

द्वितीय पत्र - सेवा सम्बन्धी

**Section A- 30 Marks**

**1. RADIOGRAPHIC TECHNIQUE**

**1.1 UPPER LIMB**

- 1.1.1 Technique for whole hand, fingers, thumb, wrist joint, Radio ulnar joints
- 1.1.2 Supplementary technique: carpal tunnel, scaphoid, ulnar groove, head of radius
- 1.1.3 Supplementary views of elbow, humerus & Supra-condylar projection

**1.2 SHOULDER GIRDLE AND THORAX**

- 1.2.1 Technique for shoulder joint, acromio-clavicular joint, and scapula
- 1.2.2 Supplementary views: projection to show recurrent dislocation of shoulder, infero-superior projection of clavicle, sterno-clavicular joint, sternum, ribs

**1.3 LOWER LIMB**

- 1.3.1 Technique for whole foot, toes, great toe, calcaneum, talo-calcaneal joint, ankle joint, lower leg with ankle joint,
- 1.3.2 Knee joint, patella, tibio-fibular joints,
- 1.3.3 Supplementary technique for torn ligaments, flat feet, axial view of calcaneum, skyline view of patella, intercondylar notch view

**1.4 VERTEBRAL COLUMN**

- 1.4.1 Technique for crano-vertebral joint, atlanto-occipital joint, first three cervical vertebra, odontoid peg view
- 1.4.2 Cervical spine for intervertebral joints and foramina, cervico thoracic vertebrae,
- 1.4.3 Thoracic spine, thoraco-lumbar vertebrae
- 1.4.4 Lumbar spine, intervertebral joints and foramina, lumbo-sacral joint, sacrum, coccyx
- 1.4.5 Supplementary techniques, to demonstrate scoliosis, kyphosis, spondylolisthesis.

**1.5 PELVIC GIRDLE AND HIP REGION**

- 1.5.1 Technique for whole pelvis, ileum, ischium and pubic bones,
- 1.5.2 Sacroiliac joints, symphysis pubis, hip joints, acetabulum, neck of femur
- 1.5.3 Supplementary projections: acetabulum view, judet view, Von-Rosen view and frog leg view for hip joint (CDH)

**1.6 SKULL**

- 1.6.1 Routine views of Skull, Towne's view, SMV, Emergency Skull radiography
- 1.6.2 Technique for mastoids, styloid process, IAM.
- 1.6.3 Routine views for facial bones, mandible, zygomatic arches, nasal bone, maxilla, temporo-mandibular joints,
- 1.6.4 Optic foramina, macroradiography for optic foramina
- 1.6.5 Routine and special views for Paranasal sinuses

**1.7 DENTAL RADIOGRAPHY**

- 1.7.1 Intra-oral and extra-oral projections, occlusal projection,
- 1.7.2 Orthopantomography (OPG)

**1.8 CHEST RADIOGRAPHY**

- 1.8.1 Routine radiography of chest, High kV technique for Chest

1.8.2 Supplementary views: apicogram, lordotic and oblique views, lateral decubitus, diaphragmatic excursions double exposure technique.

**1.9 PELVIMETRY**

1.9.1 Consideration of radiation hazards,

1.9.2 Techniques for evaluation of foetal maturity, abnormalities, position and multiplicity

1.9.3 Erect lateral projection and antero-posterior projection for CPD

**1.10 WARD AND OPERATION THEATRE RADIOGRAPHY**

1.10.1 Knowledge of Electrical supply, radiation protection,

1.10.2 Radiography of bed-ridden patients

1.10.3 Radiography in operation theatre

**1.11 MAMMOGRAPHY**

1.11.1 Soft tissue radiography

1.11.2 Principle and technique of mammography

**1.12 MACRO-RADIOGRAPHY**

1.12.1 Definition, principles and its applications

1.12.2 Magnification factors and uses of magnification radiography

**Section B- 30 Marks**

**2. SPECIAL RADIOLOGICAL PROCEDURES**

**2.1 FIRST AIDS AND EMERGENCY CARE**

2.1.1 Introduction to Shock, emergency treatment, Cardio-Pulmonary resuscitation (CPR)

2.1.2 Introduction to Haemorrhage, primary management of haemorrhage

**2.2 CONTRAST MEDIA**

2.2.1 Introduction to contrast media

2.2.2 Definition, types and uses of contrast media

2.2.3 Properties of contrast media

2.2.4 Adverse effects of contrast media and their management

2.2.5 Emergency trolley setting

2.2.6 Life saving drugs and emergency trays

**2.3 ALIMENTARY TRACT**

2.3.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming & post procedure care for following investigations:

2.3.1.1 Barium swallow

2.3.1.2 Barium meal

2.3.1.3 Barium follow -through

2.3.1.4 Small bowel enema

2.3.1.5 Barium enema -single contrast, -double contrast

2.3.1.6 Loopogram

**2.4 BILIARY TRACT**

2.4.1 Definition, indications, contraindications, equipment required contrast media, preparation of the patient, technique / procedure, filming, post procedure care for following investigations:

2.4.1.1 Oral cholecystography

2.4.1.2 Intravenous choledochography (IVC)

2.4.1.3 Percutaneous transhepatic cholangiography (PTC)

- 2.4.1.4 Endoscopic retrograde cholangio-pancreatography (ERCP)
- 2.4.1.5 Per operative cholangiography (POC)
- 2.4.2.6 T-tube cholangiography
- 2.5 URINARY TRACT**
  - 2.5.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming, post procedure care for following investigations:
    - 2.5.1.1 Intravenous urography (IVU), Modification of IVU and additional techniques
    - 2.5.1.2 Percutaneous renal puncture (PcRP)
    - 2.5.1.3 Percutaneous nephrostomy (PCN)
    - 2.5.1.4 Retrograde pyelography (RGP)
    - 2.5.1.5 Micturating cysto-urethrography
- 2.6 REPRODUCTIVE SYSTEM**
  - 2.6.1 Definition, indications, contraindications, equipment required contrast media, preparation of the patient, technique/procedure, filming, post procedure care for Hysterosalpingography
- 2.7 CARDIO-VASCULAR SYSTEM**
  - 2.7.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming, post procedure care for following investigations:
    - 2.7.1.1 Carotid angiography
    - 2.7.1.2 Abdominal aortography
    - 2.7.1.3 Portal venography
    - 2.7.4.4 Peripheral and lower limb venography
- 2.8 MYELOGRAPHY**
  - 2.8.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming, post procedure care for following investigations:
    - 2.8.1.1 Lumabr, Thoracic and Cervical Myelography
    - 2.8.1.2 Post Myelo-CT (CT Myelography)
- 2.9 ARTHROGRAPHY**
  - 2.9.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming, post procedure care for following investigations:
    - 2.9.1.1 Knee Arthrography
    - 2.9.1.2 Hip Arthrography
- 2.10 SINOGRAPHY**
  - 2.10.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique /procedure, filming, post procedure care for Sinography
- 2.11 SIALOGRAPHY**
  - 211.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming, post procedure care for following investigations:
    - 2.11.1.1 Parotid sialography
    - 2.11.1.2 Sub-mandibular sialography
- 2.12 DACRYOCYSTOGRAPHY**

- 2.12.1 Definition, indications, contraindications, equipment required, contrast media, preparation of the patient, technique/procedure, filming, post procedure care for Dacryocystography

## **Section C- 20 Marks**

### **3. EQUIPMENT FOR DIAGNOSTIC RADIOLOGY**

#### **3.1 X-RAY TUBES**

- 3.1.1 Overview of production of x-rays, Historical background,  
3.1.2 Components of an x-ray tube: Cathode assembly, Anode assembly  
3.1.3 Stationary and rotating anodes  
3.1.4 Line focus principle, anode heel effect, Off-focus radiation  
3.1.5 Glass envelope, tube shielding, care of x-ray tubes,  
3.1.6 X-ray tube faults,  
3.1.7 Modification and recent advances in x-ray tube

#### **3.2 RADIOGRAPHIC COUCHES, STANDS AND TUBE SUPPORTS**

- 3.2.1 X-ray tube supports  
3.2.2 Radiographic couches  
3.2.3 Chest stands and vertical bucky  
3.2.4 Modern basic radiographic units

#### **3.3 EXPOSURE TIMERS**

- 3.3.1 Introduction  
3.3.2 Clockwork timer, synchronous motor and impulse timers,  
3.3.3 Electronic timers,  
3.3.4 Autotimers (photoelectric timer and ionization chamber timer)

#### **3.4 BEAM CENTERING & BEAM LIMITING DEVICES**

- 3.4.1 Cones and cylinders, Aperture diaphragms,  
3.4.2 Light beam diaphragms, Positive beam limitation

#### **3.5 PORTABLE AND MOBILE RADIOGRAPHIC EQUIPMENTS**

- 3.5.1 Main features of portable and mobile equipment  
3.5.2 Mains dependent mobile equipment  
3.5.3 Capacitor discharge equipment  
3.5.4 Battery powered generators

#### **3.6 CONTROL OF SCATTERED RADIATION**

- 3.6.1 Significance of scattered radiation  
3.6.2 Reduction in the amount of scatter radiation produced (field size, use of appropriate exposure factors, compression band)  
3.6.3 Reduction in the amount of scatter radiation reaching to the film (metal backing of cassettes, filters, air-gap technique, cones and diaphragms, Grids)  
3.6.4 Grid: construction, function, grid characteristics, grid types and patterns. Grid movement  
3.6.5 Reduction in the effect of scatter (use of intensifying screens)

#### **3.7 FLUOROSCOPIC EQUIPMENT**

- 3.7.1 Introduction  
3.7.2 Conventional fluoroscopy  
3.7.3 Mobile and specialised fluoroscopic units,

- 3.7.4 Image intensified fluoroscopy,
- 3.7.5 Image intensifier- construction and working principle,
- 3.7.6 TV camera and TV monitor

**3.8 TOMOGRAPHY**

- 3.8.1 Introduction to Tomography
- 3.8.2 Main features of tomographic equipment,
- 3.8.3 Wide angle and narrow angle Tomography, Different types of tomographic movement,
- 3.8.4 Multi-section Tomography

**3.9 EQUIPMENT FOR DENTAL RADIOGRAPHY**

- 3.9.1 A simple dental radiographic unit
- 3.9.2 Orthopantomography (OPG)

**3.10 VASCULAR IMAGING EQUIPMENT**

- 3.10.1 Generators and x-ray tubes
- 3.10.2 C-Arm/U-Arm assembly
- 3.10.3 Automatic film changers (roll and cut film changers)
- 3.10.4 Angiographic tables
- 3.10.5 Automatic pressure injectors
- 3.10.6 Program selector, cine cameras

**3.11 MAMMOGRAPHIC EQUIPMENT**

- 3.11.1 Introduction
- 3.11.2 Mammography x-ray tube
- 3.11.3 Image receptors in mammography
- 3.11.4 Apparatus for magnification radiography in mammography

**3.12 DIGITAL IMAGING**

- 3.12.1 Introduction to digital imaging concepts and advantages of image digitization,
- 3.12.2 Digital image structure
- 3.12.3 Digital radiography:
  - 3.12.3.1 Scanned projection radiography (SPR)
  - 3.12.3.2 Computed radiography (CR)
  - 3.12.3.3 Direct digital radiography (DR)

**3.13 COMPUTED TOMOGRAPHY (CT)**

- 3.13.1 Introduction.
- 3.13.2 Basic principles of CT
- 3.13.3 Generations of CT
- 3.13.4 System components
- 3.13.5 Image characteristics & Image quality in CT
- 3.13.6 Artefacts in CT

**3.14 MAGNETIC RESONANCE IMAGING (MRI)**

- 3.14.1 Fundamental concepts: magnetic moments, precession, resonance, nuclear magnetic resonance (NMR)
- 3.14.2 Introduction to MR Scanners: imaging magnets, RF transmitter and receiver coils, shim coils and gradient coils
- 3.14.3 Principal parameters of MRI: spin density, T1 relaxation time, T2 relaxation time
- 3.14.4 Basic principles of MR imaging and related parameters
- 3.14.5 Spin echo pulse sequence

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नेपाल स्वास्थ्य सेवा, रेडियोग्राफी समूह, अधिकृत सातौं तह, खुला र आन्तरिक प्रतियोगितात्मक परीक्षाको  
पाठ्यक्रम

3.14.6 Gradient echo pulse sequence

3.14.7 Artefacts in MRI

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## Section D- 20 Marks

### 4. RADIOGRAPHIC PHOTOGRAPHY

#### 4.1 **PHOTOGRAPHIC PRINCIPLE**

- 4.1.1 Photographic effect
- 4.1.2 Photosensitive materials
- 4.1.3 Photographic emulsion
- 4.1.4 Characteristic curve
- 4.1.5 Spectral sensitivity
- 4.1.6 Direct exposure film (x-ray sensitive)
- 4.1.7 Gurney-Mott theory of latent image formation

#### 4.2 **FILM MATERIALS**

- 4.2.1 Construction of x-ray film
- 4.2.2 Film for medical imaging
- 4.2.3 Comparison between single coated and double coated x-ray films

#### 4.3 **FILM STORAGE**

- 4.3.1 Different storage areas
- 4.3.2 Ideal storage condition
- 4.3.3 Stock control and film ordering methods

#### 4.4 **INTENSIFYING SCREENS**

- 4.4.1 Luminescence: fluorescence and phosphorescence
- 4.4.2 Construction of Intensifying screen and their types
- 4.4.3 Types of phosphors: calcium tungsten, rare earth and their comparison
- 4.4.4 Detective Quantum efficiency (DQE)
- 4.4.5 Quantum mottle
- 4.4.6 Care, monitoring and cleaning of IF screen
- 4.4.7 X-ray film cassettes
- 4.4.8 Cassette function, construction, materials used, types and care of cassettes

#### 4.5 **RADIOGRAPHIC PROCESSING**

- 4.5.1 Manual and Automatic processing
- 4.5.2 Processing cycles
- 4.5.3 Processing chemical
- 4.5.4 Care and maintenance of automatic processors
- 4.5.5 The principle of dry silver imager
- 4.5.6 Silver recovery
- 4.5.7 Daylight processing

#### 4.6 **DESIGN AND CONSTRUCTION OF DARKROOM**

- 4.6.1 The layout of an ideal darkroom
- 4.6.2 Darkroom location, size, radiation protection, floor, walls / ceiling, ventilation and heating, entrance, white lighting and safe light and its test, film hoppers loading bench and wet bench

#### 4.7 **THE RADIOGRAPHIC IMAGE**

- 4.7.1 Radiographic image quality
- 4.7.2 Factors affecting radiographic image quality
- 4.7.3 Image artifacts

#### 4.8 **IDENTIFICATION AND VIEWING OF RADIOGRAPHS**

- 4.8.1 Methods of film identification: opaque letters and legends, actinic marking and perforating device
- 4.8.2 Viewing equipment

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नेपाल स्वास्थ्य सेवा, रेडियोग्राफी समूह, अधिकृत सातौं तह, खुला र आन्तरिक प्रतियोगितात्मक परीक्षाको  
पाठ्यक्रम  
-----The End-----

द्वितीय पत्रको एकाई, अङ्कभार र प्रश्नसंख्या निम्न बमोजिम हुनेछ ।

द्वितीय पत्रका खण्ड	A	B	C	D
द्वितीय पत्रका एकाई	१	२	३	४
प्रश्न संख्या	३	३	२	२

**Model Questions**

1. Explain the routine radiographic technique for cervical spine and Lumbar spine.
2. What is contrast media in radiology? What are different types of contrast media, explain their properties?
3. Describe the procedure of Lumbar Myelography under the following headings:
  - a. Indications and contra-indications
  - b. Preparation of patient
  - c. Procedure
  - d. Filming
  - e. After care of patient
4. What are different methods of scatter radiation control? Explain the construction, function and types of Grids.
5. What are the components of Image quality? Define radiographic contrast and explain the factors affecting radiographic contrast.