

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**
Semester - VI**Course Title: Advance Medical Techniques**
(Course Code:4360305)

Diploma programme in which this course is offered	Semester in which offered
Biomedical Engineering	6 th Semester

1. RATIONALE

The rationale for introducing advanced medical techniques in the curriculum for diploma students lies in the evolving nature of healthcare and the need for healthcare professionals to stay abreast of technological advancements. The field of medicine is continuously evolving with the introduction of advanced technologies. From diagnostic tools to treatment modalities, staying updated on the latest advancements is crucial for providing optimal patient care. Advanced medical techniques often lead to more accurate diagnoses and more effective treatments. By incorporating these techniques into the curriculum, diploma students can learn how to leverage cutting-edge tools to improve patient outcomes and enhance overall healthcare quality. Exposure to advanced medical techniques ensures that they are well-prepared to work in diverse and technologically advanced healthcare environments.

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:

- **Gain combination of education, training, and practical experience to ensure overall health care quality and can work in diverse and technologically advanced healthcare environments.**

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:

- Acquaint with Advance Medical Technologies
- Understand the Diagnostic Imaging Techniques like PET,SPECT,Thermography and Gamma Camera.
- Illustrate various Personal Health Monitors
- Demonstrate the knowledge of Telehome Care Technologies
- Explain the concept of Bio Nanotechnology.

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’.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify various Advance Medical Technologies.	1	2
2	Explore the concept of 3D printing with one model on any platform.	1	2
3	Understand brain machine interface.	1	2
4	Study the neurophysiological signals used in brain machine interface.	1	2
5	Investigate gene delivery methods for therapeutic applications.	1	2
6	Demonstrate the working principle of PET.	2	2
7	Demonstrate the working principle of SPECT.	2	2
8	Study of thermography.	2	2
9	Explore image acquisition and processing of Gamma cameras.	2	2
10	Study the portable medical device	3	2
11	Understand the design consideration for portable medical device	3	2
12	Study the concept of smart clothes.	3	2
13	To understand application of biostamps.	3	4
14	To get familiar with personal health data standards	3	2
15	Understands the building components of Telehealth care	4	2
16	Analyze various parameters on smart watch	4	2
17	Interpret parameters monitored by wearable wireless healthcare patch	4	2
18	To study the Characteristics required for Green medical device and its examples	4	2
19	Study and understand application of nanotubes, nanocomposite and nanoparticles.	5	2
20	Study about green nanotechnology	5	2
Total			Hrs 40

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
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

1. 3D Printer
2. Wearable
3. Diagnostic equipment
4. Imaging Equipment
5. Nano devices

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 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd 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
Unit- I Introduction to Advance Medical Technologies	1.a Familiarize with Advance Medical Technologies. 1.b Explain the concept of 3D printing with its application 1.c Explain brain machine interface 1.d Gene therapy	1.1 Introduction to Advance Medical Technologies. 1.2 3D Printing concept and its application. 1.3 Brain Machine Interface concept and its application. 1.4 Gene Therapy concept and its application
Unit – II Advance Diagnostic Imaging Techniques	2.a Describe the Concept of Diagnostic Imaging Techniques. 2.b State the principle behind PET. 2.c Explain simplified diagram of SPECT 2.d Explain thermography. 2.e Describe the gamma camera with its block diagram.	2.1 Introduction to Diagnostic Imaging Techniques. 2.2 PET -Principle 2.3 SPECT-Simplified diagram of SPECT 2.4 Thermography-Infrared Camera 2.5 Gamma Camera-Block Diagram
Unit – III Personal Health Monitors	3.a Describe the Role and functions of Personal Health Monitors. 3.b Portable Medical Devices 3.c Explain the Concept Intelligent Medical Clothes 3.d Wearable Monitors 3.e Learning Personal Health Data standards	3.1 Role and functions of Personal Health Monitors. 3.2 Portable Medical Devices-System block diagram 3.3 Design Considerations for Portable Medical Devices 3.4 System on chip Architecture for Portable Medical Devices- 3.4.1 Concept 3.4.2 Block diagram 3.5 Smart Clothes 3.5.1 Technology involved in the development of Smart clothes 3.5.2 Types of Smart Clothing. 3.6 Wearable Monitors-Remote health Monitoring system based on Wearable sensors 3.6.1 Biostamps 3.7 Personal Health Data Standard-IEEE 11073 Device specifications.

Unit	Unit Outcomes (UOs)	Topics and Sub-topic
Unit- IV Telehome Care and Telehealth	4.a Describe the brief concept of Telehome Care 4.b Understand Telehome care Technologies 4.c Telehome Care devices 4.d Concept of Green Medical device	4.1 What is Telehome care- main elements 4.2 Telehome care technologies 4.2.1 Components of telehome care 4.2.2 Telehealth end to end system architecture 4.2.3 Basic telehealth system Wearable wireless Healthcare Patch 4.2.4 Smart Watches. 4.3 Characteristics required for Green medical device and its examples
Unit – V BioNanotec hnology	5.a Explain concept of BioNanotechnology 5.b What are Nanomaterials 5.c Nanotechnology in drug delivery 5.d Green Nanotechnology	5.1 Introduction to Nanotechnology 5.2 Overview of nanoscale materials and their properties 5.3 Nanomaterials- Nanoparticles, nanotubes, and nanocomposites 5.4 Nanotechnology in Drug Delivery 5.5.1 Nanocarriers and drug delivery systems 5.5.2 Targeted drug delivery and controlled release 5.5 Concept of Green Nanotechnology

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	Introduction to Advance Medical Technologies	4	4	4	0	8
2	Advance Diagnostic Imaging Techniques	8	6	6	4	16
3	Personal Health Monitors	12	6	6	6	18
4	Telehome Care and Telehealth	10	6	6	4	16
5	Bionanotechnology	8	4	6	2	12
Total		42	26	28	16	70

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 vary slightly from the 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.

1. Student should visit the general hospital and diagnostic center.
2. Visit websites of various manufacturers of Advance medical devices/instruments to collect details of the products and prepare a report for the same.
3. Students can attend interactive seminars on recent advancements in medical techniques.
4. Students can explore scientific journals; research papers review papers and present their findings to the class, fostering a deeper understanding of the subject matter.
5. Integrate virtual reality simulations that allow students to virtually analyze advance medical techniques.
6. Assign topics to students and have them prepare and deliver the presentations to their peers.

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) Class Test
- c) Assignment
- d) Seminar/Symposium
- e) Group discussion/Debate
- f) Arranging hospital and reputed diagnostic centre visit.
- g) Show video/animation films of working and maintenance of medical instruments using Advance Technologies.
- h) Perform practical virtually on the various online website/software
- i) Arrange expert lectures on advanced topics related to Medical Imaging.

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.

Following micro projects can be implemented:

1. Choose a specific advance medical technique, Collect information on the step-by-step process, instruments used, potential complications, and best practices. Make a power point presentation on it.
2. Find Animation/Video on 3D Printing, Brain Machine Interface and Gene Therapy. Create a 4-5 pages report that includes details about the technology used, the development process, and challenges.
3. Prepare a chart depicting various advanced imaging modalities like MRI, PET and Nuclear Medicine.
4. Literature review: Search and compile information on the types of nanoparticles commonly used in drug delivery
5. Literature review: Understand the advantages and challenges associated with nanoparticle-mediated drug delivery.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Telemedicine Technology and Application(mHealth, Telehealth and eHealth)	R. S. Khandpur	PHI Learning Pvt. Ltd. Delhi
2	Handbook of biomedical Instrumentation	R.S. Khandpur	Tata McGraw Hill, New Delhi
3	Fundamentals of Medical Imaging	Paul Suetens	Cambridge University Press
4	Wearable Technology in Medicine and Health Care	Raymond K Y Tong	Marra Conner
5	Nanotechnology Fundamentals and Applications	Manasi Karkare	I K publishing House

14. SOFTWARE/LEARNING WEBSITES

[A] List of software/learning websites:

Sr No	Topic key word	Link
1.	Brain machine interface	https://www.nature.com/subjects/brain-machine-interface
2.	Gene therapy	https://www.fda.gov/vaccines-blood-biologics/cellular-gene-therapy-products/what-gene-therapy

3.	Nanotechnology	https://www.understandingnano.com/nanomaterials.html
4.	Wearable Monitors in healthcare system	https://www.techtarget.com/searchmobilecomputing/definition/wearable-technology
5	SwayamMooc	https://swayam.gov.in/
6	Nptel	https://nptel.ac.in/

15. PO-COMPETENCY-CO MAPPING

Semester VI	Pos						
	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ developmen t of solutions	PO 4 Enginee ring Tools, Experim entation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage ment	PO 7 Life-long learning
<u>Competency</u>							
Acquaint with Advance Medical Technologies	3	1	-	-	1	-	3
Understand the Diagnostic Imaging Techniques like PET,SPECT,Thermography and Gamma Camera.	3	3	-	2	2	-	3
CO-3 Illustrate various Personal Health Monitor	3	2	3	2	2	-	3
CO-4 Demonstrate the knowledge of Telehome Care Technologies	3	2	3	2	2	-	3
CO-5 Explain the concept of Bio Nanotechnology.	3	2	3	2	1	-	3

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO2

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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