त्रिभुवन विश्वविद्यालय
सेवा आयोग

सहायक प्रथम, मुख्य स्वास्थ्य सहायक (रेडियोलोजी) पदको खुला प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

२०८१

लिखित परीक्षा योजना

लिखित परीक्षा : **कुल पूर्णाङ्क :** १००

पत्र/विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या × अङ्क	समय
प्रथम	१००	४०	वस्तुगत - बहुवैकल्पिक प्रश्न (MCQs)	५० प्रश्न × १ अङ्क	५० मिनेट
			विषयगत प्रश्न	१० प्रश्न × ५ अङ्क	१ घण्टा ४५ मिनेट

द्रष्टव्य :

1. लिखित परीक्षाको लागि १०० पूर्णाङ्कको एक पत्र हुनेछ ।
2. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नको विकल्प छनौट गर्दा गलत विकल्प छानेमा ऋणात्मक मूल्याङ्कन (Negative Marking) गरिने छ । अर्थात् यसरी मूल्याङ्कन गर्दा प्रत्येक गलत उत्तरको लागि २० प्रतिशत अङ्ककट्टा गरिनेछ । बहुवैकल्पिक प्रश्नको २० प्रतिशत अङ्क प्राप्ताङ्कबाट घटाइने छ । (उदाहरणका लागि परीक्षार्थीले २० अङ्कको बहुवैकल्पिक प्रश्नमा १५ प्रश्नको सही उत्तर र ५ प्रश्नको गलत उत्तर दिएमा निजको प्राप्ताङ्क (०.२० × ५=१.००) अर्थात् १५–१= १४ अङ्क हुनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।
3. विषयगत प्रश्नको हकमा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरू (Short notes) सोध्न सकिने छ ।
4. विषयगत प्रश्नमा प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन् । उम्मेदवारले प्रत्येक खण्डका प्रश्नको उत्तर सोही खण्डका उत्तरपुस्तिकामा लेख्नुपर्नेछ ।
5. प्रत्येक पत्रको उत्तीर्णाङ्क पूर्णाङ्कको ४० प्रतिशत हुनेछ ।
6. भाषा विषयबाहेक अन्य विषयका लागि उत्तरको माध्यम अंग्रेजी वा नेपाली हुनेछ ।

1. Radiological Anatomy

1.1 Definition of Terms:

1.1.1 Sagittal, coronal, axial.

1.1.2 Anterior, posterior, dorsal, ventral, supine, prone, erect, medial, lateral, superior, inferior, cranial, caudal.

1.1.3 Flexion, extension, abduction, adduction, circumduction, rotation.

1.1.4 Proximal, distal, oblique, decubitus, superficial, deep, palmar, plantar, inversion, eversion, apical.

1.1.5 Foramen, condyle, fossa.

1.2 Different Radiographic Positions:

1.2.1 Posteroanterior, anteroposterior, RAO, LAO, RPO, LPO, dorsal decubitus, ventral decubitus, lateral decubitus OF, OM.

1.3 Bones:

1.3.1 Types of bones: Classification based on location, shape, ossification, composition

1.3.2 Anatomy of following bones:

1.3.2.1 Cranial bones

1.3.2.2 Facial bones and paranasal sinuses.

1.3.2.3 Clavicle, scapula, humerus, ulna, radius, carpals, metacarpals, and phalanges.

1.3.2.4 Pelvic bones, Femur, tibia, fibula, tarsals, metatarsals and phalanges.

1.3.2.5 Vertebrae: Cervical, dorsal/thoracic, lumbar, sacral and coccygeal

1.4 Joints:

1.4.1 Common types (synovial, fibrous, cartilaginous)

1.4.2 Main movement in different joints

1.5 Muscles:

1.5.1 Types (skeletal, smooth and cardiac)

1.5.2 Location and principal function of common muscles (rotator cuff muscles, pectoralis major muscle, psoas muscle, intercostal muscles, diaphragm)

1.6 Gastrointestinal System

1.6.1 Parts of alimentary tract

1.6.2 Location and function of salivary glands, liver, pancreas

1.7 Respiratory System

1.7.1 Parts of respiratory system

1.7.2 Number of lobes in lungs

1.7.3 Diaphragm location and function

1.7.4 Pleura; structures forming thoracic cage.

1.8 Cardiovascular System

1.8.1 Structure of heart (chambers, valves, conducting system, coverings)

1.8.2 Parts of aorta

1.8.3 Name of major arteries

1.8.4 Pulmonary circulation; portal circulation; blood cells and composition.

1.9 Urinary System

1.9.1 Location, size and function of kidneys, ureter, urinary bladder and urethra

1.9.2 Surface markings of kidneys

1.10 Endocrine System

1.10.1 Location, Structure, functions of Pituitary, Thyroid, Parathyroid, Pancreas, Suprarenal, Ovary, and Testis

1.11 Reproductive System

1.11.1 External and internal genital organs of males and females
1.11.2 Location, structure and function of vagina, uterus, uterine tubes ovary in females
1.11.3 Testis, epididymis, vas deferens, seminal vesicles and prostate in males
1.11.4 Process of menstruation and ovulation
1.11.5 Location, structure and function of Breast

1.12 Nervous System

1.12.1 Different lobes of brain
1.12.2 Segments of spinal cord
1.12.3 Different layers of meninges; ventricles and common cisterns; CSF circulation; cranial nerves; common peripheral nerves; location of brachial and lumbo-sacral plexus; structure and function of special senses

1.13 Surface anatomy of Important Bones and Internal Organs

2. Radiographic Techniques

2.1 Radiographic Drill

2.1.1 Definition of radiographic drill
2.1.2 Purpose and significance radiological requisition form
2.1.3 Common clinical terms used in the requisition forms
2.1.4 Patient identification methods (name, hospital number, radiological markers).

2.2 Radiographic Projections

2.2.1 Routine and alternate radiographic projections
2.2.2 Centering and image quality for radiographs of skull; Mastoids; paranasal sinuses; spine; soft tissue neck; chest, abdomen, KUB, pelvis, upper extremity (shoulder, arm, elbow, forearm, wrist, hand, finger/thumb), lower extremity (hip, thigh, knee, leg, ankle, foot).

3. Radiological Procedures

3.1 Contrast Media

3.1.1 Definition, Types (positive, neutral, negative),
3.1.2 Classification, common names, route of administration, contrast reactions (identification and management),
3.1.3 Common emergency drugs and equipment for radiology department.

3.2 Procedures of GI Tract

3.2.1 Definition, indication, contraindications, equipment and common projections for barium swallow, barium meal, barium follow through, enteroclysis and barium edema.
3.2.2 Indication for gastrograffin/Iodine study.

3.3 Procedures of Genitourinary Tract

3.3.1 Definition, indications, contraindications, common complications, contrast media used/dose, common projections for excretory urography/intravenous urography, micturating cystourethrography, retrograde cystourethrography, hysterosapingography.

3.4 Procedures in Biliary Tree

3.4.1 Definition, indications, contraindications, common complications, contrast media used, common projections for Percutaneous Transhepatic Cholangiogram (PTC), Percutaneous Transhepatic Cholangiogram and Drainage (PTCD), T-tube cholangiogram.

3.5 Vascular Procedures

3.5.1 Definition, indications, contraindications, contrast media used, equipment for angiogram (carotid, vertebral, peripheral) and venogram.

3.6 Other contrast Procedures:

3.6.1 Definition, indications, contraindications, contrast media used and common projections for myelography, sialography, sinogram/fistulogram.

3.7 Mammography

3.7.1 Indications, routine projections; technique for craniocaudal and medic-lateral projections.

3.8 Portable/ward Radiography

3.8.1 Common indications, organs/projections Equipment.

4. Radiographic Photography

4.1 Image Receptor for Conventional Radiography

4.1.1 **X-ray film**: definition, types, different layers of film, characteristics of film base; difference of conventional and mammography films.

4.1.2 **Intensifying screen:** Definition, construction and function; advantages and disadvantages of various material used, care and cleaning)

4.1.3 **Radiographic cassette:** Definition, construction, function and process of cleaning.

4.2 Latent Image:

4.2.1 Definition and mechanism of formation of latent image.

4.3 Sensitometry

4.3.1 Definition of sensitometry, sensitometer, step wedge, densitometer, spectral sensitivity and importance of spectral matching of radiographic film.

4.4 Characteristic Curve

4.4.1 Definition of characteristic curve, photographic density (Optical density)
4.4.2 Transparency and Opacity
4.4.3 Features of characteristic curve

4.5 Radiographic Film Processing

4.5.1 Steps of manual and automatic film processing
4.5.2 Constituents of developer and fixer solutions
4.5.3 Factors affecting development time, fixation and regeneration of fixer
4.5.4 Advantages and disadvantages of manual and automatic film processing.
4.5.5 Method of preparing developer and fixer solution.

4.6 Digital Image Receptors

4.6.1 Definition of CR and DR.
4.6.2 Definition and construction of CR imaging plate rnetatarsals,
4.6.3 Mechanism of image formation with use of CR imaging plate,
4.6.4 Mechanism of image formation of DR

4.7 Image Artifacts

4.7.1 Definition of image artifacts
4.7.2 Types of artifacts (Processing artifacts, Exposure artifacts and Handling and storage artifacts)
4.7.3 Causes and remedies of artifacts

5. Radiographic Equipment

5.1 X-ray Tube

5.1.1 Definition of X-ray tubes
5.1.2 Different components of fixed anode and rotating anode x-ray tubes
5.1.3 Line focus principle
5.1.4 Concept of anode angle and its choice.
5.1.5 Anode heel effect and its applications; x-ray tube cooling methods
5.1.6 Care and maintenance of x-ray tube.

5.2 Conventional Fluoroscopy:

5.2.1 Definition of luminescence, fluorescence and phosphorescence
5.2.2 Fluorescent screen construction including descriptions of all layers and materials used as phosphor
5.2.3 Construction & working principle of conventional fluoroscopy
5.2.4 Limitations of conventional fluoroscopy

5.3 Modern Fluoroscopy

5.3.1 Definition, components and working principle of image intensifier
5.3.2 Definition of Digital Fluoroscopy

5.4 Scatter Radiation and its Control:

5.4.1 Definition, source and significance of scatter radiation
5.4.2 Techniques to control scatter radiation (compression band, air gap technique, beam limiting devices-cone, diaphragm, LBD, beam centering device and compression devices; use of grid)
5.4.3 Definition, construction and working principle of grid
5.4.4 Grid ratio, grid lattice and concept of proper choice of grid ratio
5.4.5 Types of grids (Parallel, Focused and crossed)
5.4.6 Advantages and disadvantages of grid

5.5 Computerized Radiography (CR)

5.5.1 Definition of CR
5.5.2 Definition of Photostimulable phosphor (PSP), construction and working of PSP
5.5.3 Construction of CR Cassette
5.5.4 Working of different components of CR
5.5.5 Basic concept of image formation in PSP plate and scanning of PSP plate to form image

5.6 Direct Digital Radiography (DR)

5.6.1 Definition of DR
5.6.2 Definition of Detector
5.6.3 Construction and working of Scintillation Detector
5.6.4 Working of different components of DR
5.6.5 Basic concept of image formation in DR
5.6.6 Differentiate between CR and DR

5.7 Portable/Mobile X-ray Equipment

5.7.1 Definition and components of portable & Mobile x-ray equipment
5.7.2 Comparison of portable and mobile x-rays
5.7.3 Working mechanism of Condenser discharge mobile units
5.7.4 Working and proper use of Mobile image intensifier for O. T.

5.8 Equipment for Vascular Imaging Technology

5.8.1 Angiographic tables:
5.8.2 Basic constructions, types and uses
5.8.3 Pressure injector
5.8.4 Basic settings, use and advantages
5.8.5 Definition of DSA and use

5.9 Mammography:

5.9.1 Definition and basic concept of Mammography
5.9.2 Mammography x- ray tube, filters and factors used
5.9.3 Major difference between mammography and conventional x-ray tube
5.9.4 Use of Mammography

5.10 CT/MRI

5.10.1 Definition, basic principle and common uses of CT and MRI

6. Basic Radiation Physics

6.1 Electricity & X-ray Apparatus

6.2 Static & Current Electricity

6.2.1 Principle of capacitor
6.2.2 The factors affecting the capacitance of a capacitor
6.2.3 Series & parallel connections of the capacitors
6.2.4 Charging and discharging of capacitors
6.2.5 Concept of dielectric
6.2.6 Electromagnetic: induction & its laws
6.2.7 Concepts of mutual & self-induction.
6.2.8 Alternating and Direct current with advantages and disadvantages
6.2.9 Generation, frequency, losses from peak & effective values of alternating current
6.2.10 Types, construction, principle, losses, efficiency & regulation of a transformer
6.2.11 Turns ratio, current ratio, voltage ratio & their relation
6.2.12 Low & high-tension transformer

6.3 Thermionic Emission- tubes & Valves

6.3.1 Definition of thermionic emission
6.3.2 Variation of electron emission with temperature
6.3.3 Construction, principle & characteristics of a diode
6.3.4 Construction & principle of a cold cathode gas filled diode
6.3.5 Self-rectified circuit and its disadvantage in a x-ray production
6.3.6 Half-wave (two valve) & full wave (four-valve fridge) circuits
6.3.7 Hazards of electric fire in the use of x- ray apparatus; precautions to be taken against the hazards
6.3.8 The generator symmetry & its necessity in rectifier circuit
6.3.9 Types of measurement of high voltage
6.3.10 Main parts involved in x-ray generator
6.3.11 The uses of x-ray cable fuses, switches, earthling & insulation
6.3.12 Wirings (single phase, three phases), switches (one way, two ways) & fuses

6.4 Atomic Structure, X-Ray Production & Radioactivity

6.4.1 Proton, electron, neutron mass number & atomic number
6.4.2 Energy level of K, L, and M shells in an atom; Ionization & excitation; isotopes, isobar & isomer
6.4.3 Radioactivity (definition of alpha particles, beta particles, gamma particles) and Half- Life
6.4.4 Definition of electromagnetic radiation
6.4.5 Types of production of x-rays, characteristic & continuous spectrum of an electromagnetic radiation
6.4.6 Factors influencing quality and intensity of an x-ray
6.4.7 Radiation intensity and Inverse square law

6.5 Interaction of X-Ray with Matter

6.5.1 Interaction of radiation with matter (coherent scattering, photoelectric effect, Compton scattering, pair production and photodisintegration)
6.5.2 Half-value layer, effective photon energy and intensity or quantity (exposure, roentgen) of an x-ray
6.5.3 Attenuation, absorption & scattering of the radiation
6.5.4 Exponential law
6.5.5 Attenuation coefficients
6.5.6 Linear attenuation coefficient, Relation between attenuation coefficient & half value layer; filtration & filters
6.5.7 X-ray detection & x-ray measurements

6.5.8 Construction & working principle of a free air ionization chamber, Thimble ionization chamber and condenser ionization chamber

6.5.9 Conventional and SI unit of radiation

7. Radiation Detection and Measurement

7.1 Principle of measurement, Ionization chamber, Electrometer, Scintillation counter, Gieger-muller counter, Thimble chamber, Condenser chamber.

8. Radiation Protection

8.1 Introduction, objective and principle of radiation protection, Radiation and Radiation units

8.2 Personnel monitoring, Protective materials, ICRP recommendations on dose limits.

९.१ त्रि.वि ऐन र नियम सम्बन्धी सामान्य जानकारी

९.१ त्रि.वि ऐन, २०४९

९.२ त्रि.वि शिक्षक कर्मचारी सेवा सम्बन्धी नियम, २०५०

त्रिभुवन विश्वविद्यालय
सेवा आयोग

प्राविधिक सेवा, प्राविधिक समूह, सहायक प्रथम, मुख्य स्वास्थ्य सहायक (रेडियोलोजी) पदको खुला प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

(Specification Chart)

२०८१

वस्तुगत - बहुवैकल्पिक प्रश्न

खण्ड	एकाई	विषय शीर्षक	अङ्क	प्रश्न संख्या	प्रश्न संख्या × अङ्क भार
	1.	Radiological Anatomy	8	50	50 प्रश्न × 1 अङ्क
	2.	Radiographic Techniques	5		
	3.	Radiological Procedures	6		
	4.	Radiographic Photography	6		
	5.	Radiographic Equipment	5		
	6.	Basic Radiation Physics	5		
	7.	Radiation Detection and Measurement	5		
	8.	Radiation Protection	5		
	9.	त्रि.वि ऐन र नियम सम्बन्धी सामान्य जानकारी	5		
कुल जम्मा			50	50	

विषयगत प्रश्न

खण्ड	एकाई	विषय शीर्षक	अङ्क	प्रश्न संख्या	प्रश्न संख्या × अङ्क भार
	1.	Radiological Anatomy	10	2	10 प्रश्न × 5 अङ्क
	2.	Radiographic Techniques	5	1	
	3.	Radiological Procedures	5	1	
	4.	Radiographic Photography	5	1	
	5.	Radiographic Equipment	5	1	
	6.	Basic Radiation Physics	5	1	
	7.	Radiation Detection and Measurement	5	1	
	8.	Radiation Protection	5	1	
	9.	त्रि.वि ऐन र नियम सम्बन्धी सामान्य जानकारी	5	1	
कुल जम्मा			50	10	