

# **DIPLOMA IN MEDICAL RADIATION TECHNOLOGY (DMRT)**



Government of Odisha

Health & Family Welfare Department

Revised vide DMET-LT/RT-Board

# Syllabus

## Diploma in Medical Radiation Technology (DMRT)

**2022**



Health & Family Welfare Department  
**Govt. of Odisha**

**DIPLOMA IN MEDICAL RADIATION TECHNOLOGY**  
**(DMRT) COURSE CURRICULUM**

**GENERAL INFORMATION**

1. The Duration of Diploma Course of Medical Radiation Technology (DMRT) is two years.
2. The minimum educational qualification for selection of trainees for the Diploma Course of Medical Radiation Technology is +2 Science with Biology or Mathematics one of the subject.
3. A total mark of the DMRT Course is 1000.
4. Minimum pass mark of the trainees is 40% in Theory, 50% in Oral & Practical and 50% in Aggregate.
5. 1st Class mark is 60% in Theory, Practical & Oral in aggregate respectively.
6. Less than 40% either in Theory or in Practical or in Oral in any paper will be treated as unsuccessful (Fail).

**Examination schedule: There will be two Regular Annual Examinations one in each year**

**Part-1: Annual: In First year**

**Part-2: Annual: In Second year**

**Part-3: Compulsory Internship Training Three Months**

**There will be a supplementary examination within six weeks of annual result publication.**

**Question Pattern: Total Marks = 60**

|                           |   |
|---------------------------|---|
| <b>Long Question</b>      | <b>10 marks X 01 question = 10 marks</b>  |
| <b>Short Question</b>     | <b>04 marks X 05 questions = 20 marks</b> |
| <b>Fill in the blanks</b> | <b>01 marks X 10 questions = 10 marks</b> |
| <b>Matching</b>           | <b>01 marks X 10 questions = 10 marks</b> |
| <b>Multiple choice</b>    | <b>01 marks X 10 questions = 10 marks</b> |

**DMRT - FIRST YEAR****Table -I**

| PAPER | SUBJECT                                | MARK  |        |           |      | HOURS |
|-------|--|-------|--------|-----------|------|-------|
|       |  | TOTAL | THEORY | PRACTICAL | ORAL |       |
| 1     | ANATOMY                                | 100   | 60     | 20        | 20   | 40    |
| 2     | HEALTH,<br>DISEASE & ENVIRONMENT       | 100   | 60     | 20        | 20   | 30    |
| 3     | PHYSIOLOGY, PATHOLOGY,<br>MICROBIOLOGY | 100   | 60     | 20        | 20   | 60    |
| 4     | COMPUTER                               | 100   | 60     | 20        | 20   | 40    |
| 5     | SAFETY COURSE                          | 100   | 60     | 20        | 20   | 30    |

**DMRT - SECOND YEAR****Table-II**

| PAPER | SUBJECT                               | MARK  |        |           |      | HOURS |
|-------|---------------------------------------|-------|--------|-----------|------|-------|
|       |                                       | TOTAL | THEORY | PRACTICAL | ORAL |       |
| 1     | RADIOLOGY PHYSICS                     | 100   | 60     | 20        | 20   | 40    |
| 2     | RADIOGRAPHY,<br>IMAGING, DARK<br>ROOM | 100   | 60     | 20        | 20   | 30    |
| 3     | MODERN IMAGING                        | 100   | 60     | 20        | 20   | 60    |
| 4     | RADIATION HAZARDS &<br>PROTECTION     | 100   | 60     | 20        | 20   | 40    |
| 5     | HOSPITAL<br>MANAGEMENT                | 100   | 60     | 20        | 20   | 30    |

# **FIRST YEAR**

## **PAPER- I**

### **Human Anatomy (Theory) :-**

1. **Introduction:** Introduction to Anatomy, Physiology, Pathology, definition of topographic term / terms used to describe body.
2. **Structure of Body:** Basic unit cells & tissues of body.
3. **Musculoskeletal system:** Structure of bone, types of bone, skull, PNS, Mastoid, vertebral column, bones of shoulder girdle, bones of superior extremity, thoracic cage, Pelvic girdle, bones of lower extremity, joints – type of joints, movement, important joints – their structure & location, types of muscles (striated, non-striated, cardiac). Origin insertion & function of some important muscles, Radiological anatomy of bones.
4. **Cardiovascular system:** Heart, major vessels, portal vein & tributaries.
5. **Lymphatic system (structure, function):** Circulation of lymph, lymph glands, thoracic duct.
6. **Abdominal organs / Digestive system:** Oral cavity, Pharynx, Esophagus, Stomach, small & large intestine, gall bladder, pancreas, liver, spleen.
7. **Respiratory system (Respiratory passage & organs):** Larynx, Trachea, Lungs, Bronchus.
8. **Nervous System:** Brain, Meninges, Ventricles, Spinal Cord.
9. **Genitourinary & Reproductive system:** Kidney, Ureter, Bladder, Prostate in Males, Male & Female Urethra, Ovary, Fallopian tubes, Uterus, Cervix, Scrotum testis, Vas deferens, Seminal vesicle.
10. **Endocrine system (Name, Location & Function):** Pituitary, Thyroid & Parathyroid Gland, Supra-renal.
11. **Ear:** Structure
12. **Eye:** Bony Orbit & soft parts.

### **CELL BIOLOGY (Theory) :-**

Cell physiology - Structure of the cell - Types of cells and tissue, their structures and functions - Organic constituents of cells - Carbohydrates, fats, proteins and nucleic acids – Enzymes and their functions - Functions of mitochondria, ribosomes, Golgi bodies and lysosomes - Cell metabolism - Krebs cycle - DNA as concepts of gene and gene action - Mitotic and meiotic cell division – Semi conservative DNA synthesis, Genetic variation Crossing over, mutation, chromosome segregation - Heredity and its mechanisms.

### **PRACTICAL :-**

#### **Experiments related to Anatomy**

1. Surface marking of organs like heart, lungs, liver, spleen, stomach, kidney, bladder, important bony landmarks, femoral artery & vein, brachial artery & vein, radial artery, carotid artery, different quadrants of abdomen.
2. Identification of bones of skeleton.
3. Identification of various parts structures of human body in charts & models. (Interior of thorax with organs in situ in models, interior of abdomen, pelvis & reproductive organs model)
4. Identification of various anatomical structures in X-ray plate (heart, lungs, bones, liver, spleen, kidney, bladder and one barium study: Stomach, small and large intestine)
5. Demonstration of brain & spinal cord.
6. Visit to Anatomy museum for specimen recognition.

## **PAPER- II**

### **Health, Disease and Environment (Theory) :-**

#### **1. Health and Disease:**

- a. Definition of Health, Dimensions of Health, Determinants of Health.
- b. Describe characteristics of Agent, Host & Environmental factors in Health & Diseases & multi factorial etiology of Disease.
- c. Describe & discuss natural history of diseases
- d. Describe application of interventions at various levels of Preventions
- e. Dynamics of diseases transmission and modes of diseases transmission
- f. Occupational diseases- Industrial situation, Agricultural situation, & prevention of occupational diseases
- g. Communicable diseases- Measles, Diphtheria, Tetanus, Poliomyelitis, Whooping cough, Viral Hepatitis, Malaria, Dengue, COVID-19, Filariasis, Tuberculosis, Leprosy, AIDS, Cholera
- h. Non-communicable- Cardio Vascular diseases, Diabetes, Obesity, Cancer, Accidents & Injuries.
- i. Health hazards of Air, Water, Noise, Radiation Pollution.

#### **2. Health Care Delivery System and National Health Policy:**

Health Care Delivery System – Primary Health Care, Secondary Health Care and Tertiary Health Care, Provision for health in constitution of India, Health Administration and Management at different levels in India.

#### **3. Organization of Health care delivery system:**

- a. Village level: Trained birth attendants, village health guides, Anganwadi workers.
- b. Sub-centre level: Females Health Workers, Male Health Workers and their functions.
- c. Sector level: Male Health Supervisors, Female Health Supervisors
- d. Primary Health Centre-Organization, Staffing and functions.
- e. Community Health Centre-Organization, Staffing and functions.
- f. Sub-Divisional Level.
- g. District Level: District Health Organization, Staffing and its functions.
- h. State Level: Health Department, Directorates.
- i. National Level: Ministry of Health, Govt. of India, National Health Programme, Referral and Apex Health Institutions and Laboratories.

#### **4. Hospital Organization (Administration):** Management functions and its application, WHO definition of Hospital, Types of Hospitals, Hospital services in relation to radiological services, Returns, Reports and records in hospital, Indents books, Registers and Log-book etc. in relation to radiological services, Hospital and the Community Hospital hazards.

#### **5. Health Education:** Personal Hygiene, Aims and Objectives of Health Education, Communication Media.

#### **6. First Aids:** Definition, Simple first-aid kit material etc., Shock, Coma and its management, Control of bleeding, splitting of patient, Transportation of injured, Immediate first aid to drowning patient.

## **PAPER- III**

### **Physiology, related Pathology and Microbiology**

#### **1. PHYSIOLOGY (Theory= 10 hrs) :-**

- **Physiology:** Circulation & Physiology of Blood, Blood volume, constituents of blood, Bleeding time, Clotting time, Blood Group, Normal Blood Pressure, Physiology of Heart: Systole, diastole, Maintenance of cardiac output, Normal Pulse, Normal respiration: Types of respiratory muscles, abnormal respiration, Normal temperature, Maintenance of body temperature, Kidney function.

### **PRACTICAL (05 hrs) :-**

1. Respiration / Pulse / Temperature recording.
2. Maintenance of TPR chart.
3. Recording of Blood pressure, Blood Pressure instrument.

### **2. PATHOLOGY (Theory= 20 hrs) :-**

#### ➤ **Pathology:**

- Cell Biology: Structure of cell, cell division, Cell growth, Cell deformities, Defense mechanism, Cell damage and cell repair.
- Definition, Etiology & classification of pathological processes and terms: Infection, Inflammation, Immunity.
- Neoplasia: Benign & Malignant including its mode of growth & metastasis, Physical and chemical carcinogens
- Common Neoplasm of different systems: Oral, oropharyngeal, Laryngeal, GI tract, Breast, Cervix, Bone Tumors, Soft tissue sarcoma, Penis, Lymphoma, Leukemia.
- Fracture, types of fracture, fracture healing, dislocation of joints.

### **3. MICROBIOLOGY (Theory= 10 hrs) :-**

#### ➤ **Microbiology:**

- Classification of bacteria, virus, fungus, Characteristics, shape and arrangements, special characters – Spores, capsules, motility.
- Antiseptics, Disinfections.

### **PRACTICAL**

1. Different weights & measures (liquid & solid), familiarity with Laboratory, glassware–cleaning of glass wares.
2. Visit to pathology museum for identification of common pathological specimen.

## **PAPER - IV**

### **COMPUTER**

#### **1. Use of computers (Theory) :-**

##### i. Basics of computers:

- Historical evolution, structure & configuration of computers, familiarization with input and out-put devices, their use functions, Algorithms and flow charts.

##### ii. Communication with a computer, common operating knowledge on hardware and software, Operating system, application software, input output statements, MS-DOS.

- iii. Computer languages, simple BASIC Programming.
- iv. Application of windows :
  - MS-Office, MS-Word, MS-Excel, MS-Power point etc. Application of computers in patient treatment
- v. Use of computers in radiotherapy:
  - Application of computers in patient treatment, Treatment planning system, Contouring system, Record & verify systems, networking systems, DICOM facilities.



**PAPER- V**  
**SAFETY COURSE (Theory) :-**

**1. Common Syllabus for the training on "Radiation Safety in Radiotherapy and Radio diagnosis"**

➤ **Basic Radiation Physics :**

Atomic Structure, Nucleus, Atomic No., Mass No., Electron orbit and energy levels, Isotopes and isobars, Radioactivity, Radioactive decay, Half life, Particle radiation, Electromagnetic Radiation, Production of X-rays, Continuous X-ray spectrum, Bremsstrahlung radiation Characteristic X-rays, Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, Properties of X-rays.

➤ **Interaction of Radiation with Matter :**

Photoelectric effect, Compton Effect, Pair production, Ionisation of matter, Energy absorbed from X-rays, X-rays Scattering, X-rays transmission through the medium, linear and mass attenuation coefficient, HVT and TVT, Interaction of charged particle and neutrons with matter

➤ **Radiation Quantities and Units :**

Radioactivity, Flux, Fluence, Kerma, Exposure, Absorbed Dose, Equivalent Dose, Weighting Factors, Effective Dose, Natural Background Radiation, Occupational Exposure Limits, Dose limits to Public.

➤ **Radiation Hazard evaluation and control :**

Philosophy of radiation protection, Effect of Time, Distance and Shielding, Calculation of workload, Calculation of Weekly dose to the radiation worker and general public, good work practices in diagnostic radiology and/or radiotherapy practices (including teletherapy and Brachytherapy), Planning consideration for radiology and/or radiotherapy installation including work load, use factor & occupancy factors, effect of different shielding material.

➤ **Biological effects of radiation**

The Cell, Effect of ionising radiation on Cell, Chromosomal aberration and its application for the biological dosimetry, Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and Chronic exposure, LD<sub>50/60</sub>.

➤ **Detection and measurement of radiation & measuring instruments**

Ionisation of gases, Fluorescence and phosphorescence, Effect on photographic emulsion, Ionisation chambers, Proportional Counters, G.M. Counters, Scintillation Detectors, Liquid scintillator, Pocket Dosimeters, TL Dosimeters and their use in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

## 2. Exclusive Syllabus for the training on "Radiation Safety in Radio diagnosis"

### Physics of Diagnostic Radiology

#### ➤ Introduction:

Familiarization with various X-ray diagnostic tools, Radiological image formation, Use of contrast media, Films, Characteristic of X-ray films, Film Processing, Optical Density Measurements, Different types of Screens, Use of fluorescent screens in radiology, Effect of screening reduction of patient dose, Various types of grids.

#### ➤ QA in Diagnostic Radiology

Verification of Optical and Radiation field congruence, Beam alignment, Focal spot size, Linearity of tube current mA and Timer, applied potential, HVT and total tube filter, Contact between film and intensifying screen, Contrast resolution, Grid alignment, Special techniques like mammography, CT and Digital Radiography.

#### ➤ Regulatory requirements

National Regulatory Body, Responsibilities, organization, Safety Standards, Codes and Guides, Responsibilities of licensees, registrants and employers and Enforcement of Regulatory requirements, Role of technologist in radiology department.

#### ➤ Demonstration:

- Time, Distance and Shielding, measurement of HVT&TVT
- Familiarization of radiation survey meters and their functional performance checks
- Radiological Protection Survey of Diagnostic X-ray installation
- QA on Diagnostic Equipment(s)

## **SECOND YEAR**

### **PAPER- I**

#### **Physics of Radiology and Radiation Protection (Theory) :-**

- 1. Modern Atomic Physics :** Constituents of matters & atomic structure, orbits and orbital, binding energy and mass defect, isotopes, isotones and isobars, electromagnetic and particle radiations.
- 2. Radioactivity:** Radioactivity decay, half-life & mean-life, decay series, modes of decay: alpha, beta and gamma radiation, electron capture, internal conversion, isomeric transition, production of radioisotopes.
- 3. Production of X-Rays :** Discovery and origin of X-rays, Production of X-rays, Nature and properties of X-rays, Energy spectrum, characteristic radiations, Absorption, scattering and quality of X-rays, HVT and TVT, Angular distribution.
- 4. X-ray tube and Generators :** Features of X-ray tube, anode, cathode and filament, characteristics of target materials, cooling system, insulation and tube housing, filters, rating of tubes, faults of X-ray tubes; Gas tube, Hot cathode tube, fixed anode and rotating anode tube, line-focus tube, dual focus tube, Mammography X-ray tube; X-ray generators, power supply : transformers, Half-wave and full-wave rectifications, timer.
- 5. Physical Principles of X-ray Diagnosis:** Radiological images: Photon fluence, Unsharpness, resolution, Contrast, scattered radiation, grids, Radiographic film processing: Film, Density of films, Characteristic curves, gamma factor, film processing, intensifying screens, speed, fluoroscopy.
- 6. Radiation Units:** Units for activity, specific activity, Kerma, exposure, absorbed dose, dose rate, dose equivalent, specific gamma-ray constant, RHM, RMM factors. Effective dose, quality and RBEfactor.
- 7. Radiation Interaction :** Photoelectric effect, Compton effect, pair production, attenuation coefficients; Radiobiology : RBE, OER, Four r's of radiobiology, somatic & genetic effects radiation, dose & dose rate effects, time-dose-fractionation concept, stochastic and non- stochastic effects, LD50/30, survival fraction & target theories.
- 8. Principle of detection of and measurements:** Gas filled detector, Ionisation chamber, proportional counter, GM counter, survey meters, dosimeters and contamination monitors.
- 9. Radiation Hazards-Evaluation & control:** Personal monitoring, Gamma Zone monitor, Filmbadge & TLDbadge, concept of time, distance & shielding, survey of Radiography installations.

**10. Radiation protection and operational limits** : Aims of radiation protection, system of dose limitations, dose limits for radiation workers and general public, Radiation installations, Planning of a Radiological Department : Model lay outs of X-ray rooms & Dark Room, Mammography installations, Universal angiocardiac catheterization Lab, CT-installations, Radiography room of a dental hospital, Planning for radiotherapy installations, Brachytherapy wards, radiological safety levels, ALARA Principle.

## PAPER- II

### Radiography, Imaging & Dark Room Techniques (Theory) :-

#### ➤ General Radiography :

1. Upper Limb : Radiographs of Hands, Metacarpus, Finger thumb, wrist, carpus, carpus / carpal tunnel , forearm, Radio-ulna joints, elbow, head of radius, olecranon process, humerus, shoulder joint, acromion, clavicular joint, scapula, sternoclavicle.
2. Lower Limb: Foot, toes, great toe, tarsus, calcaneus, ankle joint, leg, knee, patella, intercondylar notch, femur.
3. Hip & Pelvis: Hip joint, neck of femur, O.T., procedure of hipping or reduction, pelvis, sacroiliac joint, acetabulum, and pubic bones.
4. Vertebral Column : Curves, postures, relative levels of vertebrae, atlanto occipital region, odontoid process, cervical spine-cervico-thoracic spine, lumbo sacral spine, sacrum, coccyx.
5. Bones of Thorax: Ribs & sternum.
6. Skull & Mandible: Skull & Mandible, Temporomandibular joint general planes, and landmarks of skull, various projections of skull-AP / Lateral / Town's submentovertical / Opticforamina.
7. Facial Bones: Maxilla, Zygoma, Mastoid, petrous bone, nasal bone, orbits PNS.
8. Abdomen: Plain X-ray of abdomen, preparation, positioning for fluid and air level, invertogram.
9. Soft Tissue : Neck; Mammography
10. Chest : Tale Radiography - chest AP/PA/lateral, oblique, lateral decubitus, lordotic, penetrated view, portable X-ray (Supine or recumbent position)
11. Dental Radiography: Occlusal view, dental X-Ray.

#### ➤ Special Radiography :

1. Contrast media, Emergency provisions for contrast reactions.
2. Urinary Tract: Excretory urography, cysto urothography (Retrograde & micturating), Retro grade pyelography, Nephrostography.
3. Billiary Tract: OCG (Oral cholecystogram) per-operative and T-Tube cholangiography ERCP.
4. GI Tract: Barium Swallow, Ba-meal upper part of GI Tract, Double contrast Ba-meal Examination. Hiatus hemiaoesophageal varices, Ba-meal follow through, Ba-enema single & double contract examination, Ba-enema thro' colostomy, fistula.
5. Genital Tract: Hysterosalpingogram, seminalvasiculogram.
6. Angiograph: Carotid, femoral, Aortogram, selective Renalangiography.
7. CNS: Myelography, lumbarradiculogram.

8. Venography: Splenoporto Venography, peripheral, Venography, Superior & inferior Venography.
9. Lymphangiography, Dacrocystography, Sialography, Bronchography, Orthography, Hip, Knee, and wrist joint.
10. Cranial CT, Plain & contrast, whole body CT scan, MRI.
11. Ultrasound of pelvis for obstetrics & gynaecology, pelvis wall, ultrasound of abdomen for gallbladder, liver, kidney and pancreas, spleen.

➤ **Radiography Films :**

1. **Photographic process:** Light image, image produced by radiation, photosensitive material, latent image & permanent image; Radiographic image & its quality : Density, contrast, Definition.
2. **X-ray Films :** Structure of X-ray Film, Resolving power of X-ray film & grains, sensitivity of film, types of radiographic films & other imaging films, dental, occlusal and photo fluorographic film; storage of Films : unexposed films, Exposed films, Factors controlling their quality.
3. **Photographic accessories :** Construction of screen, Cassette and hangers, choice of fluorescent material, Mounting of intensifying screen, Intensifying factors, Radiographic sharpness and contrast, cones, diaphragms, stationary and moving grids.

➤ **Dark Room Techniques :**

**Processing of films:**

- constituent of processing solution, developer and fixer, method of processing of films: rinsing, washing and drying, factors affecting developer and fixer.
- Film processing Equipments: Manual processing, Hangers, tanks
- Dark Room Design: outlay of the equipment and furniture in the dark room, safelight.
- Film Defects: Fog, Stains, error in Radiographic Techniques, artifacts and drying fault.
- Miscellaneous: Trimming, Identification and film legends, record filing report distribution, common radiographic fault in dark room techniques.

**PAPER- III**

**Modern Imaging Techniques (Theory) :-**

1. Mammography: Introduction and historical developments, method of examination, examination of milk duct, Breast Tomosynthesis.
2. Orthopantomography (OPG): Principle, Components of Panoramic Machine, Digital OPG (Principle, Advantage).
3. Cardiac Catheterization: Specialized Equipments.
4. Computed Tomography :Historical Development, Principle, CT Slice, Matrix, Pixel, Voxel, CT number, HU, Windowing, Equipment and methodology, Reconstructed image parameters (3D,VRT,MIP,MPR), Examination protocol, Patient Preparation, Advantages of Spiral CT Scanner, MDCT, Dual Source CT Scanners, Dual-energy CTScanner..
5. Computerized Radiography (Principle, Types, Advantages), Digital Radiography (Principle, Types, Advantages), Xero-radiography (Principle, Types, Component, Charging Procedure, Advantage), Fluoroscopic imaging (Conventional & Digital) & C arm.

6. Magnetic Resonance Imaging : Historical Development and equipments, Basics of MRI, Component of MRI, Image Formation, Biological effect of MRI, Examination protocols.
7. Diagnostic Ultrasound : Historical development and equipments, principles of ultrasonographic scanning, Ultrasound Production, Components of Transducer, Transducer probes, Components of Ultrasound machine, Mode of ultrasound.
8. Nuclear Medicine: Principles of Thyroid uptake, rectilinear scanners and Gramm Camera scanning, PET scan, ScintiMammography.
9. Cath Lab & DSA: Cath Lab, Single Plane C-arm System, Biplane C-arm System, Angiography, Terminology, Angiography Team, Vessel Access for Contrast Media, Equipment for Angiography, General Indications for the Angiography, Benefits of Angiography, Risk during the Angiography, Angioplasty & Stent Placement, Principal, Procedure, Cerebral angiography, Photographic subtraction technique (DSA), interventional Radiography.
10. Pressure Injector.
11. Dry Imaging Camera: Laser-Based Dry Imaging Cameras, Thermal Imaging Cameras.
12. PACS (Picture Archiving & Communication system): PACS Components, Steps of PACS, Advantage of PACS.
13. Bone Mineral Densitometry (DEXA): Principal, Average BMD, Types of DEXA Scanner, Types of X-ray Beam, Pencil-Beam System, component of DEXA, Indications for DEXA, Contraindications, Patient Preparation, Procedure.9
14. CT Simulator: CT Simulation, Components.

## **PRACTICAL**

### **Experiments related to Radio Diagnosis**

1. To check the lead apron for any crack.
2. Survey of an X-ray installation.
3. To demonstrate that the intensifying effect of X-ray intensifying screen is due to the light produced by its fluorescence and not the x-rays.
4. Verification of Optical & Radiation field coincidence.
5. To study the effect of KV & mA on X-ray production.
6. Testing of safelight.
7. Testing of Intensifying screen for uniform and firm contact.
8. Preparation of developer and fixer solution.
9. Loading and unloading of X-ray film and processing.
10. Loading and unloading of imaging film.
11. Identification of imaging film, cassette & screen, Grid. Cones & LBD, safe light, developer & fixer solution.
12. Taking of X-ray of all the parts of human body as per the theory syllabus.

## **PAPER- IV**

### **1. Radiation Hazards & Protection (Theory) :-**

Principles, Types, Sources, Radiation Protection (Definition & Effect) , Radiation safety in X- ray procedure, Principles of Radiation Protection, Time Distance Shielding, Room housing, Room shielding, Patient protection & shielding, Personnel protection & shielding.

### **2. AERB**

The atomic energy act, 1962

The environment (protection act), 1986.

Atomic energy (radiation protection) rules, 2004.  
Aerb guidelines for institution registration

**3. Control of scattered radiation and grids/Bucky**

Methods of minimizing formation of scatter radiation, effectiveness of grids [types (moving grids), composition and grid ratio) in preventing scattered radiation, use of cones, diaphragm light beam devices and effectiveness of collimation in reducing effects of scatter. Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure.

**4. Radiation units Dosimetry and Detection of ionizing radiation**

Units of radiation, ICRU definition of absorbed dose, KERMA exposure, Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose. Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors, thermoluminescent dosimeters, film batches.

**5. Biological effects of radiation**

Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell, DNA, RNA, chromosome, tissue and organ radio sensitivity, cytoplasm, cellular membranes, effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus stochastic and non- stochastic effects, mean and lethal dose, direct and indirect effects, multi target and multi hit theory, factors affecting radio sensitivity, RBE, survival curves, LD<sub>50</sub> and oxygen enhancement ratio. Biological effects of non-ionizing radiation (ultrasound, sound lasers, IR, UV and magnetic fields).

**6. Radiation protection**

Natural and background radiation (cosmic, terrestrial). Principles of radiation protection, time- distance and shielding, shielding calculation and radiation survey, personnel dosimeters (TLD and film batches), occupational exposure, radiation protection of self and patient, ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection.

**PAPER- V**

**Hospital Management (Theory) :-**

1. Organizational Structure of Radiology Department
2. Code of Ethics for Radiographers
3. Importance of Patient care
4. Enema
5. Hospital Charts or Medical Record, or Patient Chart
6. Cleaning, Disinfection and Sterilization Process
7. Hospital-acquired infections(HAI)
8. Safe Handling of Sterilized Instruments and Equipment
9. Injection Techniques
10. Intravenous Drip Setting
11. Oxygen Supply in Hospitals
12. Dignity of Patient
13. Psychology of Patient

14. Patient Preparation in Various Radiological Procedures
15. Special Investigation Tray and Contrast Media
16. Crash Cart or Emergency Trolley
17. Handling of Patients during Radiological Examination
18. Care of Cancer Patient
19. Medico-legal case (MLC), Records & Marks of Identity
20. Record-keeping of the Reported Films & Storage of Unexposed Films
21. Distribution of Reported Films
22. Storage of Waste Films & Used Processing Solution
23. Shops and Establishments Act
24. Municipal by-Laws
25. Hospital Management
26. The International Organization for Standardization
27. Biomedical Waste Management
28. Patient Rights and Responsibilities
29. Hospitals Laws and Regulations

### **Book Reference-**

1. **Hospital Management & Patient Care In Diagnostic Radiology**  
By Dr. N.K. Kardam & Lalit Agarwal  
JBD PUBLICATIONS
2. **Special Radiographic Investigations & Techniques**  
By Dr. Kushal Gelhot & Lalit Agarwal  
JBD PUBLICATIONS
3. **Basic Radiography**  
By Lalit Agarwal  
JBD PUBLICATIONS
4. **Radiology for Residents & Technician**  
By Satish K. Bhargav & Sumeet Bhargava  
CBS Publishers & Distributors Pvt. Ltd.
5. **CLARK'S Positioning In Radiography**
6. **MRI Made Easy By JAYPEE**
7. **Step by Step CT Scan By JAYPEE**

