

प्रदेश लोक सेवा आयोग

गण्डकी प्रदेश

नेपाल स्वास्थ्य सेवा, विविध समूह, सातौं तह, बायोमेडिकल इन्जिनियर पदको खुला र आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

पाठ्यक्रमको रूपरेखा: यस पाठ्यक्रमको आधारमा निम्नानुसार दुई चरणमा परीक्षा लिइने छः

प्रथम चरण:- लिखित परीक्षा

पूर्णाङ्क:- २००

द्वितीय चरण:- सामूहिक परीक्षण र अन्तर्वार्ता

पूर्णाङ्क:- ४०

प्रथम चरण - लिखित परीक्षा योजना (Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या x अङ्कभार	समय
प्रथम	Technical Subject, General	१००	४०	वस्तुगत बहुवैकल्पिक (MCQs)	१००x१= १००	१ घण्टा १५ मिनेट
द्वितीय	Knowledge and Related Legislation	१००	४०	विषयगत (Subjective)	४x५= २० ८x१०= ८०	३ घण्टा

द्वितीय चरण

विषय	पूर्णाङ्क	परीक्षा प्रणाली	समय
सामूहिक परीक्षण (Group Test)	१०	सामूहिक छलफल (Group Discussion)	३० मिनेट
व्यक्तिगत अन्तर्वार्ता	३०	मौखिक	-

- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुन सक्नेछ।
- पाठ्यक्रमको प्रथम र द्वितीय पत्रको विषयवस्तु फरक फरक हुनेछन्।
- प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ।
- प्रथम तथा द्वितीय पत्रहरूका एकाइहरूबाट सोधिने प्रश्नसंख्या निम्नानुसार हुनेछः

प्रथम पत्रका खण्ड	A	B
प्रश्न संख्या	80	20
द्वितीय पत्रका खण्ड	A	
प्रश्न संख्या	विषयगत ४ प्रश्न x ५ अङ्क = २० अङ्क ८ प्रश्न x १० अङ्क = ८० अङ्क	

- 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।
- 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।
- द्वितीय पत्रमा प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन्। परिक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको 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।
- पाठ्यक्रम लागू मिति:-

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प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

**प्राविधिक विषय, सामान्य ज्ञान र सम्बन्धित कानूनहरू**

(Technical Subject, General Knowledge and Related Legislation)

**खण्ड (A): Technical Subject**

**1. Bio-Engineering Materials and Components**

- 1.1 Introduction to bio-materials and Classes of materials used in medicine
- 1.2 Types of polymers used in medicine, Molecular weight and synthesis, Solid-state polymers and copolymers, Characterization techniques, Hydrogel
- 1.3 Structure, chemistry and properties of ceramics and glasses used in medical devices; Types of bio-ceramics; Characteristics and processing of bio-ceramics; Inert crystalline ceramics; Porous ceramics; Bioactive glasses and glass ceramics; Calcium phosphate ceramics, resolvable calcium phosphates
- 1.4 Different types of natural materials; Structure of native collagen; Physical modification of the native structure of collagen; Chemical modification of collagen; Proteoglycans and glycosaminoglycans; Elastin, Graft copolymers of collagen and glycosaminoglycans

**2. Human Anatomy**

- 2.1 Anatomy and its branches, Anatomical positions, planes, Topography
- 2.2 Cell Anatomy: Overview of Cellular Anatomy
- 2.3 Extremities (Upper and Lower): Bones, muscles, ligaments, tendons, bursae, reticulae, capsules, arteries, veins, Lymphatic system,
- 2.4 Vertebral Anatomy: Vertebrae, Pelvic girdle, spinal cord, nervous system, Thorax- Thoracic Viscera: Surface anatomy, bones surface musculature, lungs, heart, Abdomen: Organs (location, structures, relations and function), Head & Neck: Bones, muscles, cranial nerves (location, structures, relations and function)

**3. Human Physiology**

- 3.1 Functional organization of human body and control of the internal environment
- 3.2 Cell and its function, protein synthesis and cell reproduction
- 3.3 Metabolism of carbohydrates and formation of ATP
- 3.4 Lipid and Protein Metabolism, transport through Cell membrane
- 3.5 Quantitative issues at the organ and whole body levels of: Cardiovascular, Respiratory, Renal and Digestive systems
- 3.6 Nerve and Muscle: Membrane potential, Action potential, Excitation and Rhythmicity
- 3.7 Contraction of Skeletal and cardiac muscles, sliding filament Mechanism, Heart as a pump
- 3.8 Sensory Systems: Sensory Receptors: Classification and basic mechanism of action, Somatic Sensations: Mechanoreceptive sensations, pain, thermal and visceral pain, headache, Special Senses: Eye, receptor function of the retina, Neurophysiology of Vision, the Chemical Sense-taste and smell, Nervous System: Organization of Nervous System, Basic functions of synapses; Neuronal Mechanism and circuits for processing information, Motor Functions: Spinal cord and the cord reflexes; the cerebral cortex and intellectual functions of the Brain. Motor function of the Brain stem. Vestibular control of postural reflexes, Cerebrum and basal ganglia.
- 3.9 Reticular formation, Behavioral functions of the Brain: Limbic System, role of the Hypothalamus, and control of the vegetative functions of the body; the Autonomic nervous system; the Adrenal Medulla. Electrical Activity from Brain,
- 3.10 Endocrinology and Reproduction: Introduction to Endocrinology and the pituitary Hormones; Hormonal functions in male and female

#### 4. Biophysics

- 4.1 Sound: Hearing and Echolocation, Ultrasound
- 4.2 Optics of Vision: Quantum Nature of Vision
- 4.3 Nervous system: Biophysics of Neural Spike. Information theory and Memory; Nervous system
- 4.4 Structural Biophysics: Conformational analysis and forces that determine protein and nucleic acid structure
- 4.5 Molecular Modeling of protein, nucleic acid structures
- 4.6 Radiation and Radiobiology: Interaction of radiation with matter, Biological effects of radiation, radiobiological effects of radiation, medical imaging using radio-isotopes
- 4.7 Biopotentials: Electrocardiograms and electric shocks,
- 4.8 Fundamental laws for current in biological tissues, Biopotentials in hearts, electrocardiogram, Action potentials in nervous system
- 4.9 Bioenergetics: Thermodynamic Laws, Free energy, standard physical free energy and standard biological free energy, determination of the free energy from equilibrium constant and EMF measurements. Thermodynamics of phosphate compounds and role of ATP for biological energy transfer, thermodynamics of life
- 4.10 Energy Pathways: Coupled Reactions, Group Transfer Potential, Role of Pyridine Nucleotides, Energy Conversion Pathways, Biological Membrane, Active Transport, Chemi-osmotic theory-passive transport

#### 5. Biochemistry

- 1.1 Colloidal state, buffer, pH, significance of pH Henderson equation, surface tension, viscosity, osmosis, diffusion,
- 1.2 Concept of chromatographic techniques (TLC, paper chromatography, GLC column chromatography)
- 1.3 carbohydrates, amino acids, nucleic acids, proteins, vitamins, enzymes, hormones and signaling agents, carbohydrate derivatives, optical activity, polarimetry, glycogenesis, gluconeogenesis, glycolysis, tricarboxylic acid cycle, hexose monophosphate shunt
- 1.4 Effects of hormones on carbohydrate metabolism
- 1.5 Chemistry and Metabolism of Lipids and Proteins

#### 6. Bio Fluid Mechanics

- 6.1 Basic concepts in fluid mechanics: Viscosity, surface tension, compressibility; hydrostatics, pressure on plate; kinetics & kinematics of fluid flow; continuity equation; conservation of momentum; Bernoulli's equation; Poiseuille equation; viscous, unsteady flows; dimensional analysis
- 6.2 Physiological Fluid Mechanics: Introduction to blood flow in the circulatory system, respiration, peristaltic motion, ciliary and flagellar transport, Rheology of blood and blood vessels, static and steady flow model, native heart valve, Fluid dynamics measurement techniques

#### 7. Fundamental of Electrical Engineering

DC and AC Series And Parallel Circuits, Kirchhoffs Law, Network Graph, Matrix Representation - Solution Of Steady State, equations, transients in AC networks, Network theorems, super position, reciprocity, Thevenin and Norton's theorems, Maximum power transfer theorem, star delta transformation, frequency response of RL, RC, RLC series and parallel circuits, solutions of balanced and unbalanced 3 phase circuits

**8. Electronic Devices and Circuit**

Bipolar transistors switching characteristics, MOS transistor switching characteristics, TTL logic circuits, NMOS/CMOS logic circuits. Memory: RAM, DRAM, PROM, EPROM, Operational amplifiers, Butterworth and Chebysev filters, A/D Converters, Adders, Arithmetic operations, Digital comparators, Parity check generator, Multiplexer & Demultiplexers, Flipflops, Shift register, Counters, Sequence generators. Power electronics: Thyristor, Controlled rectifier circuits, 7 segment display, Untuned amplifier, Push-pull amplifier, tuned power amplifiers, Feedback amplifiers, bode plot analysis, Wien bridge oscillators, tuned LC oscillators, resonant circuits, crystal oscillator

**9. Digital Logic and Microprocessor**

Switching algebra, Number systems, Logic gates and circuits, Minimization techniques, Logic families, shift registers, Counters, Multiplexer, Demultiplexer, semiconductor Memories, LSI, VLSI, 8, 16, 32 and 32 bit microprocessors and their architecture, Instruction set, Peripherals and Interfacing Microcontrollers Microprocessor based system design

**10. Biomedical Control System**

Open loop and closed loop control system, System Stability and Sensitivity, System transfer functions and responses, Poles and Zeros locations and their significance, Root locus method, Frequency response method.

**11. Biomedical Signal Analysis and Processing**

Information theory, Shannon-Hartley law, Transmission of signals, Impulse response and convolution, Fourier series, Fourier Transform, Unit step, Delta, Sinc & Signum function, Helbert transform, LTI system, System described by Differential & Difference equations, FIR & IIR Filters, Discrete Fourier Transforms, IDFT, FFT, Circular convolutions, Parseval's theorem, Energy & power and auto correlation, Z transform

**12. Biomedical Electronics**

Amplifier Characteristics: Input and output impedance, Real and Apparent gain, Amplifier loading, Impedance matching of amplifiers, Power Supplies: Regulated and switched mode power supplies, Power Amplifiers: Classes of Power amplifiers, Oscillators: Hartley oscillators, Colpitt oscillators, RC phase shift oscillators, Wein Bridge oscillators, Crystal oscillators based on BJT and FET, Differential Amplifiers: Darlington transistor circuit, properties of differential amplifier stage, circuits of differential amplifiers using BJTs and FETs, Operational Amplifiers: Analysis of OP-AMP action, OP-AMP specifications: interpreting OP-AMP data sheet, offset voltage and current, temperature rating, output swing, CMRR, slew rate, Applications: Inverting amplifiers, non-inverting amplifiers, voltage follower, summing amplifiers, instrumentation amplifiers, integrator, differentiator, non linear amplifiers. Frequency response of OP-AMPs, A/D and D/A converters, power control using Op-Amp, Op Amp based timing circuits.

**13. Biomedical Instrumentation**

13.1 Precision, resolution, sensitivity, accuracy, uncertainty, Principles and development of Biomedical Instrumentation, Problems encountered in living systems, Biological

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### गण्डकी प्रदेश

नेपाल स्वास्थ्य सेवा, विविध समूह, सातौं तह, बायोमेडिकल इन्जिनियर पदको खुला र आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

- Systems: Study of various physiological systems, related biopotentials and physiological parameters
- 13.2 Diagnostic Equipment: invasive and noninvasive measurement, techniques and related equipment
  - 13.3 Cardiovascular Measurements: Electrocardiography, Measurement of Blood pressure, Blood flow and Cardiac output, Biofeedback Instrumentation
  - 13.4 Biomedical Sensors and Transducers: Introduction, principles, theory, design and applications, Principles and design, Speed, Position, Temperature, light & Pressure transducers, Programmable logic controller, PLC interfacing, memory processor,
  - 13.5 Patient Monitoring Equipment: Patient Monitors, Central Monitoring System, telemetry system, Gas Exchange and distributions, Respiratory therapy equipment,
  - 13.6 Therapeutic Equipment: ventilator, inhaler, defibrillator, pacemaker and heart lung machines,
  - 13.7 Radiological Equipment: concept of ionization and nonionization radiation and related equipment, medical lasers and applications, Laser Safety
  - 13.8 Safety in Medical Equipment: Electrical/Mechanical safety, Standards of Medical Devices, Biohazards and Safety Regulations
  - 13.9 Quality Assurance and Quality Control: Calibration, maintenance and reparability of monitoring equipment
  - 13.10 Microscopy: Electron Microscopy, Atomic Force Microscopy, Confocal Microscopy, Spectroscopy: U. V., I. R., NMR & Visible Absorption, Fluorometric Methods, Flame Photometry, Spectrographic Spectroscopy, Circular Dichroism, Mass Spectrometry
  - 13.11 Electrochemical methods of analysis: Electrophoresis Chromatography, High Performance Liquid Chromatography, Clinical Chemistry Analysis, Study of different blood components through automated cell-counter, Centrifuging Techniques, Blood Banking and Transfusion, Service Automation, Polymerase Chain Reaction
  - 13.12 Surgical Diathermy Machine, Safety Aspects in Electro-surgical Units, Surgical Diathermy Analysers; Dental Clinic and Laboratory : suction pressure unit, suction machine and dental chair; Physical Therapy : Diathermy, Hydrotherapy, Traction & TMT unit; ENT : Audiometers, Tympanometers, ENT icroscope, ENT Drill and Autoscope

#### 14. Biomechanics

Statics: General principles of Statics, laws of triangle, Parallelogram and polygon forces, Equilibrium of rigid body, Free body Diagrams. Trusses, Methods of Joints and section for force analysis. Shear force and bending moments. Application of these forces with analysis in human body, Dynamics: Rectilinear and curvilinear motion, Rotational mechanics, Simple and multiple degrees of freedom, Application of these motions in human body and prosthetics, Fluid Mechanics: Basic concepts of Fluid Mechanics, Hydrodynamic lubrication of natural and normal synovial joints, Biomedical Applications: Mechanical properties of biological tissues and tissue mechanics, cardiac mechanics and modeling, muscle mechanics, gait kinetics, kinematics and analysis. Stress analysis and application to musculoskeletal system.

**15. Biomaterials and Design**

Biomaterials Science and Review: Hard Tissues and Pathologies, Orthopaedic prostheses, Properties of Natural Tissue Replacements, Biopolymers and Biomaterials: 3D structure of Biopolymers by Bio X-ray diffraction, Biomedical application of chitosan and other Biopolymers, Structure property relationships, Metals – Dental Implants, Bioceramics and Composites, Biocompatibility: Immune System, Corrosion, Deterioration of Non-metallic Materials, Mechanical Factors, Testing of Biomaterials, Applications: Joint Replacements, Fracture Fixation, Soft Tissue Implants, Vascular Implants, Tissue Engineering; Gene Therapy using viral vectors, Materials for Scaffolding.

**16. Medical Imaging**

X-ray Equipment: X-ray tubes, X-ray control and indicating equipment, Filters and grids, Different types of X-ray equipment (portable, fluoroscopy, mammography), Digital Imaging: Introduction, Digital Radiography, PACS (Picture Archiving and Communicating System), Computer Tomography (CT): Basic Principles of CT, Generation of CT, System Components, Recent Advances in CT, Magnetic Resonance Imaging (MRI): Fundamental Concepts, Basic Principles of MRI, Contrast Enhanced MRI, Artifacts in MRI, MR Scanners, Clinical Application, Ultrasonography (USG): Physics of Ultrasound, Construction and Properties of Ultrasound Transducer, Ultrasonic Beam, Modes of Ultrasound Imaging, Doppler Ultrasound, Clinical Application, Contrast Media in Ultrasound Imaging, Recent Advances in Ultrasonic Equipment, Interaction of Radiation with Matter, Scattered & absorbed Radiation, spatial image formation, Imaging Transducers: Various transducers used in medical imaging systems, Imaging development: X-ray Film, Fluoroscopic imaging, Digital Imaging System, X-ray imaging, Film-less radiographic imaging, CT imaging, Emission Tomography imaging, Nuclear imaging, MR Imaging, Functional MRI imaging, Advance imaging modalities PET and SPECT. Emerging areas in medical imaging, Ultrasound Imaging: Ultrasonic imaging, Doppler Imaging, software based estimations and measurement in ultrasonic imaging. Planar and Volumetric analysis techniques, Medical imaging software: Algorithms, techniques, imaging archival and management. Molecular imaging and other advance biomedical imaging techniques and their image manipulation, Quality Assurance and Control in Medical Imaging Equipment: Quality assurance of medical imaging, Evaluation of imaging parameter and related equipment calibration, Diagnostic values, Statistical performance measures.

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**खण्ड (B): General Knowledge and Related Legislation**

**सामान्य ज्ञान तथा ऐन, नियमहरू**

१. नेपालको भौगोलिक, ऐतिहासिक, आर्थिक, सामाजिक, सांस्कृतिक र राजनैतिक अवस्था सम्बन्धी सामान्य जानकारी,
२. राष्ट्रिय र अन्तर्राष्ट्रिय महत्वका समसामयिक घटनाहरू: राजनैतिक, आर्थिक, वैज्ञानिक, खेलकूद, सूचना प्रविधि, पुरस्कार, स्वास्थ्य,
३. नेपालको संविधानमा स्वास्थ्य सम्बन्धी व्यवस्था,
४. नेपाल स्वास्थ्य सेवा ऐन, २०५३ र स्वास्थ्य सेवा नियमावली, २०५५
५. नेपाल मेडिकल काउन्सिल ऐन, २०२० र नियमावली, २०२४
६. नेपाल स्वास्थ्य व्यवसायी परिषद् ऐन, २०५३
७. जनस्वास्थ्य सेवा ऐन, २०७५,
८. स्वास्थ्यकर्मी तथा स्वास्थ्य संस्थाको सुरक्षा सम्बन्धी ऐन, २०६६,
९. सार्वजनिक खरिद ऐन, २०६३ र नियमावली, २०६४,
१०. राष्ट्रिय स्वास्थ्य नीति र राष्ट्रिय औषधी नीति,
११. बायोमेडिकल इन्जिनियरीङ्ग कार्यसँग सम्बन्धित पेशाको आदर्शता र व्यवहारिक पक्षसंग सम्बन्धित ज्ञान,
१२. अस्पतालको बहिरङ्ग सेवा, अन्तरङ्ग सेवा, आकस्मिक सेवा र शल्यक्रिया सेवा संचालनमा बायोमेडिकल इन्जिनियरिङ्गको महत्व तथा भूमिका ।

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नेपाल स्वास्थ्य सेवा, विविध समूह, सातौं तह, बायोमेडिकल इन्जिनियर पदको खुला र आन्तरिक  
प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

### सामूहिक परीक्षण (Group Discussion)

यस प्रयोजनको लागि गरिने परीक्षण १० पूर्णाङ्क र ३० मिनेट अवधिको हुनेछ जुन नेताविहिन सामूहिक छलफल (Leaderless Group Discussion) को रूपमा अवलम्बन गरिने छ। दिइएको प्रश्न वा Topic का विषयमा पालैपालोसँग निर्दिष्ट समयभित्र समूहबीच छलफल गर्दै प्रत्येक उम्मेदवारले व्यक्तिगत प्रस्तुति (Individual Presentation) गर्नु पर्नेछ। यस परीक्षणमा मूल्याङ्कनको लागि देहाय अनुसारको कम्तीमा ३ जनाको समिति रहनेछ।

आयोगका सदस्य - अध्यक्ष

विज्ञ - सदस्य

दक्ष/विज्ञ (१ जना) - सदस्य

### सामूहिक छलफलमा दिइने नमुना प्रश्न वा Topic

उदाहरणको लागि - उर्जा संकट, गरीबी निवारण, स्वास्थ्य बीमा, खाद्य सुरक्षा, प्रतिभा पलायन जस्ता Topics मध्येकुनै एक Topic मात्र दिइनेछ।