Government of Karnataka

PARA MEDICAL BOARD

Revised Syllabus
of
II & III Year Diploma in Medical Imaging Technology Courses

(Previously first/second year certificate course / I year DMXT/II DMXT)

2017

Model Curriculum Handbook
MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY

Who is an Allied and Healthcare Professional?

The Ministry of Health and Family Welfare, accepted in its entirety the definition of an allied and healthcare professional based on the afore-mentioned report, though the same has evolved after multiple consultations and the recommended definition is now as follows-

'Allied and healthcare professionals (AHPs) includes individuals involved with the delivery of health or healthcare related services, with qualification and competence in therapeutic, diagnostic, curative, preventive and/or rehabilitative interventions. They work in multidisciplinary health teams in varied healthcare settings including doctors (physicians and specialist), nurses and public health officials to promote, protect, treat and/or manage a person('s) physical, mental, social, emotional, environmental health and holistic well-being.'[1]

Since the past few years, many professional groups have been interacting and seeking guidance on all those who would qualify under the purview of "allied and healthcare professionals". In the healthcare system, statutory bodies exist for clinicians, nurses, pharmacists and dental practitioners; but a regulatory structure for around 50 professions is absent in India. Currently, the Government is considering these professions (as listed Annex-1) under the ambit of the allied and healthcare system. However, this number is subject to changes and modifications over time, particularly considering how quickly new technologies and new clinical avenues are expanding globally, creating newer cadres of such professionals.

Scope and need for allied and healthcare professionals in the Indian healthcare system

The quality of medical care has improved tremendously in the last few decades due to the advances in technology, thus creating fresh challenges in the field of healthcare. It is now widely recognized that health service delivery is a team effort involving both clinicians and non-clinicians, and is not the sole duty of physicians and nurses.[1] Professionals that can competently handle sophisticated machinery and advanced protocols are now in high demand. In fact, diagnosis is now so dependent on technology, that allied and healthcare professionals (AHPs) are vital to successful treatment delivery.

Effective delivery of healthcare services depends largely on the nature of education, training and appropriate orientation towards community health of all categories of health personnel, and their capacity to function as an integrated team. For instance in the UK, more than 84,000 AHPs, with a range of skills and expertise, play key roles within the National Health Service, working autonomously, in multi-professional teams in various settings. All of them are first-contact practitioners and work across a wide range of locations and sectors within acute, primary and community care. Australia's health system is managed not just by their doctors and nurses, but also by the 90,000 university-trained, autonomous AHPs vital to the system.[2,3]

As the Indian government aims for Universal Health Coverage, the lack of skilled human resource may prove to be the biggest impediment in its path to achieve targeted goals. The benefits of having AHPs in the healthcare system are still unexplored in India. Although an enormous amount of evidence suggests that the benefits of AHPs range from improving access to healthcare services to significant reduction in the cost of care, though the Indian healthcare system still revolves around the doctor-centric approach.

The privatization of healthcare has also led to an ever-increasing out-of-pocket expenditure by the population. However, many examples assert the need of skilled allied and healthcare professionals in the system, such as in the case of stroke survivors, it is the support of AHPs that significantly enhance their rehabilitation and long term treatment ensures return to normal life. AHPs also play a significant role to care for patients who struggle mentally and emotionally in the current challenging environment and require mental health support; and help them return to well-being.[2] Children with communication difficulties, the elderly, cancer patients, patients with long term conditions such as diabetes people with vision problems and amputees; the list of people and potential patients who benefit from AHPs is indefinite.

Thus, the breadth and scope of the allied and healthcare practice varies from one end to another, including areas of work listed below:

- Across the age span of human development from neonate to old age
- With patients having complex and challenging problems resulting from systemic illnesses such as in the case of diabetes, cardiac abnormalities/conditions and elderly care to name a few;
- Towards health promotion and disease prevention, as wellas assessment, management and evaluation of interventions and protocols for treatment;
- In a broad range of settings from a patient's home to community, primary care centers, to tertiary care settings; and
- With an understanding of the healthcare issues associated with diverse socio-economies and cultural norms within the society.

Learning goals and objectives for allied and healthcare professionals

The handbook has been designed with a focus on performance-based outcomes pertaining to different levels. The learning goals and objectives of the undergraduate and graduate education program will be based on the performance expectations. They will be articulated as learning goals (why we teach this) and learning objectives (what the students will learn). Using the framework, students will learn to integrate their knowledge, skills and abilities in a hands-on manner in a professional healthcare setting. These learning goals are divided into nine key areas, though the degree of required involvement may differ across various levels of qualification and professional cadres:

1. Clinical care
2. Communication
3. Membership of a multidisciplinary health team
4. Ethics and accountability at all levels (clinical, professional, personal and social)
5. Commitment to professional excellence
6. Leadership and mentorship
7. Social accountability and responsibility
8. Scientific attitude and scholarship (only at higher level- PhD)
9. Lifelong learning

Promoting self-directed learning of the professionals

The shift in the focus from traditional to competency-based education has made it pertinent that the learning processes may also be revisited for suitable changes. It is a known fact that learning is no more restricted to the boundaries of a classroom or the lessons taught by a teacher. The new tools and technologies have widened the platform and introduced innovative modes of how students can learn and gain skills and knowledge. One of the innovative approaches is learner-centric and follows the concept of **self-directed learning.**

Self-directed learning, in its broadest meaning, describes a process in which individuals take the initiative with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying resources for learning, choosing and implementing learning strategies and evaluating learning outcomes (Knowles, 1975).[14]

In self-directed learning, learners themselves take the initiative to use resources rather than simply reacting to transmissions from resources, which helps them learn more in a better way.[15] Lifelong, self-directed learning (SDL) has been identified as an important ability for medical graduates (Harvey, 2003)[16] and so is applicable to other health professionals including AHPs. It has been proven through many studies worldwide that the self-directed method is better than theteacher-centric method of learning. Teacher-directed learning makes learners more dependent and the orientation to learning becomes subject-centred. If a teacher provides the learning material, the student is usually satisfied with the available material, whereas if a student is asked to work on the same assignment, he or she invariably has to explore extensive resources on the subject.[15]
Thus the handbook promotes self-directed learning, apart from the usual classroom teaching and opens the platform for students who wish to engage in lifelong learning.

Integrated structure of the curriculum
Vertical integration, in its truest sense, is the interweaving of teaching clinical skills and knowledge into the basic science years and, reinforcing and continuing to teach the applications of basic science concepts during the clinical years. (Many efforts called 'vertical integration' include only the first half of the process).
Horizontal integration is the identification of concepts or skills, especially those that are clinically relevant, that cut across (for example, the basic sciences), and then putting these to use as an integrated focus for presentations, clinical examples, and course materials. e.g. Integration of some of the basic science courses around organ systems, e.g., human anatomy, physiology, pathology; or incorporating ethics, legal issues, finance, political issues, humanities, culture and computer skills into different aspects of a course like the Clinical Continuum.
The aim of an integrated curriculum is to lead students to a level of scientific fluency that is beyond mere fact and concept acquisition, by the use of a common language of medical science, with which they can begin to think creatively about medical problems.19
This innovative new curriculum has been structured in a way such that it facilitates horizontal and vertical integration between disciplines; and bridges the gaps between both theory & practice, and between hospital-based practice and community practice. The amount of time devoted to basic and laboratory sciences (integrated with their clinical relevance) would be the maximum in the first year, progressively decreasing in the second and third year of the training, making clinical exposure and learning more dominant.[11] However it may differ from course to course depending on the professional group.

Learning methodologies
With a focus on self-directed learning, the curriculum will include a foundation course that focuses on communication, basic clinical skills and professionalism; and will incorporate clinical training from the first year itself. It is recommended that the primary care level should have sufficient clinical exposure integrated with the learning of basic and laboratory sciences. There should also be an emphasis on the introduction of case scenarios for classroom discussion/case-based learning.
Healthcare education and training is the backbone of an efficient healthcare system and India's education infrastructure is yet to gain from the ongoing international technological revolution. The report '*From Paramedics to Allied Health: Landscaping the Journey and way ahead*', indicates that teaching and learning of clinical skills occur at the patient's bedside or other clinical areas such as laboratories, augmented by didactic teaching in classrooms and lecture theatres. In addition to keeping up with the pace of technological advancement, there has been a paradigm shift to outcome-based education with the adoption of effective assessment patterns. However, the demand for demonstration of competence in institutions where it is currently limited needs to be promoted. The report also mentions some of the allied and healthcare schools in India that have instituted clinical skill centres, laboratories and high-fidelity simulation laboratories to enhance the practice and training for allied and healthcare students and professionals. The report reiterates the fact that simulation is the replication of part or all of a clinical

encounter through the use of mannequins, computer-assisted resources and simulated patients. The use of simulators addresses many issues such as suboptimal use of resources and equipment, by adequately training the manpower on newer technologies, limitations for imparting practical training in real-life scenarios, and ineffective skills assessment methods among others.[1] The table mentioned below lists various modes of teaching and learning opportunities that harness advanced tools and technologies.

Table 1 Clinical learning opportunities imparted through the use of advanced techniques[1,20]

Teaching modality	Learning opportunity examples
Patients	Teach and assess in selected clinical scenarios
	Practice soft skills
	Practice physical examination
	Receive feedback on performance
Mannequins	Perform acquired techniques
	Practice basic procedural skills
	Apply basic science understanding to clinical problem solving
Simulators	Practice teamwork and leadership
	Perform cardiac and pulmonary care skills
	Apply basic science understanding to clinical problem solving
Task under trainers	As specific to Operation Theatre Technology

Assessment methods

Traditional assessment of students consists of the yearly system of assessments. In most institutions, assessments consist of internal and external assessments, and a theory examination at the end of the year or semester. This basically assesses knowledge instead of assessing skills or competencies. In competency-based training, the evaluation of the students is based on the performance of the skills as per their competencies. Hence, all the three attributes – knowledge, skills, and attitudes – are assessed as required for the particular competency.

Several new methods and tools are now readily accessible, the use of which requires special training. Some of these are given below:

- Objective Structured Clinical Examination(OSCE), Objective Structured Practical Examination (OSPE), Objective Structured Long Examination Record(OSLER)
- Mini Case Evaluation Exercise(CEX)
- Casebased discussion(CBD)
- Direct observation of procedures(DOPs)
- Portfolio
- Multisource feedback
- Patient satisfaction questionnaire

An objective structured clinical examination (OSCE) is used these days in a number of allied and healthcare courses, e.g. Optometry, Physiotherapy, and Radiography. It tests the performance and competence in communication, clinical examination, and medical procedures/prescriptions. In physiotherapy, orthotics, and occupational therapy, it tests exercise prescription, joint mobilization/manipulation techniques; and in radiography it tests radiographic positioning, radiographic image evaluation, and interpretation of results. The basic essential elements consist of functional analysis of the occupational roles, translation of these roles ("competencies") into outcomes, and assessment of trainees' progress in these outcomes on the basis of demonstrated performance. Progress is defined

solely by the competencies achieved and not the underlying processes or time served in formal educational settings. Most methods use predetermined, agreed assessment criteria (such as observation check-lists or rating scales for scoring) to emphasize on frequent assessment of learning outcomes. Hence, it is imperative for teachers to be aware of these developments and they should suitably adopt them in the allied and healthcare education system.

Background of the profession

Statement of Philosophy– Why this profession holds so much importance

Medical Radiology and Imaging Technology is the health profession concerned with the direct administration of radiation, primarily x-rays, in disease diagnosis and injury assessment and treatment. From the humble beginnings of plain film techniques, we are now with a wide array of imaging methods using Conventional and Digital X-rays, ultrasound, magnetic resonance and Radionuclide. Modern diagnostic radiography and Medical Imaging forms an integral part of medical practice, both in making diagnosis and also in treatment. The term "diagnostic radiography" is used to describe a variety of radiographic or x-ray examinations. These simple procedures as well as those which require the use of contrast agents, make it possible to study organs that otherwise cannot be seen. These professionals are at the heart of modern medicine.

Diagnostic radiographers employ a range of different imaging techniques and sophisticated equipment to produce high quality images of an injury or disease. They take the images using range of techniques including: X-rays, Mammography, Fluoroscopy, CT (computed tomography), MRI (magnetic resonance imaging), Nuclear medicine, Angiography etc. Medical imaging studies have been a cornerstone in medical diagnosis for decades; however, technological advances and the addition of new imaging modalities now place medical imaging among the most dynamic, expanding and high demand fields in clinical medicine.

About Medical Radiology and Imaging Technology

Radiology is a branch of medicine that uses radiation and imaging technology to diagnose and treat disease. It allows the radiologic technologist to produce images of various internal parts of the body, to aid in the detection of injury or disease by using radiations. Radiology is central to the clinical practice of medicine across a wide range of disciplines. It is the best practical way to diagnose, monitor treatment and detect progression or relapse of many important and common diseases in a minimally invasive and anatomically precise manner. As a consequence of the increasing sophistication and accuracy of clinical imaging, the utilization and importance of radiology has increased dramatically and consistently over the last 20 years. In recent years, the increasing complexity of radiologic procedures has made Medical Radiology and Imaging technology a highly specialized and sophisticated science requiring competently trained personnel to maintain a high degree of accuracy in radiographic positioning and exposure technique. A qualified Medical Imaging Technologist is skilled in both interventional and Diagnostic Radiology.

Scope of practice

Diagnostic Radiographers/technologists possess, utilize and maintain knowledge of radiation protection and safety. Radiographers have an extremely thorough understanding of the structure of the body, how the body can be affected by injury, and causes and effects of disease when taking X-ray images. Their work does include a wide range of different imaging modalities radiographers are the primary liaison between patients, radiologist and other members of the support team. They remain sensitive to needs of the patient through good communication, patient assessment, patient monitoring and patient care skills. As members of the health care team, diagnostic radiographer /technologist participate in quality improvement processes and continually assess their professional performance. They engage in continuing education to include their area of practice to enhance patient care, public education, knowledge and technical competence. Diagnostic radiographers use a range of imaging technology:

- X-ray - Penetrate through the body to examine and view internal structures
- Fluoroscopy uses X-rays to obtain real-time moving images of the internal parts of the body.
- CT (Computed Tomography) provides cross-sectional views / images of the body using computer with the help of X-Rays.

- MRI (Magnetic Resonance Imaging)- images of the different tissue types within the body using strong magnet and RF waves
- Ultrasound– uses high frequency sound waves to produce images of the structure within the body. It is well known for its use in obstetrics and gynecology. Also used to check circulation and examine the heart
- Angiography– radiological study which is used to investigate blood vessels.
- Mammography-Imaging of the soft tissue breast
- DEXA—Bone Densitometry.

Recognition of Title and qualification

The practice of medical radiography is performed by health care professionals responsible for the administration of ionizing radiation for diagnostic purposes. In addition to medical radiology and imaging technologists, they are also known as *Diagnostic Radiographers/ Imaging Technologist/ Radio-Diagnosis Technologist.*

The recommended title thus stands as the Medical Radiology and Imaging Technologists for this group of professionals.

A medical radiology and imaging technologist performs radiographic procedures at the request of practitioner. They form an indispensable part of the medical team.

It is a known fact that with the career advancement, the nomenclature will also vary and will also depend on the sector and profile of the professional. Considering the 10 NSQF levels designed by the NSDA, the following level progression table has been proposed by the taskforce to map the nomenclature, career pathways and progression in different sectors of professional practice for medical radiology and imaging technologist. **The proposed progression is for further discussion and deliberation, the implementation time of the same may vary depending on the current system and regulations in place**.

The table 2 below indicates the various channels of career progression in three distinct sectors such as clinical setting, academic and industry (management/sales or technical) route. It is envisaged that the radiology and imaging technologist will have two entry pathways – students with diploma or baccalaureate. The level of responsibility will increase as the career progresses and will starts with **level four (4)** for diploma holders and **level five (5**) for baccalaureate holders. The table also indicates the corresponding level of qualification with experience required by the professional to fulfill the requirements of each level. Considering the degree of patient dealing, the government aims to phase out the Diploma and PG Diploma level courses and promote Bachelor and Master Degree courses. In the academic front, as per UGC guidelines, to work at the position of a Lecturer/Assistant Professor, the candidate must attain Master's degree. At present as there are limited master degree seats in medical radiology and imaging technology thus it has been decided that eventually provisions will be made to provide bridge courses for PG Diploma holder for certain number of years to bring them at par with the master's level courses and universities will be promoted to start master degree courses. The table also indicates that career progression is upto the level 10, however it needs to be stated that the ultimate signatory authority on patient prescription stands with the physician/doctor (radiologist) on role in terms of the clinical interpretation, the director of the unit (clinical route) will be the ultimate authority for the management responsibilities, the final authority for the clinical decisions will be with the radiologist. However, the technologist may sign the computer generated report considering the fact that there is no interpretation of the report needed at that point.

Second Year Diploma in Medical Imaging Technology

(DMXT II)
SUBJECT: RADIATION PHYSICS
SECTION-A Q P Code : 5121

Imaging Equipment
Description
Content establishes a knowledge base in radiographic, fluoroscopic and mobile equipment requirements and design. The content also provides a basic knowledge of quality control.
Content :

I. X-ray Circuit

A. Electricity
1. Potential difference, 2. Current a) Direct b) Alternating , 3. Resistance

B. Protective devices
1) Ground 2) Circuit breaker

C. Transformers
1) Step-up 2) Step-down 3) Auto transformer

D. Components and functions
1) Filament circuit 2) Tube circuit

E. Rectification
1) Purpose 2) Mechanisms

F. Generator types
1) Single phase 2) High frequency (single and three phase)
   a. Constant load – constant mA
   b. Falling load – decreasing mA with time

II. Radiographic Equipment

A. Permanent installation
1) Tubes 2) Collimators 3) Tables 4) Control panels 5) Tube stands 6) Wall units
7. Equipment manipulation

B. Mobile units
1) Components 2) Purpose 3) Applications

C. Automatic exposure control (AEC) devices
1) Ionization chambers 2) Solid state detector 3) Minimum response time
4) Backup time 5) Alignment/positioning considerations
   a. Cell locations, b. Cell size, c. Cell sensitivity/balance
6. Compensation issues
   a. Patient size, b. Pathology/metal, c. Field size, d. Image receptor variations

III. Diagnostic X-Ray Tubes
A. Construction
B. Extending tube life,
1. Warm-up procedures, 2. Rotor considerations, 3. Filament considerations

4. Single exposure limits, 5. Multiple exposure limits, 6. Anode thermal capacity
7. Tube movement

IV. Image-Intensified Fluoroscopy

A. Construction

B. Intensification principles/characteristics

1) Brightness gain 2) Flux gain 3) Minification gain
4) Automatic brightness control (ABC)
5) Multi-field intensifiers
    a. Magnification
    b. Dose
6) Spatial resolution 7) Contrast 8) Distortion 9) Noise

C. Viewing systems

1) Video camera tube 2) CCD 3) CRT/LCD/flat screen monitor

D. Digital fluoroscopy

1) Types of acquisition 2) Operations and technique

<u>SECTION-B</u> Q P Code : 5122

Radiation Production and Characteristics

Description

Content establishes a basic knowledge of atomic structure and terminology. Also presented are the nature and characteristics of radiation, x-ray production and the fundamentals of photon interactions with matter.

Content :

I. Structure of the Atom

A. Composition

1. Nucleus 2. Structure – proton and electron balance
3. Electron shells
    a. Binding energy, b. Valence shell, c. Ionization, d. Excitation

B. Nomenclature

1) Atomic number 2) Mass number

II. Nature of Radiation

A. Radiation

1) Electromagnetic
    a) Spectrum b) Wave-particle duality c) Properties
2) Particulate
    a) Types b) Characteristics
3) Non-ionizing (excitation) vs. ionizing
    a) Energy b) Probability

B. Radioactivity

1. Radioactive decay
    a) Alpha emission b) Beta emission c) Gamma emission
2. Half-life (T½)

III. X-Ray Production

A. Historical introduction

B. Target interactions

1. Bremsstrahlung 2. Characteristic 3. Percentage relationship with energy

C. Common terms related to the x-ray beam

1. Primary beam, 2. Exit/remnant beam, 3. Leakage radiation
4. Off-focus/stem radiation

D. Conditions necessary for x-ray production

1). Source of electrons 2). Acceleration of electrons
3). Focusing the electron stream 4). Deceleration of electrons

E. X-ray emission spectra

1. Continuous spectrum 2. Discrete spectrum
3. Minimum wavelength

F. Factors that affect emission spectra

1. kVp 2. mA 3. Time 4. Atomic number of target 5. Distance 6. Filtration
7. Voltage waveform

G. Efficiency in production

1. Description 2. Frequency and wavelength

IV. Interaction of Photons with Matter

A. Transmission of photons

1. Attenuated radiation 2. Exit/remnant radiation

B. Unmodified scattering (coherent)

C. Photoelectric effect

1. Description of interaction 2. Relation to atomic number
3. Energy of incident photon and resulting product
4. Probability of occurrence
    a. Atomic number, b. Photon energy, c. Part density
5. Application

D. Modified scattering (Compton)

1. Description of interaction 2. Relation to electron density
3. Energy 4. Probability of occurrence

E. Pair production

F. Photodisintegration

A. Magnetic resonance (MR) imaging, nuclear medicine, ultrasonography, mammography, bone densitometry, interventional radiography

1. Basic principles of operation
2. Image data presentation/appearance

Introduction to Computed Tomography

Description

Content is designed to provide entry-level radiography students with an introduction to and basic understanding of the operation of a computed tomography (CT) device. Content is not intended to result in clinical competency.

Content :

I. Components, Operations and Processes

A. Data acquisition

1. Methods
    a. Slice-by-slice b. Volumetric
2. Elements
    a. Beam geometry
    1) Parallel 2) Fan 3) Spiral 3. Data acquisition system (DAS)
    a. Components
    1) Tube 2) Detectors 3) Filters 4) Collimators 5) ADC
    b. Functions
    1) Measurement of transmitted beam
    2) Data transmission to computer
    4. Data acquisition process
        a. Scanning/raw data/image data
        1) Rays 2) Views
        3) Profiles
            a) Pixels, b) Matrices, c) Voxels, d) Attenuation

1) Linear attenuation coefficients
2) CT numbers (Hounsfield numbers)
    a) Baseline reference numbers
        i) Water equal to 0
        ii) Bone (white) equal to 400 to 1000 HU
        iii) Air (black) equal to -1000 HU
    b. Selectable scan factors
        1) Scan field of view 2) Display field of view 3) Matrix size
        4) Slice thickness , 5) Algorithm 6) Scan time and rotational arc
        7) Radiographic tube output, 8) Region of interest (ROI)
        9) Magnification 10) Focal spot size and tube geometry

B. Factors controlling image appearance

C. Anatomical structures

1. Artifacts 2. Contrast resolution (window width)
3. Grayscale manipulation (window level)
4. Distortion 5. Noise 6. Spatial resolution

Suggested Reference Books Of Radiation Physics & Medical Physics

1. Christensen, Curry And Dowdy: An Introduction Of The Physics Of Diagnostic Radiology (Lea Febiger) 2nd Ed.

2. D.N. And M.O. Chesney, X-Ray Equipment For Student Radiographers (Cbs)

3. W.J. Meredith & J.B. Massey: Fundamental Physics Of Radiology. (Varghese Publishing House).

THEORY EXAMINATION -100 MARKS

Section A : 50 Marks

I. Short Notes:

1. 5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:

2. 3 marks X 10 questions = 30 marks (Answer All 10 Questions)

Section B : 50 Marks

I. Short Notes:

5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. Short Answers:

3 marks X 10 questions = 30 marks (Answer All 10 Questions)

Examination Pattern:

Theory Examination only. No practical exam.

<u>Second Year Diploma in Medical X-Ray Technology</u>

(DMXT II)
SUBJECT: ANATOMY
Q P Code : 5123

General Anatomy:

1. Introduction to Anatomy:
   a. Definition of Anatomy
   b. Anatomical position
      - Supine, prone, lithotomy → positions
   c. Different parts of human body: → Axial / → Appendicular

      →Head and neck, Thorax and abdomen, pelvis and perineum, upper and lower limbs.
   d. Anatomical planes and sections: Median, sagittal, coronal, transverse, longitudiual, horizontal, oblique.

   e. Anatomical terms:
      Anterior, posterior, superior, inferior, medial, lateral, proximal, distal, superficial, deep, ventral, dorsal, cephalic, caudal, interior, exterior, invagination, evagination, ipsilateral, contralateral.
   f. Terms for describing muscles:
      Origin, insertion, Belly, tendon, aponeurosis, raphe.
   g. Anatomical movements:
      Flexion, extension, adduction, abduction, Medial rotation, lateral rotation, circumduction, pronation, supination, protraction, retraction, elevation, depression.

2. <u>Basic tissues:</u> Definitions of
   Epithelium, connective tissue (including cartilage and bone), muscle, nerve.

3. <u>Skeletal System:</u> → Parts of a young long bone (epiphysis, diaphysis, metaphysis), ossification.

Types and number of bones: Identification of each bone with its major features (ex: Femur with its upper end, lower end, shaft, trochanters, condyles, linea aspera etc)

Radiological anatomy with radiograms

Arthrology and kinesiology in detail with classification of Joints and study of large synovial joints, their parts, movements (shoulder, elbow, wrist, Hip, Knee, Ankle & T.M. Joints)

4. Anatomy of Thorax

   Thoracic cage → Types

   Diaphragm, vertebral column.
5. Skull as a whole with different views
6. Systemic Anatomy:

   The student should be able to identify and understand the anatomical components of each system with functional co-relation. (Diagrams, models, specimens from the dissected cadavers and colour photographs, 2D and 3D animation techniques can be used to teach.)

a. Surface anatomy of each organ/structure with regards to location, is “must”.
b. Respiratory system→ Nose with paranasal air sinuses, Larynx, trachea and lungs → Identification and functions, Mediastinum and diaphragm.
c. Cardiovascular system

   Heart, major arteries and veins (Aorta, common carotid, subclavian, Renal, common iliac, internal and external iliac arteries, Internal and external carotid arteries, vertebral artery, Radial and femoral arteries, Jugular veins (both internal & external), superior and inferior vena cava, portal vein).

   → Identification only
d. Lymphatic system → spleen, Lymph nodes, Thymus → Identification and functions.
e. Nervous system → Parts of CNS → identification only.
f. Endocrine system → Pituitary, Thyroid, Parathyroid, Adrenal glands - location, parts and functions.
g. Urinary system → parts and urinary passages → Kidney, ureter, urinary bladder and urethra.

h. Reproductive system- parts of male and female reproductive systems including mammary gland → location and identification only.
i. Digestive system and glands associated.

Practicals

Gross Anatomy (including Surface anatomy) only

The students should maintain practical records and submit the same to the HOD of Anatomy for scrutiny.

Basic tissues to be demonstrated for identification.

1. Identification of each bone in the body → demonstration and understanding of major features of bones, under the following.

   i. Appendicular skeleton

   ii. Axial skeleton
2. Identification of each joint in the body with demonstration and understanding of bones forming the joints.
3. Radiological anatomy of bones and joints studied under 1 & 2.
4. Identification and surface anatomy of organs and tissues studied under theory→ system-wise study and their functions in brief.

Examination Pattern:

Theory Examination only. No practical exam.

THEORY EXAMINATION -50 MARKS

Section A : 50 Marks

I. Short Notes:
5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

(DMXT II)
SUBJECT: PHYSIOLOGY
Q P Code : 5124

GENERAL PHYSIOLOGY (Duration of Teaching - 3 Hrs)

Introduction:-

Physiology - Homeostasis

Cell:-
Structure of a Cell, Intracellular Organelles, Cell Junctions, Stem Cells, Cell Aging & Death

Transport through cell membranes:-
Mechanisms of Transport across Cell Membrane

Body Fluids:- Compartments of Body Fluid, And Measurement Of Body Fluids.
BLOOD (Duration of Teaching - 7 Hrs)
Composition & Functions of Blood
Plasma:- Composition and Functions of Plasma Proteins
Cellular Components of Blood:-
(RBC, WBC, PLATELETS) Morphology, Physiological Values, Functions, Formation Of Hemopoietic Cells, Life Span & Applied Aspects
Hemoglobin:- Formation, Functions, Physiological Values, Destruction Of RBC, Applied Aspects
ESR, PCV, Blood Indices & Anemia
Blood Groups:- ABO Blood Grouping, Rh Typing, Landsteiner's Law, Cross Matching, Storage Of Blood, Indications And Contraindications Of Blood Transfusion.
Hemostasis:- Clotting Factors, Anticoagulants, Applied Aspects

EFFECTS OF RADIATION ON HEMATOPOIETIC SYSTEM.
NERVE PHYSIOLOGY (Duration of Teaching - 3 Hrs)
Nerve:- Structure, Types Of Neuralgia Cells, Functions Of Nerves
Receptors:- Definition, Types Of Sensory Receptors.
Reflex:- Arc, Action & Reflexes.
Autonomic Nervous System:- Organization And Functions
Synapse & Neuromuscular Junction

MUSCULOSKELETAL SYSTEM (Duration of Teaching - 2 Hrs)
Types of Muscle, Functions of Muscle
Types of bones, Functions of bones

EFFECTS OF RADIATION ON BONE

GASTROINTESTINAL PHYSIOLOGY (Duration of Teaching - 3 Hrs)

Structural overview: of Gastrointestinal Tract
Movements of GIT
Salivary Glands- Its Secretions and Functions,
Hepatobillary System - Secretions and Its Functions
Pancreatic - Secretions and Its Functions
Intestinal- Secretions and functions
Applied Aspects In GIT. Defecation

THE CARDIOVASCULAR SYSTEM(Duration of Teaching - 4 Hrs)

Anatomy Of The Heart, Structure And Function Of Cardiac Muscle, Conducting System Of Heart, Systemic And Pulmonary Circulation, Over View -Heart Rate, Stroke Volume, Cardiac Output, Heat Sounds, Pulse, BP &ECG And Recording Of ECG.

RESPIRATORY SYSTEM (Duration of Teaching - 3 Hrs)

An Overview of respiratory system: air way anatomy, muscles of ventilation, Functions of respiratory system, ventilation: exchange & transport of respiratory gases, compliance, surfactant.
Spirometry: dynamic and static volumes and capacities
Applied aspects: artificial respiration, hypoxia.

RENAL SYSTEM (Duration of Teaching – 4 Hrs)

Overview of Anatomy of kidneys, renal blood flow, structure of Nephron.
Renal and non renal functions of kidney
General principles of formation of urine, GFR, auto regulation of GFR and Renal blood flow, estimation of GFR
Renal regulation of acid base balance,

ENDOCRINE SYSTEM (Duration of Teaching - 4 Hrs)

Over view of endocrine system; hypothalamic hormones, Functions and applied aspects, hormonal regulation by positive and negative feedback mechanism of **Anterior & Posterior Pituitary Hormones, Thyroid Hormones, Parathyroid Hormones, Pancreatic Hormones, Adrenal Cortical Hormones**.

REPRODUCTIVE SYSTEM(Duration of Teaching - 3 Hrs)

Over view: Male And Female Reproductive System Functions Of Male And Female Gonads, Menstrual Cycle
Oogenesis And Spermatogenesis, Fertilization, Implantation And Parturition, Male Reproductive Hormones It Functions & Cryptorchidism

Female Reproductive Hormones And Its Functions,
Pregnancy Tests And Contraceptive Methods In Male And Females.

CNS & SPECIAL SENSES(Duration of Teaching - 4 Hrs)

Functional Organization Of Brain, Spinal Cord & Its Functions, Cranial And Spinal Nerves.
CSF Composition And Functions.

Special Senses :

Vision: Structure And Functions Of Eye Ball, And Errors Of Refraction And Correction.

Hearing : Structure And Function Of Ear, Audiometry.

Tongue : Taste Buds, Primary Taste sensation and abnormalities of taste

Examination Pattern:

Theory Examination only. No practical exam.

THEORY EXAMINATION -50 MARKS

Section A : 50 Marks

I. **Short Notes:**
5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

(DMXT II)
SUBJECT: PATHOLOGY
Q P Code : 5125

Syllabus

i. Introduction to Pathology & Various branches of Pathology
ii. Definitions and terms used in Pathology – with examples. Cell injury – hyperplasia, Hypertophy, Hypoplasia and atrophy – Inflammation and repair - Definition, Types with examples,

Healing of fractures, Callus

Haemodyanic changes – Edema, Thrombosis, Embolism, Infarction, Necrosis and Gangrene – Definitions, Types and examples.

- Neoplasia – Definition, Types with examples, characters of Benign and Malignant tumours.
- Nutritional disorders – causes and deficiency diseases – Vitamin – A,B,C and D – Kwashiorkar, Marasmus and Obesity.

Systemic Pathology

a. Diseases of the Bone – Oeteomylitis – Type and examples Syquestrum, Involucrum, cold abcess, Pyogenic abcess, Osteopdrosis, Arthritis (Stress on Rheumatoid and Osteoarthritis) and Fractures- Definitions & Examples.
Brief account on Tuberculosis of Bone and Spine, Tumours – Osteochondroma.

b. Diseases of the Lung – Pnueomonia, Pleural effusion, Emphysema – Definitions, Types and Examples.
Brief note on TB Lung including primary complex, Lung tumours

(Bronchogenic Carcinoma)

c. Diseases of Paranasal Sinuses – Sinusitis, Epistaxis – Cause, Nasal Polyps
d. Renal System – Congenital anomalies, Calculus, Hydronephrosis Tumours of the kidney and Bladder.
e. GIT – Achalasia cardia, Hiatus hemia, Causes of stenosis and Strictures of Oesophagus, Ca oesophagus, Gastric ulcer, Ca Stomach Duodenal ulcer, Pyloric stenosis, Leather bottle stomach, Ca Colon, Clcers in the intenstines
f. Liver & Gall Bladder – Gall Stones, Cholecystitis, Fatty liver, Cirrhosis, Ca Liver – Definition and brief account.
g. CardiovascularSystem – Rheumatic heart disease, Myocardial infarction, Aneurysm of aorta, Pericardial effusion, causes of Cardiomegaly.

h. **Thyroid** – Goiter, Thyrotoxicosis – Definition causes and types
- Ca Thyroides - Names

i. **Breast** – Fibroadenoma, Phylloides tumour, Ca Breast, - Brief account.
j. **Female Genital Tract** – Fibroid uterus, Ovarian tumours, Ca Cervix and Endimetrium – Brief account.
NOTE: Above mentioned topics should be covered briefly with definitions, types and examples of the lesion wherever necessary.

Examination Pattern:

Theory Examination only. No practical exam.

THEORY EXAMINATION -50 MARKS

I. **Short Notes:**
5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

Paper	SUBJECT	SECTION	Question paper Code	MAX. MARKS
Paper 1	Radiation Physics	Section A	**5121**	50
		Section B	**5122**	50
Paper 2	Anatomy		**5123**	50
Paper 3	Physiology		**5124**	50
Paper 4	Pathology		**5125**	50

Third Year Diploma in Medical Imaging Technology

PAPER-I– RADIOGRAPHIC POSITIONING & RADIOGRAPHIC PHOTOGRAPHY

THEORY 100 HRS
PRACTICALS 200 HRS

SECTION-A **Q P Code 6121**

Principles of Imaging

I. Fundamental Principles of Exposure
1. Milliampere-seconds (mAs) 2. kVp 3. Collimation 4. Grid
5. Source-to-image distance (SID) 6. Speed class 7. Fog

II. Beam-limiting Devices
A. Function/Purpose
1. Reduce irradiated tissue volume 2. Reduce patient effective dose
3. Improve contrast
B. Types – applications
1. Cylinders 2. Collimator 3. Lead masks 4. Alignment

III. Grids
A. Function/mechanism
B. Construction
Patient Care in Radiologic Sciences
Responsibilities of the radiographer
1. Performing radiographic examination 2. Performing patient care and assessment
3. Adhering to radiation protection guidelines 4. Following practice standards
5. Assisting the radiologist

IV. Safety and Transfer Positioning
A. Environmental safety
1. Fire 2. Electrical 3. Hazardous materials 4. Radioactive materials
5. Personal belongings 6. Occupational Safety and Health Administration (OSHA)
7. Environmental Protection Agency (EPA)
B. Patient transfer and movement
1. Assess the patient's mobility 2. Rules for safe patient transfer
3. Wheelchair transfers 4. Stretcher transfers
Asepsis
a. Hand washing b. Chemical disinfectants

V. Medical Emergencies
A. Terminology
B. Emergency equipment
C. Shock signs and symptoms
Fainting and convulsive seizures – signs, symptoms and interventions
Trauma - Head injuries, Spinal injuries, Extremity fractures, Wounds, Burns

Reactions to Contrast Agents Signs and symptoms , Medical intervention

D. Mobile and Surgical Radiography

Steps followed during bedside procedure

Bedside procedure for the orthopedic patient

Radiography in surgery

VI. Radiation Effects

A. Subcellular radiation effects

1. Radiation effects on DNA
    a. Types of damage
    b. Implications for humans
2. Radiation effects of chromosomes
    a. Types of damage
    b. Implications for humans

B. Cellular radiation effects

Reproductive failure, Interference of function

C. Individual radiation effects

1. Somatic effects

a. Short-term b. Long-term c. Stochastic effects

D**. Genetic effects**

a. Mutagenesis
b. Genetically significant dose (GSD)

E. Embryo and fetal effects

VII. Radiation Protection

A. Justification for radiation protection

1. Somatic effects 2. Genetic effects

B. Potential biological damage of ionizing radiation

1. Stochastic (probabilistic) effects, 2. Nonstochastic (deterministic) effects

C. Objectives of a radiation protection program

1. Documentation , 2. Occupational and nonoccupational dose limits
3. ALARA concept (optimization) 4. Comparable risk
5. Negligible individual dose (NID)

D. Sources of radiation

1. Natural 2. Man-made (artificial)

VIII. Radiation detectors

1. Area monitors 2. Personal detectors

Cardinal principles in protection

1. Time 2. Distance 3. Shielding

IX. Patient Protection

A. Beam-limiting devices B. Filtration C. Shielding D. Exposure factors
E. Positioning F. Image receptor system G. Immobilization

H. Fluoroscopic procedures
I. Mobile radiography

SECTION-B Q P Code 6122

RADIOGRAPHIC PROCEDURES

I. Standard Terminology for Positioning and Projection

A. Standard terms

1. Radiographic position 2. Radiographic projection 3. Radiographic view

B. Positioning terminology

1. Recumbent 2. Supine 3. Prone 4. Trendelenburg 5. Decubitus
6. Erect/upright 7. Anterior position 8. Posterior position 9. Oblique position

C. General planes

1. Sagittal or midsagittal 2. Coronal or midcoronal 3. Transverse
4. Longitudinal

D. Skull lines

1. Glabellomeatal line 2. Interpupillary line 3. Orbitomeatal line
4. Infraorbitomeatal line 5. Acanthiomeatal line 6. Mentomeatal line

E. Skull landmarks

1. Auricular point 2. Gonion (angle) 3. Mental point 4. Acanthion
5. Nasion 6. Glabella 7. Inner canthus 8. Outer canthus 9. Infraorbital margin
10. Occlusal plane 11. External auditory meatus 12. Mastoid tip

F. Terminology of movement and direction

1. Cephalad/caudad 2. Inferior/superior 3. Proximal/distal 4. Plantar/palmar
5. Pronate/supinate 6. Flexion/extension 7. Abduction/adduction
8. Inversion/eversion 9. Medial/lateral

G. Positioning aids

1. Sponges 2. Sandbags 3. Immobilization devices

H. Accessory equipment

1. Calipers 2. Lead strips 3. Lead shields or shadow shields
4. Lead markers 5. Image receptor holders

<u>II. General Considerations</u>

A. Evaluation of radiographic orders

1. Patient identification 2. Verification of procedure(s) ordered
3. Review of clinical history
4. Clinical history and patient assessment
    a. Role of the radiographer b. Questioning skills
    c. Chief complaint d. Allergy history e. Localization
    f. Chronology g. Severity h. Onset i. Aggravating or alleviating factors
    j. Associated manifestations k. Special considerations
5. Exam sequencing

B. Room preparation

1. Cleanliness, organization and appearance
2. Necessary supplies and accessory equipment available

III Patient Considerations

A. Establishment of rapport with patient

1. Patient education
    a. Communication
    b. Common radiation safety issues and concerns
2. Cultural awareness 3. Determination of pregnancy

B. Patient preparation

1. Verification of appropriate dietary preparation
2. Verification of appropriatemedication preparation
3. Appropriate disrobing and gowning
4. Removal of items that may cause artifacts

C. Patient assistance

D. Patient monitoring

E. Patient dismissal

IV. Positioning Considerations for Routine Radiographic Procedures

A. Patient instructions

B. Image analysis

1. Patient positioning 2. Part placement 3. Image receptor selection and placement
4. Beam-part-receptor alignment 5. Beam restriction and shielding

C**. Special considerations**

1. Atypical conditions 2. Mobile procedures 3. Surgical unit procedures
4. Special needs patients 5. Trauma 6. Obesity 7. Cultural awareness
8. Claustrophobia

V. Positioning for the following studies:

1. Skeletal system
    a. Upper extremity

1) Fingers 2) Hand 3) Wrist 4) Forearm 5) Elbow 6) Humerus

    b. Shoulder

1) Shoulder joint 2) Scapula 3) Clavicle 4) Acromioclavicular articulations

    c. Lower extremity

1) Toes 2) Foot 3) Ankle 4) Calcaneus 5) Tibia/fibula 6) Knee 7) Patella
8) Femur

    d. Pelvic girdle

1) Pelvis 2) Hip

    e. Vertebral column

1) Cervical 2) Thoracic 3) Lumbar 4) Sacrum 5) Coccyx 6) Sacroiliac articulations
7) Scoliosis survey

    f. Bony thorax

1) Ribs 2) Sternum 3) Sternoclavicular articulations

    g. Cranium

1) Skull 2) Facial bones 3) Nasal bones 4) Orbits/optic foramina
5) Zygomatic arches 6) Mandible 7) Temporomandibular articulations
8) Paranasal sinuses

    h. Special studies

1) Bone survey 2) Long bone measurement 3) Bone age 4) Foreign body
2. Respiratory system
    a. Upper airway
    b. Chest

Reference Book:

1. Philip W.Ballinger: Atlas Of Radiographic Positioning And Radiological Procedures (Mosby)
2. Ra Swallow, E Naylor: Clarks Positioning In Radiography E J Roebuck, A S Whitley
3. Sante Lr: Roentgenologic Technique (Edwards Inc)
4. Goldman: A Radiographic Index
5. Ross And Gailway: A Handbook Of Radiography (Lewis)
6. Glenda J.Bryan: Diagnostic Radiography (Mosby)
7. Piles: Medical Radiographic Technique (Thoms).

THEORY EXAMINATION -50 MARKS

Section A : 50 Marks

I. **Short Notes:**
5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

Section B : 50 Marks

I. **Short Notes:**
5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

PAPER-II– SPECIAL PROCEDURES, RADIOGRAPHIC PHOTOGRAPHY AND MEDICAL RECORDS

THEORY 100 HOURS
PRACTICAL 250 HOURS

SECTION-A **Q P Code 6123**

Contrast media
Types of contrast and dosage
Toxicity and side effect and treatment

GASTRO - INTESTINAL TRACT

1. Barium Swallow, 2. Barium Meal, 3.Hypotonic Duodenography,
4. Barium Meal Follow Through, 5.Small Bowel Enema, 6.Barium Enema
7. Special investigation – Ultrasound & Computed Tomography.

HEPATOBILIARY SYSTEM

1. Oral Cholecystography, 2. Intravenous Cholangiography
3. Per Operative Cholangiography, 4.Post Operative T tube Cholangiography
5. Percutaneous Transhepatic Choledochography, 6.Endoscopic Retrograde Cholangioopancreatography, 7. Special Investigation : Ultrasound ,Radio Isotope Scanning,Computed Tomography & MRI

URINARY SYSTEM:

1. Intravenous Urography, 2.Ascending Urethrography,
3.Micturating Cysto Urethrography, 4.Reterograde Pyeloureterography
5. Percutaneous Nephrostomy, 6. Additional Investigation : Ultrasound Scanning, Radio-Isotope, Computed Tomography, 7.Magnetic resonance Imaging

REPRODUCTIVE SYSTEM

1. Hystero Salpingogram
2. Special Investigations :Ultrasound Scanning, Computed Tomography , Magnetic Resonance Imaging

SECTION-B **Q P Code 6124**

CARDIOVASCULAR SYSTEM

Arteriography:

Technique, Catheters and guide wires, Percutaneous Catheterization, Use of Digital Subtraction, Single Plane and Biplane, Regional arteriography, Interventional Vascular Radiography.

Additional Investigations : Echo Cardiogram(ECG), Radio-Isotope Scanning, Computed Tomography(CT), Magnetic Resonance and Imaging(MRI)

Venography

Peripheral Venography - Lower Limb, Upper Limb, Percutaneous Splenoportography

Special Investigation: Ultrasound Imaging, Radio Isotope Scanning , Computed Tomography, Lymphangiography

CENTRAL NERVOUS SYSTEM

1. Myelography, 2. Computed Tomography, 3. Radio Isotope Scanning 4.Magnetic Resonance And Imaging, 5. Ultrasound Imaging

RESPIRATORY SYSTEM

1. Bronchography
2. Special Investigations: Ultrasound Imaging, Computed Tomography, Radio Isotope Scanning

MISCELLANEOUS:

1. Arthrography, 2. Sialography, 3. Sinography, 4. Fistulography,
5. Dacrocystography, 6. Mammography, 7. Subtraction Radiography
8. Foreign Body Localisation, 9. Mobile Radiography, 10. Theatre Radiography
11. Domiciliary Radiography, 12. Forensic Radiography, 13. Tomography.

THEORY EXAMINATION -100 MARKS

Section A : 50 Marks

I. Short Notes:

1 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. Short Answers:

2 marks X 10 questions = 30 marks (Answer All 10 Questions)

Section B : 50 Marks

I. Short Notes:

5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. Short Answers:

3 marks X 10 questions = 30 marks (Answer All 10 Questions)

PAPER-III - RADIOGRAPHIC PHOTOGRAPHY AND IMAGE PROCESSING
SECTION-A Q P Code 6125

Dark Room Planning:

1. For a Small Hospital, For a Large Hospital, 2. Location of Dark Room
2. Construction of Dark Room, 3. Ventilation, 4. Wall Protection
5. Entrance to Dark Room - Single Door, Double Door, Labyrinth

Dark Room:

1. Instruction to Staff, 2. Dry Bench, 3. Hopper, Drawer, Cupboard
3. Loading and Unloading Cassettes, 4. Hangers, Types of Hangers and Storage of Hangers

5.Printing, 6. Wet Bench, 7. Cleanliness, 8. Control of Dust, 9. Dark Room Sink
10. Hatches, 11. Drier, 12. Safe Lights, 13. Direct and Indirect, 14. Uses,
15.Factors Affecting Safelight Performance, 16. Safelight Tests, 17. Viewing Room,
18. Film Dispensing

X-Ray Films:

1. Glass, 2. Cellulose and Ployester Bases, 3. Structure of X-Ray Films - Emulsion, 4. Gelatin, 5. Base and Supercoating, 6. Types of X-Ray Films, 7. Single Coated, 8. Duplitised, 9. Spectral Sensitivity, 10. Colour Sensitivity,
11. Grainness of Films, 12. Speed of Films, 13. Screen & Non Screen Films

14. Various Formats of Films, 15. Films for Special Procedures
16. Storage Of Film Materials And Radiographs
17. Record Of Film Stock And Radiographs
18. Deterioration Of Films On Storage
19. Characteristic Curves - Uses of Step Wedge
20. Information On Basic Fog, 21. Film Gamma, 22. Contrast, Speed, Film Latitude, Effects On Development

Intensifying Screens:

Fluorescence – Phosphors, Phosphors Employed - Calcium Tungstate, - Barium Fluochloride, - Rare Earths, Construction of Intensifying Screens, The Influence of Kilovolatage in Different Phosphors, Intensification Factor, Resolving Power of Intensifying Screens, Speed of Screens, Screen Film Contact Tests, Types of Intensifying Screens, Advantages And Limitations of Intensifying Screens.

X-Ray Cassette:

Construction of X-Ray Cassettes, Types of Cassettes, Mounting Intensifying Screens on Cassettes, Identification of Cassettes, Care of Cassettes

SECTION-B Q P Code 6126

Photochemistry:
Chemistry of Image Formation, Formation of Latent Image, Conversion of Latent Image to Visible Image, Meaning of Ph, Importance of Ph In Processing Films

Processing Methods:
Preparation of Solution, Manual Processing Apparatus, Control of Temperature
Rapid Processing, Automatic Processor - Principle and Features, Water Supply, Use of Thermostat, Regeneration of Solutions, Maintenance, Advantage and Limitations.
Processing of Cut Films and Roll Films.

Computer Photography.
Digital Radiography - Principles, Processing, Equipments, Advantages, Radiological Information Systems.

Resolution
Factors Affecting Resolution Choice Of Kilovoltage And Milliamperage Choice Of Short Focus And Broad Focus Selection Of Focus To Film Distance And Object To Film Distance Selection Of Cassettes
Avoiding Scatter Radiation, Magnification, Distortion, Penumbra Presentation of a Radiograph - Identification Markers
- Name Printer
Viewing Equipment Magnifiers for Cut Films and Roll Films

Developer:
Constituents, Characteristic, Manual and Automatic Processors, Effects on Developing Time, Temperature, Agitation, Replenisher, Exhaustion

Rinsing:
Acid Stop-Bath, Methods, Objects

Fixer:
Constituents, Characteristics, Manual and Automatic Processors, Fixing Time and Clearing Time, Factors Affecting Fixing Time, Replenisher, Exhaustion

Washing and Drying:
Objects, Methods, Factors Affecting Washing and Drying, Wetting Agents, Comparison of Different Methods

Day Light Film Handling:
Day Light System Using Cassettes
Day Light System without Cassettes

Film Faults:
Fog - Various Fogging In Films, Causes And Prevention. Stains - Types, Causes And Prevention Spots And Splashes - Types, Causes And Prevention Marks And Prints - Types, Causes and Prevention Drying Marks - Types, Causes and Prevention Faults in Automatic Processor - Types, Causes.

Reproduction of Radiographs:
Copying Radiographs, Magnification and Magnification, Contact Prints, Types of Paper Equipment

Essentials of medical records

REFERENCE BOOKS:

Philip Wballiger	:	Merils Atlas Of Radiographic Positions And Radiological Procedures (Mosby)
STEPHEN CHAPMAN& RICHARE NAKIELNY	:	A GUIDE TO RADIOLOGICAL PROCEDURES (JAYPEE BROTHERS)

D.N. Chesney & M.O Chesney : Radiographic Imaging (Cbs)
Derrick P. Roberts & Nigel L. Smith : Radiographic Imaging A Practical Approach (Churchill Uvingstone)
Kodak : Fundamentals Of Radiographic Photography Books 1,2,3,4,5 (Kodak Ltd.)
Seeman & Herman : Physical And Photography Principles Of Medical Radiography (Wiley)

THEORY EXAMINATION -100 MARKS

Section A : 50 Marks

I. **Short Notes:**
5marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

Section B : 50 Marks

I. **Short Notes:**
5 marks X 4 questions = 20 marks (Answer any 4 out of 5 questions)

II. **Short Answers**:
3 marks X 10 questions = 30 marks (Answer All 10 Questions)

PRACTICAL EXAMINATION PATTERN (ONE INTERNAL AND ONE EXTERNAL EXAMINER): Practicals 100 marks

Pattern of practicals :
10 spotters 2 mark each - 20 marks (2 mins each)
Two special procedures to be described 30 marks each – 60 marks (I hour)
Practical Record -10 marks
Viva voce -10 marks

Paper	SUBJECT	SECTION	Question paper Code	MAX. MARKS
Paper 1	Radiographic Positioning & Radiographic Photography	Section A	**6121**	50
		Section B	**6122**	50
	Practical			100
Paper 2	Special Procedures, Radiographic Photography And Medical Records	Section A	**6123**	50
		Section B	**6124**	50
	Practical			100
Paper 2	Radiographic Photography And Image Processing	Section A	**6125**	50
		Section B	**6126**	50

Students should know- In All 3 years * (not included in practical examination)

Basic computers and Information Science-Practical

Practical on fundamentals of computers -

1. Demonstration of basic hard ware of the computers and laptops
2. Learning to use MS office: MS word, MS PowerPoint, MS Excel.
3. To install different software.
4. Data entry efficiency

DMXT- Communication and Soft Skills, Spoken English-Practical

1. Précise writing and comprehension of simple passages from a prescribed text book. The passage should be atleast100 words and students should answer a few questions based on it.
2. To practice all forms of communication i.e. drafting reports, agendas, notes, précise writing, circulars, presentations, telephonic communication, along with practice on writing resumes and applications for employment.

DMXT- Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical X-RAY Technology (MXT)-Practical

1. General discussion/Sensitization on career opportunities and role of MXT in Hospital Care
2. Visit to Central Sterile Supply Department (CSSD)
3. Visit to incinerator complex
4. Visit to Immunization section

DMXT- Introduction to Quality and Patient safety (including Basic emergency care and life support skills) Practical

DMXT- Environmental Science-Practical

1. Any Activity related to public awareness about the environment:
   1.1. Preparation of Charts/Models
   1.2. Visit to any effluent treatment plant
2. Effects of environmental pollution on humans through poster presentation.
3. Any activity related to biomedical waste management in a hospital or clinical laboratory

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