

## **SYLLABUS FOR TRAINING X-RAY COURSE CERTIFICATE & DIPLOMA**

1. Structure of X-ray films, Types of X-ray films.
2. Manufacture of X-ray films
3. Characteristics of X-ray films.
4. Safe Light.
5. Testing safe light.
6. Special sensibility.
7. Latent image information.
8. Development techniques.
9. Factors affecting quality of X-ray films in processing.
10. Testing the safe light.
11. Cassettes for X-ray screen films, construction.
12. Factors affecting quality of (X-ray) Radiography.
13. Intensifying screens, types & effects, cleaning & maintenance.
14. Artifacts: Identification, Remedial measures.
15. General Principles of X-rays.
16. Hazards of Radiation.
17. Protective Measures.
18. Film processing room planning, lighting, Air & Ventilation.
19. Types of hangers.
20. Composition & Functions of Developer & fixer Solutions.
21. Disposal of used chemicals.
22. Film drying.
23. Account of expenditure.
24. Loading of 70 mm & 100 mm films.

# RADIOGRAPHERS

Case:

1. Training" Certificate - 12months  
(a) Duration of training Diploma 24 months.
2. The syllabus will cover the following subjects:-
  - (a) Physics
  - (b) Hospital practice and care of the patient
  - (c) Anatomy physiology and pathology (basic)
  - (d) Equipment of radio diagnostic radiography
  - (e) Radio graphic technique
  - (f) First Aid
  - (g) Radiation Protection.
3. Physics: Must be conversant with the following: -
  - (a) **BASIC PHYSICS:**  
Basic ideas on measurement and units; mechanical force, work and energy heat temperature and energy, heat conduction, convention and radiation.
  - (b) **ELECTRICITY AND X-RAY APPARATUS: Electrostatics-**  
Related to X-ray production X-ray valve and tubes- construction of x-ray tubes (inserts and fields) filament design, anode design, methods of cooling, simple high tension circuits- self rectified, half wave full wave, H.T. cables, measurement of high tension, control and indicating equipment- control of tube voltage auto transformer mains voltage compensator, methods of tube voltage indication, control of tube current, filament transformer primary and secondary circuits, tube current indication, control of exposure, contactor and basic principles of times, feeder cables, fuses mains switches earthing, insulation , voltage, electrical hazards.
  - (c) **RADIATION PHYSICS:**  
Outline of atomic structure, electromagnetic radiation waves and quanta, general properties of electromagnetic radiation- = fundamentals of radioactivity. Light- intensity and quality, spectrum of white light, line spectra, photo electric emission, photocell, fluorescence X-ray, production intensity and quality, continuous and characteristic spectra, effects of variation of tube and current production for therapeutic purposes, X-ray and processes of interaction secondary radiation emission and ionisation transmission of a homogeneous beam through an object, transmission through body tissues, transmission of homogeneous X-ray beams reduction in intensity due to absorption and inverse square law, filtration relative amount of scattered radiation in an X-ray beam during its measurement chemical, simple principles of dose meters, the fluorescent specifications and measurement, KVP, half value layer, routine method of checking quality. Basic principles of ultrasound, MRI & C.T.



- (c) **X-ray PROTECTION:**  
 Historical development, permissible exposure, international recommendations for protection of persons exposed to ionising radiation, the protective materials lead, lead-impregnates substances, building materials, lead equivalents and variation with quality, design of tube and room protection, survey of department personnel monitoring.
4. Must be conversant with hospital practice and care of patient hospital departmental procedure.
- (a) Hospital staffing and organisation, records relating to patients and departmental statistics, professional attitude of the radio grapher to patients and other members of the staff, medico legal aspects, minimising waiting time, appointments organisation stock taking and stock keeping.
- (b) **Care of patient:** - first contact with patient in the department handling of chair and stretcher patients, lifting of ill and injured patients, elementary hygiene, personal cleanliness, hygiene in relation to patients. E.g. clean linen and acceptable nursing care, temperature.
- (c) **First Aid:** - Shock, asphy, convulsions, artificial respiration, electric shock, burns, scalds, haemorrhage, pressure point, tourniquet, fractures, splints, bandaging, foreign bodies, poisons, drug reactions, administration of oxygen.
- (d) Preparation of a patient for general X-ray examinations. Departmental instruction to out patients or ward staff, use of aperients, enema and colonic irrigation, flatulence and flatus causes and methods of relief, principles of anaesthesia and intubations, premeditation, its uses and methods, anaesthetised patients, nursing care before and after special X-ray examinations e.g. in neurological, vascular and respiratory conditions diabetic patients, special attention to food, trauma hazards.
- (e) Preparation of patients for special x-ray examinations barium enema, barium meal, intravenous pyelography cholecystography etc. and their administration.
- (f) **Principles and aspects:** - Methods of sterilisation, care and identification of instruments and surgical dressings in common use, setting of trays and trolleys for various examinations etc. intravenous pyelography, biopsy, elementary operating theatre procedure.
- (g) **Drugs in department** - storage, labellings checking, regulations regarding
- (h) **Contrast media** - barium preparations, iodine,
5. Just to be conversant with the following anatomy, physiology & pathology (basic)
- (a) General anatomical terms
- (b) Regions of the body
- (c) Structure of wall and general tissues simple, compound etc.
- Heart and blood vessels, structure and function of heart, pericardium peripheral muscular system names of the main arteries and veins circulation, common terms used in connection with diseases of this system.



- (i) Respiratory system, nasal passage and accessory sinuses, pharynx and larynx, trachea, bronchi and lungs, pleura nature and function of respiration common terms used in connection with diseases of this system.
  - (j) Lymphatic system, lymph and tissues fluid, main lymphatic gland groups and drainage, lymphoid tissue and tonsil.
  - (k) Reticule endothelial system, spleen and liver, bone marrow extent and nature life cycle of the red and white corpuscles of the blood.
  - (l) **Alimentary system**- mouth, tongue and teeth, salivary glands, pharynx and esophagus, stomach small and large bowel liver and billiard tract pancreas, motor functions of alimentary tract, nature of food, digestion and absorption, nature and metabolism, nutrition and dietetics, common terms used in connection with diseases of this system.
  - (m) Urinary tract kidneys, ureters, bladder and urethra, urinary secretion.
  - (n) Reproductive system, male genital tract, testis, epididymus and prostate, female genital tract, fallopian tubes, ovaries, uterus vagina and vulva, the mammary gland pregnancy common terms used in connection with diseases of this system.
  - (o) **Nervous system**- brain, main subdivision & lobes, ventricles, spinal cord, crucial and main system nerve tracts, meaning and cerebrospinal fluid, its circulation autonomic nervous system common terms used in connection with diseases of this system.
  - (p) **Special sense organs** – structure and function of eye, structure and function of ear.
  - (q) Topographical relation of organs of the neck and trunk elementary pathology inflammation, benign and malignant tumours and endocrine disorders.
6. **Knowledge of equipment for diagnostic radiography: -**
- (a) **High-tension control equipment** – Diagnostic H.T. circuits, high tension generators, half wave full wave three phase, condensers discharge, contact voltage high tension switches, control and establishing equipment, tube filament supply, mains compensator mains resistance compensator. X-ray tubes – design, rating and care of X-ray tubes, practical considerations in choice of focus, inherent filtration. MAS meter elementary principles and construction, importance as check on.
  - (i) Radiographic results.
  - (ii) **Apparatus behaviour and additive tube loading, exposure timers** – spring activated, synchronous motor, value (Low-tension ionisation testing timer accuracy). Interlocks and safety devices.
  - (iii) **Circuits** – Simple circuit diagram and illustration of sequence from mains supply to control X-ray exposure beam. Centering devices – mechanical and optical, interaction of X-rays and the body transmission in body tissues.
  - (b) **Scattered radiation** – control of scattered radiation, cones, diaphragm, single and multiple filters grid ratio in relation to KV, construction and operation, focused and non – focused, single stroke reciprocating and oscillating potter – bucky, diaphragms, criss cross grids, stationary grids, use etc.



- Self : healthcare in
- (c) Production of X-ray tubes and high tension circuits for the production of control panel and control safety device and interlocks, basic principles of mega voltage X-ray machines.
  - (d) **Fluoroscopy** – Tube filtration, diaphragm, tilting couch screen grid and exploratory and control safety devices, compressors, protection, electrical radiographic and mechanical control, use and care of couch accessory fittings.
  - (e) **Special equipment** – body section radiography, apparatus and controls simultaneous multi section accessories specialised couches, skull table, mobile units. Image intensifiers, principles, optical systems, for viewing and recording final image electrical and x-ray supply protection, applications, including cine radiography, mass miniature radiography, special radiography, equipment for high speed serial techniques (etc.) rapid cassette changer rapid films changer, roll films, full size and miniature, biplane equipment, grids, protection, problems of processing and presentation, care and maintenance – general principle and routine use of charts supplied by manufactures, radiographic calibration procedure.
7. **Must be conversant with the following radiographic photography:**
- (a) **Photographic aspects of radiography** – the fundamentals of the photographic process, light sensitive salts of silver, the photographic emulsion gelatine as suspension medium, size and frequency of the silver halide grain in relation to sensitivity and contrast, formation of the latent image, chemical development, construction of x-ray film base material, substratum coating, emulsion, coating anti-abrasive super coating sensitivity, storage of unexposed film.
  - (b) **X-ray materials** : - Type of emulsion, characteristics and control screen films, non screen films, dental films, comparative speed and contrast to light and x-rays. Characteristics of x-ray emulsions, characteristics curves of x-ray film assessment of the results of correct exposure under & over exposure, density (D max) speed, contrast (Gamma infinity) graduation, fog, grain, exposure, kilovoltage and developing latitude. Intensifying screens fluorescence application of fluorescence in radiography, construction of an intensifying screen, types of emulsion in relation to type of salt, size of grain, coating, weight, kilovoltage, mounting and general care of screens, after glow test for reciprocal failure, intermittency effect. The X-ray, testing a cassette for proving good screen contact, general case of cassettes. X-ray developers – characteristics and detail freedom from chemical fog and staining, long life possibility of degeneration. Standardisation of quality of developers and development – function and constituents of an x-ray developer, standardisation by time and temperature development latitude, exhaustion of a developer, replenishment of developers, ultra rapid developers, combined developer and fixer, fixers and fixing, hardening agent, time of fixation, exhaustion of a fixer, electrolytic silver recovery and fixer regeneration, rapid fixers, separate hardening. Rinsing, washing and drying – objects of rinsing and washing, methods, employed, methods of drying films, processing – preparation of solutions, available water supply, nature of mixing, vessels, order of mixing solutions, filtration, making stock solutions, storage of dry chemicals, storage of solutions, processing units, hangers, care of hangers, control of temperature by heating elements and thermostat, water mixer, by refrigeration, use of ice – film quality, ultra rapid processing, tank or dish units, stop bath rinse, wetting agents, after treatment of films. Automatic processing principles, procedure and regeneration of solutions.



(c)

### **Technical and processing faults : -**

Chemical reduction – chemistry and characteristics of reducer, local and general application the x-ray dark room size, light proof entrances, construction of walls for protection against chemicals and radiation, ceiling, colour schemes water proofing of floors, loading bench of drying cabinets in darkroom or in adjacent drying room, darkroom illumination and testing for safety, ventilation. The radiographic image radiographic factors affecting image contrast and sharpness, variation in exposure time in accordance with quality of radiation filters distance, intensifying screens, film speed, developer and development. Presentation of the radiograph – identification of film aspect for direct viewing, mounting dental films. **Accessories** – Viewing boxes, including high intensity illumination of small areas, illuminators, projectors and viewing screens for miniature and cine radiography, magnifiers, embossing machine, inscribing materials, film trimmors and corner cutters, dental mouths and cutters filling units.

### **Fluorescent screen photography: -**

Optical principles, basic principles of a camera construction of a camera lens, speed, focal length, function of lens diaphragm focusing, conjugate distances, mirror systems.

### **Equipment for miniature radiography –**

Camera unit with conventional lens, camera unit with mirror system, cassettes, manual and motor driven for single and serial exposures, assessment of photographic requirements, fluorescent screen, spectral omission to provide maximum brightness. Optimum resolution, sensitive material, speed resolutions, colour sensitive material, speed resolution, colour sensitivity of films in relation to spectral omission. Dark room illumination and speed spectral sensitivity of film methods of processing sizes of roll and out film, technique of mass miniatures radiography, exposure technique uniformity, special protective measures, projection records, fillings. Conversant with the following radiographic technique: -

(a) Protection – radiation hazards,

(b) Contrast media – General principles, relationship of x-ray transmission to density and atomic weight of materials employed. Barium Operations –

Barium sulphate, particle size suspending agents concentration, adaption of preparation for a particular uses e.g. dry powder, cream thick and thin liquids, additional modifications, activators, non flocculating suspension, flavouring agents, food mixtures for children, iodine preparations organic, water soluble group, inorganic percentage tests, side effects, dangers, quantity, methods of introduction.

Skeletal system – Upper limb, techniques for whole hand fingers thumb, wrist, joint, carpus, forearm, elbow joint, radio-ulnar joints, lower two thirds humerus, supplementary techniques, carpal tunnel, scaphoid ulnar groove head of radius, supracondylar projections, etc.

Lower limb: - Techniques for whole foot, toes, great toes, calcaneum, talocalcaneal, joint, ankle joint lower leg, knee joint, patella, tibial tubercle, lower two thirds femur, supplementary techniques, position for torn ligaments, comprehensive projections for congenital and acquired flat feet, axial projection to include the talocalcaneal and joint, projections, for loose bodies in knee, infrapatellar for patella, arthrography, etc.



Skull technique for whole skull temporal bones internal auditory meatus sella turcica floor of foramina anterior fossa, jugular foramen magnum orbits, optic foramina, maxillae, zygomatic arches, nasal bones, mandible and temporomandibular joints, etc.  
Teeth, techniques, occlusal projections, vertical, horizontal extra oral projections edentulous subjects, children supplementary techniques, etc.  
Nasal sinuses, techniques frontal maxillary sphenoidal sinuses, erect and horizontal projections, contrast media positioning.

Cardiac vascular system techniques for heart and main vessels, peripheral vessels, supplementary techniques, for aneurysm, cardiac catheterisation, selective angiographic, arterial, capillary and venous. Phases of angiography, carotid, vertebral, etc.

**Cardiac angiography:** Abdominal angiography, portal venography.

- (d) **Respiratory system:** Upper respiratory passage, techniques for post nasal airway, larynx, trachea, thoracic inlet, thyroid and Para thyroid gland supplementary techniques for routine projection, supplementary techniques for anteroposterior, oblique, lordotic projections, unilateral density, full inspiration and expiration, Valsalva maneuvers, etc.  
**Lungs-** technique to define fluid levels, effusions, adhesions, oblique lordotic decubites, projections, supplementary techniques full inspiration and expiration, etc.

- (e) **Diaphragmatic excursion** – double exposure technique, fluoroscopy mediastinum techniques, for routine projections, bronchography, danger of anaesthetised larynx inhibition of cough reflex – methods of introducing contrast medium and positioning during the introduction. Precautions for fluoroscopic control.

- (f) **Genit-urinary system:**

Techniques for plain film for examination, supplementary, techniques, erect, lateral and cross projection, inspiration expiration and double exposure technique, IVP techniques, special consideration, time factor variation with different contrast media and pathological conditions, ureteric compression, danger and contra indications, supplementary techniques oblique, lateral, erect, prone and tilt projections, retrograde techniques special consideration position and identification of ureteric catheters, fluoroscopic control.

### **Cystography**

– Injection, relaxed and straining techniques: Fistulae, micturating – cystography urethrography, selective renal angiography, etc.

- (g) **Obstetrics and Gynaecology :** - Radiation - Precaution special consideration in pregnancy. Factors and accessories, compensatory filters, pregnancy techniques for estimation of fetal development, maturity normality, position and multiplicity, placental localisation soft tissue and contrast media techniques, cystography and arteriography reclining lateral projections – pelvimetry, inlet outlet and erect lateral projections, cephalometry, hysterosalpingography, preparation of theatre and departmental procedure, techniques for routine projection, etc.

- (h) **Elementary system :** -

Techniques for routine projections. Barium swallow Pharynx and oesophagus, supplementary techniques, trachea – oesophagus fistula, Valsalva maneuver. Barium meal and follow through stomach, small and large intestine, compression technique, appropriate timing of film

series, the mucosal pattern, serial exposures supplementary techniques, intestine obstructions, etc.

Diaphragmatic hernia, perforation, post operative techniques Barium Enema.

CT – Principles of CT – Basic Physics – Recent developments, applications etc. MRI – Magnetic Resonance Imaging – Principle – Physics – Techniques – Types of coils – Basic term used in MRI Operations, Applications, etc. U/S Physics – Types of ultrasound – Techniques of ultrasound scanning in different parts – positioning and filming – Principles of Doppler effect and colour Doppler. Structure of x-ray films- Types of X-ray films, manufacture of films characteristics of X-ray films, safe light – testing, safe light – special sensitivity. Latent image formation – development techniques – factors affecting quality of x-ray films in processing. Testing the safe light. Cassettes for X-ray screen films, construction, intensifying screens. Types & effects, cleaning & maintenance. Factors affecting the quality of Radiography. Artefacts: - Identification, remedial measures. General principles of x-rays, Hazards of Radiation. Protective measures, film processing, Darkroom planning, lighting Air & Ventilation. Types of hangers, composition & function of developer & fixer solution. Disposal of used chemicals, film drying Account of expenditure loading of 70 mm & 100 mm.