निजामती कर्मचारी अस्पताल

प्रशासन सेवा, इन्जिनियरिङ्ग तथा मेन्टेनेन्स समूह, बायोमेडिकल उपसमूह बायोमेडिकल इन्जिनियर पद, छैटौं (६) तहको लिखित परीक्षाको पाठ्यक्रम (करार तर्फ)

पुर्णाङ्कः१०० समयः ४५ मिनेट

उत्तीर्णाङ्कः ४० बस्तुगत प्रश्नपत्र अंकभार २X५०

1. **Human Anatomy and Physiology**
   - 1.1 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
   - 1.2 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
   - 1.3 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
   - 1.4 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
   - 1.5 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
   - 1.6 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
2. **Medical Imaging**
   - 2.1 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
   - 2.2 Computed Tomography (CT): Introduction; Basic Principles of CT; Generation of CT; System Components
   - 2.3 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
   - 2.4 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
   - 2.5 Digital Imaging: Introduction; Digital Radiography; PACS (Picture Archiving and Communicating System)
3. **Biomedical Instrumentation**
   - 3.1 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

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

3.3 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

3.4 Biomedical Recorders: Electrocardiograph (ECG); Electroencephalograph (EEG); Electromyograph (EMG); Biofeedback Instrumentation

3.5 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

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

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

3.8 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

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

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

3.11 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

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

3.13 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

3.14 Blood Gas Analyzers: Acid Base Balance; Blood pH Measurements; Measurement of Blood PCO2; Blood pO2 Measurement; Intra-Arterial Blood Gas Monitoring; A Complete Blood Gas Analyzer

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

3.16 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

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

3.18 Cardiac Defibrillators: Need for a Defibrillator; DC Defibrillator; Pacer –

cardioveter-defibrillaror; Defibrillator Analyzers

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

3.20 Laser Applications in Biomedical Field: Principle of Laser; Pulsed Ruby Laser; Nd-YAG Laser; Helium-Neon Laser; Argon Laser; CO2 Laser; Excimer Lasers; Semiconductor Lasers; Laser Safety

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

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

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

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

3.25 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

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

3.27 Patient Safety: Electric Shock Hazards; Leakage Currents; Safety Codes for Electromedical Equipment; Electrical Safety Analyzer

4. Biomedical Chemistry

4.1 Electrochemistry

4.1.1 Introduction and range of electrochemical techniques

4.1.2 Classification of electrochemical techniques: Potemetry and Voltmetry

4.2 Organic Chemistry: introduction, classification and general uses of organic compounds

4.3 Carbohydrates, Proteins and Lipids: definition, classification and properties

5. Electronic Principles and Practices

5.1 Circuit Parameters: introduction

5.2 AC and DC circuits: introduction and analysis

5.3 Transistors: introduction and classification (BJT, JFET, MOSFET)

5.4 Power Supplies, Voltage Regulators and IC Regulators

5.4.1 Introduction and characteristics 3.4.2 Rectifiers, filters, voltage regulation and switching regulation 3.5 Amplifiers

5.4.2 Introduction, characteristics, ideal amplifier and differential amplifier

5.4.3 Operational Amplifier: introduction, characteristics and application

5.5 Opto Electronic Components

5.5.1 General introduction

5.5.2 Photoconductive cells, Photodiodes, Phototransistors, Solar cells, Light activated SCR, Light Emitted Diodes (LEDs), Optocouplers and Liquid Crystal Displays (LCD)

6. Digital Electronics and Microprocessors

6.1 Fundamental of Digital Electronics

6.1.1 Transistor: application as switch and relay

6.1.2 Logic Gates: truth tables and Boolean expressions

6.1.3 Universal gates and gate conversion

6.1.4 DeMorgan's theorem

6.2 Combinational Logic Devices
- 6.2.1 Encoder and Decoder
- 6.2.2 Multiplexer and Demultiplexer
- 6.2.3 Half and Full: Adder and Subtractor

6.3 Sequential Logic Devices
- 6.3.1 Counters: types and characteristics
- 6.3.2 Registers: SISO, SIPO, PISO, PIPO
- 6.3.3 Digital clocks and frequency counter

6.4 Introduction and characteristics of analog to digital or digital to analog conversion

6.5 Fundamentals of microprocessor, introduction and architecture of 8085 microprocessor

7. **Digital Signal Processing**
- 7.1 Introduction to Discrete Signal and Systems
- 7.2 Discrete signals – unit impulse, unit step, exponential sequences.
- 7.3 Linearity, shift invariance, casualty.
- 7.4 Convolution summation and discrete systems, response to discrete inputs.
- 7.5 Stability, sum and convergence of power series.
- 7.6 Sampling continuous signals – spectral properties of sampled signals.
- 7.7 General Introduction of various filters

8. **Control Systems**
- 8.1 System Modeling
- 8.2 Differential equation and transfer function
- 8.3 State-space formulation of differential equations, matrix notation
- 8.4 Mechanical components and Electrical components: mass, spring, damper, inductance, capacitance, resistance, sources, motors, tachometers, transducers, operational amplifier circuits
- 8.5 Linearized approximations
- 8.6 Frequency domain characterization of systems
- 8.7 Bode amplitude and phase plots, Effects of gain and time constants on Bode diagrams, Stability from the Bode diagram
- 8.8 Nyquist plots, Correlation between Nyquist diagrams and real time response of systems: stability, relative stability, gain and phase margin, damping ratio

9. **Communication Systems**
- 9.1 Analog and digital communication sources, transmitters, transmission channels and receivers.
- 9.2 Types and reasons for modulation.
- 9.3 Representation of Communication Signals and Systems
- 9.4 Frequency Modulation (FM) and Phase Modulation (PM)
- 9.5 Distortion, noise, and interference.
- 9.6 Nyquist sampling theory, sampling of analog signals, spectrum of a sampled signal.
- 9.7 Sampling theorem for band-limited signals, effects of aliasing, reconstruction of sampled signals.

10. **Medical Industry Management**
- 10.1 Introduction to Medical Industry concept: Classification of medical devices: Class I, IIa, IIb, III; Introduction to ISO, CE marking, FDA
- 10.2 Selection and purchase and management of Medical equipment: Need analysis; Specification preparation
- 10.3 Various procurement methods: Direct purchase, Sealed quotation, Tender; Incoming inspection and commissioning
- 10.4 Preventive maintenance; Corrective maintenance; AMC (Annual Maintenance Contract); CMC (Comprehensive Maintenance Contract); Decommissioning

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

10.6 Basics of Patient Management system and Laboratory management system

11. निजामती कर्मचारी अस्पताल (कर्मचारीहरुको सेवाका शर्त र सुविधा) विनियमावली,२०७० सम्बन्धी सामान्य जानकारी