby.*
- *Kremkau FW. Diagnostic Ultrasound: Principles and Instruments. Elsevier.*

Course Title: PACS & Digital Imaging Systems Practical	L	T	P	Cr.
Course Code: BIG510	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate understanding of PACS (Picture Archiving and Communication System) architecture and workflow.
2. Operate PACS software for image acquisition, storage, retrieval, and distribution.
3. Apply DICOM standards for image handling and interoperability.
4. Perform quality checks on digital imaging systems.
5. Manage basic troubleshooting in PACS and RIS integration.
6. Maintain data security, confidentiality, and compliance in digital imaging.

Course Content

List of Practicals / Experiments (60 Hours):

- Introduction to PACS workstation and user interface.
- Configuration and navigation of PACS modules.
- Image acquisition and transfer using DICOM standards.
- Retrieval and display of digital images from PACS.
- Practice in image annotation, measurement, and reporting tools.
- Workflow demonstration: Modality → PACS → Radiologist → Clinician.
- Integration of RIS (Radiology Information System) with PACS.
- Demonstration of teleradiology system and remote reporting.
- Hands-on practice in query/retrieve and image routing.
- Data backup, archiving, and retrieval processes.
- Role of HIS (Hospital Information System) in digital imaging integration.
- Digital image compression (lossy vs. lossless) and file management.
- Quality assurance in PACS and digital radiography systems.
- Troubleshooting common errors in PACS.

- Demonstration of security protocols (access control, encryption, HIPAA compliance).

Suggested Readings

- *Huang HK. PACS and Imaging Informatics: Basic Principles and Applications. 2nd ed. Wiley-Blackwell; 2011.*
- *Ratib O, Rosset A. From PACS to Cloud: Medical Imaging Informatics. Springer; 2016.*
- *Reiner BI, Siegel EL, Carrino JA. Workflow and Productivity in Radiology. Springer; 2010.*
- *Dreyer KJ, Mehta A, Thrall JH. PACS: A Guide to the Digital Revolution. Springer; 2nd ed. 2013.*
- *Oosterwijk H. DICOM Basics. OTech; latest edition.*

Course Title: Research Methodology & Biostatistics Practical	L	T	P	Cr.
Course Code: BIG511	0	0	4	2

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Formulate research problems, objectives, and hypotheses.
2. Design research studies and select appropriate sampling techniques.
3. Collect, organize, and summarize data using statistical tools.
4. Apply descriptive and inferential statistics using manual and software-based methods.
5. Interpret statistical results in the context of biomedical and health sciences.
6. Prepare research reports, abstracts, and presentations following scientific guidelines.

Course Content

List of Practicals / Experiments (60 Hours):

- Introduction to research methodology: Identifying a research problem.
- Writing objectives, research questions, and hypotheses.
- Preparation of a research proposal outline.
- Types of study designs – observational vs. experimental (case study examples).
- Sampling techniques: simple random, stratified, cluster (demonstrations).
- Designing a data collection tool (questionnaire/interview schedule).
- Data entry and management using MS Excel/SPSS/R.
- Descriptive statistics: calculation of mean, median, mode, standard deviation.
- Graphical representation of data – bar charts, histograms, pie charts.

- Probability distributions: normal curve and its applications in health sciences.
- Hypothesis testing – t-test (independent and paired).
- Chi-square test application in categorical data.
- Analysis of variance (ANOVA) with practical dataset.
- Correlation and regression analysis with biomedical examples.
- Critical appraisal of a published research article.
- Writing an abstract and short research report.
- Introduction to referencing styles (Vancouver/APA) using software (Mendeley/Zotero).
- Ethical issues in research: plagiarism check and informed consent.

Suggested Readings

- *Mahajan BK, Gupta MC. Textbook of Preventive and Social Medicine. Jaypee Brothers; latest edition.*
- *Rao PSS, Richard J. Introduction to Biostatistics and Research Methods. PHI Learning; latest edition.*
- *Pandey P, Pandey MM. Research Methodology: Tools and Techniques. Bridge Center; 2015.*
- *Kothari CR, Garg G. Research Methodology: Methods and Techniques. New Age International; 2019.*
- *Dawson B, Trapp RG. Basic & Clinical Biostatistics. 5th ed. McGraw-Hill; 2017.*
- *Suresh KP, Chandrashekara S. Sample Size Estimation and Power Analysis in Research. IJRMHS; 2012.*
- *WHO. Ethical Issues in Public Health Surveillance. Geneva: WHO Press; 2017.*

Semester 6th

Course Title: Internship	L	T	P	Cr
Course Code: BIG601	0	0	40	20

Total Hours 600

Learning Outcomes: After Completion of this course, the learner will be able to:

1. Demonstrate proficiency in patient preparation, positioning, and assistance during various imaging procedures.
2. Apply principles of radiation protection and safety protocols for patients, staff, and self.
3. Operate and handle imaging equipment (X-ray, CT, MRI, ultrasound) under professional supervision.
4. Maintain accurate records, images, and reports while following medico-legal and ethical standards.
5. Integrate theoretical knowledge of imaging technology with practical clinical training to function as a competent imaging technologist.

Course Contents

List of Practical's / Experiments: 600 Hours

The internship in Imaging Technology is designed to provide students with real-time clinical exposure in diagnostic radiology departments of hospitals, medical colleges, and imaging centers. During the training, students will work under the supervision of radiologists and radiology technologists to gain practical skills in performing and assisting with imaging procedures such as X-rays, CT scans, MRI, ultrasonography, and mammography. They will learn patient preparation, positioning, radiation safety protocols, contrast administration, and post-procedure care. Emphasis will also be placed on equipment handling, quality assurance, image acquisition, and documentation of reports. Students will rotate across different imaging modalities to ensure multidisciplinary exposure and will also participate in community health screening programs and radiological safety awareness activities. Each student is required to maintain a logbook, prepare case

records, and submit a comprehensive internship report summarizing their clinical learning experience.