Pokhara University Teaching Hospital
Curriculum for Biomedical Engineer Level Examination

For Written Examination
Full Marks: 65

There shall be 4 hrs. written examination based on the following syllabus

Group A: Written Examination **65 Marks**

Section: I (20)

1. **Bio-Engineering Materials and Components**
   Introduction of bio-materials and Classes of materials used in medicine, Types of bio-ceramics; Characteristics and processing of bio-ceramics
2. **Human Anatomy**
   Overview of Human Anatomy and its branches, concept of Anatomical positions.
3. **Human Physiology**
   Functional organization of human body and control of the internal environment.
4. **Biophysics**
   Overview of Interaction of radiation with matter, Biological effects of radiation, radiobiological effects of radiation, medical imaging using radio-isotopes,
5. **Biochemistry**
   Concept of chromatographic techniques (TLC, paper chromatography, GLC column Chromatography), Overview of Effects of hormones on carbohydrate metabolism.
6. **Bio Fluid Mechanics**
   Basic concepts in fluid mechanics: Viscosity, surface tension, compressibility, Hydrostatics, Overview of kinetics & kinematics of fluid flow; Overview of 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**
   Overview of DC and DC Series and Parallel Circuits, Kirchhoffs Law, Overview of Network theorems, Basic concept of 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**
   Overview of Bipolar transistors switching characteristics, MOS transistor switching characteristics, Overview of RAM, DRAM, PROM, EPROM, Operational amplifiers, Butterworth and Chebysev filters, A/D Converters, Concept of 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**

   Overview of Switching algebra, Number systems, Logic gates and circuits, Minimization techniques, Logic families, shift registers, Counters, Multiplexer, Demultiplexer, semiconductor Memories

Section: II (45)

10. **Biomedical Control System (5)**

    Overview of Open loop and closed loop control system, System Stability and Sensitivity, System transfer functions and responses

11. **Biomedical Signal Analysis and Processing (5)**

    Overview of Information theory, 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 (5)**

    Overview of Amplifier Characteristics: Input and output impedance, Real and Apparent gain, Amplifier loading, Impedance matching of amplifiers, Basic Concept of Power Supplies: Regulated and switched mode power supplies, Overview of Power Amplifiers: Classes of Power amplifiers, information about 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, Frequency response of OP-AMPs, A/D and D/A converters, power control using Op-Amp, Op Amp based timing circuits.

13. **Biomedical Instrumentation (10)**

    Overview of Precision, resolution, sensitivity, accuracy, uncertainty, Principles and development of Biomedical Instrumentation, Basic Principle of Diagnostic Equipment: invasive and noninvasive measurement, techniques and related equipment, Basic Concept of Cardiovascular Measurements: Electrocardiography, Measurement of Blood pressure, Blood flow and Cardiac output, Biofeedback Instrumentation, Basic principle of Biomedical Sensors and Transducers, Overview of Patient Monitoring Equipments: Patient Monitors, Central Monitoring System, telemetry system, Gas Exchange and distributions, Respiratory therapy equipment, Basic Principle of Therapic Equipment: ventilator, inhaler, defibrillator, pacemaker and heart lung machines, Conceptualization of Radiological Equipment: concept of ionization and nonionization radiation and related equipment, medical lasers and applications, Laser Safety, Basic Safety in Medical Equipment: Electrical/Mechanical safety, Standards of Medical Devices, Biohazards and Safety Regulations, Basic concept of Quality Assurance and Quality Control: Calibration, maintenance and reparability of monitoring

14. Biomechanics (10)

General principles of Statics, laws of triangle, Parallelogram and polygon forces, Equilibrium of rigid body, Overview of Dynamics: Rectilinear and curvilinear motion, Rotational mechanics, Simple and multiple degrees of freedom, 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. Medical Imaging (10)

Working Principle of X-ray Equipment, its Components and Types : X-ray tubes, X-Ray control and indicating equipment, Filters and grids, Different types of X-ray equipment (portable, fluoroscopy, mammography), Basic Concept of Digital Imaging: Introduction, Digital Radiography, PACS (Picture Archiving and Communicating System), Basic Principles of CT, Generation of CT, System Components, Recent Advances in CT, Basic Principle of Magnetic Resonance Imaging (MRI): Fundamental Concepts, Basic Principles of MRI, Contrast Enhanced MRI, Artifacts in MRI, MR Scanners, Clinical Application, Working Principle and concept of 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 Overview of Quality Assurance and Control in Medical Imaging Equipment

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For Practical Examination
Full Marks: 35

Practical examination based on the following syllabus
Group B: Practical Examination **35 Marks**

1. **Personal protection equipment (PPE): like electrical, thermal and chemical**
2. **Maintenance, planning, types of maintenance and formation of maintenance schedule**
3. **Care and storage of medical equipment and parameters**
4. **Purchase planning and disposable of medical equipment management plane**
5. **Quality assurance of medical diagnostic and imagine system: like calibration, validation and verification plan**

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