

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV/ II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX 76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What are the physiological effects of electricity? How are the sources of noise levels reduced? What are the leakage currents? Draw a proper grounding circuit to minimize noise produced by signal sources. What are the differences between micro-shocks and macro-shocks? [8]
2. What are resting and action potentials? Explain electrode theory and draw an equivalent circuit of electrode for the measurement of a cell potential. What are the applications of electrodes and transducers in medical instruments? [8]
3. What is a wireless telemetry system? What are the components? How is telemedicine useful in saving patients' lives using computers and communications equipment? Describe with an example. [8]
4. What is electrocardiography? Describe typical characteristics of a normal ECG. How can one record ECG by using bipolar leads (I, II and III) and also the chest leads (V1, V2, V3, Va, V5 and V6)? Explain with necessary diagrams. [8]
5. a) What is cardiac output? Explain the circuit diagram of the DC defibrillator machine with consideration of patient and physician's safety. [4]
b) What is EMG? Explain its recording technique. [4]
6. What are the operating principles of ultrasonic and electromagnetic blood flow meters? Describe an ultrasonic blood flow meter with a suitable schematic diagram. [8]
7. What are the functions of the kidney? Define an artificial kidney. Explain the application and working principle of the extracorporeal shock wave lithotripter machine. [8]
8. Describe the principle of the MRI System. How the image is detected and reconstructed by the receiver after receiving nuclear magnetization signals from the human body? [8]
9. Explain the basic pulse-echo apparatus briefly. State applications of both A-mode and B-mode display formats. [8]
10. Write short notes on: [2×4]
 - a) X-Ray machine
 - b) Man-Instrumentation system and its objectives

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX 76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. a) What is a man-instrumentation system? Briefly explain the five objectives of a man instrumentation system. Write ten design consideration factors. [8]
- b) What are the resting and action potentials? Explain electrode theory and draw an equivalent circuit of electrodes for the measurement of a cell potential. Write about the application of electrodes in medical instruments. [8]
2. a) Define the transducer and sensor. Differentiate between an active transducer and a passive transducer. Explain any four performance characteristics of a transducer. [8]
- b) What is Electrocardiography? Describe the typical characteristics of a normal ECG. How one can record ECG by using bipolar leads (I, II and III) and also the chest leads (V₁, V₂, V₃, V₄, V₅ and V₆)? [8]
3. a) What are systolic and diastolic pressures? Explain the Doppler type ultrasonic blood flow meter with a neat and proper diagram. [8]
- b) What does a diagnostic medical imaging system mean? Explain the function diagram of X-rays. What are the biological effects of X-ray radiation and how can it be minimized? [8]
4. a) What are the functions of the kidney? Define an artificial kidney. Explain the application and working principle of the extracorporeal shock wave lithotripter machine. [8]
- b) Define a biomedical telemetry system. What are the advantages of biotelemetry? Explain a single-channel telemetry system with a proper block diagram. [8]
5. a) Explain the physiological effects of electricity on the human body. What are the causes of the leakage current? Explain any two types of leakage current found in medical equipment. [8]
- b) Write short notes on: (Any One) [8]
 - (i) Electroencephalography (EEG)
 - (ii) Electromyography (EMG)

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. a) What is Cardiac fibrillation? How is it caused? What is the solution to restore the more normal cardiac rhythm during cardiac fibrillation? Describe your solution with necessary diagram and explain its function. [8]
- b) Draw a Basic Pulse Echo Apparatus. How it operates? Describe its Amplitude modulated and Brightness modulated display modes. [8]
2. a) What is Electromyography? Explain its recording technique with proper types of electrodes. Describe the design of electrodes you have chosen. Is EMG recording technique is useful for sports medicine? [8]
- b) Explain the basic principle of CT-SCAN Machine. How images are scanned in CT-Scanner? Define its profile. What are the differences between CT and digital x-ray machine? [8]
3. a) What types of transducer is used in Ultrasonic blood flow meter? Describe its equivalent circuit and output performances. By using ultrasonic transducer how blood flow in certain blood vessel are measured? Explain it briefly. [8]
- b) What is Dialyzer? How it works as a mass exchanger during application in medicine? Draw a lay-out diagram for ESWL machine. What are the major components of this machine? [8]
4. a) What is leakage current? How a cardiac patient is protected from this current during treatment? Draw a protective circuit diagram assuming 500Ω patient resistance and $100\mu A$ leakage current with low value of ground wire. How much value of leakage current will flow through a patient? Show it is the circuit diagram. [8]
- b) What is wireless Telemetry system? Design a Telemedicine using mobile communication devices to transmit an ECG signal of a patient to the hospital during medical evacuation. [8]
5. Write short notes on: [2×8]
 - a) Man Instrument system and design consideration factors
 - b) ECG Recording configurations with 12 leads

NATIONAL COLLEGE OF ENGINEERING

QUESTION BANK

Biomedical Instrumentation

(Elective II)(EX76505)

BEL IV/II



BI013



15 C TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Describe the scenario for protection system of hospitals and Medical equipment's. "Medical electrical equipment involves the measurement of certain leakage currents". Describe causes of leakage current and its types. [8]
- b) Differentiate Single channel telemetry and multi-channel telemetry. How can you use information and communication technology for realizing the concept of telemedicine? Explain with related diagrams. [8]
2. a) What is Defibrillator Machine? Differentiate Cardiac Pacemaker and defibrillator? Describe different types of dialyzers. [8]
- b) Describe the system components of CT-scan and MRI Machine. Explain Image detection system (NMR receiver) with its function and uses. [8]
3. a) What are the biological effects of X-Ray? Describe the principle of ultrasound. Explain Basic Pulse Echo Apparatus of ultrasound with block diagram. [8]
- b) Describe any three Muscle Related Diseases. Explain the 12 leads configuration for ECG measurement with diagram. Also describe the Rhythm and sleeping stages during EEG measurement. [8]
4. a) Define Nerst equation. Describe Polarization and Depolarization process in relation with Resting and action Potential. Describe the different types of bio- potential electrodes with related diagrams. [8]
- b) Describe the blood flow mechanism in human body. Define RBC and compute the cardiac output. Explain the Electromagnetic blood flow meter with appropriate diagram. [8]
5. Write short notes on: [8]

 - a) MAN Instrumentation system
 - b) Active Vs Passive Transducer
 - c) X-ray Machine
 - d) ESWL Machine

4×4

25C TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) What is man-instrument system? What are the five objectives of a man-instrument system? Explain briefly. Write Ten design consideration factors.
b) Explain electrode theory. Draw an equivalent circuit of electrodes for the measurement of a cell potential. What are the differences between Electrodes and Transducers? Write their applications in medical field.
2. a) Design a PC based ECG machine. Explain its function briefly. What are the differences between EEG and EMG potentials?
b) Draw a neat schematic diagram of blood flow instrumentation based on Doppler principle and explains its function.
3. a) What is ultrasound? Discuss Basic Ech's Apparatus of ultrasound machine with its B-mode application in medicine.
b) Explain function diagram of an X-ray machine. How its intensity is varied? What are the biological effects of X-rays?
4. a) What is computer Tomography? Explain its scanning procedure with complete diagram. What are the differences between CT and MRI?
b) What is artificial kidney? Draw a lay-out diagram of therodialysis and explain its function.
5. Write short notes on: (any two)
 - i) Electroencephalography
 - ii) Litho tripy
 - iii) Defibrillator machine
 - iv) Physiological effect of electricity

24

25C TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) What is wireless Telemetry system? What are the most indispensable components required to transmit ECG and B.P signals of a patient who is under medically evacuated to the well equipped hospital? Draw an overall diagram showing the information flow between telemedicine unit and base unit. Explain briefly.
- b) What is cardiac fibrillation? Explain normal ECG waveform and its characteristics. What types of device and electrical machine are used to restore a normal ECG rhythm? Explain it.
2. a) What is electrocardiography system? Show the connection diagram of three Augmented unipolar limb leads. Explain with suitable diagram of computer aided Electrocardiograph and briefly explain.
- b) How an SCR circuit discharges a capacitor through the crystal to generate large amplitude pulses? How these pulses are used to examine various structures of the body?
3. a) Explain the MR phenomenon. Draw a schematic diagram of system composition of MRI machine. Explain the function of detection system.
- b) What is artificial kidney? How it serves as a mass exchanger during clinical use? Explain. How shock-wave is generated for lithotripsy in electro-hydraulic method?
4. a) What are the differences between micro and macro shocks? What is leakage currents? Draw a circuit diagram showing to flow leakage current safely to ground. How ground fault interrupter detect leakage current?
- b) What is the physical principle used for designing video angiography? How this technique is used to assess the extent of damage after heart and brain stroke? What are the biological effects of X-rays?
5. Write short notes on: (any two)
 - i) Resting and Action potentials
 - ii) Scanning system of CT-Scan
 - iii) Electromyography recording



25C TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) Explain the areas of engineering contribution in medical field. Design a complete set up to transmit an ECG and B.P signals of the patient to the central monitoring unit. How would you add some more desirable components in this design to transmit other parameters if required?
- b) Discuss some electrode theory. What are the differences between ventricular fibrillation and defibrillation? How defibrillator works as an electrical machine? Explain its function.
2. a) Draw an equivalent circuit of the transducer used in ultrasonic blood flow meter. How the response of this transducer effected? Explain ultrasonic blood flow meter.
- b) What is the basis of generation of ultrasound? Describe the function of basic pulse echo apparatus for examination in B-mode display. Write its application.
3. a) What is computer tomography? How system in CT -scan is used to acquire information to reconstruct a picture of internal structures of a human body? What are the differences between CT- Scan and conventional X-ray system?
- b) What are the differences between lithotripter and haemodialyzer? What are the major components of these machine? Explain dialysis process.
4. a) What is leakage current? How 100 μ A leakage current will flow through the ground / earth in a correctly grounded instrument if the safety limit is 5 μ A for the heart patient with catheter?
- b) What are the differences between EEG and Evoked potentials? Which circuit should be added to measure these potentials in an instrument? Explain a practical EEG machine.
5. Write short notes on: (any two)
 - a) PC based ECG with lead connection
 - b) MRI machine
 - c) Wireless Telemetry

25A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs

Subject: - Biomedical Instrumentation (*Elective II*) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What is Wireless Telemetry? What would be the most indispensable components that you need to flow information between telemedicine unit and base unit? Complete this design with neat diagram. [8]
- b) What is Electrocardiography? Describe the typical characteristics of the normal ECG. How one can record ECG by using bipolar leads (I, II and III) and also the chest leads (V₁, V₂, V₃, V₄, V₅ and V₆)? [8]
2. a) How the capacitive properties of the piezo-electric transducer affect the response of the transducer? "Most transducers used for mechanical variables utilize a resistive element called the strain gauge". How? [8]
- b) How Conventional Image Intensifier X-Ray Machine differs from CT-Scan Machine? Explain the scanning and processing system of CT-Scan machine with complete diagram. How "free-radicals" are formed in human body? [8]
3. a) What are the major components of Lithotripter machine? Explain the function of ESWL based on Electro-hydraulic system with neat diagram. [8]
- b) What is leakage current? What are the differences between Micro Shock and Macro Shock? Discuss some physiological effects of electricity. [8]
4. a) "The bio-electric potentials associated with muscle activities constitute the EMG". What types of electrodes are used to measure these potentials? Design its equivalent circuit and explain the function of EMG. [8]
- b) What is ultrasound? Explain basic pulse echo apparatus of ultrasonography. Write applications of B-mode display. [8]
5. Write short notes on: (any two) [8+8]
 - a) EEG Recording Technique
 - b) Objectives of man-instrument system
 - c) PC-based ECG Machine

Exam.	New Batch (2066 B.S. 1st Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What is man-instrument system? Design a complete set-up for the micro-processor based man-instrument system for the measurement of ECG and explain each of the functional block. [8]
- b) Explain some important properties of X-rays in medical diagnosis. Explain the operating and exposing system of X-ray machine with its desirable diagram with self rectification of the tube. [8]
2. a) How Conventional Image Intensifier X-ray machine differs from CT-scan machine? Explain the scanning and processing system of CT-scan machine with necessary diagram. How "free-radicals" are formed in human body? [8]
- b) Discuss Electrode Theory. What types of electrodes are used in Defibrillator machine? What are the differences between ventricular fibrillation and defibrillation? Describe the Defibrillator machine with its functional diagram. [8]
3. a) Draw an equivalent circuit of the transducer used in ultrasonic bloodflowmeter. How the response of this transducer effected? Explain ultrasonic bloodflowmeter with complete diagram. [8]
- b) What is artificial kidney? How waste products are removed from our body? Explain. Draw a neat diagram of ESWL machine. What are the major components of ESWL? [8]
4. a) What is leakage current? How an incorrectly grounded instrument on a ground connection with some impedance can allow leakage current to flow through a human body? Discuss some physiological effects of electricity. [8]
- b) What is ultrasonography? Explain the function of basic pube echo apparatus for viewing B-mode display. Write two applications of B-mode display. [8]
5. Write short notes on: (any two) [8+8]
 - a) MRI Machine
 - b) Telemetry and Telemedicine
 - c) Resting and Action Potentials

25A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Examination Control Division		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective II) (EX76505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain six areas of electrical and other engineering contribution in man-instrument system. Design a complete set-up for the telemedicine using mobile communication to transmit ECG and HR signal of the patient to a modern hospital. [8]
- b) Compare cardiac fibrillation with the normal cardiac rhythm by plotting the normal ECG. Draw an equivalent circuit of electrode. How these electrodes are applied on the surface of the heart to restore a normal cardiac rhythm? Explain. [8]
2. a) Explain electrode theory and Nernst equation. What types of electrodes are used to record EEG potentials? Explain both available recording techniques. Design a pre-amplifier required for the measurement of both EEG and evoked potentials in EEG machine. [8]
- b) What is the physical principle used for designing electromagnetic blood flow meter? How this blood flow meter is used to detect blood flow in certain blood vessel? How blood flow is estimated by radiographic technique. [8]
3. a) What are the major system components of MRI machine? How MRI system components detects the MR signal and generates an output signal? Give four differences between CT-scan and MRI machine. [8]
- b) What is wave equation? How 'Doppler effect' associated with piezo electric crystal in transmitting ultrasonic energy? How basic pulse echo apparatus is used to visualize various organs of the body? [8]
4. a) What are the major functions of kidneys? What is dialyzer? How waste products are removed from arterial blood in Haemodialysis machine? Explain with suitable diagram. [8]
- b) How an incorrectly grounded instrument on a ground connection with some impedance can allow leakage current to flow through a human body? What is leakage currents? How ground fault interrupter detect leakage current? [8]
5. Write short notes on: (any two) [8+8]
 - a) Scanning system of CT-scan Machine
 - b) X-Ray Machine and its effects on human
 - c) Nuclear Medicine Machine
 - d) Lithotripter Machine

Exam.	New Batch (2068 & 1st Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Bio-Medical Instrumentation (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ All questions carry equal marks.
 - ✓ Assume suitable data if necessary.
1. a) What are the six areas of electrical and other engineering contribution in biomedical field? What would be the most indispensable components that you need to design a complete set up to transmit any signal of man under investigation to the main monitoring console for ICU in the Hospital? Complete this system with neat diagram.
 - b) "Bioelectric potentials are actually ionic voltages produces as a result of electrochemical activities of certain special types of cell". How? Plot the waveform of biopotentials. Discuss and compare between absolute refractory period and relative refractory period.
 2. a) Compare cardiac fibrillation with normal cardiac rhythm by plotting normal electrocardiogram. How external surface electrodes are applied on heart to restore a normal cardiac rhythm? Explain with necessary diagram.
 - b) How one can record ECG by using bi-polar leads (I, II and III) and also the chest leads (V₁-V₆)? Design PC based ECG machine and explain briefly.
 3. a) What is the physical principle used for designing ultrasonic blood flow meter? How this blood flow meter is used to detect blood flow in certain blood vessel? How blood flow is estimated by radisgraphic technique?
 - b) What is wave equation? How basic pulse echo apparatus is used to visualize various organs of the body? Explain. Write some applications of B-mode display format.
 4. a) What are the basic components of MRI system? Explain with necessary diagram. Draw a layout schematic system composition of MRI machine.
 - b) What are the differences between Micro shock and Macro shocks? What is leakage current to the medical equipment?
 5. a) What are the major functions of kidneys? What is dialyzer? How waste products are removed from arterial blood in haemodialysis machine? Explain with suitable diagram.
 - b) Write short notes on: (any one)
 - i) EEG Recording Technique and its instruments
 - ii) X-Ray machine and its effects on human

Exam.			
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Biomedical Instrumentation (Elective I)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ All questions carry equal marks.
 - ✓ Assume suitable data if necessary.
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1. a) ✓ What is wireless telemetry? Discuss the five objectives of man-instrument system in the context of wireless telemetry system. Design a complete set-up for the single channel telemetry system and explain briefly.
b) ✓ Why SA node is called pace maker of the heart? Describe the typical characteristics of the normal electrocardiogram. How one can record ECG by using bipolar leads (leads I, II, and III) and also the chest leads (V₁, V₂, V₃, V₄, V₅ and V₆)?
 2. a) ✓ Explain electrode theory. "The bio-electric potentials associated with muscle activities constitute the electromyogram". What types of electrodes are used to record these potentials? Explain with all necessary diagrams.
b) ✓ Describe the principle of generation of ultrasound. How basic pulse echo apparatus is used to visualize various internal structures of the body? Explain with schematic diagram.
 3. a) ✓ What are the differences between haemodialyser and lithotripter? How shock waves are produced to reduce a kidney stone in lithotripter system? What are the main components of a system?
b) ✓ What are the main differences between CT-Scan and MRI systems? How MRI system component detects the nuclear magnetization signal and generates an output signal? Explain with necessary diagram. What are the major system components of MRI?
 4. a) ✓ What are the physical principle used for designing magnetic blood flow meter? How magnetic blood flow meter is used to detect blood flow in certain blood vessel? How blood flow is estimated by radiographic technique.
b) ✓ What are the differences between X-ray machine and nuclear medicine machine? How low level radiation (Radioactive isotope) tracer detection device is used to measure target organ function? Explain.
 5. Write short notes on:
 - a) Safety aspects of medical instruments
 - b) Haemodialysis machine
 - c) Scanning system of CT-Scan machine
 - d) EEG recording technique