नेपाली सेना

प्रा.उ.से. बायोमेडिकल ईन्जिनियर
(खुल्ला/आन्तरिक)

समय:– २ घण्टा ३० मिनेट

पूर्णाङ्क :– १००
उत्तीर्णाङ्क :– ४०

The objective of the course syllabus is to examine the new Biomedical Engineers for Nepali Army with appropriate technical & analytical knowledge and skills required to enable them to function and practice as professional Biomedical Engineers on all aspects of Biomedical Engineering works. Candidates who are appearing for the written examination, are asked questions on the basis of their knowledge and professional skills on the subject.

A. Medium of Written Examination shall be English.
B. Those who passed in written examinations are selected for the next Examination.
C. While preparing questions, select all the subjects according to the given course Syllabus.
D. The mentioned description may be changed based on the existing requirement and miscellaneous circumstances in favor of Nepali Army.
E. Effective date of syllabus : 2070/ 04 / 10

S.No.	Description of questions	No. of question X marks	Time
1	Subjective	10 x 5= 50	2 Hrs 30 minutes
2	Objective (MCQS)	50x 1= 50	

Course Syllabus for the Post of Bio medical Engineer

Objective of the Course

The objective of the course syllabus is to examine the new Biomedical Engineers for Nepali Army with appropriate technical & analytical knowledge and skills required to enable them to function and practice as professional Biomedical Engineers on all aspects of Biomedical Engineering works. Candidates who are appearing for the written examination, questions are asked on the basis of their knowledge and professional skills on the subject.

Section 1: (5)

BIO-ENGINEERING MATERIALS AND COMPONENTS

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

2.0 Polymers:
- 2.1. Types of polymers used in medicine
- 2.2. Molecular weight and synthesis.
- 2.3. Solid state polymers and copolymers.
- 2.4. Characterization techniques.
- 2.5. Hydrogel.

3.0 Ceramics, Glasses and Composites:
- 3.1. Structure, chemistry and properties of ceramics and glasses used in medical devices.
- 3.2. Types of bio-ceramics.
- 3.3. Characteristics and processing of bio-ceramics.
- 3.4. Nearly inert crystalline ceramics.
- 3.5. Porous ceramics.
- 3.6. Bioactive glasses and glass ceramics.
- 3.7 Calcium phosphate ceramics, resolvable calcium phosphates

4.0 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.
- 4.6. Elastin, Graft copolymers of collagen and glycosaminoglycans.

5.0 Biology, Biochemistry and Medicine:
- 5.1. Properties, their structure, properties and adsorption to surfaces.
- 5.2. Structure and properties of proteins relevant to adsorption.
- 5.3. Adsorption behavior of proteins as solid-liquid interfaces.
- 5.4. The importance of adsorbed proteins in biomaterials.

Section 2: (5)

HUMAN ANATOMY AND PHYSIOLOGY

1.0 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.
  Understanding of disease mechanism

2.0 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

3.0 The Nervous System. Neurons, CNS, Brain, Spinal Cord, Peripheral Nervous system. Autonomic Nervous System. Disorders of Brain, Spinal Cord & Peripheral Nervous System. Responses of Nervous Tissue to Injury:

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. List the types of nerves
3.5. Structure of Central Nervous system (CNS)
3.6. Identification of underlying areas of Brain
3.7. Structural details of Peripheral Nervous system (PNS)

4.0 BRIEF REVISION OF BLOOD COMPONENT. HAEMOSTASIS & THROMBOSIS. DISORDERS OF BLOOD COAGULATION. BLOOD CELLS DISORDERS:

4.1. Brief revision of blood components.
4.2. Revision of blood function functions
4.3. Learning of haemostatic mechanisms
4.4. Review of Blood coagulation & disorders
4.5. Outline blood cell disorders

5.0 THE CARDIOVASCULAR SYSTEM. BLOOD VESSELS, BLOOD PRESSURE, PULSE & CIRCULATION OF THE BLOOD:

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
5.7. Brief understanding of heart diseases

6.0 THE RESPIRATORY SYSTEM, NOSE, NASAL CAVITY, PHARYNX, LARYNX, TRACHEA, :

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: **(5)**

ELECTRONIC DEVICES AND CIRCUITS

1.0 Integrated Circuit Technology and Device Models:

1.1 The planar process for integrated circuit fabrication.
1.2 Review of dc and ac diode models.
1.3 Review of dc and ac JFET models.
1.4 Review of dc and ac bipolar transistor models.
1.5 Review of dc and ac MOS transistor models.

2.0 Operational Amplifier Circuits:

2.1 Bias circuits suitable for IC design.
2.2 The widlar current source.
2.3 The differential amplifier.

2.4 Active loads.
2.5 Output stages.

3.0 Power Supplies and Voltage Regulators:
3.1 Half-wave and full-wave rectifiers.
3.2 Capacitive filtering.
3.3 Zener diodes, bandgap voltage references, constant current diodes.
3.4 Zener diode voltage regulators.
3.5 Series transistor-zener diode voltage regulators.
3.6 Series transistor-zener diode-constant current diode voltage regulators.
3.7 Voltage regulators with feedback.
3.8 IC voltage regulations.

4.0 Untuned and Tuned Power Amplifiers:
4.1 Amplifier classification.
4.2 Direct-coupled push-pull stages.
4.3 Transformer-coupled push-pull stages.
4.4 Tuned power amplifiers.
4.5 Power dissipation considerations.

5.0 Oscillator Circuits and Filter Circuits:
5.1 CMOS inverter relaxation oscillator.
5.2 Operation amplifier based relaxation oscillators.
5.3 Voltage-to-frequency converters.
5.4 Sinusoidal oscillators.
5.5 Conditions for oscillators.
5.6 Amplitude and frequency stabilization.
5.7 Swept frequency oscillators.
5.8 Functions generators.
5.9 LC Filters
5.10 RC Filters
5.11 Active Filters

Section 4: **(5)**

MICROPROCESSORS

1.0 BUS STRUCTURE AND MEMORY DEVICES:
1.1. Bus structure, synchronous and asynchronous data bus, address bus, bus timing
1.2. Static and dynamic RAM, ROM
1.3. Programmable read only memory (PROM), ultraviolet electrically programmable memory
1.4. (UVEPROM) and electrically erasable programmable memory (EEPROM)
1.5. SRAM and ROM interface requirements

2.0 INPUT/OUTPUT INTERFACES:
2.1. Serial Communication
2.1.1. Asynchronous interface: ASCII code, baud rate, start bit, stop bit, parity bit
2.1.2. Synchronous interface
2.1.3. Physical communication standard
2.1.4. 8251A programmable communication interface
2.1.5. Parallel communication
2.1.6. Data Transfer wait interface
2.1.7. RS-232 and IEEE 488-1978 general purpose interface standard
2.1.8. Keyboard and display controller

3.0 INTERRUPT:
3.1. Introduction, interrupt vector and descriptor table
3.2. Interrupt service routine requirements

3.3. Interrupt priority: Maskable and Non-maskable interrupts, software interrupts, traps and exceptions
3.4. Vectored, chained and polled interrupt structures
3.5. Interrupts in parallel and serial interfaces

4.0 MULTIPROGRAMMING:

4.1. Microprogramming, uniprogramming and multiprogramming
4.2. Process Management and semaphore
4.3. Common procedure sharing
4.4. Memory management and virtual memory

5.0 INTRODUCTION TO ADVANCED MICROPROCESSOR ARCHITECTURE:

Section 5: **(7.5)**

ELECTRICAL MACHINES

1.0 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

2.0 TRANSFORMERS:

2.1. Magnetically coupled circuits
2.2. Effects of secondary current in ideal transformer
2.3. Transformer reactance and equivalent circuits
2.4. Air core Vs iron core transformers
2.5. Losses in transformer, open circuit and short circuit tests
2.6. Series and parallel connection of windings
2.7. Audio transformer, power transformers, auto transformers and instrumentation transformers
2.8. Three phase transformers

3.0 DC MACHINES:

3.1. Construction of DC machine
3.2. Magnetic circuit, air-gap flux pattern and its effects
3.3. Torque production and voltage generation
3.4. Armature winding: lap and wave windings
3.5. Field excitation: shunt, series and compound fields
3.6. Armature reaction
3.7. Losses, cooling, rating and heating

4.0 DC MOTORS:

4.1. Torque/speed characteristics of shunt, series and compound field motors
4.2. Armature reaction and motor operation
4.3. Commutation problems, pole face compensating windings
4.4. Speed regulation and control in DC motors
4.5. Effect of field excitation and armature voltage
4.6. Reverse rotation
4.7. Starting and speed control of motors, armature voltage and shunt field control

5.0 DC GENERATORS:

5.1. Voltage/speed/load characteristics
5.2. Shunt, series and compound field machines

5.3. Separate and self-excited machines, voltage build-up in self excited generators
5.4. Automatic voltage regulation.

Section 6: **(5)**

CONTROL SYSTEMS

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

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

3.0 Computer Simulation of Control Systems:
- 3.1 Role of simulation studies
- 3.2 Linear and non-linear simulations

4.0 Performance Specifications for Control Systems:
- 4.1 Time domain specifications: steady-state errors, response rates, error criteria, hard and soft limits on responses, damping ratio, log decrement.
- 4.2 Frequency domain specifications: bandwidth, response amplitude ratio.

5.0 `Compensation and Design, Digital Control System:
- 4.3 Root locus, frequency response and simulation in design.
- 4.4 Feedback compensation
- 4.5 Lead, lag and lead-lag compensation, PID controllers.

Section 7: **(5)**

COMMUNICATION SYSTEMS

1.0 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.

2.0 Representation of Communication Signals and Systems:
2.1. Review of signal transfer in linear systems, the ideal lowpass filter and distortionless transmission, the importance of channel bandwidth.
2.2. The Hilbert transform and its properties.
2.3. Bandpass systems and band-limited signals with examples.
2.4. Complex envelope representation of band-limited signals, time domain expressions, rectangular representation (in-phase and quadrature components), polar representation (envelope and phase)

3.0 Frequency Modulation (FM) and Phase Modulation (PM):
3.1. Instantaneous frequency and instantaneous phase, time domain, representations for FM and PM, phasor diagrams for FM and PM.

3.2. FM and PM signals for a single tone message, the modulation index and phasor diagrams.
3.3. Spectral representation of FM and PM for a single tone message, Bessel' functions and the Fourier series.
3.4. Transmission bandwidth for FM, Carson's rule, narrow band and wide-band FM and PM signals.
3.5. Generation of FM using Armstrong's method, commercial FM requirements.
3.6. Demodulation of FM and PM signals, the limiter discriminator.
3.7. Commercial FM radio and stereo FM radio.
3.8. Demodulation of FM using a phase-locked loop.

4.0 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.

5.0 Digital Data Communication Systems:

5.1. Introduction to information theory, definition of information, examples of simple sources.
5.2. Information rate and Shannon's channel capacity theorem.
5.3. Baseband digital communication systems, multilevel coding using PAM.
5.4. Pulse shaping and bandwidth consideration, intersymbol interference (ISI).
5.5. Nyquist condition for zero ISI, band-limited Nyquist pulses, the eye diagram.
5.6. Correlative coding techniques, reducing transmission bandwidth with duobinary encoding. Spectral shaping using bipolar and modified duobinary encoding techniques

Section 8: **(5)**

IMPLANTABLE DEVICES

0.0 Cardiovascular Implants:

0.1 Cardiopulmonary bypass
0.2 Heart valves
0.3 Vascular grafts
0.4 Drug administration systems and vascular access
0.5 Stents, catheters and cannulas
0.6 Pacemakers
0.7 Inferior venacava filters
0.8 Intraaortic balloon pump
0.9 Ventricular assist device and total artificial hearts
0.10 Blood substitutes

1.0 Orthopaedic Implants:

1.1 Structure and properties of calcified tissues.
1.2 Biomaterials used in orthopaedic implants.
1.3 Total hip arthroplasty.
1.4 Ligament reconstruction.

2.0 Catheters:

2.1 Catheter materials and biocompatibility.
2.2 Biomaterials and catheter complications.
2.3 Thrombophlebitis.
2.4 Intravascular catheter and thrombosis.

3.0 Different Kinds of Artificial Organs:

3.1 Introduction.
3.2 Artificial Pancreas.
3.3 Artificial liver.

3.4 Artificial Heart and lung.
3.5 Artificial skin
3.6 Artificial reproductive organs.
3.7 Artificial vision
3.8 Artificial hearing implant.

4.0 Introduction to Tissue Engineering:
4.1 Introduction.
4.2 General principles.
4.3 Building blocks of artificial tissues.
4.4 Tissue and organ reconstruction.

Section 9: **(7.5)**

DIGITAL SIGNAL PROCESSING

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

2.0 Difference Equations and Frequency Response:
2.1 General form of the linear, shift-invariant constant coefficient difference equation – signal flow graph representation.
2.2 Steady state sinusoidal frequency response derived directly from the difference equation by assuming a form of the solution as a function of EXP (jwT)
2.3 Pole-zero diagrams, frequency response relationships.
2.4 Design of a notch filter from the pole-zero diagram, finite impulse response (FTR) and infinite impulse response (IIR) filters.

3.0 IIR Filter Design:
3.1 Classical filter design using polynomial approximations-Butterworth, Chebychev, elliptic and Bessel forms.
3.2 IIR filter design by transformation – matched Z-transform, impulse-invariant transform and bilinear transformation.
3.3 Application of the bilinear transformation to IIR lowpass discrete filter design.
3.4 Spectral transformations, highpass, bandpass and notch filters.

4.0 FIR Filter Design:
4.1 FIR filter design by Fourier approximation, the complex Fourier series.
4.2 Gibbs phenomena in FIR filter design approximations, applications of window functions to frequency response smoothing.
4.3 Window functions, rectangular, Hanning, Hamming and Kaiser windows.
4.4 FIR filter design by the frequency sampling method.
4.5 FIR filter design using the Remez exchange algorithm.
4.6 Linear phase FIR filters, unit sample response symmetry, group delay.

5.0 The Discrete Fourier Transform:
5.1 The discrete Fourier transforms (DFT) derivation.
5.2 Properties of the DFT.
5.3 DFT of non-periodic data, use of window functions.
5.4 Introduction of the fast Fourier transform (FST).
5.5 Power spectral density using DFT/FST algorithms.

6.0 Signal Averaging:
6.1 Basic of signal averaging

6.2 S/W for signal averaging
6.3 Limitations of signal averaging

7.0 Data Reduction Techniques:
7.1 Turning point algorithm
7.2 Fan algorithm
7.3 AZTEC algorithm
7.4 Huffman welding

Section 10: **(16)**

MEDICAL IMAGING

1.0 X-ray Equipment:

X-ray tubes
X-ray control and indicating equipment
Filters and grids
Different types of X-ray equipment (portable, fluoroscopy, mammography etc.)

2.0 Digital Imaging:
1.1 Introduction
1.2 Digital Radiography
1.3 PACS (Picture Archiving and Communicating System)

3.0 Computer Tomography (CT):
3.1 Basic Principles of CT
3.2 Generation of CT
3.3 System Components
3.4 Recent Advances in CT

4.0 Magnetic Resonance Imaging (MRI):
4.1 Fundamental Concepts
4.2 Principles of Parameters or MRI
4.3 Basic Principles of MR Imaging and Related Parameters
4.4 Contrast Enhanced MRI
4.5 Artifacts in MRI
4.6 MR Scanners
4.7 Clinical Application

5.0 Ultrasonography (USG):
5.1 Physics of Ultrasound
5.2 Construction and Properties of Ultrasound Transducer
5.3 Ultrasonic Beam
5.4 Modes of Ultrasound Imaging
5.5 Doppler Ultrasound
5.6 Clinical Application
5.7 Contrast Media in Ultrasound Imaging
5.8 Recent Advances in Ultrasonic Equipment
5.9 Biological Effects of Ultrasound

Section 11: **(30)**

BIOMEDICAL INSTRUMENTATION

1.0 Fundamental of Medical Instrumentation:

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

2.0 Bioelectric Signals and Electrodes:

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

3.0 Physiological Transducers:

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

4.0 Recording System:

4.1 Basic Recording System
4.2 General Consideration for Signal Conditioners
4.3 Preamplifiers
4.4 Sources of Noise in Low Level Measurement
4.5 Biomedical Signal Analysis Techniques
4.6 Signal Processing Techniques
4.7 The Main Amplifier and Driver Stage
4.8 Writing Systems
4.9 Direct Writing Recorders
4.10 The Ink Jet Recorders
4.11 Potentiometric Recorders
4.12 Digital Recorders
4.13 Instrumentation Tape Recorders

5.0 Biomedical Recorders:

5.1 Electrocardiograph
5.2 Vectrocardiograph (VCG)
5.3 Phonocardiograph (PCG)
5.4 Electroencephalograph (EEG)
5.5 Electromyograph (EMG)
5.6 Other Biomedical Recorders

5.7 Biofeedback Instrumentation

6.0 Patient Monitoring Systems:

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

7.0 Arrhythmia and Ambulatory Monitoring Instruments:

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

8.0 Foetal Monitoring Instruments:

8.1 Cardiotocograph
8.2 Methods of Monitoring Foetal Heart Rate
8.3 Monitoring Labour Activity
8.4 Recording System

9.0 Biomedical Telemetry and Telemedicine:

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

10.0 Oximeters:

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

11.0 Blood Flowmeters:

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

12.0 Cardiac Output Measurement:

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

13.0 Pulmonary Function Analyzers:

13.1 Pulmonary Function Measurements

13.2 Spirometry
13.3 Pneumotachometers
13.4 Measurement of Volumes
13.5 Pulmonary Function Analyzers

14.0 Clinical Laboratory Equipments:

14.1 Medical Diagnosis with Chemical Tests
14.2 Spectrophotometry
14.3 Spectrophotometer type Instruments
14.4 Colorimeters
14.5 Spectrophotometers
14.6 Automated Biochemical Analysis Systems
14.7 Clinical Flame Photometers
14.8 Selective ion Electrodes Based Electrolytes Analysers

15.0 Blood Gas Analysers:

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

16.0 Blood Cell Counters:

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

17.0 Audiometers and Hearing Aids:

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

18.0 Patient Safety :

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

19.0 Cardiac Pacemakers:

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

20.0 Cardiac Defibrillators:

20.1 Need for a Defibrillator
20.2 DC Defibrillator
20.3 Pacer – cardioveter-defibrillaror
20.4 Defibrillator Analysers

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

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

23.0 Physiotherapy and Electrotherapy Equipment:
- 23.1 High Frequency Heat Therapy
- 23.2 Short-ware Diathermy
- 23.3 Microwave Diathermy
- 23.4 Ultrasonic Therapy Unit
- 23.5 Eletrodiagnostic/ Therapeutic Apparatus
- 23.6 Pain Relief Through Electrical Stimulation
- 23.7 Diaphragm Pacing by Radio-frequency for the Treatment of Chronic Ventilatory Insufficiency
- 23.8 Bladder Stimulators
- 23.9 Cerebellar Stimulators

24.0 Haemodialysis Machines
- 24.1 Function of the Kidneys
- 24.2 Artificial Kidney
- 24.3 Dialysers
- 24.4 Membrances for Haemodialysis
- 24.5 Haemodialysis machine
- 24.6 Portable Kidney Machines

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

26.0 Anaesthesia Machine:
- 26.1 Need for Anaesthesia
- 26.2 Anaesthesia Machine
- 26.3 Electronics in Anaesthesia Machine

27.0 Ventilators:
- 27.1 Mechanisms of Respiration
- 27.2 Artificial Ventilation
- 27.3 Ventilators
- 27.4 Types of Ventilators
- 27.5 Ventilator Terms
- 27.6 Classification of Ventilators
- 27.7 Pressure-volume-flow Diagrams
- 27.8 Modern Ventilators
- 27.9 High Frequency Ventilators

27.10 Humidifiers, Nebulizers and Aspirators

28.0 Automated Drug Delivery Systems

28.1 Infusion Pumps
28.2 Components of Drug Infusion Systems
28.3 Implantable Infusion Systems
28.4 Closed-loop Control in Infusion Systems
28.5 Examples of Typical Infusion Pumps

Section 12: **(4)**

MISCELLENEOUS TOPICS

1.0 Medical Industry Management

2.0 Hospital Management System

3.0 Organization and Management

4.0 Engineering Professional Practice