SEMESTER – III

PAPER CODE	SUBJECT NAME	THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PRACTICAL MARKS
DMRT301	PREVENTIVE MEDICINE AND MEDICAL ETHICS	45 Min	1 Hrs.	50	50
DMRT302	RADIOGRAPHIC EQUIPMENT & MAINTENANCE	45 Min	1 Hrs.	50	50
DMRT303	FIRST AID AND CPR	45 Min	1 Hrs.	50	50
DMRT304	CT, MRI & ULTRASOUND	45 Min	1 Hrs.	50	50

PREVENTIVE MEDICINE AND MEDICAL ETHICS

THEORY

1. Introduction to Preventive Medicine

- Definition, scope, and importance of preventive medicine in healthcare
- Natural history of disease & levels of prevention (primordial, primary, secondary, tertiary)
- Concepts of **health** and **disease**
- Determinants of health – physical, mental, social, and environmental

2. Epidemiology

- Definition, aims, uses, and basic principles
- Types of epidemiological studies (descriptive, analytical, experimental)
- Measures of disease frequency: incidence, prevalence, morbidity, mortality
- Surveillance and notification of diseases

3. Communicable Diseases

- Modes of transmission and prevention of:
  - Tuberculosis
  - Hepatitis B & C
  - HIV/AIDS
  - COVID-19
  - Typhoid, cholera, malaria
- Universal precautions for infection control in healthcare settings

4. Non-Communicable Diseases (NCDs)

- Common NCDs: cardiovascular diseases, diabetes, cancer, stroke
- Risk factors, screening, and preventive strategies
- Role of lifestyle modification and patient education

5. Environmental Health

- Safe water supply and sanitation
- Waste disposal (including biomedical waste management in radiology departments)
- Hospital infection control
- Radiation hazards and protection measures

6. Immunization

- Immunization schedules (national & special vaccines)
- Cold chain maintenance
- Post-exposure prophylaxis for healthcare workers (e.g., Hepatitis B, rabies)

7. Occupational Health

- Occupational hazards in radiology:
  - Radiation exposure
  - Musculoskeletal strain
  - Stress and fatigue
- Safety guidelines & use of personal protective equipment (PPE)
- Periodic health checkups for radiology staff

Medical Ethics

8. Introduction to Medical Ethics

- Definition and importance of ethics in healthcare
- Difference between ethics, morals, and laws
- Principles of biomedical ethics:
  - Autonomy
  - Beneficence
  - Non-maleficence
  - Justice

9. Patient Rights & Responsibilities

- Patient confidentiality and privacy (including imaging records)
- Informed consent – purpose, types, and legal aspects
- Right to information and refusal of treatment

10. Professional Conduct

- Code of conduct for radiology professionals
- Maintaining dignity and respect towards patients
- Avoiding discrimination based on gender, religion, caste, or economic status
- Truthfulness and transparency in reporting

11. Legal Aspects in Radiology

- Relevant acts and laws:
  - PCPNDT Act (Prohibition of Sex Selection)
  - Atomic Energy Regulatory Board (AERB) guidelines
  - Consumer Protection Act in healthcare
- Medicolegal documentation in imaging

12. Ethical Issues in Radiology

- Handling incidental findings
- Ethical concerns with AI and digital image manipulation
- Reporting errors and accountability
- Conflict of interest in medical practice

13. Communication Skills

- Communicating with patients empathetically
- Breaking bad news sensitively
- Interpersonal skills with colleagues and other healthcare workers

PRACTICAL

➢ Infection Control & Universal Precautions

- Demonstration of **hand hygiene techniques** (WHO 7-step method)
- Proper use and disposal of **personal protective equipment (PPE)** – gloves, masks, gowns, lead aprons
- Safe handling and disposal of contaminated materials in radiology departments
- Needle stick injury prevention and post-exposure protocol

➢ Biomedical Waste Management

- Segregation of biomedical waste according to **color-coded bins**
- Handling of **radiographic films** and chemicals safely
- Proper disposal of expired contrast media and radioactive materials as per AERB guidelines

- **Immunization & Post-Exposure Prophylaxis**

- Observation of vaccination procedures in healthcare facilities
- Demonstration of maintaining **cold chain** for vaccines
- Preparation of a checklist for post-exposure prophylaxis for Hepatitis B, HIV, and rabies

- **Hospital Infection Control Practices**

- Visit to the hospital infection control unit
- Preparation of a **radiology-specific infection control plan**
- Demonstration of equipment cleaning and disinfection protocols (e.g., ultrasound probes, X-ray cassettes, CT gantry)

- **Radiation Protection Measures**

- Demonstration of use of **radiation monitoring devices** (TLD badge, pocket dosimeter)
- Checking and proper positioning of lead barriers, lead glass, and lead aprons
- Mock drill on safe evacuation during a radiation hazard

- **Screening & Preventive Health Measures**

- Participation in community health camps for **NCD screening** (BP, blood sugar, cancer awareness)
- Observation of preventive imaging techniques (e.g., mammography for breast cancer screening)

- **Patient Interaction & Ethical Practice**

- Role-play exercises on **informed consent** taking for imaging procedures
- Simulated patient counseling for:
    - Radiation safety
    - Procedure explanation
    - Contrast media risks
- Practicing **empathetic communication** and active listening skills

- **Legal & Ethical Documentation**

- Preparation of sample consent forms for X-ray, CT, MRI, and radiation therapy
- Mock documentation of PCPNDT records for ultrasound procedures
- Understanding confidentiality: practice scenarios of maintaining patient data security

- **Case Studies & Ethical Dilemmas**

- Group discussion on real-life ethical issues in radiology (e.g., incidental findings, patient privacy, error reporting)
- Problem-solving activities for ethical conflicts in imaging practice

➢ **Professionalism in the Radiology Department**

- Observing and noting professional behavior of radiographers and technologists

  Practicing teamwork and coordination with other healthcare professionals

RADIOGRAPHIC EQUIPMENT & MAINTENANCE

THEORY

1. Fundamentals of Radiographic Equipment

- Introduction to radiographic equipment – types and classification
- Basic electrical concepts applied in radiology (voltage, current, resistance, power, AC/DC)
- Electrical supply in X-ray departments – single-phase, three-phase, high-frequency systems
- Transformers and rectifiers used in X-ray machines
- Components of X-ray circuit

2. X-Ray Tube & Tube Housing

- Construction and working of X-ray tube
- Stationary vs. rotating anode tubes
- Tube rating charts (anode cooling, tube loading)
- Tube housing and oil cooling system
- Filtration and collimation devices (fixed and variable collimators, light beam diaphragms, cones, cylinders)
- Beam restrictors and grids

3. X-Ray Generators

- Types of X-ray generators:
  - Single phase
  - Three phase (6-pulse & 12-pulse)
  - High-frequency generators
  - Constant potential generators
- Automatic exposure control (AEC) systems
- kVp, mA, mAs selection mechanisms
- Timer circuits and exposure switches

4. Radiographic Accessories & Patient Positioning Aids

- Bucky tables, wall stands, cassette holders, tilting tables
- Compression devices and positioning aids
- Image intensifiers and fluoroscopy equipment
- Spot film devices and cine radiography units

5. Advanced Radiographic Equipment

- Digital radiography (CR & DR systems) – components and workflow
- PACS (Picture Archiving and Communication Systems) – basics
- Mammography units – design and special features
- Dental radiographic units
- Portable and mobile X-ray units
- C-arm image intensifiers used in operation theatres
- CT scan equipment – basic introduction
- MRI equipment – basic introduction

6. Maintenance of Radiographic Equipment

- Principles of preventive maintenance
- Care of X-ray tube, cables, generator, control panel, and collimators
- Daily/weekly/monthly maintenance checklists
- Safety measures for electrical and mechanical handling
- Troubleshooting common faults (flickering, uneven density, artifacts, overheating)
- Darkroom equipment maintenance (developer, fixer tanks, safelights, automatic processors)
- Care and maintenance of digital systems

7. Radiation Safety & Quality Control

- Basic radiation protection devices in equipment (lead shielding, tube housing, aprons, barriers)
- Equipment quality control tests:
    - kVp accuracy
    - Timer accuracy
    - mA linearity
    - Focal spot size test
    - Beam alignment & collimation check
    - Half value layer (HVL) test
- Importance of routine quality assurance (QA) in radiology departments

PRACTICAL

- **Familiarization & Identification**

- Identification of parts of X-ray machine (tube, collimator, control panel, generator, cables).
- Identification of Bucky table, wall stand, cassette holder, and positioning devices.
- Identification of cassettes, intensifying screens, grids, cones, and collimators.

➢ **X-Ray Tube & Collimator**

- Demonstration of stationary and rotating anode tubes.
- Handling and care of tube housing and collimators.
- Checking light beam diaphragm (field size vs. radiation field).

➢ **X-Ray Generators & Control Panels**

- Demonstration of single-phase, three-phase, and high-frequency generators.
- Operation of control panel – setting kVp, mA, timer, and exposure.
- Demonstration of exposure switch and safety interlocks.

➢ **Radiographic Accessories**

- Practical use of Bucky table, wall stand, and compression devices.
- Demonstration of fluoroscopy unit and image intensifier.
- Handling of portable/mobile X-ray unit.
- Demonstration of C-arm operation in OT setup.

➢ **Digital Imaging Equipment**

- Practical handling of CR cassettes and DR detectors.
- Demonstration of image processing in CR/DR systems.
- Care and maintenance of imaging plates and digital detectors.
- Demonstration of PACS – storage and retrieval of images.

➢ **Maintenance & Troubleshooting**

- Daily/weekly/monthly preventive maintenance checklists.
- Cleaning and care of cassettes, screens, grids, and CR plates.
- Checking and replacing fuses, cables, and connections.
- Fault finding in common X-ray equipment issues (overheating, uneven density, artifacts, flickering).
- Darkroom equipment care (safelight, developer, fixer tanks, automatic processor).

➢ **Quality Control (QC) Tests**

- kVp accuracy test.
- Timer accuracy test.
- mA linearity and reproducibility test.
- Beam alignment and collimation test.

- Measurement of Half Value Layer (HVL).
- Focal spot size test.
- Leakage radiation survey of tube housing.

➢ **Documentation & Records**

- Preparation of maintenance records and QC logbook.
- Recording of equipment servicing and calibration reports.

FIRST AID AND CPR

THEORY

1. Introduction to First Aid

- Definition, aims, and principles of first aid
- Role and responsibilities of a first aider
- Contents of a first aid box (hospital, community, radiology department)
- Basic rules of handling patients in emergency situations

2. First Aid in Common Medical Emergencies

- Unconsciousness, fainting, and syncope
- Shock (types, signs, management)
- Seizures, stroke, diabetic emergencies
- Heat stroke, hypothermia, dehydration, burns, frostbite
- Allergic reactions and anaphylaxis
- Drowning and choking

3. First Aid in Injuries

- Wounds: types, bleeding control (direct pressure, elevation, tourniquet, pressure points)
- Fractures, sprains, and dislocations – immobilization techniques
- Head injury, spinal injury – precautions in radiology setup
- Poisoning (inhalation, ingestion, injection, absorption) – general management
- Foreign bodies (eye, ear, nose, skin)

4. Cardiopulmonary Resuscitation (CPR)

- Introduction and importance of CPR in emergencies
- Basic Life Support (BLS) – adult, child, and infant
- Chain of survival
- Steps of CPR (CAB – circulation, airway, breathing)
- Use of Automated External Defibrillator (AED)

- Recovery position and post-resuscitation care

5. First Aid in Radiology Department

- Electric shock & burns due to equipment
- Contrast reaction emergencies (mild, moderate, severe)
- Radiation exposure accidents – immediate response
- Handling fainting patients during X-ray/CT/MRI procedures
- Emergency evacuation in radiology department

6. Transportation of Patients

- Methods of lifting and carrying patients (single rescuer, two-person, stretcher methods)
- Spinal board and cervical collar application
- Safe patient transfer in radiology setup (wheelchair, stretcher, trolley)
- Transport during trauma, fractures, or unconsciousness

PRACTICAL

Practical Exercises & Demonstrations

- **First Aid Kit**
  - Identification of items in a first aid box.
  - Preparation and arrangement of a first aid box for radiology department.
- **Bandaging & Wound Care**
  - Demonstration of triangular bandage applications (arm sling, head bandage, chest).
  - Roller bandage applications (hand, foot, joints).
  - Application of pressure bandage for bleeding control.
  - Demonstration of dressing techniques for wounds and burns.
- **Bleeding & Shock Management**
  - Demonstration of control of external bleeding (direct pressure, elevation, pressure points, tourniquet).
  - Positioning of patient in shock (Trendelenburg, supine).
- **Fracture & Immobilization**
  - Application of splints (upper limb, lower limb, spinal).
  - Immobilization techniques using improvised materials.
  - Demonstration of cervical collar and spinal board application.
- **Airway & Breathing Emergencies**
  - Heimlich maneuver for choking (adult, child, infant).
  - Rescue breathing (mouth-to-mouth, mouth-to-nose) demonstration.
  - Recovery position practice for unconscious but breathing patients.
- **Cardiopulmonary Resuscitation (CPR)**

- Adult Basic Life Support (BLS) – CAB sequence (Chest compression, Airway, Breathing).
- Child & Infant CPR demonstration.
- Use of AED (Automated External Defibrillator) in simulated emergency.

➢ **Radiology-Specific Emergencies**
- First aid for contrast media reactions (mild, moderate, severe).
- First aid for electric shock from radiology equipment.
- Emergency handling of fainting/syncope in X-ray/CT room.
- Demonstration of radiation accident first aid procedure.

➢ **Patient Handling & Transport**
- Lifting and carrying techniques (single rescuer, two-person, chair carry).
- Stretcher handling (loading, unloading, shifting).
- Safe transfer of trauma and unconscious patients.
- Evacuation drill for radiology department emergencies.

CT, MRI & ULTRASOUND

THEORY

1. Introduction to Advanced Imaging Modalities

- Evolution of CT, MRI, and Ultrasound in radiology
- Comparison with conventional radiography
- Applications and advantages in diagnostic imaging

2. Computed Tomography (CT)

1. **Basics of CT**
   - Principles of CT imaging
   - Generations of CT scanners (1st to modern spiral/MDCT)
   - CT system components – X-ray tube, detectors, gantry, patient couch, computer system
2. **Image Acquisition & Processing**
   - Slice thickness, pitch, reconstruction, windowing, multiplanar reconstruction (MPR), 3D imaging
   - Contrast media used in CT (types, dosage, precautions, reactions)
3. **CT Procedures**
   - CT brain, chest, abdomen, pelvis, spine, extremities
   - Special CT studies (angiography, virtual endoscopy, HRCT, cardiac CT)
4. **CT Safety & QA**
   - Radiation dose in CT & dose reduction strategies (ALARA, shielding, pediatric dose)
   - Artefacts in CT and their correction
   - Quality assurance in CT

3. Magnetic Resonance Imaging (MRI)

1. **Basics of MRI**
   - Principles of nuclear magnetic resonance (NMR)
   - Relaxation times (T1, T2, PD)
   - MRI system components – magnet, gradient coils, RF coils, computer, patient table
   - Types of magnets – permanent, resistive, superconducting
2. **Image Formation & Sequences**
   - Pulse sequences: Spin echo, Gradient echo, FLAIR, STIR, Diffusion, Perfusion, MR angiography
   - MRI contrast agents (Gadolinium-based) – safety and contraindications
3. **MRI Procedures**
   - MRI brain, spine, joints, abdomen, pelvis, cardiac MRI
   - MR angiography and MR spectroscopy – basics
4. **MRI Safety & QA**
   - MRI safety zones & bioeffects (heating, projectile effect, noise, implants)
   - Safety precautions for patients with implants (pacemakers, clips, prostheses)
   - Artefacts in MRI and troubleshooting
   - Quality assurance in MRI

4. Ultrasound

1. **Basics of Ultrasound**
   - Principles of sound waves and ultrasound imaging
   - Transducers – types and frequencies
   - Ultrasound system components – transducer, console, display
2. **Ultrasound Imaging Modes**
   - A-mode, B-mode, M-mode, Doppler (Color, Power, Spectral)
   - 3D and 4D ultrasound basics
3. **Ultrasound Procedures**
   - Abdominal ultrasound (liver, gall bladder, kidney, pancreas, spleen)
   - Pelvic ultrasound (uterus, ovaries, prostate, bladder)
   - Obstetric ultrasound (fetal imaging and biometry)
   - Vascular studies (Doppler applications)
   - Musculoskeletal ultrasound basics
4. **Safety & Artefacts**
   - Ultrasound bioeffects (thermal, mechanical index)
   - Safety guidelines in obstetric ultrasound
   - Common artefacts and troubleshooting

5. Contrast & Patient Care in CT, MRI & Ultrasound

- Types of contrast media (iodinated, gadolinium, microbubble agents)
- Patient preparation for CT, MRI, and ultrasound procedures
- Emergency handling of contrast reactions
- Positioning and communication with patients during scans

- Infection control in imaging departments

PRACTICAL

➢ CT (Computed Tomography) Practical

1. Identification of CT machine components – gantry, couch, control console, detector system.
2. Demonstration of patient positioning:
    - CT brain, chest, abdomen, pelvis, spine, extremities.
3. Setting scan parameters – slice thickness, pitch, window levels.
4. Demonstration of contrast administration techniques – IV injection, timing, precautions.
5. Post-processing techniques – MPR (multiplanar reconstruction), 3D reconstruction, windowing (lung, bone, soft tissue).
6. Artefact recognition (motion, beam hardening, metal streak) and troubleshooting.
7. Demonstration of radiation dose monitoring & ALARA principles.
8. Preparation of CT quality assurance checklist.

➢ MRI (Magnetic Resonance Imaging) Practical

1. Identification of MRI system parts – magnet, RF coils, gradient coils, console, patient table.
2. Demonstration of MRI safety procedures: patient screening, MRI zones, removal of metallic objects.
3. Positioning of patients for:
    - MRI brain, spine, knee, abdomen, pelvis.
4. Demonstration of pulse sequences: T1, T2, FLAIR, STIR, GRE, DWI (demo only).
5. Use of surface coils and phased-array coils.
6. Administration of MRI contrast (gadolinium) – dosage, precautions, contraindications.
7. Identification of common artefacts (motion, susceptibility, ghosting).
8. Preparation of MRI safety and QA checklist.

➢ Ultrasound (USG) Practical

1. Identification of ultrasound equipment – console, probes (linear, convex, phased array, endocavitary).
2. Demonstration of probe handling and use of coupling gel.
3. Patient preparation and positioning for ultrasound.
4. Demonstration of routine scans:
    - Abdominal scan (liver, kidneys, pancreas, spleen).
    - Pelvic scan (uterus, ovaries, prostate, bladder).
    - Obstetric scan – fetal biometry basics.
5. Doppler ultrasound demonstration – vascular studies (carotid, abdominal vessels).

6. Demonstration of 3D/4D ultrasound (if available).
7. Artefact identification in ultrasound imaging.
8. Infection control and probe disinfection techniques.

- Steps in case of accidental overexposure
- Demonstration of evacuation procedures in a radiation leak scenario
- Handling and reporting of damaged dosimeters
- Basic decontamination procedure for radioactive contamination (if nuclear medicine setup exists)

➢ **Documentation and Quality Assurance**

- Maintenance of radiation safety logbooks
- Record-keeping of personal dose reports and equipment QA results
- Preparation of a monthly radiation safety compliance report
- Familiarization with AERB inspection checklist

TOTAL HOURS

THEORY CLASS PER DAY	**3 HOURS**
PRACTICAL CLASS PER DAY	4 HOURS
TOTAL HOURS PER DAY	7 HOURS
TOTAL HOURS IN 1 YEAR	250*7=1750
TOTAL HOURS IN 6 MONTHS	875 HOURS

Chairman

Paramedical Education & Training Council