

DIPLOMA IN MEDICAL RADIATION TECHNOLOGY (DMRT) COURSE CURRICULUM

DMRT COURSE STRUCTURE

Semester	Duration	Paper	Subject	Full Marks
1 st	4 months	I	Section - A : Health, Disease and Environment Section - B : Human Physiology, Related Pathology & Microbiology.	100
		II	Human Anatomy	100
		Practical	Experiments related to Anatomy, Physiology and Pathology.	100
2 nd	8 months	I	Radiotherapy techniques and equipments	100
		II	Use of computers in treatment.	100
		Practical	Experiments related to Radiotherapy	100
3 rd	12 months	I	Physics of Radiology and Radiation Protection	100
		II	Radiography, Imaging and Dark Room Techniques	100
		III	Modern Imaging techniques & Nuclear Medicines	100
		Practical	Experiments related to Radio diagnosis	100

DMRT COURSE SYLLABUS

1ST SEMESTER

PAPER - I

Section -A : Health, Disease and Environment (50 MARKS) (Theory 30hrs)

1. Health and Disease :

Definition of Health, Infections, Communicable, Non-communicable and degenerative diseases, Interaction between agent, host and environment resulting diseases. Modes of transmission of communicable diseases, contact Air-borne, water-borne, Vector-borne and Occupational diseases, industrial situation, Agricultural situation, service and Management situation.

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 :

- i) Village Level: Trained birth attendants, village health guides, Anganwadi workers.
- ii) Sub-centre Level: Females Health workers, Male Health workers and their functions.
- iii) Sector Level: Male Health supervisors, female health supervisors.

- iv) Primary Health Centre-organization, Staffing and functions.
- v) Community Health Centre-organization, staffing and functions.
- vi) Sub-Divisional Level
- vii) District Level : District Health Organization, Staffing and its functions.
- viii) State Level : Health Department, Directorates
- ix) 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, splinting a patient, Transportation of injured, immediate first-aid to Drowning patient.

Section - B : Human Physiology, related Pathology and Microbiology (50 MARKS)

1. **Physiology : (Theory 10hrs Practical 5 hrs)** 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.
2. **Pathology : (Theory 20hrs Practical 10 hrs)** Cell Biology : structure of cell, cell division, Cell growth, cell deformities, defense mechanism, cell damage and cell repair. Definition, Etiology & classification of pathological processes & terms : Infection, Inflammation, Neoplasia, Metabolism, Congenital, Immunity: Fracture, types of fracture, fracture healing, dislocation of joints, Neoplasia : Benign & Malignant including its mode of growth & metastasis. Physical and chemical carcinogens : common Neoplasm of different systems : Oral, oro-pharyngeal, laryngeal, GI tract, Breast, Cervix, Bone tumors, soft tissue sarcoma, penis, lymphoma, Leukemia.
3. **Microbiology : (Theory 10hrs Practical 5 hrs)** Classification of bacteria, virus, fungus : characteristics, shape and arrangements, special characters - spores, capsules enzyme, mortality asepsis, disinfections and

PAPER - II

Human Anatomy

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 upper 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, Radio-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 tests, vas deference, seminal vesicle.
10. **Endocrine system (Name, Location & function) :** Pituitary, Thyroid & Parathyroid Gland, Supra-renal.
11. **Ear :** Structure
12. **Eye:** Bony orbit & soft parts.

PRACTICAL

Experiments related to Anatomy, physiology and Pathology

1. Surface markings 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 on barium study : stomach, small and large intestine)
5. Demonstration of brain & spinal cord.
6. Visit to Anatomy museum for specimen recognition.
7. Respiration / Pulse / Temperature recording.
8. Maintenance of TPR chart.
9. Recording of Blood pressure, Blood Pressure instrument.

10. Different weights & measures (liquid & solid), familiarity with Laboratory, glassware - cleaning of glass wares.
11. Visit to pathology museum for identification of common pathological specimen.
12. Radiography in various positions for all the special radiological procedure using contrast made as per syllabus.

2ND SEMESTER

PAPER - I

Radiotherapy Techniques and Nuclear Medicine

1. **Introduction** : External and internal radiotherapy of radical and palliative intention heliotherapy sources, brachy-therapy sources, linear accelerators, introduction to different radiotherapy machines available in India, patient interaction and information.
2. **Teletherapy**: Features of tele gamma and therapy X-ray machines, machine parameters and their functions, machine specifications and their performance testing, localization of tumors, body contours, depth dose, tumor dose, skin dose, build-up depth, Iso-dose curves, SSD and SAD techniques, Beam modifiers : use of wedges, half shield blocks, blocks, cones, filters, bolus and beam compensators, patient positioning and use of lasers and pointers, control console, safety measures. Gamma-zone monitors, common problems and solutions, maintenance of patient records and machine log books, machine tools and their uses in emergency.
3. Patient simulation, treatment planning system, mould machines and Styrofoam cutter
4. **Brachytherapy**: Different types of brachytherapy, sources of brachytherapy, manual and remedy after loading units, intra-cavitary, interstitial, Intra-luminal and intra-operative applications.
5. **Immobilization techniques**: Preparation of acrylic and POP moulds, moulding casts and orfits, other mould room techniques.
6. **Nuclear Medicine**: Principles of thyroid uptake, rectilinear scanners and gamma camera scanning.

PAPER - II

Use of computers in Treatment

1. **Basics of Computers**: Historical evolution, structure & configuration of computers, familiarization with input and output devices, their use and functions, Algorithms and flow-charts.
2. Communication with a computer, common operating knowledge on hardware and software, Operating system, application software, input output statements, MS-DOS.
3. Computer languages, simple BASIC Programming.
4. Application of windows, MS-Office, MS-Word, MS-Excel, MS-Power point etc.
5. Application of computers in patient treatments.

PRACTICAL

Experiments related to Radiotherapy

1. Different types of patient setups in treatment machines.
2. Familiarization of machine parameters and functions.
3. Treatments with different beam modifiers and accessories.
4. Preparation of moulds as per theory syllabus.

3RD SEMESTER

PAPER - I

Physics of Radiology and Radiation Protection

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 RBE factor.
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, Film badge & TLD badge, concept of time, distance & shielding, survey of Radiography installations natural &
- 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

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, acromioclavicular 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, atlant 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 sub-mentovertical / Optic foramina.
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), RETrograde-pyelography, Nephrostography.
3. Biliary 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, seminal vesiculogram.
6. Angiograph : Carotid, femoral, Aortogram, selective Renal angiography.
7. CNS : Myelography, lumbar radiculogram.
8. Venography : Splenoportal Venography, peripheral, Venography, Superior & inferior Venography.
9. Lymphangiography, Dacryocystography, Sialography, Bronchography, Arthrography : Hip, Knee, and wrist joint.
10. Cranial CT, Plain & contrast, whole body CT scan, MRI.
11. Ultrasound of pelvis for obstetrics & gynaecology, pelvic wall, ultrasound of abdomen for gall bladder, 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 photofluorographic 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 :

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

PAPER - III

Modern Imaging Techniques

1. Mammography : Introduction and historical developments, method of examination, examination of milk duct.
2. Circulation System : Cerebral angiography, Photographic subtraction technique (DSA), interventional Radiography.
3. Cardiac Catheterization : Specialised Equipments.
4. Computed Tomography : Historical Development, equipment and methodology, Reconstructed image parameters, Examination protocol.
5. Digital Radiography, Xero-radiography, Fluoroscopic imaging.
6. Magnetic Resonance Imaging : Historical Development and equipments, Biological effect of MRI, Examination protocols.

7. Diagnostic Ultrasound : Historical development and equipments, principles of ultrasonographic scanning.
8. Nuclear Medicine : Principles of Thyroid uptake, Rectilinear scanners and Gramm Camera scanning.

PRACTICAL

Experiments related to Radiodiagnosis

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 safe light.
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.