प्रदेश लोक सेवा आयोग

सुदूरपश्चिम प्रदेश

प्रदेश निजामती सेवा र स्थानीय सरकारी सेवा अन्तरगत स्वास्थ्य सेवा, वायोमेडिकल इन्जिनियरिङ समूह, सातौं तह, वायोमेडिकल इन्जिनियर वा सो सरह पदको खुला, अन्तर तह र आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

पाठ्यक्रमको रुपरेखा : यस पाठ्यक्रमलाई निम्नअनुसार दुई चरणमा विभाजन गरिएको छ।

प्रथम चरण : लिखित परीक्षा (Written Examination) **पूर्णांक : २००**

द्वितीय चरण : सामूहिक परीक्षण र अन्तरवार्ता (Group Test & Interview) **पूर्णांक : ३५**

परीक्षा योजना (Examination Scheme)

१. प्रथम चरण : लिखित परीक्षा (Written Examination) **पूर्णांक : २००**

पत्र	विषय	पूर्णांक	उत्तीर्णांक	परीक्षा प्रणाली	प्रश्न संख्या × अंक	समय
प्रथम	वायोमेडिकल इन्जिनियरिङ सम्बन्धी	१००	४०	वस्तुगत बहुवैकल्पिक (MCQs)	१०० प्रश्न × १ अंक	१ घण्टा १५ मिनेट
द्वितीय		१००	४०	विषयगत (Subjective)	१० प्रश्न × १० अंक	३ घण्टा

२. द्वितीय चरण : सामूहिक परीक्षण र अन्तरवार्ता (Group Test & Interview) **पूर्णांक : ३५**

विषय	पूर्णांक	परीक्षा प्रणाली	समय
सामूहिक परीक्षण (Group Test)	१०	सामूहिक छलफल (Group Discussion)	३० मिनेट
व्यक्तिगत अन्तरवार्ता (Interview)	२५	मौखिक (Oral)	-

द्रष्टव्य

१. लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुन सक्नेछ ।

२. प्रथम पत्र र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।

३. प्रथम तथा द्वितीय पत्रका पाठ्यक्रमका एकाईहरुबाट सोधिने प्रश्नहरुको संख्या निम्न अनुसार हुनेछन ।

पत्र	खण्ड (Section)	परीक्षा प्रणाली	अंकभार	प्रश्न संख्या × अंक
प्रथम	(A)	बहुवैकल्पिक (MCQs)	३०	३० × १
	(B)		२५	२५ × १
	(C)		२५	२५ × १
	(D)		२०	२० × १
द्वितीय	(A)	विषयगत (Subjective)	३०	३ × १०
	(B)		३०	३ × १०
	(C)		२०	२ × १०
	(D)		२०	२ × १०

४. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरुको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अंक कट्टा गरिनेछ। तर उत्तर नदिएमा त्यस बापत अंक दिइने छैन र अंक कट्टा पनि गरिने छैन ।

५. बहुवैकल्पिक प्रश्नहरु हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर प्रयोग गर्न पाइने छैन ।

६. विषयगत प्रश्नहरुको हकमा तोकिएको अंकको एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तरगत दुई वा बढी टिप्पणीहरु (Shorts notes) सोध्न सकिने छ ।

७. द्वितीय पत्रमा प्रत्येक खण्डका लागि छुट्टाछुटै उत्तरपुस्तिकाहरु हुनेछन । परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरुको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नु पर्नेछ ।

८. यस पाठ्यक्रम योजना अन्तरगतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरु परीक्षाको मिति भन्दा ३ महिना अगाडि संसोधन भई कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ ।

९. प्रथम चरणको लिखित परीक्षामा छनौट भएका उम्मेदवारहरुलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराईने छ ।

१०. यो पाठ्यक्रम मिति २०८०।१०।२४ गते देखि लागु हुनेछ ।

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प्रदेश लोक सेवा आयोग

सुदूरपश्चिम प्रदेश

प्रदेश निजामती सेवा र स्थानीय सरकारी सेवा अन्तरगत स्वास्थ्य सेवा, वायोमेडिकल इन्जिनियरिङ समूह, सातौं तह, वायोमेडिकल इन्जिनियर वा सो सरह पदको खुला, अन्तर तह र आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

प्रथम र द्वितीय पत्र : वायोमेडिकल इन्जिनियरिङ सम्बन्धी

Section: (A)

1. Cell Biology, Immunology & Tissue Device Interaction

1.1 Cell biology: Cell growth, apoptosis and oncogenic transformation, cell signaling

1.2 Biomolecules: Proteins, carbohydrates, lipids, nucleic acid

1.3 Molecular biology and genetics: DNA, RNA and Protein synthesis; Techniques of genetic engineering

1.4 Immunology: Types of immunity, Antigen and antibody, Antigen-Antibody reactions

1.5 Tissue Device Interactions: Inflammation, wound healing and foreign body response; Endothelial cells & ECM-Biomaterial interaction; Blood-biomaterials interaction Bacteria and biomaterials

2. Human Anatomy and Physiology

2.1 Introduction to Human Body: Understanding of body design at structure-function level; Interpretation of the molecular cell biology to the development of body organs & system; Appreciation of the Control & regulation of body function; The Cells, Tissues & Organization of the Body; Understanding of structure & function of different types of cells & tissues; Cell to cell transport mechanisms

2.2 Blood: Composition of Blood; Erythrocytes (RBCs), leukocytes (WBCs) and platelets and their functions; Clotting factors; Haematopoesis; Haematopoetic stem cell; Differentiation and maturation of haematoblast into RBCs, WBCs and Platelets; Hemostasis, Components of coagulation cascades; Extrinsic, intrinsic and common pathway of coagulation cascades

2.3 The Cardiovascular System: Understanding of Anatomy of heart & blood vessels; Study of blood supply of heart or coronary circulation; Blood circulation from different organs to the heart & from the heart to different organs; Outline the heart functions; Understanding of cardiac cycle, cardiac output & blood pressure; Learning of conduction system of heart

2.4 The Respiratory System: Understanding of Anatomy-physiological relationship of upper respiratory tract; Lungs & its topography. Pleura & pleural cavity; Learning of lung functions; Mechanism of breathing, types of breathing & control of respiration; Understanding of Ventilation & Lung volumes Gas transfer & diffusion

2.5 The Digestive System: Structure of oral cavity & underlying glands; Teeth systems, functions & abnormalities of teeth; Structure of alimentary system; Functions of stomach, intestine & role of smooth muscle of gut; Understanding of digestion, secretion & absorption capacity of gut; Structure-function relationship of liver, billiary tract & gall bladder; Pancreas & its functions; Revision of Metabolic functions of body

2.6 The Urinary System: Topography of Kidneys; Microanatomy of kidney; Role of kidney in salt-water balance Structure-function relationship of ureter, bladder & urethra; Control of bladder function Renal & urinary diseases

3. Implantable Devices

3.1 Cardiovascular Implants: Heart valves: Single leaflet, Bi-leaflet, Bio prosthetic; Vascular grafts: Artificial and biological; Stents, catheters and cannulas; Pacemakers; Inferior venacava filters; Intraaortic balloon pump; Ventricular assist device

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3.2 Orthopaedic Implants: Biomaterials used in orthopaedic implants; Total hip Replacement; Total Knee Replacement

3.3 Urology Implants: Materials used in urology implants; Urethral catheters; Urology stents

3.4 Plastic Surgery implants: Materials used in plastic surgery implants; Types and procedures of breast implants; Gels and fillers in plastic surgery

3.5 Tissue Engineering: Introduction; Basic procedure of cell culture

4. Bio-engineering Materials and Components

4.1 Biomaterials: Introduction to Bio-materials and biocompatibility; Classes of materials used in medicine.

4.2 Metals: Introduction, structure, chemistry, mechanical properties and applications of various metals relating to biomaterials.

4.3 Polymers: Introduction, Types of polymers used in medicine Hydrogel

4.4 Ceramics, Glasses and Composites: Structure, chemistry and properties of ceramics and glasses used in medical devices; Types of bio-ceramics.

4.5 Natural Materials: Different types of natural materials; Collagen: Structure, Physical modification, Chemical Modification; Proteoglycans and glycosaminoglycans

5. Biomechanics

5.1 Human joints: Classification and forces in joints (elbow, shoulder, hip, knee, spine, ankle, wrist)

5.2 Mechanics of hard tissues: Bone growth and development, fracture mechanics, mechanical properties of cortical and cancellous bones

5.3 Mechanics of soft tissues: Mechanical properties of ligaments & tendons, collagen, elastin; Muscle Mechanics-skeletal and cardiac muscles

5.4 Biofluid Mechanics: Basics of blood rheology; Blood flow and measurement

Section (B)

6. Medical Imaging

6.1 X-ray Equipment: X-ray production and methods; X-ray tubes: Stationary and Rotating anode; X-ray control and indicating equipment; Filters and grids; Fluoroscopy: Introduction; Biological Effects of X-rays

6.2 Computed Tomography (CT): Introduction; Basic Principles of CT; Generation of CT; System Components

6.3 Magnetic Resonance Imaging (MRI): Fundamental Concepts; Principles of Parameters of MRI; Basic Principles of MR Imaging and Related Parameters Image formation; Contrast Enhanced MRI; Clinical Application

6.4 Ultrasonography (USG): Physics of Ultrasound; Construction and Properties of Ultrasound Transducer Ultrasonic Beam; Modes of Ultrasound Imaging; Doppler Ultrasound; Clinical Application; Biological Effects of Ultrasound

6.5 Digital Imaging: Introduction; Digital Radiography; PACS (Picture Archiving and Communicating System)

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7. Biomedical Instrumentation

7.1 Fundamental of Medical Instrumentation: Sources of Biomedical Signals; Basic Medical Instrumentation System; Performance Requirements of Medical Instrumentation Systems; Intelligent Medical Instrumentation Systems; General Constraints in Design of Medical Instrumentation; Systems Regulation of Medical Devices

7.2 Signals and Electrodes: Bioelectric potential; Resting potential; Action potential; Propagation of action potential; Biological signals; Electrodes; Bio-potential electrodes; Microelectrodes; Skin surface electrodes

7.3 Physiological Transducers: Introduction; Classification of Transducers: Active and Passive; Performance Characteristics of Transducers; Displacement, Position and Motion,Transducers; Pressure Transducers; Transducers for Body Temperature Measurement; Photoelectric Transducers; Optical Fiber Transducers; Optical Fiber Sensors; Biosensors; Smart Sensors

7.4 Biomedical Recorders: Electrocardiograph (ECG); Electroencephalograph (EEG); Electromyography (EMG); Bio feedback Instrumentation

7.5 Patient Monitoring System: System Concept; Cardiac Monitor; Beside Patient Monitoring Systems; Central Monitors; Measurement of Heart Rate; Measurement of Pulse Rate; Blood Pressure Measurement; Measurement of Temperature; Measurement of Respiration Rate; Catheterization Laboratory Instrumentation

7.6 Arrhythmia and Ambulatory Monitoring Instruments: Cardiac Arrhythmias; Arrhythmia Monitor; QRS Detection Techniques; Exercise Stress Testing; Ambulatory Monitoring Instruments

7.7 Fetal Monitoring Instruments: Cardiotocograph; Methods of Monitoring Fetal Heart Rate; Monitoring Labor Activity; Recording System

7.8 Biomedical Telemetry and Telemedicine: Wireless Telemetry; Single Channel Telemetry Systems; Multi-patient Telemetry; Multi-channel Wireless Telemetry Systems; Implantable Telemetry System; Transmission of Analog Physiological Signals; Telemedicine

7.9 Oximeters: Ear Oximeter; Pulse Oximeter; Skin Reflectance Oximeters; Intravascular Oximeter

7.10 Blood Flowmeters: Electromagnetic Blood Flowmeter; Types of Electromagnetic Blood Flowmeter; Ultrasonic Blood Flowmeters; NMR Blood Flowmeters; Laser Doppler Blood Flowmeter

7.11 Cardiac Output Measurement: Indicator Dilution Method; Dye Dilution Method; Thermal Dilution Techniques; Measurement of Continuous Cardiac Output Derived from Aortic Pressure Waveform; Impedance Technique; Ultrasound Method

7.12 Pulmonary Function Analyzers: Pulmonary Function Measurements; Spirometry; Pneumotachometers; Measurement of Volumes; Pulmonary Function Analyzers

7.13 Clinical Laboratory Equipment: Medical Diagnosis with Chemical Tests; Spectrophotometry; Spectrophotometer type Instruments; Colorimeters; Biochemistry Analyzers; Electrolyte Analyzers; Microscope; Centrifuge; ELISA reader and washer; Biosafety Cabinet; Autoclave

7.14 Blood Gas Analyzers: Acid Base Balance; Blood pH Measurements; Measurement of Blood PCO_2; Blood pO_2 Measurement; Intra-Arterial Blood Gas Monitoring; A Complete Blood Gas Analyzer

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7.15 Blood Cell Counters: Methods of Cell Counting; Coulter Counters; Automatic Recognition and Differential Counting of Cells

7.16 Audiometers and Hearing Aids: Mechanism of Hearing; Measurement of Sound; Basic Audiometer; Pure Tone Audiometer; Speech Audiometer; Audiometer System Bekesy; Evoked Response Audiometry System; Calibration of Audiometers; Hearing Aids

7.17 Cardiac Pacemakers: Need for Cardiac Pacemaker; External Pacemaker; Implantable Pacemakers; Recent Development in Implantable Pacemakers; Pacing System Analyzer

7.18 Cardiac Defibrillators: Need for a Defibrillator; DC Defibrillator; Pacer – cardioveter- defibrillaror; Defibrillator Analyzers

7.19 Instruments for Surgery: Principle of Surgical Diathermy; Surgical Diathermy Machine: Monopolar and Bi-polar; Safety Aspects in Electro-surgical Units

7.20 Laser Applications in Biomedical Field: Principle of Laser; Pulsed Ruby Laser; Nd-YAG Laser; Helium-Neon Laser; Argon Laser; CO_2 Laser; Excimer Lasers; Semiconductor Lasers; Laser Safety

7.21 Physiotherapy and Electrotherapy Equipment: High Frequency Heat Therapy; Short-ware Diathermy; Microwave Diathermy; Ultrasonic Therapy Unit; Electrodiagnostic/ Therapeutic Apparatus; Pain Relief Through Electrical Stimulation

7.22 Hemodialysis Machines: Function of the Kidneys; Artificial Kidney; Dialyzers; Membranes for Hemodialysis; Hemodialysis machine

7.23 Lithotripters: The Stone Disease Problem; Conventional Lithotripter Machine; Modern Lithotripter Systems; Extra-corporeal Shock-wave Therapy

7.24 Anesthesia Machine : Need for Anesthesia; Anesthesia Machine: Introduction and Electronics parts in Anesthesia Machine

7.25 Ventilators: Mechanisms of Respiration; Artificial Ventilation Ventilators; Types of Ventilators; Ventilator Terms; Classification of Ventilators; Pressure-volume-flow Diagrams; Modern Ventilators; High Frequency Ventilators Humidifiers, Nebulizers and Aspirators

7.26 Automated Drug Delivery Systems: Components of Drug Infusion Systems; Closed-loop Control in Infusion Systems; Examples of Typical Infusion Pumps and syringe pumps

7.27 Patient Safety: Electric Shock Hazards; Leakage Currents; Safety Codes for Electro medical Equipment; Electrical Safety Analyzer

7.28 Reverse Osmosis : Treatment of water, procedure, regeneration of water, storage and looping

7.29 Oxygen plant : Production of oxygen, procedure, storage and supply pressure

Section (C)

8. Electronic Devices and Circuits

8.1 Integrated Circuit Technology and Device Models

8.2 Overview of dc and ac diode models, JFET models, bipolar transistor models, MOS transistor models.

8.3 Operational Amplifier Circuits

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8.4 Bias circuits suitable for IC design.
8.5 The differential amplifier
8.6 Active loads.
8.7 Power Supplies and Voltage Regulators
8.8 Half-wave and full-wave rectifiers.
8.9 Capacitive filtering.
8.10 Zener diodes, bandgap voltage references, constant current diodes.
8.11 Zener diode voltage regulators.
8.12 Untuned and Tuned Power Amplifiers
8.13 Amplifier classification.
8.14 Direct-coupled push-pull stages.
8.15 Transformer-coupled push-pull stages.
8.16 Tuned power amplifiers.
8.17 Oscillator Circuits and Filter Circuits:
8.18 CMOS inverter relaxation oscillator.
8.19 Operation amplifier-based relaxation oscillators.
8.20 Voltage-to-frequency converters.
8.21 LC Filters, RC Filters, Active Filters

9. Digital Electronics and Microprocessors

9.1 Logic Gates: truth tables and Boolean expressions
9.2 Universal gates and gate conversion
9.3 DeMorgan's theorem
9.4 Combinational Logic Devices, Encoder and Decoder
9.5 Multiplexer and Demultiplexer
9.6 Half and Full: Adder and Subtractor
9.7 Sequential Logic Devices
9.8 Counters: types and characteristics
9.9 Registers: SISO, SIPO, PISO, PIPO
9.10 Digital clocks and frequency counter
9.11 Bus Structure and Memory Devices
9.12 Bus structure, synchronous and asynchronous data bus, address bus, bus timing
9.13 Static and dynamic RAM, ROM, PROM, EPROM, EEPROM
9.14 Input/output Interfaces for serial communication
9.15 Asynchronous interface: ASCII code, baud rate, start bit, stop bit, parity bit Synchronous interface
9.16 Physical communication standard
9.17 Interrupt vector and descriptor table

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9.18 Interrupt service routine requirements

9.19 Interrupt priority: Maskable and Non-maskable interrupts, software interrupts, traps and exceptions

10. Digital Signal Processing

10.1 Introduction to Discrete Signal and Systems

10.2 Discrete signals – unit impulse, unit step, exponential sequences.

10.3 Linearity, shift invariance, casualty.

10.4 Convolution summation and discrete systems, response to discrete inputs.

10.5 Stability, sum and convergence of power series.

10.6 Sampling continuous signals – spectral properties of sampled signals.

10.7 General Introduction of various filters

11. Control Systems

11.1 System Modeling

11.2 Differential equation and transfer function

11.3 State-space formulation of differential equations, matrix notation

11.4 Mechanical components and Electrical components: mass, spring, damper, inductance, capacitance, resistance, sources, motors, tachometers, transducers, operational amplifier circuits

11.5 Linearized approximations

11.6 Frequency domain characterization of systems

11.7 Bode amplitude and phase plots, Effects of gain and time constants on Bode diagrams, Stability from the Bode diagram

11.8 Nyquist plots, Correlation between Nyquist diagrams and real time response of systems: stability, relative stability, gain and phase margin, damping ratio

12. Communication Systems

12.1 Analog and digital communication sources, transmitters, transmission channels and receivers.

12.2 Types and reasons for modulation.

12.3 Representation of Communication Signals and Systems

12.4 Frequency Modulation (FM) and Phase Modulation (PM)

12.5 Distortion, noise, and interference.

12.6 Nyquist sampling theory, sampling of analog signals, spectrum of a sampled signal.

12.7 Sampling theorem for band-limited signals, effects of aliasing, reconstruction of sampled signals.

Section (D)

13. Medical Industry Management

13.1 Introduction to Medical Industry concept: Classification of medical devices: Class I, IIa, IIb, III; Introduction to ISO, CE marking, FDA

13.2 Selection and purchase and management of Medical equipment: Need analysis; Specification preparation

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13.3 Various procurement methods: Direct purchase, Sealed quotation, Tender; Incoming inspection and commissioning

13.4 Preventive maintenance; Corrective maintenance; AMC (Annual Maintenance Contract); CMC (Comprehensive Maintenance Contract); Decommissioning

13.5 Basics of hospital management: Hospital traffic flow; Architectural planning of hospital

13.6 Basics of Patient Management system and Laboratory management system

14. Engineering Professional Practice

14.1 Codes of ethics and guidelines for professional engineering practice

14.2 Relationship of the engineering profession to basic science and technology

14.3 Relationship of the engineering profession to other professions

15. Applicable Legislations:

15.1 The Public Procurement Act, 2063 & Public Procurement Rules, 2064

15.2 The Prevention of Corruption Act, 2059

15.3 Right to Information Act, 2064

15.4 Sudurpashchim Province Civil Service Act, 2079 & Regulation, 2081

15.5 National & Sudurpashchim Provincial Health policy

15.6 Sudurpashchim Province Public Health Service Act, 2076

ΩΩΩ

द्वितीय चरण (Second Phase) : सामूहिक परीक्षण र अन्तरवार्ता (Group Text & Interview)

सामुहिक परिक्षण (Group Test) **(१० अंक)**

सामुहिक छलफल (Group Discussion)

यस प्रयोजनको लागि गरिने परीक्षण १० पूर्णाङ्क र ३० मिनेट अवधिको हुनेछ, जुन नेता विहिन सामुहिक छलफल (Leaderless Group Discussion) को रुपमा अवलम्बन गरिने छ | दिइएको प्रश्न वा Topic का बिषयमा पालैपालोसंग निर्दिस्ट समय भित्र समूह बीच छलफल गर्दै प्रत्येक उम्मेदवारले व्यक्तिगत प्रस्तुति (Individual Presentation) गर्नु पर्नेछ।

सामुहिक छलफलमा दिइने नमुना प्रश्न वा Topic

उदारणको लागि - उर्जा संकट, गरिबी निवारण, स्वास्थ्य बीमा, खाद्य सुरक्षा, प्रतिभा पलायन, आरक्षण, सामाजिक सुरक्षा जस्ता समसामयिक विषयवस्तुहरुबाट कुनै एक Topic दिइनेछ |

अन्तरवार्ता (Interview) **(२५ अंक)**

मौखिक (Oral)

ΩΩTHE ENDΩΩ

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