

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EET312	BIOMEDICAL INSTRUMENTATION	PEC	2	1	0	3

Preamble : Nil

Prerequisite : Measurements and Instrumentation

Course Outcomes : After the completion of the course, the student will be able to:

CO 1	Explain the basics of anatomy and physiology of human body.
CO 2	Explain different techniques for the measurement of various physiological parameters.
CO 3	Describe modern imaging techniques for medical diagnosis
CO 4	Identify the various therapeutic equipments used in biomedical field
CO 5	Discuss the patient safety measures and recent advancements in medical field.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	-	-	-	-	2	-	-	-	-	-	-
CO 2	2	-	2	-	-	2	-	-	-	-	-	-
CO 3	2	-	2	-	-	2	-	-	-	-	2	-
CO 4	2	2	-	-	-	2	-	-	-	-	2	-
CO 5	2	2	2	-	-	2	-	-	-	-	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	20	20	40
Apply	15	15	30
Analyse			
Evaluate			
Create			

End Semester Examination Pattern : There will be two parts; Part A and Part B. **Part A** contain 10 questions (each carrying 3 marks) with 2 questions from each module. Students should answer all questions.

Part B contains 2 questions from each module, out of which students should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Explain the anatomy of heart and cardiac system.
2. Describe the physiology of respiratory system.
3. Discuss the generation and propagation of action potential with neat sketches.
4. Explain electrode theory and Nernst equation.
5. Draw and explain the equivalent circuit of skin electrode interface.
6. Discuss about surface electrodes.
7. What are the applications of needle electrodes?
8. What are microelectrodes?
9. What are the different bioelectrical potentials generated in human body?

Course Outcome 2 (CO2):

1. What are the problems encountered in measuring living systems?
2. Explain the direct method of blood pressure measurement.
3. Explain the indirect method of blood pressure measurement.
4. Explain the Oscillometric method of blood pressure measurement.
5. Explain the Ultrasonic method of blood pressure measurement.
6. Explain the method of blood flow measurement using electromagnetic blood flowmeter.
7. Explain the method of blood flow measurement using Ultrasonic blood flowmeter.
8. Explain the measurement of Cardiac output.
9. What is phonocardiography?
10. Explain the measurement of respiratory parameters using spirometer.

Course Outcome 3(CO3):

1. Explain ECG with a neat block diagram.
2. What is Einthoven triangle?
3. With neat sketches explain the different electrode placement schemes of ECG.
4. Explain the 10-20 system of EEG electrodes placement.
5. Draw and explain the block diagram of EEG machine.
6. Draw and explain the block diagram of EMG recorder.
7. What are the applications of EEG waveforms?
8. Draw the different EEG waveforms and state its frequency.

Course Outcome 4 (CO4):

1. Explain the generation of X-rays and also mention its applications in biomedical engineering.
2. What are the types of CAT scanning?
3. Explain the principle of MRI scanning.
4. Explain the principle of PET scanning.
5. Explain demand pacemaker with a neat block diagram.
6. Why a dual peak DC defibrillator preferred over DC defibrillator?

7. Explain artificial kidney with neat sketches.
8. Explain shortwave diathermy.
9. Explain microwave diathermy.

Course Outcome 5 (CO5):

1. Discuss the need for ventilators.
2. Draw and explain the block diagram of infant incubator.
3. Explain lithotripsy.
4. What is a heart lung machine?
5. What are the different methods of accident prevention in hospitals?
6. Differentiate between macro shock and micro shock.
7. Explain the physiological effects of electric current.
8. Draw the block diagram of a telemetry system.
9. What are the chemical blood tests carried out in a clinical laboratory?
10. Enumerate the application of robotics in medical field.

Model Question paper

QP CODE:

PAGES: 2

Reg. No: _____

Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR**

Course Code: EET312

Course Name: Biomedical Instrumentation

Max. Marks: 100

Duration: 3 Hours

PART A (3 x 10 = 30 Marks)

Answer all Questions. Each question carries 3 Marks

1. What are Microelectrodes?
2. What are the different bioelectrical potentials generated in human body?
3. Explain the measurement of Cardiac output.
4. What is Phonocardiography?
5. What are the applications of EEG waveforms?
6. Explain the 10-20 system of EEG electrodes placement.
7. What are the types of CAT scanning?
8. Explain the principle of MRI scanning.
9. What are the different methods of accident prevention in hospitals?
10. Discuss the need for ventilators.

PART B (14 x 5 = 70 Marks)

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. a) Discuss the generation and propagation of action potential with neat sketches. (8)
b) Draw and explain the equivalent circuit of skin electrode interface. (6)
12. a) Briefly explain different Bio potential electrodes. (10)
b) Discuss about surface electrodes. (4)

Module 2

13. a) Explain the Ultrasonic method of blood pressure measurement. (7)
b) Explain the method of blood flow measurement using electromagnetic blood flow meter (7)
14. a) Explain the direct method of blood pressure measurement. (7)
b) Explain the measurement of respiratory parameters using Spirometer (7)

Module 3

15. a) Draw and explain the block diagram of EEG machine. (8)
b) Explain the significance of Einthoven triangle. (6)
16. a) Draw the different EEG waveforms and state its frequency (7)
b) Explain ECG with a neat block diagram (7)

Module 4

17. a) Explain the generation of X-rays and also mention its applications in biomedical engineering. (14)
18. a) Explain the principle of CAT scanning (7)
b) Explain the principle of MRI scanning (7)

Module 5

19. a) Draw the block diagram of infant incubator and explain (10)
b) Write a note on medical robotics (4)
20. a) What are the chemical blood tests carried out in a clinical laboratory (10)
b) Explain artificial kidney with neat sketches (4)

Syllabus

Module 1

Human Physiological systems: Brief discussion of Heart and Cardio-vascular system - Physiology of Respiratory system - Anatomy of Nervous and Muscular systems - Problems encountered in measuring living systems

Bioelectric potential: Resting and action potential - Generation and propagation - Bioelectric potentials associated with physiology systems (ECG, EEG and EMG).

Bio potential Electrodes: Theory – Surface electrode – Microelectrode - Needle electrodes.

Transducers for biomedical applications: Transducers for the measurement of pressure, temperature and respiration rate.

Module 2

Measurement of blood pressure: Direct and indirect measurement – Oscillometric method – Ultrasonic method - Measurement of blood flow and cardiac output - Plethysmography – Photo electric and Impedance Plethysmographs - Measurement of heart sounds – Phonocardiography.

Cardiac measurements: Electro-conduction system of the heart - Electro-cardiography – Electrodes and leads – Einthoven triangle - ECG read out devices - ECG machine – block diagram

Module 3

Measurements from the nervous system: Neuronal communication - EEG waveforms and features - 10-20 electrode measurement - EEG Block diagram – Brain-Computer interfacing.

Muscle response: Electromyography - Block diagram of EMG recorders – Nerve conduction velocity measurement

Measurements of respiratory parameters: Spiro meter - Pneumograph

Module 4

Modern Imaging Systems: Basic X-ray machines - CAT scanner - Principle of operation - scanning components - Ultrasonic Imaging principle - types of Ultrasound Imaging - MRI and PET scanning (Principle only).

Therapeutic equipment: Cardiac Pacemakers - De-fibrillators - Hemodialysis machines - Artificial kidney – Lithotripsy - Short wave and Micro wave Diathermy machines

Module 5

Ventilators - Heart Lung machine - Infant Incubators

Instruments for clinical laboratory: Test on blood cells – Chemical tests

Electrical safety: Physiological effects of electric current – Shock hazards from electrical equipment – Method of accident prevention.

Introduction to Tele- medicine - Introduction to medical robotics

Text Books

L. Cromwell, F. J. Weibell and L. A. Pfeiffer, “Biomedical Instrumentation Measurements”, Pearson education, Delhi, 1990.

J. G. Webster, “Medical Instrumentation, Application and Design”, John Wiley and Sons

Reference Books

1. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill
2. J. J. Carr and J. M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education
3. AchimSchweikard, “Medical Robotics”, Springer

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	Human Physiology Systems and Transducers (8 hours)	
1.1	Problems encountered in measuring living systems - Cardio-vascular – Respiratory- nervous and muscular systems of the body.	2
1.2	Electrode theory-Bioelectric potential - Resting and action potential - Generation and propagation.	1
1.3	Bioelectric potentials associated with physiology systems (ECG, EEG and EMG).	1
1.4	Electrodes Theory - Surface electrode - Needle electrode - Microelectrode	2
1.5	Transducers for the measurement of Pressure, temperature and respiration rate.	2
2	Cardio Vascular System Measurements(8 hours)	
2.1	Measurement of blood pressure – direct and indirect measurement – Oscillometric measurement –Ultrasonic method	2
2.2	Measurement of blood flow and cardiac output -Plethysmography – Photo electric and Impedance Plethysmographs	3
2.3	Measurement of heart sounds –Phonocardiography.	1

2.4	Electro-conduction system of the heart - Electro Cardiography – Electrodes and leads – Einthoven triangle.	1
2.5	ECG read out devices - ECG machine – Block diagram	1
3	Nervous System and its Measurements(7 hours)	
3.1	Neuronal communication - Measurements from the nervous system.	1
3.2	Electroencephalography- Lead system -10-20 Electrode system,	1
3.3	EEG Block diagram - EEG waveforms and features – Brain-Computer interfacing.	2
3.4	Electromyography- Block diagram of EMG recorders - Nerve conduction velocity	2
3.5	Respiratory parameters measurements – Spiro meter - Pneumography.	1
4	Modern Imaging Systems and Therapeutic Equipment(7 hours)	
4.1	Basic X-ray machines	1
4.2	CAT Scanner- Principle of operation - Scanning components	1
4.3	Ultrasonic imaging principle - Types of Ultrasound imaging - MRI and PET scanning(Principle only).	2
4.4	Cardiac pace makers - De-fibrillators	1
4.5	Hemo-dialysis machines -Artificial kidney -Lithotripsy	1
4.6	Short wave and Micro wave diathermy machines	1
5	Instrumentation for Patient Support and Safety(6 hours)	
5.1	Ventilators - Heart lung machine - Infant incubators	1
5.2	Instruments for clinical laboratory – Test on blood cells – Chemical tests	1
5.3	Electrical safety– Physiological effects of electric current	1
5.4	Shock hazards from electrical equipment - Method of accident prevention	1
5.5	Introduction to tele- medicine	1
5.6	Introduction to medical robotics	1