

निजामती कर्मचारी अस्पताल
प्राविधिक सेवा, मेडिसिन समूह, रेडिएसन अंकोलोजी उपसमूह, रेडियोथेरापि टेक्निसियन पद, पाँचौं तहको खुला
तथा आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम
 यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजन गरिएको छ :

प्रथम चरण :- लिखित परीक्षा (Written Examination)

पूर्णाङ्क :- २००

द्वितीय चरण :- अन्तर्वार्ता (Interview)

पूर्णाङ्क :- ३०

प्रथम चरण (First Phase) : परीक्षा योजना (Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली		प्रश्नसंख्या X अङ्क	समय
प्रथम	Technical Subject	१००	४०	वस्तुगत	बहुवैकल्पिक प्रश्न	५० प्रश्न x २ अङ्क	४५ मिनेट
द्वितीय		१००	४०	विषयगत		१० प्रश्न x १० अङ्क	३ घण्टा

द्वितीय चरण (Second Phase)

विषय	पूर्णाङ्क	परीक्षा प्रणाली
अन्तर्वार्ता	३०	मौखिक

द्रष्टव्य :

- यो परीक्षा योजनालाई प्रथम चरण (लिखित परीक्षा) र द्वितीय चरण (अन्तर्वार्ता) गरी दुई चरणमा विभाजन गरिएको छ ।
- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुनेछ ।
- प्रथम र द्वितीय पत्रको पत्रको विषयवस्तु एउटै हुनेछ ।
- प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।
- परीक्षामा सोधिने प्रश्नसंख्या, अङ्क र अङ्कभार यथासम्भव सम्बन्धित पत्र/विषयमा तोकिए अनुसार हुनेछ ।
- वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।
- वस्तुगत बहुवैकल्पिक हुने परीक्षामा परीक्षार्थीले उत्तर लेख्दा अंग्रेजी ठूलो अक्षर (Capital letter) A, B, C, D मा लेख्नुपर्नेछ । सानो अक्षर (Small letter) a, b, c, d लेखेको वा अन्य कुनै सङ्केत गरेको भए सबै उत्तरपुस्तिका रद्द हुनेछ ।
- बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।
- विषयगत प्रश्नका लागि तोकिएका १० अङ्कका प्रश्नहरूको हकमा १० अङ्कको एउटा लामो प्रश्न वा 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 ।
- विषयगत प्रश्नमा प्रत्येक पत्र/विषयका प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन् । परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डका उत्तरपुस्तिकामा लेख्नुपर्नेछ ।
- यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ ।
- प्रथम चरणको परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ ।
- पाठ्यक्रम लागू मिति :-

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तथा आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

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Paper I and II: Technical subject
Section (A): 50 % Marks

1. Anatomy and Physiology

- 1.1 Cell and Tissues (Epithelial, Connective, Skeletal, Muscular and Nervous)
- 1.2 General pathology : Bacteria, Viruses, Tumours
- 1.3 Surface and regional anatomy
 - 1.3.1 Anatomical position
 - 1.3.2 Head, Neck, Thorax, Abdomen and Pelvic cavity
- 1.4 Skeleton System
 - 1.4.1 Structure and function of bones
 - 1.4.2 Development and growth of bones, and healing of fractures
 - 1.4.3 Skull
 - 1.4.3.1 The skull viewed from the above and the below
 - 1.4.3.2 The skull viewed from the side and the front
 - 1.4.3.3 The interior of the skullcap
 - 1.4.3.4 The interior of the base of the skull
 - 1.4.3.5 The nasal cavity
 - 1.4.3.6 The accessory nasal sinuses
 - 1.4.3.7 The individual bones of the skull
 - 1.4.4 Vertebral column, ribs and sternum
 - 1.4.5 Bones of the upper limbs
 - 1.4.5.1 clavicle, scapula, humerus, radius, ulna, carpal bones, metacarpal bones, phalanges
 - 1.4.5.2 Arteries and nerves related to the bones of the upper limb
 - 1.4.5.3 Ossification of the bones of the upper limb
 - 1.4.6 Bones of the lower limbs
 - 1.4.6.1 Hipbone, pelvis, femur, patella, tibia, fibula, tarsal bones, metatarsal bones, phalanges
 - 1.4.6.2 The arches of the foot
 - 1.4.6.3 Arteries and nerves related to the bone of the lower limb
 - 1.4.6.4 Ossification of the bones of the lower limb
 - 1.4.7 Types of joints
 - 1.4.8 Muscles and joints of the head, neck and trunk, upper limbs and lower limbs
- 1.5 Circulatory System
 - 1.5.1 Blood and blood vessels
 - 1.5.2 Heart
 - 1.5.3 Pulmonary circulation
 - 1.5.4 Systemic circulation
 - 1.5.5 Veins
- 1.6 Lymphatic System
 - 1.6.1 Lymph and lymphatic vessels
 - 1.6.2 Lymph nodes
 - 1.6.3 Lymphatic drainage of the body
 - 1.6.4 Lymphatic tissue
 - 1.6.5 Spleen
- 1.7 Respiratory System
 - 1.7.1 Nose, pharynx, larynx, trachea, bronchi, lungs

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- 1.7.2 Physiology of respiration
- 1.8 Digestive System
 - 1.8.1 Mouth, salivary glands, pharynx, oesophagus, stomach, small intestine, large intestine, pancreas, liver, biliary apparatus
 - 1.8.2 Function of the alimentary system
- 1.9 Urinary System
 - 1.9.1 Kidneys, ureters, urinary bladder, urethra
 - 1.9.2 Functions of kidneys
 - 1.9.3 Control of micturition
- 1.10 Nervous System
 - 1.10.1 Nervous tissue
 - 1.10.2 Central nervous system, brain and spinal cord
 - 1.10.3 Peripheral nervous system
 - 1.10.4 Autonomic nervous system
- 1.11 Reproductive System
 - 1.11.1 Female Reproductive System & Breast
 - 1.11.1.1 External genitalia, Uterus, Ovaries: Position, structure functions
 - 1.11.1.2 Menstrual cycle, Reproduction & menopause
 - 1.11.1.3 Breast-Position, structure and its functions
 - 1.11.1.4 Puberty
 - 1.11.2 Male Reproductive System:
 - 1.11.2.1 Position structure and functions of scrotum, testes, epididymis, deferent ducts, seminal vesicles, ejaculatory ducts and penis
 - 1.11.2.2 Puberty
- 1.12 Special Senses
 - 1.12.1 Skin- structure and function
 - 1.12.2 Ear (external, middle & internal ear)-structure and function
 - 1.12.3 Eye- structure and functions
 - 1.12.4 Nose- structure and functions
 - 1.12.5 Tongue-structure, functions,
 - 1.12.6 Taste buds and Sense of taste
- 1.13 Endocrine System
 - 1.13.1 Endocrine glands - pituitary gland, thyroid gland, parathyroid glands, adrenal gland, islets of langerhans, pineal gland, testis, ovaries, thymus etc.
 - 1.13.2 Endocrine glands - Position, structure, functions and hormone secretion

2. Radiation Physics

2.1 Atomic structure

- 2.1.1 General introduction
- 2.1.2 Electron shells & energy levels
- 2.1.3 Mass number, atomic number, atomic mass unit, binding energy
- 2.1.4 Properties of electromagnetic waves
- 2.1.5 Concept of photon and quanta
- 2.1.6 Nuclear fission and fusion

2.2 Radioactivity

- 2.2.1 Radioactive elements
- 2.2.2 Radioactive series, different types of radioactive disintegration
- 2.2.3 Properties of radioactive particles

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- 2.2.4 Radioactive decay law
- 2.2.5 Alpha, beta and gamma disintegration
- 2.3 **X-rays and Gamma rays**
 - 2.3.1 Historical background of x-rays
 - 2.3.2 Mechanism and production of x-rays
 - 2.3.3 Properties of x-rays
 - 2.3.4 Continuous and characteristic spectra
 - 2.3.5 Gamma rays and its properties
- 2.4 **Basic interactions between x-rays and matter**
 - 2.4.1 Coherent scattering
 - 2.4.2 Photoelectric effect
 - 2.4.3 Compton scattering
 - 2.4.4 Pair production
 - 2.4.5 Photodisintegration
- 2.5 **Radiation detection and measurement**
 - 2.5.1 Principle of measurement
 - 2.5.2 Construction and working of the free air ionization chamber
 - 2.5.3 Thimble ionization chamber
 - 2.5.4 Condenser ionization chamber
 - 2.5.5 Scintillation counter
 - 2.5.6 Gieger-muller counter
- 2.6 **Clinical Dosimetry**
 - 2.6.1 Radiation absorbed dose
 - 2.6.2 Relationship between Kerma, Exposure and absorbed dose
 - 2.6.3 Cavity theory
 - 2.6.4 Measurement of absorbed dose
 - 2.6.5 Phantom
 - 2.6.6 Dose calibration parameters
 - 2.6.7 Depth dose distribution
 - 2.6.7.1 Percentage depth dose
 - 2.6.7.2 Tissue-air ratio
 - 2.6.7.3 Tissue maximum ratio
- 2.7 **Review of Electricity**
 - 2.7.1 Electromagnetic induction and its laws
 - 2.7.2 Self and mutual induction,
 - 2.7.3 A.C generator, Peak and effective values of AC
 - 2.7.4 Concept of Reactance, Impedance & phase angle
- 2.8 **Transformer**
 - 2.8.1 Theory, construction, Losses & Efficiency, Transformer ratings
 - 2.8.2 Filament transformer
 - 2.8.3 High-tension transformer
 - 2.8.4 Autotransformer or variac transformer

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2.9 Thermionic emission and rectifiers

- 2.9.1 Diode - construction, principle & characteristics
- 2.9.2 Rectifiers: Self-rectification, Half-wave, Full-wave (two valves and four valves) and constant voltage rectifiers
- 2.9.3 The cold cathode gas filled diode and its use

3. Clinical Oncology

3.1 Tumors

- 3.1.1 Tumor definition
- 3.1.2 Benign tumors and malignant tumors
- 3.1.3 Spread of tumors

3.2 Clinical Presentation

- 3.2.1 Symptoms and signs
- 3.2.2 Diagnostic procedure
 - 3.2.2.1 Hemogram
 - 3.2.2.2 Biochemical
 - 3.2.2.3 Tumor marker
 - 3.2.2.4 Radiological- X-ray, U.S.G., C.T, M.R.I
 - 3.2.2.5 Pathological – FNAC, FNAB, Incision biopsy, excision biopsy
 - 3.2.2.6 Surgery

3.3 Staging

- 3.3.1 TNM Classification

3.4 Malignancies and Treatment

- 3.4.1 CNS tumours
- 3.4.2 Ca-Larynx
- 3.4.3 Ca-Tongue, Head and Neck cancers
- 3.4.4 Ca-Breast
- 3.4.5 Ca-Lung
- 3.4.6 Ca-Cervix and Gynecological malignancies
- 3.4.7 Ca-Oesophagus
- 3.4.8 Bone and soft tissue cancers, thyroid

Section (B): 50% Marks

4. Radiotherapy Technique

4.1 Principle of Radiotherapy

- 4.1.1 Tumor histology
- 4.1.2 Grade, sensitivity,
- 4.1.3 Anatomical site, critical organs
- 4.1.4 General condition of the patient, extent of tumor, previous treatments
- 4.1.5 Radical/Palliative and prophylaxis

4.2 Types and Methods of Radiotherapy

- 4.2.1 Tele-therapy Technique
- 4.2.2 Brachytherapy Technique

4.3 Radiotherapy Resources

- 4.3.1 Low energy beams
- 4.3.2 High energy beams
- 4.3.3 Electron beams

4.4 Treatment Planning

- 4.4.1 Tumor localization and verification

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- 4.4.2 Isodose Curves
- 4.4.3 Single field, parallel opposed field, multiple field
- 4.4.4 Rotation therapy
- 4.4.5 Beam Modification

5. Radiotherapy Equipment and Quality Assurance

- 5.1 Teletherapy Equipments
 - 5.1.1 Superficial and orthovoltage equipment
 - 5.1.2 Cobalt-60 tele therapy equipment
 - 5.1.3 Linear accelerator
 - 5.1.4 Simulator
 - 5.1.5 Brachytherapy equipment
 - 5.1.5.1 Low dose rate (LDR)
 - 5.1.5.2 Medium dose rate (MDR)
 - 5.1.5.3 High dose rate (HDR)
 - 5.1.6 Tomotherapy
- 5.2 Quality Control
 - 5.2.1 Cobalt-60
 - 5.2.2 Linear Accelerator
 - 5.2.3 Brachytherapy
 - 5.2.4 Simulator
- 5.3 Radiation Protection
 - 5.3.1 Concept of radiation protection
 - 5.3.2 Justification, Optimization and Limitation
 - 5.3.3 Units, Maximum Permissible Dose
 - 5.3.4 Personnel monitoring
 - 5.3.5 Protective materials

6. Radiographic equipment

- 6.1 Historical background of x-ray and its production
 - 6.1.1 5.5.1 X-ray tube construction
 - 6.1.2 Stationary and rotating x-ray tube
 - 6.1.3 Recent advancement of an x-ray tube
 - 6.1.4 Tube rating cooling and care of x-ray tube and its faults
 - 6.1.5 USG
 - 6.1.6 CT
 - 6.1.7 MRI
- 6.2 Control panel, x-ray table and tube column
 - 6.2.1 Type of x-ray table
 - 6.2.2 Different metering equipment
 - 6.2.3 X-ray tube support
- 6.3 Fluoroscopic equipment
 - 6.3.1 Conventional fluoroscopy, image intensifier tube and Digital fluoroscopy
- 6.4 Control of scatter radiation & beam restricting devices
 - 6.4.1 Secondary radiation grids
 - 6.4.2 Air gap technique
- 6.5 Portable and mobile x-ray units
 - 6.5.1 Capacitor discharge and c-arm
- 6.6 Computed and Direct Digital Radiography

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6.7 Introduction to modern modalities (CT, MRI, mammography)

7. Radiation Biology

- 7.1 Cell cycle
- 7.2 Effect of radiation on the normal cell, tissue and organs
- 7.3 Radiation sensitivity
- 7.4 Physical and biological factors affecting radiation sensitivity
 - 7.4.1 LET
 - 7.4.2 RBE
 - 7.4.3 OER
- 7.5 Cell survival curves
- 7.6 4Rs of radiobiology
- 7.7 Radiation hazard and radiation protection

8. General knowledge about Civil Service Hospital and its Bylaws