



SEMESTER – I

PAPER CODE	SUBJECT NAME	THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PRACTICAL MARKS
DXET101	ANATOMY & PHYSIOLOGY	45 Min	1 Hrs.	50	50
DXET102	BASICS OF PHYSICS FOR RADIOLOGY	45 Min	1 Hrs.	50	50
DXET103	BIOCHEMISTRY & PATHOLOGY	45 Min	1 Hrs.	50	50
DXET104	PATIENT CARE & SAFETY	45 Min	1 Hrs.	50	50

ANATOMY & PHYSIOLOGY

THEORY

1. Introduction

- Definition & scope of Anatomy and Physiology
- Levels of structural organization: cells → tissues → organs → systems
- Anatomical positions, planes, directions, body regions

2. Cell Biology

- Structure & function of cell
- Cell organelles: nucleus, mitochondria, ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes
- Cell division: mitosis & meiosis

3. Tissues

- Epithelial tissue
- Connective tissue (bone, cartilage, blood)
- Muscular tissue (skeletal, smooth, cardiac)
- Nervous tissue

4. Skeletal System

- Classification of bones



- Structure of bone & bone growth
- Names & location of major bones: Skull, Vertebral column, Ribs, Sternum, Pelvis, Limbs
- Joints: types & movements
- Clinical correlation: fractures, dislocations, orthopedic imaging

5. Muscular System

- Types of muscles
- Structure of skeletal muscle
- Physiology of muscle contraction
- Important muscles of chest, abdomen, limbs
- Clinical correlation: muscular injuries, cardiac muscle in ECG

6. Circulatory System (Cardiovascular System)

- Structure of heart: chambers, valves, major vessels
- Blood circulation: systemic & pulmonary
- Cardiac cycle & heart sounds
- Blood pressure, pulse
- Conduction system of heart (SA node, AV node, Bundle of His, Purkinje fibers)
- ECG waves: P wave, QRS complex, T wave – relation with cardiac physiology

7. Blood & Lymph

- Composition & functions of blood
- Blood groups & Rh factor
- Hemoglobin, clotting mechanism
- Lymphatic system: organs & circulation

8. Respiratory System

- Anatomy: nose, pharynx, larynx, trachea, bronchi, lungs
- Physiology: mechanics of breathing, gas exchange, transport of oxygen & CO₂
- Clinical correlation: chest X-rays in pneumonia, TB, asthma

9. Digestive System

- Anatomy: alimentary canal & accessory organs (liver, pancreas, gall bladder)
- Physiology: digestion & absorption
- Clinical correlation: abdominal imaging, barium studies

10. Nervous System

- Central nervous system: brain (cerebrum, cerebellum, brainstem), spinal cord
- Peripheral nervous system: cranial & spinal nerves
- Autonomic nervous system: sympathetic & parasympathetic functions



- Clinical correlation: stroke, seizures, positioning of patients with neurological issues

11. Urinary System

- Kidneys, ureters, bladder, urethra – structure & functions
- Physiology of urine formation
- Clinical correlation: IVP (Intravenous Pyelography), renal imaging

12. Reproductive System

- Male & Female reproductive organs
- Physiology: spermatogenesis, oogenesis, menstrual cycle
- Clinical correlation: precautions for female patients (pregnancy & radiation exposure)

13. Endocrine System

- Major glands: Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal, Gonads
- Hormones & their functions
- Clinical correlation: diabetes (affecting ECG), thyroid disorders

14. Special Senses

- Eye: structure & functions
- Ear: structure & functions
- Nose, tongue & skin receptors
- Clinical correlation: patient communication, visual/hearing defects

PRACTICAL

➤ General Orientation

- Demonstration of anatomical positions, body planes & directional terms
- Identification of body regions (head, thorax, abdomen, limbs)
- Surface landmarks for ECG lead placement and X-ray positioning

➤ Skeletal System

- Identification of major bones using skeleton models: Skull, Vertebrae, Ribs, Sternum, Pelvis, Upper & Lower Limbs
- Demonstration of types of joints with models/charts
- Clinical correlation: Demonstration of X-ray films of fractures & dislocations

➤ Muscular System

- Identification of important muscles (thoracic, abdominal, limb muscles) using charts/models



- Demonstration of cardiac muscle (microscopic slide/chart)
- Clinical correlation: Role of muscles in patient positioning for X-ray
- **Circulatory System**
 - Demonstration of external & internal structure of heart (model/chart)
 - Identification of chambers, valves, major vessels
 - Demonstration of blood circulation pathway (systemic & pulmonary)
 - Practical relevance: Location of heart for chest X-rays, ECG electrode placement
- **Blood & Lymph**
 - Demonstration of blood smear under microscope (RBC, WBC, Platelets)
 - Demonstration of lymphatic organs using charts/models
 - Clinical correlation: Importance of blood groups & Rh factor (for emergency cases)
- **Respiratory System**
 - Identification of respiratory organs in models/charts
 - Demonstration of lung lobes & tracheobronchial tree
 - Clinical correlation: Chest X-rays in TB, pneumonia, asthma cases
- **Digestive System**
 - Identification of organs in models/charts: Stomach, Intestines, Liver, Pancreas
 - Demonstration of accessory glands (salivary, pancreas, gall bladder)
 - Clinical correlation: Abdominal X-ray/Barium study films
- **Nervous System**
 - Demonstration of brain parts (cerebrum, cerebellum, brainstem)
 - Demonstration of spinal cord in model/chart
 - Clinical correlation: Effect of neurological conditions on ECG/positioning
- **Urinary System**
 - Identification of kidney, ureter, bladder in models/charts
 - Demonstration of nephron structure using diagrams
 - Clinical correlation: X-rays & IVP (Intravenous Pyelography)
- **Reproductive System**
 - Demonstration of male & female reproductive organs in models/charts
 - Clinical correlation: Importance of radiation safety in female patients
- **Endocrine System**



- Identification of endocrine glands in charts/models (Pituitary, Thyroid, Pancreas, Adrenal, Gonads)
- Clinical correlation: ECG changes in diabetes & thyroid disorders

➤ **Special Senses**

- Demonstration of Eye & Ear anatomy in models/charts
- Identification of tongue (taste areas) and skin receptors
- Clinical correlation: Patient care during radiology/ECG procedures

➤ **Correlation with Radiology & ECG**

- Demonstration of ECG electrode placement on human body (practical exercise)
- Correlation of X-ray films with skeletal & organ anatomy
- Case study demonstration: Normal vs abnormal ECG tracings with cardiac physiology

BASICS OF PHYSICS FOR RADIOLOGY

THEORY

1. Introduction to Physics in Radiology

- Scope & importance of physics in medical radiology
- Role of physics in X-ray production & ECG equipment
- Units & measurements: length, mass, time, volume, density, velocity, acceleration

2. Matter & Energy

- States of matter (solid, liquid, gas, plasma)
- Mass, weight, density & specific gravity
- Energy: definition, forms (mechanical, chemical, electrical, thermal, nuclear, radiant)
- Law of conservation of energy (applied in X-ray production)

3. Heat & Thermodynamics

- Temperature, heat, specific heat, latent heat
- Methods of heat transfer: conduction, convection, radiation
- Application in X-ray tubes (heat production & dissipation in anode)

4. Sound & Waves

- Nature & properties of sound waves
- Frequency, wavelength, amplitude, velocity



- Ultrasound basics (though detailed study is in higher courses)
- Application: Doppler ECG sounds, echocardiography basics

5. Light & Optics

- Nature of light (wave & particle theory)
- Reflection, refraction, lenses & mirrors
- Image formation principles (basis of radiographic images)
- Filters & grids in radiology
- Application: use of lenses in radiographic photography, collimators

6. Magnetism & Electromagnetism

- Magnetic field, magnetic flux, electromagnets
- Electromagnetic induction: Faraday's law, Lenz's law
- Transformers (step-up & step-down) – importance in X-ray machines
- Application in ECG: galvanometers & magnetic fields in recording devices

7. Electricity & Electronics

- Electric charge, current, voltage, resistance (Ohm's law)
- Series & parallel circuits
- AC & DC current
- Capacitors, resistors, inductors (basic role in radiology equipment)
- Rectifiers & diodes (conversion of AC to DC in X-ray units)
- ECG machine basics: electrical signal amplification, filters, grounding

8. Atomic Structure

- Structure of atom (protons, neutrons, electrons)
- Atomic number, mass number, isotopes
- Electron orbits & energy levels
- Ionization & excitation

9. X-Ray Physics

- Discovery of X-rays (Roentgen's contribution)
- Nature & properties of X-rays
- Production of X-rays in X-ray tube (cathode, anode, high-voltage supply)
- Types of X-rays: soft & hard X-rays
- Factors affecting X-ray quality & quantity: kVp, mA, exposure time, distance
- Filtration & collimation

10. Radiation Physics & Interaction with Matter

- Types of radiation: alpha, beta, gamma, X-rays



- Radiation units: Roentgen, Rad, Gray, Sievert, Becquerel
- Interaction of X-rays with matter: photoelectric effect, Compton scattering, pair production
- Attenuation of X-rays (basis of image contrast)

11. Radiation Protection & Safety Basics

- Biological effects of radiation (somatic & genetic)
- Time, distance & shielding principle
- Personal protective devices: lead apron, thyroid collar, lead glass
- Dosimeters & film badges
- ALARA principle (As Low As Reasonably Achievable)

12. Imaging & Recording Physics

- Fluorescence & phosphorescence (basis of intensifying screens)
- Image formation in radiography
- Darkroom physics: safe light, intensifying screen, developer & fixer
- Digital imaging basics (CR, DR)
- ECG paper, graph recording & signal tracing basics

PRACTICAL

➤ Units & Measurements

- Demonstration of measuring instruments (vernier caliper, screw gauge, measuring scales)
- Verification of density & specific gravity of solids/liquids
- Application: Helps understand body density differences in radiology images

➤ Mechanics

- Demonstration of laws of motion using simple apparatus
- Study of force, work, power using weights & pulleys
- Application: Patient positioning & movement in X-ray table/mechanisms

➤ Heat & Thermodynamics

- Demonstration of heat transfer: conduction, convection, radiation
- Measurement of temperature using different thermometers
- Application: Heat production in X-ray tube anode & cooling systems

➤ Sound & Waves

- Demonstration of wave properties: frequency, wavelength, amplitude (using tuning fork/oscilloscope)
- Study of resonance & vibration



- Application: Understanding principles of echocardiography & ultrasound basics

➤ **Light & Optics**

- Experiment on reflection & refraction of light using glass slab/lenses
- Demonstration of image formation with convex & concave lenses
- Study of prism & dispersion of light
- Application: Radiographic image formation, collimators, darkroom safelight

➤ **Electricity**

- Verification of **Ohm's law** using resistors
- Study of series & parallel circuits (bulbs/resistors)
- Demonstration of AC vs DC supply
- Application: Power supply in X-ray & ECG machines

➤ **Magnetism & Electromagnetism**

- Demonstration of magnetic field using iron filings & bar magnet
- Study of electromagnet & solenoid
- Demonstration of transformer action (step-up & step-down model)
- Application: Transformers in X-ray machine high-voltage supply

➤ **Electronics (Basic)**

- Demonstration of rectification (half-wave & full-wave rectifier)
- Study of capacitors & their role in circuits
- Application: Rectification & smoothing in X-ray machines and ECG circuits

➤ **Atomic Physics**

- Demonstration of atomic models using charts/models
- Identification of isotopes & their medical uses (demo charts)
- Application: Understanding ionization, radiation origin

➤ **X-Ray Tube & Imaging Physics**

- Demonstration of X-ray tube parts (cathode, anode, filament, target) using model
- Study of factors affecting X-ray production (kVp, mA, exposure time – demo with equipment/films)
- Observation of X-ray films with different exposures (effect of distance, filtration, collimation)

➤ **Radiation Safety**

- Demonstration of lead apron, thyroid shield, lead glass
- Use of dosimeter/film badge (demo only)



- Application: Radiation protection in clinical practice
- **ECG Physics Correlation**
- Demonstration of ECG machine basic circuit (input → amplifier → output graph)
- Demonstration of ECG electrode placement on human subject/dummy
- Study of ECG graph recording

BIOCHEMISTRY & PATHOLOGY

THEORY

Section A – Biochemistry

1. Introduction

- Definition, scope, importance of Biochemistry in medical diagnostics
- Role of biochemistry in radiology & cardiology

2. Biomolecules

- **Carbohydrates:** classification, examples (glucose, glycogen, starch), role in energy
- **Proteins:** amino acids, protein structure & functions, plasma proteins
- **Lipids:** fats, phospholipids, cholesterol, triglycerides – role in cardiovascular health
- **Nucleic acids:** DNA & RNA basics

3. Enzymes

- Definition, properties, classification
- Factors affecting enzyme action (temperature, pH)
- Clinical importance of enzymes in diagnostics (SGPT, SGOT, CK-MB, LDH, Amylase, Lipase)

4. Metabolism

- Carbohydrate metabolism: glycolysis, glycogen, diabetes relevance
- Protein metabolism: nitrogen balance, urea cycle
- Lipid metabolism: role in atherosclerosis, obesity, heart disease
- Clinical correlation: biochemical changes in heart attack (cardiac enzymes)

5. Clinical Biochemistry

- Blood glucose, urea, creatinine, cholesterol, uric acid – diagnostic significance
- Cardiac markers: Troponin, CK-MB, LDH
- Liver function tests (LFT) basics
- Kidney function tests (KFT) basics
- Electrolytes: sodium, potassium, chloride, calcium – relevance in ECG interpretation



Section B – Pathology

1. Introduction

- Definition, scope, importance of pathology for technicians
- Causes of disease (etiology), pathogenesis, lesions

2. Cell Injury & Adaptation

- Reversible & irreversible cell injury
- Necrosis & apoptosis
- Atrophy, hypertrophy, hyperplasia, metaplasia

3. Inflammation & Healing

- Acute & chronic inflammation
- Signs of inflammation (redness, swelling, heat, pain, loss of function)
- Healing & repair, wound healing stages

4. Hematology

- Normal blood composition & values
- Anemia (types, causes, relevance in X-ray/ECG patients)
- Leukemia & other blood disorders
- Coagulation disorders

5. Cardiovascular Pathology

- Atherosclerosis, ischemic heart disease, myocardial infarction
- Hypertension & its effects
- Heart failure, arrhythmias
- Clinical correlation: ECG changes in MI, LVH, arrhythmias

6. Respiratory Pathology

- Pneumonia, tuberculosis, bronchitis, asthma, COPD
- Lung cancer basics
- Clinical correlation: chest X-ray findings in TB, pneumonia, cancer

7. Gastrointestinal & Hepatobiliary Pathology

- Gastritis, peptic ulcer, liver cirrhosis, hepatitis, gallstones
- Clinical correlation: radiology in liver/gall bladder imaging

8. Renal Pathology

- Glomerulonephritis, nephrotic syndrome, renal failure



- Kidney & urinary tract stones
- Clinical correlation: IVP, KUB X-ray, ultrasound

9. Endocrine Pathology

- Diabetes mellitus (type I & II)
- Thyroid disorders (goiter, hyper/hypothyroidism)
- Clinical correlation: ECG changes in diabetes & thyroid disease

10. Musculoskeletal Pathology

- Osteoporosis, bone fractures, arthritis, bone tumors
- Clinical correlation: X-ray changes in bone diseases

11. Neoplasia (Tumors)

- Benign vs malignant tumors
- Common cancers (lung, breast, bone)
- Clinical correlation: radiological detection of tumors

PRACTICAL

A. Biochemistry Practicals

- **Laboratory Orientation**
 - Familiarization with laboratory glassware & instruments (pipettes, centrifuge, colorimeter, spectrophotometer).
 - Demonstration of lab safety precautions.
- **Blood Investigations**
 - Demonstration of blood collection techniques & anticoagulants.
 - Estimation of **hemoglobin** (demo).
 - Estimation of **blood glucose** (using glucometer/biochemical method).
 - Demonstration of **serum cholesterol & triglycerides**.
 - Observation of **renal function tests** (blood urea, creatinine).
 - Demonstration of **liver function tests** (bilirubin, SGPT, SGOT).
- **Urine Investigations**
 - Physical examination of urine (color, appearance, specific gravity).
 - Chemical tests for:
 - Glucose (Benedict's test)
 - Protein (heat & acetic acid test)
 - Ketone bodies (Rothera's test)
 - Bile salts & pigments
- **Enzymes & Cardiac Markers**
 - Demonstration of enzyme activity (effect of pH & temperature).
 - Observation of clinical test reports: CK-MB, LDH, Troponin.
 - Clinical correlation: ECG changes in myocardial infarction with elevated cardiac markers.



B. Pathology Practicals

- **Basic Hematology**
 - Preparation & staining of peripheral blood smear.
 - Identification of **RBC, WBC, Platelets** under microscope.
 - Observation of abnormal smears: anemia, leukemia (demo slides).
 - Estimation of **ESR (Erythrocyte Sedimentation Rate)**.
 - Demonstration of **Packed Cell Volume (PCV)**.
- **Clinical Pathology**
 - Demonstration of routine urine analysis (microscopy for pus cells, casts, crystals).
 - Observation of stool sample (demo slides for ova & cysts).
- **Histopathology (Demonstration Only)**
 - Handling of biopsy specimens.
 - Demonstration of fixation, processing & stained tissue slides.
 - Observation of prepared slides: liver cirrhosis, tuberculosis, cancer tissue.
- **Systemic Pathology Correlation**
 - Demonstration of X-ray films in:
 - **Respiratory system:** TB, pneumonia, lung cancer
 - **Skeletal system:** fracture, osteoporosis, bone tumors
 - Observation of ECG tracings in:
 - Myocardial infarction
 - Arrhythmias
 - Electrolyte imbalance

PATIENT CARE & SAFETY

THEORY

1. Introduction to Patient Care

- Principles of patient-centered care
- Duties & responsibilities of X-Ray & ECG Technicians
- Professional ethics & communication skills
- Patient rights & consent (informed & written consent)

2. Patient Handling & Positioning

- Methods of safe patient transfer (from wheelchair/bed to X-ray/ECG table)
- Positioning of patients for:
 - **X-ray examinations** (chest, abdomen, limbs, skull, spine)
 - **ECG recordings** (supine, sitting, bedridden patients)
- Care of **critically ill, pediatric, elderly, disabled & pregnant patients**
- Comfort measures (pillows, immobilization devices, draping)



3. Patient Preparation

- General preparation before X-ray/ECG procedures
- Special instructions:
 - Fasting, bowel preparation (for abdominal X-ray)
 - Removal of metal objects, jewelry, ECG electrode site preparation (skin cleaning, shaving if required)
- Psychological preparation & reassurance of anxious patients

4. Patient Safety

- General hospital safety rules
- Fall prevention & safe movement
- Prevention of hospital-acquired infections (universal precautions, hand hygiene, PPE use)
- Handling of contaminated material, biomedical waste disposal
- First aid in emergencies: fainting, seizures, cardiac arrest, trauma

5. Radiation Safety in X-Ray Technology

- Hazards of radiation exposure (short-term & long-term effects)
- Radiation protection principles:
 - ALARA (As Low As Reasonably Achievable) principle
 - Time, distance & shielding
- Protective devices: lead aprons, thyroid shields, gonadal shields
- Radiation monitoring devices: film badges, TLDs
- Safe use of X-ray equipment & periodic quality checks

6. Safety in ECG Technology

- Safe use of ECG machines & electrodes
- Electrical safety & prevention of shocks
- Skin preparation for proper electrode contact
- Infection control while using ECG electrodes/leads
- Care of bedridden & unconscious patients during ECG recording

7. Emergency Care in Radiology & ECG

- Recognition of common emergencies during X-ray/ECG:
 - Breathlessness, chest pain, fainting, cardiac arrest, allergic reaction to contrast media
- Basic Life Support (BLS) & CPR demonstration
- Use of crash cart & emergency drugs (introductory level)
- Immediate communication with doctors & nursing staff



8. Ethical & Legal Aspects

- Patient confidentiality & medical records maintenance
- Ethical handling of sensitive cases (trauma, medico-legal cases, pregnancy scans)
- Legal responsibilities in radiation & ECG practices
- Importance of patient identity verification before procedures

9. Communication & Soft Skills

- Effective communication with patients, attendants, and healthcare team
- Techniques to reduce patient anxiety & fear
- Dealing with uncooperative or pediatric patients
- Professionalism, empathy & cultural sensitivity

PRACTICAL

➤ Patient Handling & Positioning

1. Demonstration & practice of **safe patient transfer techniques** (from wheelchair, stretcher, and bed).
2. Practice of **body mechanics** for lifting, turning, and supporting patients.
3. Positioning of patients for common **X-ray examinations** (chest, abdomen, limbs, skull, spine).
4. Demonstration of **ECG electrode placement** on normal and bedridden patients.
5. Immobilization techniques for pediatric and uncooperative patients.

➤ Patient Preparation

6. Demonstration of patient preparation for:
 - X-ray abdomen (bowel prep, fasting)
 - Chest X-ray (removal of metal/jewelry)
 - ECG (skin cleaning, electrode site prep).
7. Practice of psychological reassurance & communication with patients before procedures.

➤ Infection Control & Safety

8. Demonstration of **hand hygiene techniques** (hand washing & sanitization).
9. Use of **PPE**: gloves, masks, aprons, shoe covers, lead aprons.
10. Demonstration of **biomedical waste disposal** (segregation in color-coded bins).
11. Cleaning & disinfection of ECG electrodes and X-ray table after use.

➤ Radiation & Electrical Safety

12. Demonstration of **radiation safety devices**: lead apron, thyroid shield, gonadal shield.



13. Familiarization with **radiation monitoring devices** (film badge, TLD badge).
14. Demonstration of **safe use of ECG machine** (checking leads, avoiding electrical hazards).
15. Practice of proper **cable management** to prevent tripping/fall accidents.

➤ **Emergency Care**

16. Demonstration of **Basic Life Support (BLS)** – CPR on mannequins.
17. First aid practice for fainting, seizures, chest pain.
18. Simulation of **handling a trauma patient** during emergency X-ray.
19. Demonstration of oxygen mask application & patient positioning in breathlessness.
20. Familiarization with **crash cart** & basic emergency drugs (introductory level).

➤ **Communication & Record-Keeping**

21. Role-play exercises for effective **communication with patients & attendants**.
22. Practice of **patient identity verification** before procedures.
23. Maintaining **patient procedure records & consent forms**.