

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BIO-MEDICAL ENGINEERING (03) THERAPEUTIC TECHNIQUES & INSTRUMENTATION SUBJECT CODE: 2160303 B.E. 6<sup>th</sup> SEMESTER

**Type of course:** Core

**Prerequisite:** Human Anatomy & Physiology, Elements of Electrical Engineering, Basic Electronics, Biopotential Measurement & Techniques.

**Rationale:** to impart in students detailed knowledge about various therapeutic equipments and familiarize students with their basic working principle, instrumentation, clinical significance and advancements.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	30	0	20	150

### Content:

Sr. No.	Content	Total Hrs	% Weightage
<b>1</b>	<b><u>DC Defibrillator:</u></b> Need and circuit description. Rectangular wave defibrillator, electrodes used. DC defibrillator with synchronizer, cardioverter. Performance aspects of DC defibrillator. Implantable defibrillator and defibrillator analyzers, Cardiac Pacemakers.	10	20%
<b>2</b>	<b><u>Ventilators:</u></b> Artificial ventilation, Types & classification of Ventilators.	4	8%
<b>3</b>	<b><u>Dialysers:</u></b> Principle of dialysis, artificial kidney, function and working of dialyser, parallel flow dialyser, coil hemodialyser, hollow fiber hemodialyser. Performance analysis of dialysers, membranes used for hemodialysis. Block diagram and working of hemodialysis machine. Blood leak detector, portable kidney machine –working and flow diagram.	8	12%
<b>4</b>	<b><u>Principle of surgical diathermy:</u></b> Electrosurgical equipments & techniques. Electrotomy, fulguration, coagulation, dessication. Electrosurgery units, spark gap valve, solid-state generator. Construction and working of surgical diathermy machine, electrodes used. Safety aspects like burns, high frequency current hazard, and explosion hazard, operating principle of surgical diathermy analyzer.	4	10%
<b>5</b>	<b><u>Basic concepts about LASER:</u></b> LASER coherence. Its principle of operation, properties, gain medium, pumping mechanism and resonator design. Types of LASER: pulsed ruby laser, ND YAG laser, argon laser and CO2 laser. Applications of laser in medicine: control of gastric hemorrhage by	6	10%

	photocoagulation, retinal detachment.		
6	<b>Short-Wave, Diapulse, Microwave and Ultrasonic Therapy:</b> circuit description, application and dosage control. Electrotherapy: diagnosis, electrical stimulation for pain relief, apparatus and current waveforms, electrodes. Spinal cord stimulator and cerebral stimulation.	8	15%
7	<b>Neonatal instrumentation:</b> Incubator: physiological heat balance, heat production and heat loss methods. Apnea detection. Photo therapy devices.	6	5%
8	<b>Anesthesia machine:</b> Gas supply and delivery, vapor delivery. Patient breathing circuit. Complete schematic of anesthesia machine.	8	14%
9	Cardiovascular and vascular surgery, catheters, heart lung machine, coronary angiography, balloon angiography, stents.	4	8%
10	<b>Biotelemetry</b> and their clinical significance	2	6%
<b>Total</b>		60	100%

#### Reference Books:

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", Tata McGraw Hill.
2. Carr & Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. J. Webster, "Bioinstrumentation", Wiley & Sons.
4. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg . , Boston.
5. Leslie Cromwell, "Biomedical Instrumentation and Measurements".
6. Geddes & Baker, "Principles of Applied Biomedical Instrumentation" Wiley.
7. Medical Electronics and Instrumentation by Sanjay Guha - University Publication.

#### Suggested Specification table with marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15%	35%	25%	15%	10%	0

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

#### Course Outcome:

After learning the course the students should be able to:

1. Understand diagnosis related equipments in entirety covering its principle of working, instrumentation related, modes of operation and various advancements.
2. Understand medical terminology, relevant for biomedical instrumentation.
3. Analyze and evaluate the effect of different diagnostic therapeutic methods, their risk potential, physical principles, opportunities and possibilities for different medical procedures.
4. Understand the elements of risk for different instrumentation methods and basic electrical safety.
5. Explain the different therapeutic medical systems, compare advantages and disadvantages, understand the limitations and find the best suitable method for treating different medical conditions.

#### List of Experiments: (Outlines)

1. The study Defibrillator along with its electrode and instrumentation system.
2. The study of pacemaker models and test using simulators.
3. The study of Haemodialysis Machine along with its types.

4. The study of Surgical Diathermy Machine and Surgical Diathermy Analyzer.
5. The study of LASER along with its types and applications.
6. The study of short Wave Diathermy.
7. The study of Long Wave Diathermy.
8. The study of Computerized Ultrasound.
9. The study of Anaesthesia Machine.
10. The study of Heart Lung Machine.
11. The study of Cardiovascular Surgery procedure & Instruments: Coronary and Balloon Angiography and catheters.
12. The study of ventilator.
13. The study of Incubator.
14. The study of Biotelemetry system.

**Major Equipment:**

Biomedical Trainer and Demo Kit

**Active Learning Assignments:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will assign topics from which students can grasp knowledge about current scenario of the Therapeutic Instrumentation. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.