

**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)****Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**

Semester - IV

**Course Title: Therapeutic Medical Instrumentation**

(Course Code: 4340304)

Diploma programme in which this course is offered	Semester in which offered
Biomedical Engineering	4 <sup>th</sup> Semester

**1. RATIONALE**

Therapeutic medical instruments are widely used in the field of biomedical engineering. The students studying the subject are supposed to learn the therapy for any disease after diagnosing it. The course in addition, will provide knowledge of principle and constructional features of various therapeutic medical equipments. The course will also deal with different advanced Therapeutic Technology.

**2. COMPETENCY**

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Operate and maintain different therapeutic medical instruments.**

**3. COURSE OUTCOMES (COs)**

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes:

- Use Laser in therapeutic instruments.
- Identify Physiotherapy and Electrotherapy Equipments
- Maintain Haemodialysis Machine and infusion pumps
- Identify Electrosurgical unit and incubator
- Understand EPT and its impact on health care.

**4. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	CA	ESE	CA	ESE	
3	0	4	5	30	70	25	25	150

(\*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

**Legends:** *L*-Lecture; *T* – Tutorial/Teacher Guided Theory Practice; *P* -Practical; *C* – Credit, *CA* - Continuous Assessment; *ESE* -End Semester Examination.

## 5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the PrOs marked ‘\*’ are compulsory, as they are crucial for that particular CO at the ‘Precision Level’ of Dave’s Taxonomy related to ‘Psychomotor Domain’.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Investigate the use of lasers as a means of transmitting information and determine the wavelength.	1	4
2.	Demonstrate the working of Laser Therapy Unit.	1	4
3.	Operate and test short wave diathermy in condenser/ inductive fields and operation of its control panel.	2	4
4.	Test 1MHz frequency ultrasound therapy using an electronic circuit.	2	4
5.	Observe the performance and effect of electrotherapy equipment on human body and operation of its control panel.	2	4
6.	Demonstrate the working of nerve stimulation using TENS.	2	4
7.	Identify various applications of infusion pumps in hospitals and observe their operation.	3	4
8.	Demonstrate the working of hemodialysis machine.	3	4
9.	Identify various setting parameters and it’s significant during hemodialysis procedure.	3	4
10.	Demonstrate the delivering of drugs by infusion pump in dummy patients.	3	2
11.	Demonstrate the working of volumetric Infusion pump.	3	2
12.	Operate and test Electrosurgical Unit in different mode using various electrodes.	4	4
13.	Perform cut, coagulation and desiccation operation using shop.	4	4
14.	Demonstrate working of neonatal incubators.	4	4
15.	Analyze the importance of active transport as environmental	5	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	physiotherapy intervention.		
16.	Observe the relevance of nutrition on physiotherapy.	5	2
	<b>Total</b>		<b>56 Hrs</b>

**Note**

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
	<b>Total</b>	<b>100</b>

**6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED**

- a) Laser therapy unit
- b) Electro-surgical unit
- c) Short wave diathermy
- d) Ultrasound therapy machine
- e) Muscle stimulator
- f) TENS
- g) Haemodialysis Machine
- h) Volumetric infusion pump
- i) Syringe infusion pump
- j) Baby incubator
- k) Photo therapy unit

**7. AFFECTIVE DOMAIN OUTCOMES**

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this competency.

- a) Work as a leader/a team member.
- b) Follow safety practices while using electrical appliances.
- c) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1<sup>st</sup> year
- ii. 'Organization Level' in 2<sup>nd</sup> year.
- iii. 'Characterization Level' in 3<sup>rd</sup> year.

## 8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topic
<b>Unit – I Laser Therapy</b>	1.a Define therapeutic instrumentation. Enlist different equipment. 1.b Explain basic principle operation of LASER. 1.c Explain the main elements of LASER.	1.1 Introduction to therapeutic instrumentation 1.2 LASER 1.2.1 Basic Principle 1.2.2 Main elements of LASER.
<b>Unit– II Physiotherapy and Electrotherapy Equipment</b>	2.a Explain principle of Short-Wave Diathermy. 2.b Draw and explain circuit diagram of Short-Wave Diathermy. 2.c Elucidate application techniques of short wave diathermy. 2.d Explain Ultrasonic Therapy Unit using a suitable diagram. 2.e Define electrotherapy. 2.f Draw various waveforms used for electrotherapy simulation. 2.g Give Principle of Transcutaneous Electrical Nerve Stimulator (TENS).	2.1 High frequency heat therapy: 2.1.1 Short wave diathermy 2.1.2 Ultrasonic Therapy Unit. 2.2 Electrotherapy : including different types of waveforms such as galvanic current, faradic current, surging current, exponentially progressive current, biphasic stimulation 2.3 Pain relief through electrical stimulation 2.3.1 Transcutaneous Electrical Nerve Stimulator (TENS).
<b>Unit– III Haemodialysis Machines and Automated Drug Delivery System</b>	3.a Explain principle of Artificial Kidney 3.b Draw and explain block Diagram Of Haemodialysis Machine. 3.c Give the basic principle of Infusion pumps. 3.d Draw and explain working of Syringe pump.	3.1 Artificial Kidney 3.2 Hemodialysis machine: 3.2.1 hollow fiber hemodialyzer 3.3 Infusion pumps and its applications. 3.3.1 Syringe pumps.
<b>Unit – IV Surgical Diathermy and Neonatal Therapy</b>	4.a Give principle of surgical diathermy 4.b Describe electrodes used for cutting and coagulation 4.c Describe safety aspects of electrosurgical machine draw and explain temperature controlled type incubator 4.d Describe principle of temperature controlled type incubator	4.1 Surgical diathermy – 4.1.1 Electrodes – used for cutting and coagulation 4.1.2 safety aspects- of electrosurgical machine 4.2 Neonatal therapy 4.2.1 temperature controlled incubator

Unit	Unit Outcomes (UOs)	Topics and Sub-topic
Unit – V Environmental Physiotherapy (EPT)	5.a Define EPT 5.b Enlist an essential steps towards an environmental physiotherapy 5.c Explain the effect of active transport on human health.	5.1 Environmental Physiotherapy 5.2 Steps towards EPT 5.3 EPT in patient care: 5.3.1 nature based interventions: Active transport, physical exercise

**Note:** The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
1	Laser therapy	6	5	5	2	12
2	Physiotherapy and Electrotherapy Equipment	10	6	6	4	16
3	Haemodialysis Machines and Automated Drug Delivery System	10	5	5	4	14
4	Surgical Diathermy and Neonatal Therapy	10	6	6	4	16
5	Environmental Physiotherapy (EPT)	6	5	5	2	12
<b>Total</b>		<b>42</b>	<b>26</b>	<b>30</b>	<b>14</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may varies lightly from above table.

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

- Visit the nearest physiotherapy center.
- Visit nearer Hospital where physiotherapy treatment is available
- Prepare a chart of components currently used for therapeutic instruments
- Prepare mini/micro project
- Participate in a seminar/workshop for learning new trends and technology in therapeutic instruments
- Prepare a poster for creating awareness about environmental physiotherapy.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (MOOCs) may be used to teach various topics/ subtopics.
- b) Guide student(s) in undertaking micro-projects.
- c) Arrange to visit nearer Hospital/pathological laboratory
- d) Video films/animation films on working of different types of therapeutic instruments
- e) Perform practical virtually on the various online website/software
- f) Arrange expert lectures of physiotherapists.

## 12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, in the fifth and sixth semesters, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about 14-16 (fourteen to sixteen) student engagement hours during the course. The students ought to submit micro-project by the end of the semester to develop the industry oriented COs. A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

1. Prepare digital mini stimulator
2. Prepare a model to understand the principle of lasers .
3. Prepare a posture corrector for cervical and lumbar pain.
4. Prepare a DIY model of hemodialysis machine
5. To make effective charts of physiotherapy machines used in the medical field.
6. Make a report on environmental physiotherapy specifically active transport use and physical exercise for healthy lifestyle

## 13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Handbook of biomedical Instrumentation	R.S. Khandpur	Tata McGraw Hill, New Delhi
2	Medical instrumentation Application and Design	John Webster	John Wiley and Sons, New Delhi
3	Medical Lasers and their safe use	David H Shiney, Stephen and L. Trokel	Springer Publications
4	Introduction to Biomedical Equipment and technology	Carr and Brown	Pearson Education-Asia, New Delhi

S. No.	Title of Book	Author	Publication with place, year and ISBN
5	Biomedical Instrumentation and Measurements	Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer	PHI Learning, New Delhi

#### 14. SOFTWARE/LEARNING WEBSITES

- [https://www.physio-pedia.com/An Introduction to Environmental Physiotherapy](https://www.physio-pedia.com/An_Introduction_to_Environmental_Physiotherapy)
- <https://www.fusfoundation.org/posts/therapeutic-ultrasound-course-mooc-now-available-online/>
- [www.coursera.org](http://www.coursera.org)
- [www.edx.org](http://www.edx.org)
- [www.nptel.ac.in](http://www.nptel.ac.in)
- [www.swayam.gov.in](http://www.swayam.gov.in)

#### 15. PO-COMPETENCY-CO MAPPING

Semester III	Pos						
	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ developmen t of solutions	PO 4 Engineerin g Tools, Experiment ation & Testing	PO 5 Engineering practices for society, sustainabilit y & environmen t	PO 6 Project Managemen t	PO 7 Life-long learning
<b>Competency &amp; Course Outcomes</b>							
<b>Competency</b>							
CO-1 Use the Laser in therapeutic instruments.	2	2	-	-	2	-	2
CO-2 Identify Physiotherapy and Electrotherapy Equipments	3	2	3	3	-	1	2
CO-3 Maintain Haemodialysis Machine and infusion pumps	3	2	2	3	-	-	2
CO-4 Identify Electrosurgical unit and incubator	3	-	-	3	1	-	2
CO-5 Understand EPT and its impact on health care.	3	2	3	-	3	3	3

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO



**16. COURSE CURRICULUM DEVELOPMENT COMMITTEE****GTU Resource Persons**

<b>S. No</b>	<b>Name and Designation</b>	<b>Institute</b>	<b>Contact No.</b>	<b>Email</b>
1	Ms. M.H.Dave	G.P.Gandhinagar	9099757202	maitrihdave@gmail.com
2	Mr. Atul N. Kataria	AVPTI Rajkot	9925458109	atul.12.1.84@gmail.com