



SARVEPALLI RADHAKRISHNAN UNIVERSITY, BHOPAL

NH-12, BEHIND NISSAN MOTORS, HOSHANGABAD ROAD, MISROD BHOPAL (M.P.)
(Statutory University established under M.P. Act No. 17 of 2007 & Covered u/s 2 (f) of UGC Act)
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Diploma in X – Ray Technician

SCHEME FOR FIRST YEAR

		Internal Assessment		University Examination			
Code	Title of Papers	Theory	Practical	Theory	Viva	Practical	Total
XR-101T	Anatomy and Physiology	20	20	100	20	40	200
XR-102T	Radiographic, Photography	20	20	100	20	40	200
XR-103T	Elementary Radiation Physics	20	20	100	20	40	200
TOTAL							600

Note

Passing marks in the all subject candidate must obtain 50% in aggregate with minimum of 50% in theory, including viva and minimum 50% in practical.



FIRST YEAR

Subject code-XR101

Paper- 1. 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

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.



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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

Subject code-XR102

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.



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- (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

A) ELEMENTARY RADIATION PHYSICS

Subject code-XR103

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 eletroma-genetic 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.

B) Radiography Techniques:

No. of lectures:20

No. of Practical demonstration: 20

Skeletal system: Radiography techniques for x-ray of:



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- (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 Ist year (Paper in IInd year with basic Radiographic Techniques)



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SCHEME FOR SECOND YEAR

		Internal Assessment		University Examination			
Code	Title of Papers	Theory	Practical	Theory	Viva	Practical	Total
XR-201T	Anatomy and Physiology	20	20	100	20	40	200
XR-202T	Radiation Physics Including Radiation Protection	20	20	100	20	40	200
XR-203T	Basic Radiographic Techniques	20	20	100	20	40	200
TOTAL							600

Note

Passing marks in the all subject candidate must obtain 50% in aggregate with minimum of 50% in theory, including viva and minimum 50% in practical.



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OUTLINES OF SYLLABUS FOR SECOND YEAR

(Paper I) 2nd year

No. of Lectures: 40

Anatomy and Physiology of Human Body:

Subject code-XR 201

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:



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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.



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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:

Sympathetic 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.



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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 (collimators). 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.



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(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.

PAPER II

RADIATION PHYSICS INCLUDING RADIATION PROTECTION

Subject code-XR202

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.



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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, bolus 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.



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PAPER III

BASIC RADIOGRAPHIC TECHNIQUES

Subject code-XR 203

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.