Azadi Ka Amrit Mahotsav

GOVERNMENT OF MIZORAM
HEALTH & FAMILY WELFARE DEPARTMENT
MIZORAM SECRETARIAT BUILDING, MINECO, KHATLA, AIZAWL – 796001

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NOTIFICATION

Dated Aizawl, the 6th December, 2024

No.A.11018/3/2024-HFW/131 : In the interest of public service, the competent authority is pleased to notify Syllabus for Direct Recruitment to the post of **X-Ray Technician** under Health & Family Welfare Department as per Annexure.

This is issued with the approval of DP&AR(GSW) vide their I.D.No.A.12018/11/2024-P&AR(GSW) dated 28.11.2024.

Sd/-SANGCHHIN CHINZAH
Secretary to the Govt. of Mizoram
Health & Family Welfare Department

Memo No.A.11018/3/2024-HFW/131 : Dated Aizawl, the 6th December, 2024

Copy to :

1. P.S. to Secretary, Health & Family Welfare Department.
2. Principal Director, Health & Family Welfare Department.
3. Director of Health Services, Health & Family Welfare Department.
4. Director of Hospital & Medical Education, Health & Family Welfare Department.
5. Director, Zoram Medical College.
6. Controller of Examinations, Mizoram Public Service Commission.
7. Website Manager, IT Cell, DHS.
8. Guard File.

06/12/2024

(LALHLIMPUII HMAR)
Under Secretary to the Govt. of Mizoram
Health & Family Welfare Department

APPROVED SYLLABUS FOR DIRECT RECRUITMENT TO THE POST OF X-RAY TECHNICIAN (LEVEL 06) UNDER HEALTH & FAMILY WELFARE DEPARTMENT

1)	Paper – I General English	:	100 Marks (3 hours)
2)	Paper - II General Studies (MCQ)	:	100 Marks (2 hours)
3)	Paper – III (Technical Paper)(MCQ)	:	200 Marks (2 hours)
4)	Paper – IV (Technical Paper)(MCQ)	:	200 Marks (2 hours)
	Personal Interview	:	80 Marks
		Total :	**680 Marks**

DETAILS OF SYLLABUS:

PAPER – I (General English) – 100 marks

(a)	Précis Writing	:	10 Marks
(b)	Letter Writing	:	15 Marks
(c)	Comprehension of given passages	:	15 Marks
(d)	Grammar: Parts of Speech	:	20 Marks
(e)	Correct usage and Vocabularies	:	20 Marks
(f)	Formation of Sentence	:	20 Marks

PAPER – II (General Knowledge)(MCQ) - 100 Marks

(a) Current events of state, national and international importance : 12 marks
(b) History of India and Indian National Movement : 12 marks
(c) Indian and World Geography - Physical, Social, Economic Geography of India and the World : 12 marks
(d) Indian Polity and Governance - Constitution, Political System, Public Policy, Duties & Rights Issues : 12 marks
(e) Economic and Social Development Sustainable Development, Poverty, Inclusion, Demographics, Social Sector initiatives, and other related issues : 12 marks
(f) General issues on Environmental Ecology, Bio-diversity and Climate : 12 marks
(g) General Science : 12 marks
The topics listed above shall cover the State of Mizoram wherever applicable.
(h) General awareness on Mizo culture, its heritage and society. :16 marks

PAPER III - Technical Subject –I (MCQ) : 200 Marks (2 hours)

Unit-I (40 marks)

Human Anatomy:

- Introduction of human body, cells, tissues, anatomical positions, terms and description
- Musculoskeletal system of body- structure of bones, vertebral column, joints, type of joints, trunk, muscles, types of muscles.
- Upper and Lower limbs-structure, blood supply, nerve supply , venous drainage, lymphatics
- Cardiovascular system including the heart and circulatory system, major blood vessels, arteries, veins, capillaries, lymphoid
- Respiratory system including the lungs, trachea, bronchus, broncho-pulmonary segments, alveoli, arterial supply, venous drainage, lymphatics, capillaries.
- Central Nervous system including the brain, spinal cord, control and peripheral nervous systems, autonomic nervous system, brachial plexus, sacral plexus , cranial nerves.
- Head & Neck including the skull, ears, middle ear cavity, temporal bone, PNS , pharynx, larynx, oral cavity, face and tongue, nasal cavity, eyes and other sensory organs.
- Gastro-intestinal traits including the esophagus, stomach and small intestine, large intestine, caecum , appendix, anal canal
- Hepato-billiary system including liver, gall bladder, biliary tree pancreas, spleen canaliculi
- Gerito-Urinary, excretory system including kidneys, ureters, urinary bladder, urethra, prostrate
- Male and Female reproductive system
- Endocrinal system including the pituitary, thyroid, hormones,etc

Unit II

Basic Physiology and Pathology- (20 marks)

- Introduction, functional organization of body structures, musculoskeletal system.
- Blood cells, plasma, blood groups etc
- Physiology of cardiovascular system including heart and circulatory blood pressure, arteries, veins
- Physiology of respiration including lungs, trachea, Larynx, bronchus, broncho-pulmonary segments.
- Physiology of the excretory system including formation and excretion of urine, reabsorption of water, functional unit of kidneys, process of micturition
- Physiology of the hepato-biliary system including circulation of bile, portal circulation
- Physiology of the Gastro-Intestinal tract including digestive system, brain, CSF
- Basic Pathology-Pathological condition, cellular structure, metabolism, pathogenesis and disease

- Inflammation-Definition, types, degeneration, cell death, granulose inflammation,etc
- Regeneration and healing process
- Tumours, definition, benign, malignant, tumours, affecting various system-neoplasia
- Hypersensitivity, infection , infestation
- Hemodynamic disorders, haemorrhage, Ischemia, infection

UNIT III

Radio Physics, Radiation Hazards & Protection (50 marks)

- X-Ray production and properties- history, origin, construction of X-Ray Tubes, requirements for X-Ray production
- (electron source, target and anode material) tube voltage, current, space charge, cathode, assembly, efficiency, stationary and rotating tubes, KVp, mAs
- Common factors affecting thermionic emission, specialized types (metallic, fluoro, CT) focal spot, target angle.
- Heat dissipation methods, tube rating, heat units, operating conditions, and maintenance& Quality assurance procedures.
- Image and its characteristics-formation of radiological image, latent image, intensifying screens, factors affecting image quality, quality assurance tests.
- Factors affecting image quality: Radiographic image contrast, density, sharpness, magnification, distortion of image, noise, blur
- Scattered radiation, appliances, to reduce scattered radiation, grids-stationary and moving, use of cones, diaphragm, light beam devices, collimation
- X-ray generation and circuits: filament, current and voltage, primary circuits, auto transformers, types of exposure switch and timers, principle of automatic exposure control. (AEC) , filament circuit, high voltage circuits, half and full wave rectification, three phase circuits
- Types of generators, 3 phase, 6 & 12 pulse circuits, falling load generators, capacitators discharge and grid control systems.
- Radioactivity: Structure & property of nucleus, nuclear forces, binding energy, radioactive decay, characteristics x-ray, charge of radio nuclides, alpha, beta, positron, gamma emissions, modes of decay, auger electrons, electron capture, isomeric transmissions, internal conversions, naturally occurring radio nuclides
- Interaction of x-rays with matter, types of interactions of x-rays , gamma radiation, photoelectric and Compton, bremsstrahlung, pair production, annihilation radiation
- Radiation units, dosimetry and detection of ionizing radiation,
- Units of radiation, ICRU definition of absorbed doses, quality factor, dose equivalent, relationship between absorbed and equivalent dose.
- Basic principles of ionization chamber, proportional counter, GM counters, Scintillizationdetector, thermo luminescence dosimeter.

UNIT IV

RADIATION HAZARDS AND PROTECTION (30 MARKS)

- Patient dose, occupational exposure, natural and background radiation, population exposure.

- Choice of equipment, control panel, waiting area
- Biological effects of radiation including excitation and free radical formation, DNA, RNA and tissue radiosensitivity
- Effects of Ionizing Radiation, Non-Ionizing Radiation, Stochastic and Non Stochastic effects, Mean and lethal dose
- Principles of Radiation, Radiation protection – time, distance, shielding, relationship of radiation to time , distance of shielding, protection during Fluoroscopic procedure, angiographic procedure, interventional procedure,
- Personal monitoring devices, occupational hazards and precautions, personal shielding- lead apron, thyroid shield, limb shields.
- Protective barriers, methods, lead equivalent
- Shielding requirements for films, safety of radiation workers in diagnostic radiology
- AERB guidelines , BHABHA Atomic research centre (BARC) , Room layout , construction and installation
- Quality assurance, Radiation leakage, devices to measure radiation.
- Principles of ALARA, radiation protection in mobile units, exposure during pregnancy, ten day rule

UNIT V

RADIOGRAPHIC AND DARKROOM TECHNIQUES (40 marks)

- Introduction to X-rays, production x-ray, General principles of radiography, formation of image, latent image, film focus distance , motion blurring
- Anatomical positions.
- Anatomical positions techniques, planes, longitudinal planes, transverse planes, sagittal plane, anterior, posterior, lateral, proximal, distal, supine, prone, abbreviations and symbols.
- Image quality, factors affecting image quality, photographic density, image contrast, sharpness/ unsharpness.
- Characteristic curve, Steep range radiography, selective filtration, high kV radiography, rapid sequence radiography.
- Beam Collimation, Umbra, Penumbra, Use of Cones, diaphragms, collimating devices, external collimation, selective filtration
- Scattered radiation, effect of scatter radiation on image quality, use of grids/ Bucky- advantages, disadvantages, stationary grids, moving grids, grid ratio, make of grids.
- Planning of Radiology departments, room layout, size, setting up X-ray machines, locating dark rooms, earthing of machines, patient waiting, lead barriers
- Types of machine, types of tubes, machine calibration, low mA, high mA machines, tube ratings heat dissipation methods, maintenance and Quality assurance procedures, choosing an equipment, importance of approved manufacturers etc.
- Principles of fluoroscopy, IITV (Image Intensifier Television), C-arms, Subtraction Radiography, mobile units, mobile image intensifiers, advantages and disadvantages
- Spot films, real time X-ray images, factors affecting video image quality, minimizing radiation exposure during fluoroscopy, radiography in OT, Cath-labs.
- Introduction of dark room, layout, ventilation, illumination, developer, fixer tanks.
- Dry bench, wet bench, pass boxes
- Characteristics, features and requirements of safe light.
- Process of developing, fixing, rinsing
- Film material, construction of films, types of films, storage of films, sizes.

- Film speed, high speed, low speed.
- Newer film types - laser films, dry laser, wet laser
- Screens- Construction of screen, uses of screen, types of High speed, low speed, care of screens, film-screen' combination - advantages, technique modification in relation to speed.
- Principles of fluorescence and phosphorescence, rare earth screens, blue and green screens.
- Special screens
- Film processing - manual, automatic film processing, washing, drying, hangers - clip hangers, channel hangers.
- Chemicals- Developers, fixers, rinser, replenisher solution etc.
- Advantages, disadvantages of automatic, manual processing.
- Effect of temperature on chemicals, processing.
- Film fog -definition, types of fog, causes of fog.
- Effect of temperature, sunlight in improper storage, old films, artifacts.
- Cassettes - Design, care, construction, types and mounting Care of cassettes, cleaning, drying of cassettes

UNIT VI

HOSPITAL PRACTICES AND PATIENT CARE (20 MARKS)

- Preliminary to examinations, patient perception, consent informed and applied.
- Communication and relational skills-development of appropriate communication skills with patients- verbal and nonverbal, appearance of radiographer.
- Financial aspects, Hospital Structure and organisation, Radiography as a profession- Presenting professional image, desirable and essential personal qualities
- General Principles of Hygiene, Personal Hygiene, Patient Hygiene, Departmental Hygiene
- Special Care in reference to communicable diseases, AIDS, Universal Precautions, Patients preventing cross section
- ASEPSIS in department, procedure, importance of aseptic environment, handling of syringes, Needles, personal protection
- Clinical responsibilities of Radiographers and Ethical responsibilities
- Legal responsibilities, record maintenance, malpractices- legal implications
- Mobile Xray precaution, Minimising risk, use of lead apron, use of Xray in operational theatre, C-Arm in OT, etc
- First- Aid, vital signs, pulse, blood pressure
- Emergencies in radiological department- care of patient with hypersensitivity reaction, post procedural care, pneumothorax.
- Anesthetized patient, stretcher patient, care of patient in wheelchairs, moving and lifting patients, safety of lifter, lifted
- Special care in paediatric patients, pregnant patients, Geriatric patients
- Care of female patients, 10 day rule- importance- principles of minimizing radiation dose
- Medico-Legal in aspects in Diagnostic Radiology.

Paper IV

Technical Subject paper II (200 marks) 2hours

Unit I - Special Radiographic procedure. (40 marks)

- Procedures in imaging the Genitourinary system including intravenous urography
- Retrograde Urography and Urethrogram
- Micturatingcystourethrography-
- Percutaneous nephrostomy
- HisteroSalpinography
- A methods of imaging the gastro intestinal tract
  - Including Barium swallow, Barium meal, a hypotonic dudeonography, Barium meal follow through and enteroclysis, barium enema including instant enema and enema reduction of intussusception.
- Methods of imaging the hepato-biliary system including
- Investigation of Jaundice/obstruction non obstruction jaundice, oral cholecystography , T-Tube cholangiography / Intravenous cholangiography, endoscopic retrograde cholangio-pancreatography, percutaneous trans hepatic cholangiography , biliary drainage including PTBD
- Basics of Fluoroscopy, IITV and its use, advantages and disadvantage, spot films, video recording of fluoroscopy procedure.
- Special Investigative Procedures including Sailography ,Myelography, cistenography, Arthrography, Dacryocystography (OCA), Laryngography, Broncho-graphy, lymphangiography.
  - Oral and IV contrast agent, new generation contrast agents, reaction to contrast agents and management of reaction to contrast agents, Drugs and emergencies in Radiology department including anaesthesia in radiology dept.

UNIT II

MRI (40 Marks)

  - Introduction to MRI, History of MRI, Basicphysics, data acquisition, relaxation time, gradient, Spin echo techniques
- Effect of magnetic field on cells
  - Types of Magnets, field strength -tesla,
  - Closed and open magnets, slice selection, RF coil, types of coils & uses, Diffusion MRI & echoplanar imaging
  - Image Reconstruction, display and recording devices.
  - Sequences in MRI, Basic Sequences,T1 T2 weighted images, newer Sequences, IV Contrast in MRI, MRI in Brain and Spine Imaging, Characteristics of common tumours, lesions
  - MRI room design and installation, Copper Shielding, requirements, uses, Practical Aspects, effects of Shielding and angle of Quality Safety factors
  - Precautions in MRI, Super conductor MRI and newer development
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- Special Procedure In MRI

- MR Angiography, Phlebography with or without contrast, Special Sequences, and techniques, MRCP, MR Enterocleis, MR Arthrography, use of MRI in interventional MRI, MRI operation Suite.

UNIT III

CT (Computed TomographyScan) (40marks)

  - Introduction to CT scan, basic principles, history.
  - Basic physics, tube technology, rating, detector technology, generators, stabilizers, gantry, console, etc.
- Data acquisition, various methods, types and generation of CT Scanners, filters,
  - Spiral CT, slip ring technology, advantages
  - Post processing, software, work station
  - Image reconstruction and display parameters
- Hounsfield units, values of normal tissues
- Use of oral, rectal, IV contrast in CT scan, dose consideration, administration, patient preparation.
- Principles of window, grey scale contrast optimization.
- Clinical application of CT scan
- CT Scan of brain, chest ,abdomen, head and neck, etc
- Recording CT images, filming techniques, cameras and archiving, digital archiving CD, DVD, MOD etc
- Normal anatomy of various organs, common pathologies.
- Post processing and multiplanar reconstruction.
- Multi slice CT and newer developments.
- HRCT - lungs and temporal bone
- Housing, transport of CT Scan machines, power considerations, requirements, earthing, air conditioning,
- AERB regulation in respect of CT Scan
- Dose consideration in CT scan, types of equipment, techniques to reduce patient dose, reduce exposure of workers and public, safety measures.
- Emergency CT scans, trauma
- PET CT - Introduction and uses and special consideration in handling isotopes.
- Cost factor, maintenance of equipment,
- CT guidance for interventional procedures

Unit - IV

Mammography & Digital Radiography–(30 marks)

- History and introduction , Physics of Film Screen Mammography , tubes, Grids, Screens and Films, Compression techniques, Automatic Exposure Control
- Background diagnosis, screening, imaging requirements, radiation exposure
- Imaging techniques and views- Conventional and Supplementary, grids, techniques in dense breast
- Digital Mammography, Image Processing, Computer Aided Diagnosis, Dual energy Mammography

- Anatomy of Breasts, radiographic Anatomy, Formation of Mammographic image, anatomy of ductal system, Ductography, galactography, Male Breast, Radiation dose in Mammography, Basic Pathology of Breast Lesion, Breast Calcification
- Breast Cancer Screening, BiRad Classification, Current trends in Screening of breast Cancer, Self Examination versus Mammographic Screening.
- Role of Radiographer, Quality Assurance in Screening Programs, Radiation dose and Screening issues- Specificity and Sensitivity, advantages, hazards of Screening
- Evaluation of Palpable lesion, Sono-Mammography, Role of Colour Doppler, USG Screening of Breasts

Digital Radiography

- Introduction to Digital Radiography, Principles of Digitalisation, analogue to digital converter, digital to Analogy converter, advantages of digital Radiography, cine Radiography, Video recording devices, Automatic film handling systems.
- Computerised Radiography- CR Systems, Digital flat panel Radiography, display devices, Monitors, LCD Monitors, Grey scale and Colour Monitors
- Computer in radiology- Uses, benefits, DICOM- Digital Communication system, Software, Post Processing, Workstation, Tele Radiology, remote Servicing, Remote Reporting\
- Filmless Radiography and Communication Devices, future developments, Picture Archiving and Communication Systems
- Digitalisation of Radiology department- Advantages, internet and intranet in Radiology department, Hospitals
- Recording Devices
- Conventional X-rays, Spot films
- Multi Format Cameras
- Laser Cameras- Wet/ Dry laser
- Optical Disc-MOD,CD,DVD
- Paper Print out, Wax printers, Thermal Printers

UNIT- V

ANGIOGRAPHY AND INTERVENTIONAL RADIOGRAPHY-(30 MARKS)

- Angiographic Techniques in Radiology, Conventional Angiography, Setting up of Cath Labs, Rapid Sequence Film Techniques, DSA, Selective and Super-Selective Angiographic, Indications, Uses, Techniques
- Coronary Angiographic Techniques- Conventional , CT Coronary Angiography, ECG Gating, Contrast dose, Automatic Injector
- Interventional Radiology- Introduction, Principles, Sterilisation Techniques, Aseptic Precautions in Interventional Suite, Importance of Asepsis, Patient Preparation, Checklist, Consent, Rating,etc
- Types of Catheters, needles, Biopsy Guns, Glue and other Accessories used in interventional Radiology
- Image Guided non vascular Intervention Including FNA, Core biopsies, Aspirations- Diagnostic, Therapeutic, Sampling Techniques, Aseptic Precautions
- Catheter placement and care of indwdlling Catheters, Flushing of Catheters, Drainage Procedure, Nephrostomics, Non vascular Stent placement, Post Procedural Patient Care and Observation. Complications and Management of Complications

- Techniques of Image Guidance, Advantages and Disadvantages of Various Image guidance, Techniques , equipment requirement and selection of appropriate image guidance technology
- Fluoroscopic Guided procedure, USG Guided procedure- Intra- Operative USG, Use of Doppler, CT Guided procedure, CT Fluoroscopy, MRI Guided Procedures, MRI Interventional Suite.
- Vascular Interventional radiology, Embolization, Thrombolysis and Thrombolytic procedures, stents, Types of Stents, Placement of Stents, Coiling
- Vascular Interventions in treatments of cancers- Therapeutic, Palliative , etc, Newer Developments

UNIT VI

ECG, USG AND COLOR DOPPLER (20Marks)

- Basic Physics of Ultrasound imaging, Terminology and Principles, Transducer Technology, Anatomy of Transducer, Mechanical and Electronic Real time and Transducer Q Factors.
- Ultrasound Instrumentation, Transmitter, Receiver, Scan Converter and Display, Interactions between Ultrasound and Matter.
- Types of Reflectors- Specular Reflectors, Diffuse Reflectors, Refractions, absorption and attenuation, coupling agents – Types , ingredients, Preparations, Application
- Advantages and uses of Ultrasound
- Routine Abdomen, Pelvic and Obstetric Scan, USG of Small Parts, Testis, Breast, A-Scan, B-Scan, Thyroid, Neonatal Brain
- Ultrasound Guided Interventional Procedures, For image guided Aspiration,FNAC, Percutaneous Catheter Placement, Percutaneous nephrostomy, Therapeutic Aspiration of Cyst
- Obstructive biliary drainage,etc, Ultrasound in Trauma and Emergencies, Fast Scan and Extend fast Scan
- Recent advances in USG Technology, Tissue Harmonic Imaging, Ultrasound Contrast Agents, Elastography,etc
- Basic Principle of Colour Doppler and Doppler Shift Equation, Different Doppler Techniques; Pulse Doppler, Continuous Wave Doppler, Duplex Scanner and Doppler Colour Flow imaging
- Use of Doppler in Non-Vascular conditions
- USG in pregnancy, First Trimester Scan, Second Trimester Scan, Third Trimester Scan
- Emergency Scan during Pregnancy, Endo=luminal USG
- Trans-Vaginal Sonography, Trans Rectal USG, Trans-Perineal USG
- PCPNDT Act and its Sensitization
- Portable sonography or bedside Sonography
- Echocardiography, M-Mode, 2D or 3D Echocardiography
- Visualization of Valves, Morphology, Flow Pattern in Echocardiography, Artefacts in USG
- Biological Effects and Safety Measures in USG