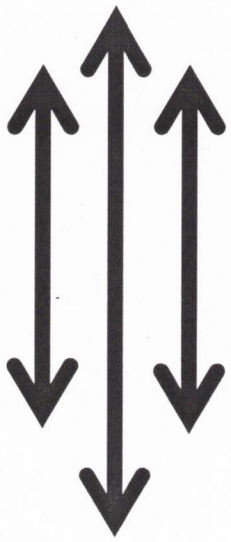
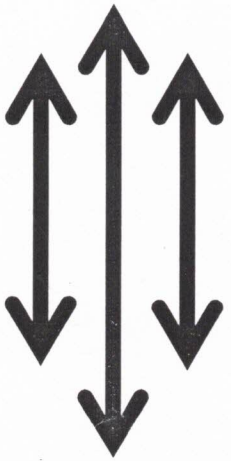
नेपाली सेना

श्री भर्ना छनौट निर्देशनालय कार्यरथी विभाग

जंगी अड्डा



प्रा.उ.से बायोमेडिकल ईन्जिनियर (खुल्ला) पदको लिखित परीक्षाको पाठ्यक्रम



२०७८

प्रा.उ.से. बायोमेडिकल ईन्जिनियर (खुला) पदको लिखित परीक्षाको पाठ्यक्रम

समयः ४ घण्टा १५ मिनेट

पुर्णाङ्कः १५०
उत्तीणाङ्कः ६०

यो पाठ्यक्रम नेपाली सेनाको प्रा.उ.से. बायोमेडिकल ईन्जिनयर (खुला) पदका उम्मेदवार छनौट परिक्षाको लागि निर्धारण गरिएको हो । लिखित परीक्षामा सरिक हुने उम्मेदवारहरुको पेशा सम्बन्धि विषयलाई आधारमानी प्रश्नहरु सोधिने छ ।

(क) लिखित परीक्षाको माध्यम नेपाली/अंग्रेजी वा दुवै भाषा हुनेछ ।
(ख) लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र अर्को चरणको परीक्षामा सम्मिलित गराईने छ ।
(ग) प्रश्नपत्र निर्माण गर्दा पाठ्यक्रममा समावेश भएका सबै विषयहरुलाई यथासंभव समेटिनेछ
(घ) बस्तुगत र विषयगत संयुक्त रुपमा पूर्णाङ्क र उत्तीर्णाङ्क कायम गरिनेछ ।
(ङ) बस्तुगत र विषयगत परीक्षाको पाठ्यक्रम एउटै हुनेछ ।
(च) बस्तुगत र विषयगत विषयको लिखित परीक्षा एकैपटक वा छुट्टाछुट्टै गरी लिन सकिनेछ
(छ) यो पाठ्यक्रम मिति २०७८/०५/१९ गतेबाट लागु हुनेछ ।

लिखित परीक्षाको योजना र पाठ्यक्रम

विषय	पुर्णाङ्क	उत्तीणाङ्क	परीक्षा प्रणाली		प्रश्न संख्याxअंङ्क	समय
पेशा सम्बन्धी	७५	६०	वस्तुगत (Objective)	बहुवैकल्पिक प्रश्न (MCQs)	७५ प्रश्न x १ अंङ्क = ७५	१ घण्टा १५ मिनेट
	७५		विषयगत (Subjective)	छोटो उत्तर	२ प्रश्न x२.५ अंङ्क = ५	३ घण्टा
				लामो उत्तर	१४ प्रश्न x५ अंङ्क = ७०	

लिखित परीक्षाको पाठ्यक्रम

Section 1:BIO-ENGINEERING MATERIALS AND COMPONENTS

1.Introduction to Bio-materials
- 1.1. Biomaterial science: An interdisciplinary course.
- 1.2. Classes of materials used in medicine.

2.Polymers
- 2.1. Types of polymers used in medicine
- 2.2. Hydrogel

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

4.Natural Materials
- 4.1. Different types of natural materials.
- 4.2. Structure of native collagen.
- 4.3. Physical modification of the native structure of collagen.
- 4.4. Chemical modification of collagen.
- 4.5. Proteoglycans and glycosaminoglycans.

Section 2:HUMAN ANATOMY AND PHYSIOLOGY

1.Introduction to Human Body
- 1.1.Understanding of body design at structure-function level.
- 1.2.Interpretation of the molecular cell biology to the development of body organs & system.
- 1.3.Appreciation of the Control & regulation of body function.
- 1.4. Understanding of disease mechanism

2.The Cells, Tissues & Organization of the Body, Disorder of the Cells & Tissues
- 2.1.Understanding of structure & function of different types of cells & tissues
- 2.2.Cell to cell transport mechanisms
- 2.3. Cell division
- 2.4. Development of organ-system
- 2.5. Abnormal development of cells & tissues
- 2.6.Tissue repair & regeneration

3.The Nervous System.
- 3.1.Understanding the microanatomy of Nerve cell (neurons)
- 3.2.Arrangement of neurons. Types of neurons & their connections
- 3.3.Functions of nerve cell. Impulse generation. Neuromuscular transmission
- 3.4.Structure of Central Nervous system (CNS)
- 3.5.Identification of underlying areas of Brain

4.Brief Introduction Of Blood Component. Haemostasis & Thrombosis, Coagulation
- 4.1.Brief revision of blood components.
- 4.2.Blood function
- 4.3.Learning of haemostatic mechanisms
- 4.4.Review of Blood coagulation & disorders

5.The Cardiovascular System

5.1.Understanding of Anatomy of heart & blood vessels.
5.2.Study of blood supply of heart or coronary circulation
5.3.Blood circulation from different organs to the heart & from the heart to different organs.
5.4.Outline the heart functions
5.5.Understanding of cardiac cycle, cardiac output & blood pressure
5.6.Learning of conduction system of heart

6.The Respiratory System

6.1.Understanding of Anatomy-physiological relationship of upper respiratory tract
6.2.Lungs & its topography. Pleura & pleural cavity
6.3.Learning of lung functions
6.4.Mechanism of breathing, types of breathing & control of respiration
6.5.Composition of air
6.6.Understanding of Ventilation & Lung volumes
6.7.Gas transfer & diffusion

Section 3: ELECTRONIC DEVICES AND CIRCUITS

1.Integrated Circuit Technology and Device Models

1.1Overview of dc and ac diode models
1.2Overview of dc and ac JFET models.
1.3Overview of dc and ac bipolar transistor models
1.4Overview of dc and ac MOS transistor models.

2.Operational Amplifier Circuits

2.1Bias circuits suitable for IC design.
2.2The differential amplifier
2.3Active loads

3.Power Supplies and Voltage Regulators

3.1Half-wave and full-wave rectifiers.
3.2Capacitive filtering.
3.3Zener diodes, bandgap voltage references, constant current diodes.
3.4Zener diode voltage regulators.
3.5voltage regulations

4.Untuned and Tuned Power Amplifiers

4.1Amplifier classification.
4.2Direct-coupled push-pull stages.
4.3Transformer-coupled push-pull stages.
4.4Tuned power amplifiers.

5.Oscillator Circuits and Filter Circuits:

5.1CMOS inverter relaxation oscillator.
5.2Operation amplifier based relaxation oscillators.
5.3Voltage-to-frequency converters.
5.4LC Filters
5.5RC Filters
5.6Active Filters

Section 4: DIGITAL ELECTRONICS AND MICROPROCESSORS

1.Fundamental of Digital Electronics
- 1.1. Logic Gates: truth tables and Boolean expressions
- 1.2 Universal gates and gate conversion
- 1.3 DeMorgan's theorem

2.Combinational Logic Devices
- 2.1 Encoder and Decoder
- 2.2 Multiplexer and Demultiplexer
- 2.3 Half and Full: Adder and Subtractor

3.Sequential Logic Devices
- 3.1 Counters: types and characteristics
- 3.2 Registers: SISO, SIPO, PISO, PIPO
- 3.3 Digital clocks and frequency counter

4.Bus Structure And Memory Devices
- 4.1.Bus structure, synchronous and asynchronous data bus, address bus, bus timing
- 4.2.Static and dynamic RAM, ROM
- 4.3.Programmable read only memory (PROM), ultraviolet
- 4.4.Electrically programmable memory (EPROM) and electrically erasable programmable memory (EEPROM)

5.Input/Output Interfacesfor serial communication
- 5.1.Asynchronous interface: ASCII code, baud rate, start bit, stop bit, parity bit
- 5.2.Synchronous interface
- 5.3.Physical communication standard

6.Interrupt
- 6.1.Introduction, interrupt vector and descriptor table
- 6.2.Interrupt service routine requirements
- 6.3. Interrupt priority: Maskable and Non-maskable interrupts, software interrupts, traps and exceptions

Section 5:ELECTRICAL MACHINES

1.Introduction
- 1.1.Magnetic circuits and Ampere's Law
- 1.2.Ferromagnetic materials: magnetic saturation, non-linearity, hysteresis
- 1.3.Types of magnetic circuit
- 1.4.Effect of DC and AC, hysteresis and eddy currents, energy losses and laminations
- 1.5.Self and mutual inductances
- 1.6.Electromagnets

2.Transformers
- 2.1.Magnetically coupled circuits
- 2.2.Effects of secondary current in ideal transformer
- 2.3.Losses in transformer

Section 6: CONTROL SYSTEMS

1.System Modeling
- 1.1Differential equation and transfer function
- 1.2State-space formulation of differential equations, matrix notation
- 1.3Mechanical components and Electrical components: mass, spring, damper, inductance, capacitance, resistance, sources, motors, tachometers, transducers, operational amplifier circuits
- 1.4Fluid and fluidic components, Thermal system components
- 1.5Mixed systems
- 1.6Linearized approximations

2.Frequency Response Methods:
- 2.1Frequency domain characterization of systems
- 2.2Bode amplitude and phase plots, Effects of gain and time constants on Bode diagrams, Stability from the Bode diagram
- 2.3Nyquist plots, Correlation between Nyquist diagrams and real time response of systems: stability, relative stability, gain and phase margin, damping ratio

Section 7: COMMUNICATION SYSTEMS

1.Analog and Digital Communication Systems
- 1.1.Analog and digital communication sources, transmitters, transmission channels and receivers.
- 1.2.Fundamental limitations due to noise, distortion, and interference and the relationships between noise, bandwidth and information.
- 1.3.Types and reasons for modulation.

2.Representation of Communication Signals and Systems
3.Frequency Modulation (FM) and Phase Modulation (PM):
4.Digital Communication Systems
- 4.1.Digital communication sources, transmitters, transmission channels and receivers.
- 4.2.Distortion, noise, and interference.
- 4.3.Nyquist sampling theory, sampling of analog signals, spectrum of a sampled signal.
- 4.4.Sampling theorem for band-limited signals, effects of aliasing, reconstruction of sampled signals.

Section 8:IMPLANTABLE DEVICES
1.Cardiovascular Implants (General Introduction)
- 1.1Cardiopulmonary bypass
- 1.2Heart valves
- 1.3Vascular grafts
- 1.4Drug administration systems and vascular access
- 1.5Stents, catheters and cannulas
- 1.6Pacemakers
- 1.7Inferior venacava filters
- 1.8Intraaortic balloon pump
- 1.9Ventricular assist device and total artificial hearts
- 1.10Blood substitutes

2.Orthopaedic Implants
- 2.1Biomaterials used in orthopaedic implants
- 2.2Total hip arthroplasty.

3.Catheters
- 3.1Catheter materials and biocompatibility.
- 3.2Biomaterials and catheter complications.

4.Different Kinds of Artificial Organs (General Introduction)
- 4.1Artificial Pancreas.
- 4.2Artificial liver.
- 4.3Artificial Heart and lung.
- 4.4Artificial skin
- 4.5Artificial reproductive organs.
- 4.6Artificial vision
- 4.7 Artificial hearing implant.

5.GeneralIntroduction to Tissue Engineering

Section 9:DIGITAL SIGNAL PROCESSING

1.Introduction to Discrete Signal and Systems:
- 1.1Discrete signals – unit impulse, unit step, exponential sequences.
- 1.2Linearity, shift invariance, casualty.
- 1.3Convolution summation and discrete systems, response to discrete inputs.
- 1.4Stability, sum and convergence of power series.
- 1.5Sampling continuous signals – sectral properties of sampled signals.

2.General Introduction of various filters

Section 10:MEDICAL IMAGING

1.X-ray Equipment
- 1.1 X-ray tubes
- 1.2 X-ray production and methods
- 1.3X-ray control and indicating equipment
- 1.4Filters and grids
- 1.5Different types of X-ray equipment (portable, fluoroscopy, mammography etc.)
- 1.6Biological Effects of Ultrasound

2.Digital Imaging
- 1.1Introduction
- 1.2Digital Radiography
- 1.3PACS (Picture Archiving and Communicating System)

3.Computed Tomography (CT)
- 3.1Basic Principles of CT
- 3.2Generation of CT
- 3.3System Components

4.Magnetic Resonance Imaging (MRI)
- 4.1Fundamental Concepts
- 4.2Principles of Parameters of MRI
- 4.3Basic Principles of MR Imaging and Related Parameters
- 4.4Contrast Enhanced MRI
- 4.5Clinical Application

5.Ultrasonography (USG)
- 5.1Physics of Ultrasound
- 5.2Construction and Properties of Ultrasound Transducer
- 5.3Ultrasonic Beam
- 5.4Modes of Ultrasound Imaging
- 5.5Doppler Ultrasound
- 5.6Clinical Application
- 5.7Biological Effects of Ultrasound

Section 11: BIOMEDICAL INSTRUMENTATION

1.Fundamental of Medical Instrumentation
- 1.1Anatomy and Physiology
- 1.2Physiological System of the Body
- 1.3Sources of Biomedical Signals
- 1.4Basic Medical Instrumentation System
- 1.5Performance Requirements of Medical Instrumentation Systems
- 1.6Intelligent Medical Instrumentation Systems
- 1.7General Constraints in Design of Medical Instrumentation Systems
- 1.8Regulation of Medical Devices 28

2.Bioelectric Signals and Electrodes
- 2.1Origin of Bioelectric Signals
- 2.2Recording Electrodes
- 2.3Silver-silver Chloride Electrodes
- 2.4Electrodes for ECG
- 2.5Electrodes for EEG
- 2.6Electrodes for EMG
- 2.7Electrical Conductivity of Electrode Jellies and Creams
- 2.8Microelectrodes

3.Physiological Transducers
- 3.1Introduction
- 3.2Classification of Transducers
- 3.3Performance Characteristics of Transducers
- 3.4Displacement, Position and Motion Transducers
- 3.5Pressure Transducers
- 3.6Transducers for Body Temperature Measurement
- 3.7Photoelectric Transducers
- 3.8Optical Fibre Transducers
- 3.9Optical Fibre Sensors
- 3.10Biosensors
- 3.11Smart Sensors

4.Recording System
- 4.1Basic Recording System
- 4.2General Consideration for Signal Conditioners
- 4.3Preamplifiers
- 4.4Sources of Noise in Low Level Measurement
- 4.5Biomedical Signal Analysis Techniques
- 4.6Signal Processing Techniques
- 4.7The Main Amplifier and Driver Stage

5.Biomedical Recorders
- 5.1Electrocardiograph
- 5.2Vectrocardiograph (VCG)
- 5.3Phonocardiograph (PCG)
- 5.4Electroencephalograph (EEG)
- 5.5Electromyograph (EMG)
- 5.6Other Biomedical Recorders
- 5.7Biofeedback Instrumentation

6.Patient Monitoring Systems:
- 6.1System Concept
- 6.2Cardiac Monitor
- 6.3Beside Patient Monitoring Systems
- 6.4Central Monitors
- 6.5Measurement of Heart Rate
- 6.6Measurement of Pulse Rate
- 6.7Blood Pressure Measurement
- 6.8Measurement of Temperature
- 6.9Measurement of Respiration Rate
- 6.10Catheterisation Laboratory Instrumentation

7.Arrhythmia and Ambulatory Monitoring Instruments
- 7.1Cardiac Arrhythmias
- 7.2Arrhythmia Monitor
- 7.3QRS Detection Techniques
- 7.4Exercise Stress Testing
- 7.5Ambulatory Monitoring Instruments

8.Foetal Monitoring Instruments
- 8.1Cardiotocograph
- 8.2Methods of Monitoring Foetal Heart Rate
- 8.3Monitoring Labour Activity
- 8.4Recording System

9.Biomedical Telemetry and Telemedicine
- 9.1Wireless Telemetry
- 9.2Single Channel Telemetry Systems
- 9.3Multi-patient Telemetry
- 9.4Multi-channel Wireless Telemetry Systems
- 9.5Implantable Telemetry System
- 9.6Transmission of Analog Physiological Signals
- 9.7Telemedicine

10.Oximeters
- 10.1Oximetry
- 10.2Ear Oximeter
- 10.3Pulse Oximeter
- 10.4Skin Reflectance Oximeters
- 10.5Intravascular Oximeter

11.Blood Flowmeters
- 11.1Electromagnetic Blood Flowmeter
- 11.2Types of Electromagnetic Blood Flowmeter
- 11.3Ultrasonic Blood Flowmeters
- 11.4NMR Blood Flowmeters
- 11.5Laser Doppler Blooe Flowmeter

12.Cardiac Output Measurement
- 12.1Indicator Dilution Method
- 12.2Dye Dilution Method
- 12.3Thermal Dilution Techniques
- 12.4Measurement of Continuous Cardiac Output Derived from Aortic Pressure Waveform
- 12.5Impedance Technique
- 12.6Ultrasound Method

13.Pulmonary Function Analyzers
- 13.1Pulmonary Function Measurements
- 13.2Spirometry
- 13.3Pneumotachometers
- 13.4Measurement of Volumes
- 13.5Pulmonary Function Analyzers

14.Clinical Laboratory Equipments:
- 14.1 Medical Diagnosis with Chemical Tests
- 14.2Spectrophotometry
- 14.3Spectrophotometer type Instruments
- 14.4Colorimeters
- 14.5 Biochemistry Analyzers
- 14.6Electrolyte Analyzers
- 14.7Microscope
- 14.8Centrifuse
- 14.9 ELISA reader and washer
- 14.10 Biosafety Cabinet
- 14.11 Autoclave

15.Blood Gas Analysers
- 15.1Acid Base Balance
- 15.2Blood pH Measurements
- 15.3Measurement of Blood PCO_2
- 15.4Blood pO_2 Measurement
- 15.5 Intra-Arterial Blood Gas Monitoring
- 15.6A Complete Blood Gas Analyser

16.Blood Cell Counters
- 16.1Types of Blood Cells
- 16.2Methods of Cell Counting
- 16.3Coulter Counters
- 16.4Automatic Recognition and Differential Counting of Cells

17.Audiometers and Hearing Aids:
- 17.1Mechanism of Hearing
- 17.2Measurement of Sound
- 17.3Basic Audiometer
- 17.4Pure Tone Audiometer
- 17.5Speech Audiometer
- 17.6Audiometer System Bekesy
- 17.7 Evoked Response Audiometry System
- 17.8Calibration of Audiometers
- 17.9Hearing Aids

18.Patient Safety
- 18.1Electric Shock Hazards
- 18.2Leakage Currents
- 18.3 Safety Codes for Electromedical Equipment
- 18.4Electrical Safety Analyser
- 18.5Testing Biomedical Equipment

19.Cardiac Pacemakers
- 19.1Need for Cardiac Pacemaker
- 19.2External Pacemaker
- 19.3Implantable Pacemakers
- 19.4Recent Development in Implantable Pacemakers
- 19.5Pacing System Analyser

20.Cardiac Defibrillators
- 20.1Need for a Defibrillator
- 20.2DC Defibrillator
- 20.3Pacer – cardioveter-defibrillaror
- 20.4Defibrillator Analysers

21.Instruments for Surgery
- 21.1Principal of Surgical Diathermy
- 21.2Surgical Diathermy Machine
- 21.3 Safety Aspects in Electro-surgical Units
- 21.4Surgical Diathermy Analysers

22.Laser Applications in Biomedical Field
- 22.1The Laser
- 22.2Pulsed Ruby Laser
- 22.3Nd-YAG Laser
- 22.4Helium-Neon Laser
- 22.5Argon Laser
- 22.6CO2 Laser
- 22.7Excimer Lasers
- 22.8Semiconductor Lasers
- 22.9Laser Safety

23.Physiotherapy and Electrotherapy Equipment:
- 23.1High Frequency Heat Therapy
- 23.2Short-ware Diathermy
- 23.3Microwave Diathermy
- 23.4Ultrasonic Therapy Unit
- 23.5 Eletrodiagnostic/ Therapeutic Apparatus
- 23.6Pain Relief Through Electrical Stimulation

24.Haemodialysis Machines
- 24.1Function of the Kidneys
- 24.2Artificial Kidney
- 24.3Dialysers
- 24.4Membrances for Haemodialysis
- 24.5Haemodialysis machine

25.Lithotripters
- 25.1The Stone Disease Problem
- 25.2First Lithotripter Machine
- 25.3Modern Lithotripter Systems
- 25.4 Extra-corporeal Shock-wave Therapy

26.Anaesthesia Machine
- 26.1Need for Anaesthesia
- 26.2Anaesthesia Machine
- 26.3Electronics in Anaesthesia Machine

27.Ventilators
- 27.1Mechanisms of Respiration
- 27.2Artificial Ventilation
- 27.3Ventilators
- 27.4Types of Ventilators
- 27.5Ventilator Terms
- 27.6Classification of Ventilators
- 27.7Pressure-volume-flow Diagrams
- 27.8Modern Ventilators
- 27.9High Frequency Ventilators
- 27.10Humidifiers, Nebulizers and Aspirators

28.Automated Drug Delivery Systems
- 28.1Infusion Pumps
- 28.2 Components of Drug Infusion Systems
- 28.3Implantable Infusion Systems
- 28.4 Closed-loop Control in Infusion Systems
- 28.5 Examples of Typical Infusion Pumps
- 28.6 Syringe Pump

Section 12:MISCELLENEOUS TOPICS

1.Medical Industry Management
2.Hospital Management System
3.Organization and Management
4.Engineering Professional Practice

माथी उल्लेखित पाठ्यक्रमका एकाईहरुबाट सोधिने प्रश्नहरुको संख्या निम्नानुसार हुनेछ

विषय(सेक्सन)	Weightage	परीक्षा प्रणाली			कै
		वस्तुगत(Objective)	विषयगत (Subjective)		
		बहुवैकल्पिक प्रश्न(MCQS) (प्रश्नX अंक)	छोटोउत्तर (प्रश्नX अंक)	लामोउतर (प्रश्नX अंक)	
1		4 x1			
2		5 x 1	1x 2.5		
3		6 x 1		1x5	
4		6 x 1		1x5	
5		2 x 1			
6		2 x 1			
7		2 x 1			
8		4 x 1			
9		2 x 1			
10		12 x1		3 x5	
11		25 x1		9 x5	
12		5 x1	1 x 2.5		
Total	150	75 x 1 = 75	2 x 2.5 = 5	14 x 5 = 70	

प्रयोगात्मक परीक्षाको पाठ्यक्रम

समय: ६ ०मिनेट

पूर्णाङ्क:५०

उत्तीर्णाङ्क:२५

S.N.	Topic	Marks	Time (Minutes)
1	Component Identification	10	10
2	Machine Identification and it's function	20	20
3	Testing the function of components	15	20
4	Viva	5	10
	Total	50	60