

**वी.पी. कोइराला मेमोरियल क्यान्सर अस्पताल**  
**प्राविधिक अन्य सेवा, हस्पिटल इन्जिनियरिङ्ग समुह, वायोमेडिकल उपसमुह, अधिकृत सातौं तह, वायोमेडिकल**  
**इन्जिनियर पदको खुला र 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

**परीक्षा योजना (Examination Scheme)**

**प्रथम चरण (First Phase) : लिखित परीक्षा**

Paper	Subject	Full Marks	Pass Marks	No. Questions & Weightage	Time Allowed
I	Technical Subject & Organizational Knowledge	100	40	100× 1= 100 (Objective Multiple Choice Questions)	1.15 hrs
II		100	40	4 × 5 = 20 8 × 10 = 80 (Subjective Descriptive Type)	3.00 hrs

**द्वितीय चरण (Second Phase)**

Subject	Full Marks	Examination
Interview	30	Oral

**द्रष्टव्य :**

- यो पाठ्यक्रमको योजनालाई प्रथम चरण र द्वितीय चरण गरी दुई भागमा विभाजन गरिएको छ ।
- प्रथम र द्वितीय पत्रको पत्रको विषयवस्तु एउटै हुनेछ ।
- प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।
- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुनेछ ।
- वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कटौत गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कटौत 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 ।
- परीक्षामा सोधिने प्रश्नसंख्या, अङ्क र अङ्कभार यथासम्भव सम्बन्धित पत्र /विषयमा दिइए अनुसार हुनेछ ।
- परीक्षामा परीक्षार्थीले मोबाइल वा यस्तै प्रकारका विद्युतीय उपकरण परीक्षा हलमा लैजान पाइने छैन ।
- विषयगत प्रश्न हुने पत्रका हकमा प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन् । परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नुपर्ने छ ।
- 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 सम्भन्नु पर्दछ ।
- प्रथम चरणको परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ ।
- पाठ्यक्रम लागू मिति :- २०७८/०९/२५

**Paper I & II : - Technical Subject & Organizational Knowledge**

**Section (A): 45 % Marks**

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
- 4.11 Radiation hazard and security measures

5. **Biochemistry**

- 5.1 Colloidal state, buffer, pH, significance of pH Henderson equation, surface tension, viscosity, osmosis, diffusion,
- 5.2 Concept of chromatographic techniques (TLC, paper chromatography, GLC column chromatography)
- 5.3 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
- 5.4 Effects of hormones on carbohydrate metabolism
- 5.5 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

**Section (B): 45 % Marks**

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, RIC 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 Systems: Study of various physiological systems, related biopotentials and physiological parameters

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- 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 microscope, 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

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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.

**Section (C): 10 % Marks**

17. **Concept of management**

- 17.1 Management: concept, scope, functions, principles, and its practices
- 17.2 Hospital Management : concept, scope, function, principle and its practices
- 17.3 Communication skills, problem solving and decision making
- 17.4 Planning, organizing, monitoring and evaluation in health sector
- 17.5 Participative management
- 17.6 Social justice and social security system in Nepal
- 17.7 Positive attitude and self-development
- 17.8 Demographic characteristic of Nepal

18. **Organizational Knowledge and General Health Issues**

- 18.1 B.P.Koirala Memorial Cancer Hospital : History, organizational structure, functions, roles, services, problems and challenges
- 18.2 National Health Policy
- 18.3 B.P.Koirala Memorial Cancer Hospital related act and regulations
- 18.4 Health Service Act, 2053 and Health Service Regulation, 2055
- 18.5 Professional council related acts and regulations
- 18.6 Professional and medical ethics
- 18.7 Cancer Registry: Hospital and Community Based Cancer Registry