SEMESTER – IV

PAPER CODE	SUBJECT NAME	THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PRACTICAL MARKS
DXET401	ECG INTERPRETATION	45 Min	1 Hrs.	50	50
DXET402	ADVANCED RADIOLOGY PROCEDURE	45 Min	1 Hrs.	50	50
DXET403	ADVANCED RADIATION PROTECTION & QUALITY CONTROL	45 Min	1 Hrs.	50	50
DXET404	RADIOGRAPHIC TECHNIQUES AND DIAGNOSTIC	45 Min	1 Hrs.	50	50

ECG INTERPRETATION

THEORY

1. Introduction to ECG Interpretation

- Importance of ECG in diagnosis and patient management.
- Difference between ECG recording and interpretation.
- Understanding ECG paper: time, voltage, calibration.
- Review of normal cardiac cycle and conduction system relevant to ECG.

2. Normal ECG

- Components of ECG waveforms: P wave, PR interval, QRS complex, ST segment, T wave, QT interval.
- Normal durations and amplitudes:
  - P wave: 0.08–0.12 sec
  - PR interval: 0.12–0.20 sec
  - QRS complex: 0.06–0.10 sec
  - QT interval: 0.36–0.44 sec
- Normal ECG patterns for adult, pediatric, and geriatric patients.

3. Heart Rate and Rhythm Analysis

- Methods of heart rate calculation from ECG:
  - Small box method, large box method, 6-second method.
- Assessment of rhythm:
  - Regular vs irregular rhythms.
  - Sinus rhythm, sinus arrhythmia, sinus tachycardia, sinus bradycardia.

4. Abnormalities of P Wave and PR Interval

- Atrial enlargement: right and left atrial abnormalities.
- AV conduction abnormalities:
  - First-degree AV block
  - Second-degree AV block (Mobitz I & II)
  - Third-degree AV block
- Pre-excitation syndromes: WPW syndrome (overview).

5. QRS Complex Abnormalities

- Ventricular conduction defects: bundle branch blocks (right & left).
- Ventricular hypertrophy: right and left.
- Ventricular ectopics: premature ventricular contractions (PVCs).

6. ST Segment and T Wave Changes

- Myocardial ischemia and infarction patterns:
  - ST elevation, ST depression
  - T wave inversion, hyperacute T waves
- Pericarditis and other ST/T abnormalities (introductory).

70 Arrhythmias

- Atrial arrhythmias: atrial fibrillation, atrial flutter.
- Supraventricular tachycardia.
- Ventricular arrhythmias: ventricular tachycardia, ventricular fibrillation.
- Recognition of pacemaker rhythms.

8. Miscellaneous ECG Findings

- Electrolyte disturbances: hyperkalemia, hypokalemia (basic patterns).
- Drug effects on ECG (digitalis, antiarrhythmics – overview).
- Artifacts and technical errors affecting ECG interpretation.

9. Clinical Correlation

- Linking ECG changes to patient symptoms and clinical history.
- Identifying **emergency ECG findings** requiring immediate physician attention.
- Awareness of limitations: DXET technician's role is **non-diagnostic but supportive**.

PRACTICAL

- **ECG Equipment Familiarization**

1. Identification of ECG machine components relevant to interpretation.
2. Checking calibration and paper speed: standard 25 mm/sec, 10 mm/mV.

3. Demonstration of ECG printout handling and storage.

➢ **Normal ECG Analysis**

4. Identification of ECG waveforms: P wave, PR interval, QRS complex, ST segment, T wave, QT interval.
5. Measurement of intervals and amplitudes: PR, QRS, QT.
6. Determination of heart rate using small box, large box, and 6-second methods.
7. Assessment of rhythm: regular vs irregular, sinus rhythm verification.

➢ **Interpretation of Common Abnormalities**

8. **P Wave & PR Interval Changes:**
    - Right & left atrial enlargement.

First-degree, second-degree, third-degree AV block.

- Pre-excitation (WPW) overview.

9. **QRS Complex Abnormalities:**
    - Right and left bundle branch block.
    - Ventricular hypertrophy patterns.
    - Premature ventricular contractions (PVCs).
10. **ST Segment & T Wave Changes:**
    - Myocardial ischemia: ST depression, T wave inversion.
    - Myocardial infarction: ST elevation, pathological Q waves.
    - Pericarditis (introductory).
11. **Arrhythmias:**
    - Atrial fibrillation and atrial flutter.
    - Supraventricular tachycardia (SVT).
    - Ventricular tachycardia, ventricular fibrillation.
    - Pacemaker rhythms.
12. **Electrolyte & Drug Effects:**
    - Hyperkalemia and hypokalemia ECG patterns.
    - Overview of drug-induced ECG changes.

➢ **Artifact Recognition and Correction**

13. Identification of common ECG artifacts: baseline drift, muscle tremor, electrical interference.
14. Corrective measures for recording errors.

➢ **Clinical Correlation Exercises**

15. Case-based exercises: linking ECG abnormalities to patient history and symptoms.
16. Prioritization of emergency ECG findings requiring immediate physician attention.
17. Documentation of findings in logbook (technician notes, non-diagnostic).

➢ **Integrated Practical Exercises**

18. Full ECG interpretation session:
    - Review normal ECG tracing.
    - Analyze abnormal ECG cases (arrhythmias, ischemia, conduction defects).
    - Measure intervals, heart rate, and rhythm.
19. Comparative analysis of multiple ECGs to identify progression of disease or recovery.

ADVANCED RADIOLOGY PROCEDURE

THEORY

1. Introduction to Advanced Radiology

- Definition and scope of advanced radiology procedures.
- Role of DXET in specialized imaging under supervision.
- Overview of modern imaging modalities and techniques.
- Safety and ethical considerations in advanced radiology.

2. Fluoroscopy

- Principles of fluoroscopy and real-time imaging.
- Components of a fluoroscopic unit.
- Clinical applications: GI studies, urinary tract, barium swallow.
- Radiation safety considerations specific to fluoroscopy.

3. Contrast Studies

- Introduction to contrast media: types, indications, contraindications.
- Gastrointestinal contrast studies:
    - Barium swallow, barium meal, barium enema.
- Urinary system: intravenous urography (IVU), retrograde pyelography.
- Gynecological studies: hysterosalpingography (HSG).
- Basic handling, storage, and safety precautions with contrast media.

4. Computed Tomography (CT)

- Basic principle of CT imaging.
- CT components: gantry, X-ray tube, detectors, computer system.
- Patient preparation for CT scans.
- Common CT protocols: head, chest, abdomen, and pelvis.
- DXET technician's role: positioning, patient care, safety under supervision.

5. Magnetic Resonance Imaging (MRI)

- Basic principles of MRI and magnetic field safety.
- MRI components: magnet, gradient coils, RF coil.
- Patient screening for contraindications (pacemaker, metal implants).

- Technician's role: patient positioning, coil placement, safety supervision.

6. Ultrasound Imaging

- Principles of ultrasonography.
- Equipment components: transducer, monitor, control panel.
- DXET role in preparing patient and assisting radiologist.
- Safety and hygiene considerations.

7. Digital Radiography and PACS

- CR (Computed Radiography) and DR (Digital Radiography) workflow.
- PACS (Picture Archiving & Communication System) overview.
- Image acquisition, storage, and retrieval.
- Technician's responsibilities in image quality and documentation.

8. Interventional Radiology

- Introduction to minimally invasive procedures using imaging guidance.
- Examples: angiography, biopsy, catheter placements.
- DXET role: assisting radiologist, patient preparation, safety precautions.

9. Radiation Safety in Advanced Procedures

- ALARA principle application in fluoroscopy, CT, and interventional radiology.
- Use of lead aprons, shields, and TLD badges in advanced imaging areas.
- Dose monitoring and patient/staff safety protocols.

10. Documentation & Reporting

- Maintaining logbooks for advanced imaging procedures.
- Proper labelling of images and records.
- Ethical and legal responsibilities of DXET in advanced procedures.

PRACTICAL

- **Equipment Familiarization**

1. Identification of advanced radiology equipment:
    - Fluoroscopy unit, CT scanner, MRI, ultrasound machine.
2. Components of each unit and their functions.
3. CR (Computed Radiography) and DR (Digital Radiography) systems overview.
4. PACS (Picture Archiving & Communication System) workflow and image handling.

- **Patient Preparation & Positioning**

5. Verification of patient identity and explanation of procedure.

6. Patient preparation for different procedures: fasting, hydration, contrast administration.
7. Correct positioning for:
    - Fluoroscopy (barium studies, urinary studies)
    - CT scans (head, chest, abdomen, pelvis)
    - MRI scans (head, spine, extremities)
    - Ultrasound (abdomen, pelvic, obstetric)
8. Special considerations for pediatric, geriatric, obese, and ICU patients.

Fluoroscopy Practical

9. Setting up fluoroscopic unit under supervision.
10. Patient positioning and movement for real-time imaging.
11. Observation of image quality, radiation safety measures, and lead shielding.
12. Basic demonstration of GI and urinary fluoroscopy procedures.

- **Contrast Studies Practical**

13. Handling and storage of contrast media.
14. Demonstration of barium swallow, barium meal, barium enema (simulation or under supervision).
15. Intravenous urography (IVU) patient positioning.
16. Hysterosalpingography (HSG) procedure overview and patient prep.
17. Safety precautions and emergency response for contrast reactions.

- **Computed Tomography (CT) Practical**

18. Familiarization with CT scanner components.
19. Patient positioning for head, chest, abdomen, and pelvis CT scans.
20. Observation of CT protocols and slice selection under supervision.
21. Radiation safety and shielding for staff and patient.

- **MRI Practical (Demonstration/Observation)**

22. Screening patients for contraindications (implants, pacemakers, metallic objects).
23. Patient positioning and coil placement.
24. Observing scan protocol and image acquisition.
25. Safety precautions: noise protection, magnetic field safety.

- **Ultrasound Practical (Assisted Observation)**

26. Familiarization with transducer and control panel.
27. Patient positioning and scanning procedure under radiologist supervision.
28. Handling gel and hygiene precautions.
29. Observation of normal and abnormal findings (if possible).

- **Radiation Safety**

30. Application of ALARA principle in fluoroscopy, CT, and portable studies.
31. Use of lead aprons, shields, and TLD badges.
32. Dose monitoring and documentation.

➢ **Documentation & Reporting**

33. Labelling images and maintaining proper records.

34. Recording exposure parameters, patient position, and contrast media used.
35. Maintaining logbooks for advanced radiology procedures.

➢ **Integrated Exercises**

36. Full workflow demonstration: patient prep → positioning → exposure → image acquisition → documentation.
37. Case-based exercises for simulated advanced radiology scenarios.
38. Safety drills and emergency response simulations.

ADVANCED RADIATION PROTECTION & QUALITY CONTROL

THEORY

1. Introduction

- Definition, scope, and importance of radiation protection in modern imaging.
- Role of X-Ray & ECG technicians in radiation safety and quality assurance.
- Regulatory authorities: ICRP (International Commission on Radiological Protection), AERB (Atomic Energy Regulatory Board, India).

2. Radiation Physics & Biological Effects

- Interaction of X-rays with matter.
- Types of radiation (primary, scattered, leakage).
- Biological effects of radiation: deterministic vs stochastic.
- Radiation dose units: Gray (Gy), Sievert (Sv), Becquerel (Bq).

3. Principles of Radiation Protection

- ALARA principle (As Low As Reasonably Achievable).
- Time, distance, and shielding as protective measures.
- Personal protective equipment (PPE): lead apron, thyroid collar, lead glasses, gonad shields.
- Staff protection vs patient protection.

4. Radiation Protection in Imaging Modalities

- Radiography: collimation, filtration, exposure optimization.
- Fluoroscopy: dose reduction techniques, pulsed fluoroscopy.
- CT: dose modulation, shielding, pediatric considerations.
- Advanced imaging: digital radiography dose management.

5. Radiation Monitoring

- Personal dosimeters: film badge, TLD (Thermoluminescent Dosimeter), OSL (Optically Stimulated Luminescence).
- Area monitoring devices.
- Dose limits for radiation workers and patients.
- Record-keeping and dose reporting.

6. Quality Control in Radiology

- Definition and importance of quality control (QC).
- Acceptance testing, routine testing, and preventive maintenance.
- QC tests for X-ray machines: kVp accuracy, timer accuracy, mA linearity, exposure reproducibility.
- QC in CT: image noise, contrast resolution, slice thickness, dose calibration.
- QC in fluoroscopy: resolution, contrast, and dose measurement.

7. Quality Assurance in Film & Digital Systems

- QC in darkroom: safelight, fog test, film-screen contact test.
- QC in CR/DR systems: image uniformity, dead pixel test, erasure cycle test.
- PACS (Picture Archiving and Communication System) data quality.

8. Emergency Preparedness & Radiation Incidents

- Common radiation hazards and accidental exposures.
- Emergency protocols in case of overexposure, equipment failure, or contrast reaction.
- Role of technician in first response and reporting.

9. Legal, Ethical & Regulatory Aspects

- AERB guidelines for diagnostic radiology.
- International radiation protection standards.
- Legal responsibilities of technicians.
- Ethical aspects of patient care during radiation exposure.

10. Quality Improvement & Documentation

- Continuous quality improvement programs in radiology.

- Maintaining radiation logbooks.
- QC audit and documentation practices.
- Role of technician in clinical governance.

PRACTICAL

➢ Radiation Protection Practicals

1. **Identification & Handling of PPE**
   - Lead apron, thyroid collar, lead glasses, gonad shields.
   - Proper storage and inspection for cracks/damage.
2. **Radiation Protection Devices**
   - Demonstration of collimators, filters, and grids.
   - Use of shielding barriers (lead-lined walls, screens).
3. **Patient Protection**
   - Correct positioning with minimal exposure.
   - Use of gonadal shielding in pelvic X-rays.
   - Pediatric dose reduction techniques.
4. **Staff Protection**
   - Safe positioning during portable X-rays and fluoroscopy.
   - Use of lead barriers and distance measures.
   - Rotational duties in high-radiation areas.

➢ Radiation Monitoring Practicals

5. **Personal Dosimeter Use**
   - Demonstration of film badge, TLD, OSL dosimeters.
   - Wearing, storage, and handling procedures.
   - Interpreting dose reports.
6. **Area Monitoring**
   - Placement of area radiation monitors in X-ray and CT rooms.
   - Checking for leakage radiation around X-ray tube housing.

➢ Quality Control (QC) in X-Ray

7. **X-Ray Equipment QC Tests** *(under supervision)*
   - kVp accuracy test.
   - Timer accuracy check.
   - mA linearity and reproducibility test.
   - Collimator and beam alignment test.
   - Half-Value Layer (HVL) measurement for beam quality.
8. **Darkroom QC Tests (for film-based systems)**
   - Safelight fog test.
   - Film-screen contact test.
   - Processor QC: temperature, chemical strength, replenishment.

➢ QC in Digital Imaging (CR/DR)

9. Image uniformity test.
10. Dead pixel/line detection on DR detectors.
11. Erasure cycle test in CR systems.

PACS workflow validation: image transfer, storage, retrieval.

- **QC in CT & Fluoroscopy**

12. **CT QC Tests** *(observation/demo)*

- Slice thickness accuracy.
- Image noise and uniformity.
- Contrast resolution check.
- Dose output measurement.

13. **Fluoroscopy QC**

- Resolution and contrast checks.
- Entrance surface dose measurement.
- Pulsed fluoroscopy dose reduction demo.

- **Emergency & Safety Drills**

14. Handling suspected over-exposure incident.
15. Demonstration of safe evacuation in case of radiation accident.
16. First-aid measures for contrast reaction during advanced imaging.
17. Documentation of radiation incidents in logbooks.

- **Documentation & Logbook Maintenance**

18. Recording daily QC checks.
19. Maintaining radiation exposure records of staff and patients.
20. Preparing QA (Quality Assurance) reports under supervisor guidance.

RADIOGRAPHIC TECHNIQUES AND DIAGNOSTIC

THEORY

1. Introduction to Radiographic Techniques

- Definition, scope, and importance of diagnostic radiography.
- Role of the X-Ray & ECG Technician in diagnosis.
- Overview of conventional vs modern radiographic methods.

2. Patient Preparation & Positioning

- General patient preparation for radiography.
- Immobilization techniques and use of positioning aids.

Positioning terminology: AP, PA, lateral, oblique, axial, tangential.

- Importance of correct positioning for diagnostic accuracy.

3. Radiographic Techniques of the Skeletal System

- Skull and facial bones.
- Spine: cervical, thoracic, lumbar, sacrum, coccyx.
- Upper limb: shoulder, humerus, elbow, wrist, hand.
- Lower limb: pelvis, hip, femur, knee, ankle, foot.
- Joints: specialized views (e.g., intercondylar, skyline).

4. Radiographic Techniques of the Thorax

- Chest X-ray (PA, lateral, oblique).
- Special chest views: lordotic, expiratory, decubitus.
- Diagnostic importance in respiratory and cardiac diseases.

5. Radiographic Techniques of the Abdomen & Pelvis

- Plain abdominal radiography.
- Supine and erect abdominal studies.
- Special procedures:
    - Barium meal, barium enema.
    - Intravenous urography (IVU).
    - Hysterosalpingography (HSG).

6. Radiographic Techniques of the Head & Neck

- Skull (AP, lateral, Towne's, Waters' view).
- Paranasal sinuses.
- Orbit, mandible, TM joint.
- Cervical spine and soft tissue neck.

7. Contrast Radiographic Techniques

- Contrast media: types, preparation, precautions.
- GI tract: barium swallow, barium meal follow-through.
- Urinary system: IVU, retrograde pyelography.
- Biliary system: cholecystography (overview).
- Gynecological studies (HSG).

8. Advanced Radiographic Techniques

- Fluoroscopy: principles and diagnostic applications.
- CT basics in diagnostic radiography.
- MRI overview in musculoskeletal and neuroimaging.

Ultrasound overview for abdomen and pelvis.

9. Radiographic Pathology & Diagnostic Correlation

- Recognition of normal vs abnormal radiographs.
- Common pathological conditions detectable on X-ray:
  - Bone fractures, dislocations, arthritis, bone tumors.
  - Pneumonia, tuberculosis, pleural effusion, lung cancer.
  - Intestinal obstruction, renal calculi, gallstones.
- Case-based interpretation exercises (technician level).

10. Radiation Safety in Diagnostic Radiography

- Application of ALARA in diagnostic imaging.
- Dose optimization for skeletal, chest, abdominal, and pediatric studies.
- Patient shielding and exposure minimization.
- Technician safety protocols.

11. Documentation & Quality Assurance

- Recording patient details, exposure factors, and positioning.
- Maintaining logbooks for diagnostic radiology procedures.
- Quality assurance in radiographic imaging.
- Ethical and legal considerations in diagnostic imaging.

PRACTICAL

- **Equipment Orientation**

1. Identification of parts of X-ray machine (tube, collimator, control panel, Bucky, grids).
2. Handling of cassettes, screens, CR/DR plates.
3. Use of positioning aids: sponges, straps, immobilizers.
4. Calibration and safety checks before use.

- **Patient Care & Preparation**

5. Patient identity verification and explanation of procedure.
6. Preparation for skeletal, chest, abdominal, and contrast studies.
7. Demonstration of immobilization techniques.
8. Use of lead shielding for patient protection.

- **Skeletal Radiography Practicals**

9. Positioning for upper limb radiographs: hand, wrist, forearm, elbow, humerus, shoulder.

Positioning for lower limb radiographs: foot, ankle, knee, femur, pelvis, hip.

10. Positioning for spine radiographs: cervical, thoracic, lumbar, sacrum, coccyx.
11. Skull radiographs: AP, lateral, Towne's, Waters' views.

- **Thoracic Radiography Practicals**

12. Chest radiographs: PA, lateral, oblique.
13. Special chest views: lordotic, expiratory, decubitus.
14. Demonstration of portable/ICU chest X-rays.

- **Abdominal & Pelvic Radiography Practicals**

15. Supine and erect abdominal X-rays.
16. Positioning for urinary tract studies (IVU, retrograde pyelography – demo).
17. Gynecological study (HSG – demonstration).

- **Contrast Study Practicals**

18. Preparation and safe handling of contrast media.
19. Demonstration of barium swallow and barium meal positioning.
20. Barium enema patient preparation and positioning.
21. Observation of contrast flow in fluoroscopy.

- **Advanced Radiography (Observation/Demonstration)**

22. Fluoroscopy positioning and patient safety measures.
23. CT basic positioning for head, chest, abdomen.
24. MRI positioning demonstration (if available).
25. Ultrasound preparation and patient positioning.

- **Radiographic Pathology Identification**

26. Recognition of fractures and dislocations on radiographs.
27. Identifying chest abnormalities: pneumonia, TB, pleural effusion.
28. Recognition of urinary calculi and intestinal obstruction.
29. Case-based exercises: differentiating normal vs abnormal films.

- **Radiation Safety in Practice**

30. Demonstration of ALARA principle during routine and special radiography.
31. Use of collimators, filters, grids for dose reduction.
32. Proper use of personal protective equipment (PPE).

- **Documentation & Logbook**

33. Recording exposure factors for each study.

Maintaining radiographic procedure logbook.

34. Proper film/digital image labelling and PACS entry.