

MADHYA PRADESH PARAMEDICAL COUNCIL6th Floor, Satpura Bhawan, Bhopal**Syllabus & Guidelines****Serial No. 5****Subjects: -X-ray Technician/Radiographer****No. Of Admission: 0-50 Admission Per Year**

S.N.	Duration/ Degree/ Diploma/ Certificate	Syllabus	Teaching faculty with minimum qualification & experience	Non teaching state with qualification & experience	Library	Laboratory with Equipment	Building		Remark
							Teaching	Hostel	
01	02	03	04	05	06	07	08	09	10
1.	1 year (12 months) Certificate	Appendix 'A'	Professor of Radiology-1. Associate Professor Radiology-1. Assistant Professor Radiology-1. Demonstrator-2. Same as above	Clerk-2. Computer operator-1. Peon-2. Technician-4. Accountant-1 Chowkidar-1. Same as above		X-ray machine 500 MA-1 300 MA-1 X-ray machine 100 MA-1 Facility of Auto injector Image Intensifier system. Same as above	Lecture Theatre- 2500 sqft. Demonstration -3 1250 sqft each. Same as above Same as above	25 room double seated 15' x 20' with kitchen dining rooms, toilets Same as above Same as above	The teaching shall be as per MCI recommendat Same as above Same as above
2.	2 Year (24 months) diploma	Appendix 'A'	Same as above	Same as above		Same as above		Same as above	
3.	B.Sc. Medical Technology (X-ray) 3 Years degree course.	Appendix 'B'	Same as above	Same as above		Same as above			

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SYLLABUS FOR TRAINING 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, convection 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-impregnated 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 radiographer 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) Regime 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 biliary 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.

(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 reciprocity 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.

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 design, disposition of processing and accessory equipment for efficient working, arrangement 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 trimmers 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 talo calcaneal and joint, projections, for loose bodies in knee, infrasuprior 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, Val salve maneuvers, etc.

Lungs- technique to define fluid levels, effusions, adhesions, oblique lordotic decubites, projections, supplementary techniques full inspiration and expiration, etc.

Diaphragmatic excursion – double exposure technique, fluoroscopy media stinum techniques, for routines 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.

B.Sc. Medical Technology (X-Ray) A THREE-YEAR PROGRAMME

Introduction:

In the modern concept of medical service, the importance of the support from Para-medical professionals cannot be over emphasised. It is _____ this reason that the Institute attaches great value to these disciplines and organizes the training programme within its fold with _____ to review and update the course outlines and syllabus periodically keep pace with the newer developments taking place in these fields. B.Sc. Medical Technology (X-Ray) is one such training programme, which has _____ important role to play in the service of suffering humanity.

The training of the candidates registering for B.Sc. Medical Technology (X-Ray) course is aimed at equipping them adequately to carry out _____ the routine and some of the modern sophisticated diagnostic and treatment procedures in a modern hospital. This is a combined training programme in Radio diagnosis and Radiotherapy techniques.

The basis for the training is "in-service training", supplemented a series of lecture-demonstrations on the theoretical aspects of various objects.

The students work by rotation in batches in the disciplines other diagnosis and Radio – therapy. They spend one year and six months in of these principal disciplines during the 3-year training period. The training, both theoretical and practical, is split into two parts on .a only basic.

The students are evaluated by a system of internal assessment three annual examinations. The final examination at the end of the third year is a comprehensive one.

Training:

The training is spread over two major disciplines. i.e. diagnosis and Radio – therapy and includes both lectures and practical. The practical training, the students are posted various rooms and in Radio –diagnosis and Radiotherapy departments and they engage

In the day-to-day work together with the employed technicians or the control of tutor technicians and supervisors. For this purpose, students spend one year and six months in each department and are posted specific period in all the sub-specialities, operation theatres and areas in each department.

Paper- I

1st year**Anatomy and Physiology of Human Body: NO. Of Lectures - 40**

1. Introduction to the body as a whole.

2. The cells: tissues of the body.

The cell: Structure, multiplication.

Tissues: types, structure, characteristics, functions.

Epithelium: Simple: Squamous, Cuboidal, Columnar, Ciliated

Compound: Stratified, transitional

Connective: Areolar, adipose, fibrous, elastic, cartilage, blood and bone. **Muscles:** Striated (Voluntary), smooth (involuntary), Cardiac

Nervous

Fibrosis

Cell regeneration

Membranes: mucous, serous, synovial Osteology (including whole skeleton, bones and joints) Development of bone (osteogenesis): cells involved Types and function of bone, Types of joints and various movement.

Axial Skeleton:

Skill: cranium, face, ear, and sinuses.

Vertebral Column: regions, movement and vertebrae characteristics sternum Ribs

Appendicular skeleton: bones involved – shoulder girdle and upper limb. Pelvic girdle and lower limb.

Healing of bones: cellular activity factors that delay healing. Diseases of bones and joints.

The respiratory system: Organs: Positions and structure nose and nasal cavities

Functions: respiratory, olfactory,

Pharynx Larynx – Functions: respiratory, vocal Teaches, Bronchi,

lungs: lobes, lobules, pleura.

Respiratory function: External and internal respiration common terms relating to diseases and conditions of the system.

Paper II

Radiographic, Photography

No of Lectures: 40

(i) The photographic process: introduction, visible light, image, produced by radiation, light sensitive photographic materials.

(ii) Photographic emulsions: The photographic latent image. Positive process.

(iii) Film materials in x-ray department. History, structure of an x-ray film, single sided films, types of films.

(iv) Spectral sensitivity of film material, graininess of film material, speed and contrast of photographic material.

(v) Sensitometry: photographic density, characteristic curve features of the characteristic curve.

(vi) Variation in the Characteristic curve with the development. Comparison of emulsions by their characteristic curves. Information from the characteristic curve.

(vii) The storage of film materials and radiograph: Storage of unprocessed films, storing of radiographs.

(viii) Intensifying screens and cassettes. Luminescence: fluorescence and phosphorescence. Construction of an intensifying screen.

(ix) The fluorescent materials. Types of intensifying screens. Intensification factor. The influence of KV, scattered radiation. Detail, sharpness and speed, size of the crystals, reciprocity failure.

(x) Cassette design, care of cassettes, mounting of intensifying screens.

- (xi) Care of intensifying screens, tests to check screen film contact and light leakage.
- (xii) **Film processing:** Development: The nature of development, manual, automatic. The PH scale.
- (xiii) The constitution of developing solutions and properties of development chemicals.
- (xiv) The development time, factors in the use of a developer. Developers in processing systems.
- (xv) **Film processing:** fixing and role of a fixing solution. Constitution of the fixing solutions and properties of the Constituents.
- (xvi) Fixers used in automatic processors. Factors affecting the use of the fixer. (xvii) Regeneration of fixing solution. Silver recovery and its various methods. (xviii) Rinsing, washing and drying. Objects of rinsing and washing, methods employed. Methods of drying films.
- (xix) Preparation of solutions and making stock solution.
- (xx) **Processing equipment:** Materials for processing equipment, processors for manual operation, hangers, and control of chemical temperature by heating and thermostat, immersion heaters as well as cooling methods.
- (xxi) Maintenance of automatic processors and common faults.
- (xxii) **Dark room:** Layout and planning. Dark room construction nature of floor, walls, ceiling and radiation protection.
- (xxiii) Type of entry door design. Dark room illumination.
- (xxiv) Dark room equipment and its layout. Location of pass through boxes or cassettes hatches.
- (xxv) **Systems for daylight film handling:** Daylight systems using cassettes and without cassettes.
- (xxvi) **The radiographic image:** Components in image quality- density, contrast and details.
- (xxvii) Unsharpness in the radiographic image. Various factors contributing towards unsharpness.
- (xxviii) The presentation of the Radiograph. Identification markers and orientation. Documentary preparation.
- (xxix) **Viewing accessories:** Viewing boxes, magnifiers, viewing conditions. (xxx) Light images and their recording. The formation of light images. Images formation by mirror, by a lens and aberrations of lenses.
- (xxxi) **Fluorography:** An optical system for image intensifier fluorography. (xxxii) Cameras for fluorography. Sensitometric response of fluorography film. (xxxiii) Processing equipment and procedures, graininess in fluorograms. (xxxiv) Some special imaging processes. Xero radiography, its meaning technique and applications.
- (xxxv) Copying radiograph. Its technique and application.
- (xxxvi) **Subtraction:** Its techniques as applied to radiography as well as its applications.
- (xxxvii) Common film faults due to manufacturing as well as due to chemical processing.
- (xxxviii) Management of the quality of the Radiographic image.
- (xxxix) **Practicals:**
- A. Test to check the X-ray films and screen contact in the cassette.
- B. Test to check light leakage in the cassette.
- C. To prepare a characteristic curve of a radiographic film.
- D. To check the effect of safe light on exposed as well as unexposed X-ray film.

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PAPER- III

ELEMENTARY RADIATION PHYSICS

No. of Lectures-25 No. of practical

demonstrations-10

Structure of matter and principles of machines, electricity and electromagnetism applied in radiological instruments. Physics principles in design and working of x-ray tube technology. Construction and working principles of transformers and autotransformers used in x-ray circuits. Measurement of voltage special KV meters. Measurement of tube current in milli and microamperes. Principles of thermionic emission and rectification in x-ray technology. High voltage D.C. circuits in imaging and therapy tube circuits. Electrical hazards and safety x-ray tube rating in imaging and therapy x-ray tubes and thermal safety. Introduction to intensity of radiation in general and its variation by distance. Introduction to electromagnetic spectrum, definition

of wavelength and its quantum relationship with peak kilovoltage. Physical principles of radiation and optical field coverage and the factor affecting the field projected on patient during x-ray imaging and radiotherapy exponential and trigonometric functions used in radiological calculations.

Radiography Techniques:

No. of lectures:20

No. of Practical demonstration: 20

Skeletal system: Radiography techniques for x-ray of:

- (a) Upper limb with special reference to hand, wrist joint, and elbow joint, supplementary techniques for carpal tunnel, scaphoid bone fracture, head of radius and supra-condylar projections.
- (b) Lower limb which includes all the bones with special reference to ankle joint, knee joint, patella, techniques for calcaneum bone, supplementary techniques for flat, intercondylar notch and femur and metatarsals, etc.
- (c) Shoulder girdle and thorax.
- (d) Vertebral column with special techniques for cervical spine, intervertebral joints and foramina. Lumbo-sacral joint.
- (e) Pelvic girdle and hip region.
- (f) Respiratory system chest radiography for both the lungs, apical, lordotic and oblique views, techniques to decubitus AP and lateral views.

N.B. Only theory classes in 1st year (Paper in IInd year with basic Radiographic Techniques)

OUTLINES OF SYLLABUS FOR SECOND YEAR

(Paper I) 2nd year

No. of Lectures: 40

Anatomy and Physiology of Human Body:

Review of:

Types of cells, tissues, bones and joints. Introduction to system and cavities of the body.

Heart and Blood vessels (Circulatory system) Blood vessels: arteries, veins, capillaries, sinusoids, structure and functions. Heart: Position, structure and functions. Circulation of Blood: Pulmonary, systemic, portal, main blood vessels, their origins and distribution, diseases of blood vessels and Heart and conditions of the system.

The Lymphatic System:

The parts of the lymphatic system.

Lymph channels: Capillaries. Vessels, ducts, structure and functions. Lymph nodes: Position, structure and functions.

Lymphatic tissues: Tonsils, adenoids, and intestinal nodules.

Spleen: Position, structure and functions,

diseases and conditions of the system.

The Digestive System:

Elementary tract structure:

Mouth, pharynx, salivary glands, oesophagus, stomach, liver, gall bladder,

Small intestine, large intestine: Position, structure and functions of these organs. Digestion and Absorption, metabolism of carbohydrates, proteins and fats. Diseases and conditions of the system.

The Urinary System:

Parts of urinary system. Position, structure and functions. Kidneys, ureters, urinary bladder and urethra. Formation and composition of urine. Water and electrolyte balance. Diseases and conditions of the system. **The Reproductive System:**Female Reproductive system:

External genitalia: Position, structure and functions. Perineum. Internal organs: Position and structures, Vagina, uterus tubes, ovaries. Menstrual cycle: Stages, hormone control, and ovulation. Breasts (Mammary glands). Changes: Puberty in pregnancy, during lactation.

Male Reproductive System:

Scrotum, testis, and epididymus: Position, structure and functions. Spermatogenesis.

Spermatic cords, seminal vesicles.

Ejaculatory ducts: Position, structure and functions.

Prostate gland: Position. Urethra and penis: Position, structure and functions.

Functions of male reproductive system,

Puberty.

Diseases of female and male reproductive system.

The Endocrine System:

Endocrine glands,

Pituitary and hypothalamus: Position and structure.

Thyroid gland, Parathyroid glands.

Adrenal (Supra renal) glands. Pancreas: Position, types of cells. Hormones: secretion, function & control, pineal gland. Common terms and diseases related to the system.

The Organs of Sense:

Hearing and the ear:

External, middle and inner ear.

Physiology of hearing & diseases of ear

Sight and the eye: Position, structure, sclera, cornea,

choroids, ciliary body, iris, lens, retina, and optic nerves. Physiology of sight and diseases of the eye.

Sense of smell:

Olfactory nerves, origins, distribution. Physiology of smell. Sense of taste. **The Nervous system:**

Neurones: Structure, types and properties.

Central nervous system: nerves, neurologia meninges.

Ventricles of brain, C.S.F.

Brain, spinal cord: Structure, functions peripheral nervous system.

Spinal and cranial nerves: Origin distribution & functions. Automatic nervous system: S

ympathetic and Para Sympathetic: Origin distribution functions.

Common diseases of the system.

The Skin:

Structure of skin,

epidermis, dermis,

functions of skin,

hypothermia.

Wound healing: Primary and secondary diseases of skin.

Equipment and apparatus construction:

No. of Lectures & Practical demonstration: 40

The following subjects will be taken up: -

(a) High Tension Generators:

The self rectified high-tension circuit. The half wave, four valve full wave, three phase full wave rectified circuit, voltage waveforms in high-tension generators. Constant potential circuits. Rectifiers-valves and solid state.

(b) The X-ray tube:

General features of the X-ray tube. The fixed anode, rotating anode X-ray tube. Rating of X-ray tubes, focal spot sizes. Methods of heat dissipation in X-ray tubes, common tube faults. Developments in the rotating anode tube, tube stands ceiling tube supports.

(c) Components and controls in the X-ray circuits:

The high-tension transformer, the rectification of high tension. The control of kilovoltage, kilovoltage indication, the circuit and control of the tube current. Exposure timers- electronic, automatic. Main voltage compensation. Main supply and the x-ray set.

(d) The control of scattered radiation:

Significance of scatter. Beam limiting devices-cones, diaphragm (colli-meters). Beam centring devices. The secondary radiation grid: its types, components of grid, grid movements. The assessment of grid functions.

(e) Portable and Mobile X-ray units:

Main requirements. Portable x-ray machines and x-ray equipment for operation theatre.

(f) Fluoroscopic Equipment:

Structure of a fluorescent screen, the fluoroscopic image. The fluoroscopic table spot film devices and explorators, protective measures and physiology of vision.

(g) Image intensifiers:

Image intensifier tube, its application, the television process and television tube. Recording of the intensified image. T.V. monitor, video tape recordings, cine radiographic cameras.

(h) Topographic Equipment:

Principle of topography. Various types of topographic movements, multi-section radiography. Transverse axial topography. Equipment for topography.

(i) Equipment for rapid serial Radiography:

The AOT changer, the roll film, cut film changer. Rapid cassette changer.

(j) Equipment for cranial and dental Radiography:

The skull table, general dental x-ray equipment, specialized dental x-ray equipment.

(k) Care, maintenance and tests of x-ray equipment:

General care like cleanliness, practical precautions pertaining to Brakes and locks, cables, meters and controls, tube stands and tracks as well as accessory equipment.

N.B. : Only theory class in 2nd year (exam will be taken in 3rd year with paper II)

PAPER II

RADIATION PHYSICS INCLUDING RADIATION PROTECTION

No. of Lectures: 30

No. of practical demonstration: 10

Atomic structure as applied to generation of x-rays and radioactivity spectrum of diagnostic imaging and therapy x-rays. Effects of variation of tube voltage, current, filtration, HT waveform and target material on x-ray production. Laws of radioactivity and decay schemes of different alpha, beta, gamma ray, negatron and positron emitters as used in medicine especially in radiotherapy. Artificial radionuclide generators employed in medicine in general and radiotherapy sources in particular. Interaction of radiation with matter attenuation absorption and scattering phenomena. Photoelectric absorption, Compton scattering, pair production and annihilation process, ionisation, effects of geometry of thickness of the absorber. Dependence on

the nature and atomic number of the absorber and on radiation quality. Transmission of x-ray through body tissues. Linear energy transfer. Range of secondary electrons and electron build up. Relative amounts of scatter from homogeneous and heterogeneous beam during the passage through a patient. Physical requirements of beam defining devices e.g. cones, diaphragm, collimators etc. Units of radiation measurement specification of quality and half-value thickness (HVT) and its measurements, filters and filtration. Measurements of radiation and dosimetric procedures. Radiation detectors and their principles of working. Definitions of Bragg-peak, percentage depth dose, and peak scatter factor, tissue air-ratio, tissue maximum ratios scatter air ratio, isodose curves and radiation penumbra of different beams. Wedge filters, scattering foils. Physics properties of phantoms, phantom materials, bonus and bolus substitutes. Factors used for treatment dose calculation method. Physical aspects of electron and neutron beam therapy.

Radiation Protection:

Definition of radiation hazards maximum permissible dose and annual limit of intake (ALI), permissible dose levels on and around sealed source housing and installation principles of radiation protection and MPD's of different ICRP rules, stochastic and non-stochastic effects. Importance of 'ALARA' physical principles of design and planning of radiation installation. Safe work practice in tele therapy and Brach therapy. Shielding materials, radiation surveys and personnel monitoring devices film badges. TLD badges, pocket dosimeters.

PAPER III

BASIC RADIOGRAPHIC TECHNIQUES

Skull:

Radiography of cranial bones, cranium, sella turcica, orbit, optic foramina, superior orbital fissure and inferior orbital fissure.

Facial Bones: Para nasal sinuses. Temporal bone.

Dental Radiography: Radiography of teeth-intra oral, extra oral and occlusal view.

Alimentary Tract: Preparation of patients, contrast media for swallow, meal and enema.

Abdomen: Preparation of patient. General, acute positioning for fluid and air levels. Plain film examination. Radiography of female abdomen to look for pregnancy: Intravenous Pyelography and cystography.

Macro radiography: Principle, advantage, technique and applications. **Stereography:** Procedure- presentation for viewing, stereoscopes, stereometry. **Soft tissue techniques:** - Mammography. Localisation of foreign bodies. Ward mobile radiography – electrical supply, radiation protection, equipments and instructions to be followed for portable radiography.

Operation theatre techniques: General precautions, asepsis in techniques – checking of mains supply and functions of equipment, selection of exposure factors, explosion risks, radiation protection and rapid processing techniques.

N.B. : This paper include the syllabus of Radiographic techniques taught in 1st year.

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Paper –IV

Equipment for radiotherapy including newer development

No. of Lectures 25

No. of practical demonstration 10

Orthovoltage equipment with special reference to physical requirements of tube and its accessories and interlocks, gamma ray and source housing and handling mechanism. Principle of isocentric teletherapy machines megavoltage X-ray and electron beam accelerator like tube design, wake guide, target design beam bending system. Radio-frequency generators like magnetron and Klystron. Basic principle of remote after-loading system/ machines and source used. Principle of simulators and vacuum forming machines for making cast. Stereform template cutting system introduction to radio-surgery equipment and dosimetry equipment.

PART-III

PAPER-I

Subject: Radiotherapy Planning and quality control

No. of lecture -25

No. of Practical 10

Demonstration

Definition of treatment planning. Planning procedure in general with special emphasis on tumour localization and target volume measurement by conventional radiographic method and simulator imaging. Role of special contrast medium base radiotherapy, CT/NRI/Ultrasound/radionuclide imaging methods. Physical and clinical requirement of field selection of treatment in teletherapy. Role of portal films in treatment planning. Choice of central axis percentage depth dose data and isodose curves from a spectrum of radiotherapy beams used for treatment. Requirement and practice of organ shielding single, multiple fields pendulum and rotational field therapy planning procedure. Computerized treatment planning system choice of dose, time and fractionation. Safety of critical organ in planning methods. Role of treatment shall immobilization devices and laser in patients set up and positioning.

Acceptance tests on therapy simulators, teleisotope, megavoltage X-ray and electron beam machines. Contribution of technologist in radiation calibration, quality control, assurance in execution of radiation treatment,

PAPER-II

Equipment for Radio-diagnosis including newer

Development and quality control

No. of lecture

No. of Practical 40

Demonstration

Computed tomography: Historic developments, its principle and applications, various generations and applications, various generations and definition of term and cross sectional anatomy.

Diagnostic Ultrasound: Its principle, applications and role in medicine. Various types of transducers and definition of terms and cross sectional anatomy.

Digital radiography: Principle scanned projection radiography, digital subtraction angiography, applications and definition of terms.

N.R.I Principle, applications, its advantage over computed tomography or ultrasonography. Its limitations and uses and cross sectional anatomy.

Quality Assurance in Radiodiagnosis: Aim of quality assurance in medical care Contents of a Q.A. Programme i.e. phases of development of a radiological facility. Q.A. activities applicable in.

i. Equipment section phase.

ii. Equipments installation of acceptance phase.

iii. Operational phase

N.B. This paper includes the syllabus of apparatus construction taught in 2nd year.

PAPER-III

Radiography:- techniques including special procedures.

Radiological procedure pertaining to salivary glands, lacrimal system, bronchography, arthrography and hystero salpangiography-various requirements trolley set up, indications and contra indications, contrast media used.

Ventriculography and encephalography:- Technique, contrast media used, film sequence indication and contra indications.

Myelography: Techniques contrast media used injection of contrast media indications and contra indications.

Intra venous cholangiography, T.Tube: Cholangiography, preoperative/ cholangiography , procedure. Contrast media, indication & contra indication.

Double contrast Barium studies (small bowel enema, Ba enema etc)procedure, requirement indications contra, indication and contrast media used

Angiography: Cerebral , cardiac abdominal aortography general, renal and selective renal splenoportovenography peripheral arterial and venous angiography, precautions radiation protection film changers manual automatic biplane film type- large miniature cine contrast media injection procedure and technique.

Interventional radiological procedures:

PTS PTCP Cine needle aspiration cytology, percutaneous nephrostomy cardiac catheterization- embolization dilations etc.

Title of the book. Name of Authors Publishers

1. The basic physics of radiation Joseph S. Charles C.

Therapy(3rd ed. 1990)

2. Basic Medical Techniques and Torrer L.S. JB Lippi.

Care for Radiological

Technologists 1989 ed.

3. Fourth principles of Radiography Carroll, Qui. Charles C.

Exposures ,Processing and

Quality control(4th Ed.1990)

4. Principles of Radiation therapy Beeley Butterworth

Physical principles of

Diagnostic Radiology

5. Foundations of Anatomy Ross and Wilson Churchill livingstone and physiology

6. An atlas of Radiological weir and Abrahms Piman Medical

Anatomy

7. treatment simulators medical physics

British Journal of radiology corp.USA

supplement.

8. radionuclides in brachy therapy -Do-

radium and after BJR supplement.

9. Quality assurance in radiation M.J. Wizenberg American college of

Therapy a manual for technologists' radiology Chicago

10. Assurance of quality in the diagnostic J.A. Garretetal British Institute radiology

X-ray deptt. The report of the BIR diagnostic

Method methods committee.

11. Essential physics for radiographer Ball and Moore Blackwell scientific wright.

12. Surface anatomy for radiographers Mekear and Owen -do-

13. Radiographic anatomy Bryan G -do-

of the human Skeleton

14. X-ray equipment for students Chesney D.N. and -do-

15. radiographer Chesney M.O.

16. fundamental physics for radiology Meredith and Massey Wright]

17. medical X-ray techniques in Vander plats Macmillan

diagnostic radiology

18. an introduction to the physics Christensen et al Lea and Febiger

(Indian) E.D. K.M. Verghes Co.

of diagnostic Radiology

19. the science of photography Baines H. Halstead, Press

20. Clark's positioning in radiology Kreeel Heinemann

21. principles of radiology Peterson

22. X-ray Physics and Equipment Ashworth Blackwell Scientific publishers
23. physics of radiology John Chales Thomas Springfield USA
24. technological basis of radiation Seymour H. levitt Lea and Febiger therapy: practical clinical application Norah Tapley
25. Physics for radiographer Ball and Moore Blackwell Scientific
26. Care of Patient in dignosic Chesney D.N
Radiogrphy Cheney M.O -do
27. Radiography anatomy Livingstone
the Human Skeleton . Bryan,G.
29. Radiographafic Photography Chesney D.N Blackwell Scientific

Cheney M.O.

30. Radigraphic Photography JENKINS d.n Churchill Livingstone
and imaging processes
31. Medium Dossage
menchenster system
32. Medical techniques in Strip, W -do-
Orthopedic Radiography
33. Concise Textbook of P.Bines & D.J Rees Faber
Radiotherapy
34. Radiotherapy in Modern Hope and Stone Crosby lockwood & Staples
Clinical practice
35. Introducton to Markin& Harbison
Radiation protection

REGULATION FOR THE AWARD OF BACHELOR OF SCIENCE

MEDICAL TECHNOLOGY RADIOLOGY TECHNIQUES DEGREE

1. The Bachelor of medical technology (Radiology Techniques) is a 3-yers intergrated degree course with effect from the admission of 1989 under 10+2+3 system of education.

2. Admission to the first year class of Bachelor of medical Technology (Radiology Techniques) Degree course shall be open to a person

i. who has passed.

10+2 examination in Science group under 10+2+3 system of education or its equilent examination with chemistry, Physics, Mathematics/Biology and English as the subject conducted by a recognized Board/Council/University. Candidates who have passed 10+2 examination in x-ray Technology in vocational scheme conducted by a recognized Board/Council/University will also be eligible.

OR

a. Matic/Higer/Secondary/Pre-University passed with Physics and Chemistry from a Board/Council/Institute.

b. Certificate/Diploma in X-Ray Technology of at-least 5 year duration from a Board/Council/University.

c. Five years experience as x-ray technichan in a teaching/ research Institute after obtaing the qualification and experience mentioned at (a) and (b) above.

ii. The selection of candidates for admission examination to the course is made on merit on the basis of combine entrance examination conducted by the Institute on a all-India basis. The admission notice is released in all the leading English newspapers.

iii. A person shall be eligible to join the second/third year class. Class of the Bachelor of medical Technology X-Ray Techniques/ Course who has passed the First year or the Second Years examination respectively under 10+2+3 system of education of PGI Chandigarh.

3. The examination in first/Second/Thied years shall be open a students who.

a. Has passed not less than one academic year previously the qualifying examination laid down in Regulation 2 above.

b. Has remained on the rolls of the course concerned for full one academic years preceding the examination and attended not less than 90% of the full course of lectures.

4. The Dean of the Institute, on the recommendation of the Co-Ordinators of the course, will have the authority to condone deficiency uo to 5% of the lectures/practicals. the Directors in exceptional cases, can also condone deficiency up to another 5% of the lectures/ Practicals.

5. During each years the student will be eligible for leave of 30 days. No other kind of leave or vacation will be admissible. In exceptional circumstances, a student may be granted 30 days leave **NOT DUE** on the condition that he/she shall work for the same number of days days after the date on he/she would have otherwise complete the course. If any student avails of leave of more than 60 days in any years(I.e. 30 days admissible leave plus 30 days leave not due), his/ her session will be shifted by on year.

EXAMINATION SCHEME

6. The examination for the First, second and third year shall ordinarily be held by the Institute during August. For those candidate who are placed in compartment, a supplementary examination will be held in December or in a month as may be decided by the Director of the Institute.

7. The students shall submit his/ her application fir admission to the examination to the Registrar of the Institute, on the prescribed form, with the required fee and certificates regarding the satisfactory completion of training by the candidate, dully signed by CO-ordinator of the course.

8. The examination for the First, Second and Third year of B,Sc Medical Technology (Radiology Techniques) Course would be held according to the prescribed syllabus.

9. The medium of examination shall be English.

10. The examination for each session will consist of four theory papers carrying 100 marks each. The title of these papers for each session/part are given in Annexure-I.

11. Each theory paper will have 12 question of which the candidate will have to attempt 10 including compulsory question, if any (Examination of parts II and III will also have practical and viva-viva Examination)
12. Internal Assessment : It will be of 100 marks in each subject which will added to the marks of theory examination I the final examination of each year at the rate of 50%.
13. Practical and viva-viva examination:- The practical and viva-voce examination will be held for all three years. The practical and viva-voce examination in each subject will carry 100 marks. Whereas the theory paper in the third examination will be based on the subject matter prescribed for the year. The practical and viva-voce examination will be comprehensive and will cover the whole course.
14. During all the three annual examination the candidate shall have to obtain 50% marks separately in theory plus internal and practical plus viva-voce examination.
15. The answer sheets of the candidates will be evaluated by the examiners setting the theory papers. The successful candidates shall be classified as under on the aggregate marks obtained in the first, Second and third Year examinations taken together:-
 - a. Those who obtain 60 percent or more First Division
of the aggregate marks
 - b. Those who obtain 50 percent or more Second Division
but below 60% of the aggregate marks
16. A candate standing first in the final examination will be eligible for the award of silver medal provided he/she secures a minimum of 70% marks and a candidate will be eligible for the award of a bronze medal provided he/she fulfills the various terms and conditions prescribed by the Institute for the purpose. In case no candate secures the percentage of marks mentioned above he/she will be eligible for the award of book prize.
17. Board of Examiners : The Board of Examiners for each discipline (including subjects) will consist of two external and two Internal examiners. The examiners concerned will set the question papers pertaining to his/her subject and evaluate the answer sheers and conduct the practical and viva-voce examination in the case of Part-II and Part –III examinations. The Co-ordicator of the course will be the Convener Cum-Internal Examiner.
18. Compartment :- A student who obtained 50% of the aggregate marks in three subject but has failed in one subject only obtaining to less than 30% marks inn that subject shall be permitted to appear in that subject only at the next two those examination, he/ she shall be deemed to have passed the examination.
19. A student to whom the above concession is granted shall be eligible to join the next higher class provisionally but if he/she fails to qualify in the compartmental subject at the supplementary: examination. He/she shall be permitted to appear again in the subject along with the annual examination compartment subject even at the second attempt, his/her result for the second year or the third year, as the case may be, shall be cancelled.
20. A failed student or who appearing in the compartmental subject at the supplenetary or the annual examiantio shall be –
 - a. be required to pay examination fee as for the whole examination and
 - b. he/she shall not be eligible for any prize or medal
21. The name of a student who has failed to appear a second time or appeared and failed for the second time in Part I or Part_II examination will be struck off the B.Sc. Medical Technology(Radiology) course of the Institute.
22. The degree of B.Sc Medical Technology (Radiology Techniques) will be awarded to the candidate only after he/she has completed the following.
 - a. Has passed all the three examinations (PartsI , part ii andII)
 - b. Has satisfactorily completed the full period of training of three years and
 - c. His/her work and conduct during the period of training have been satisfactory.

23. The Registrar shall publish the result of the examination as soon as possible after the examination has been held.

PART-I

Paper I. Anatomy and Physiology of Human Body

Paper II. Radiography Photography

Paper III. Elementary Radiation Physics

Paper IV. Radiation provection & Radiation Prology

Part-II

Paper I. Anatomy and Physiology of Human Body

Paper II. Radiography Physics including Radiation Protection

Paper III. Basic RadiographicTechniques

Paper IV. C.T. imaging techniques & M.R I imaging techniques .

Part- III

Paper I. Equipment for Radiodiagnosis including newer development and qualifty control of C.T , M.R.T coth lab radiography & imaging.

Paper II. Special Radiographic techniques incliding special ocedures.

Paper III. Special pcedure & inwestation in RadiographyAngiography, I.V.P Ba- meal, Adirirorgraphy. Cholocystragraph Decchologshography , Silography, Brouchography etc.

Paper IV. Digital Radiography Basic principles and compounded Radiography and internal working procedure C.D. Primary of immges both dynamic and shatre shice.