

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
CRITICAL CARE INSTRUMENTATION
(COURSE CODE: 3350303)**

Diploma Programmes in which this course is offered	Semester in which offered
Biomedical Engineering	5 th Semester

1. RATIONALE

Critical care instrumentation is a multidisciplinary field concerned with patients who have sustained, or are at risk of sustaining life threatening, single or multiple organ system failure due to disease or injury. Critical care medicine seeks to provide for the needs of these patients through immediate and continuous observation and intervention so as to restore health and prevent complications. Hence this course provides knowledge and underlying functional concepts of the different critical equipment used in NICU, ICCU, and ICU. This course also enhances awareness of personal health issues so as to apply and transfer the knowledge gained to the wider community, thus encouraging individual self-awareness and responsibility in these areas.

2. LIST OF COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- **Operate, calibrate and maintain different critical care instruments used in OT, ICCU, ICU and NICU.**

3. COURSE OUTCOMES

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

- Identify various biomedical critical care instruments.
- Maintain different types of critical care instruments such as defibrillators, Pacemakers, incubators etc.
- Maintain various patient monitoring instruments.
- Maintain various life support equipments.

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	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

Legends: L - Lecture; T - Tutorial/Teacher Guided Theory Practice; P - Practical; C - Credit ; ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (Outcomes' in Cognitive Domain)	Topics and Sub-topics
Unit – I Critical care instrumenta tion	1.a Define critical care instrumentation 1.b list different critical care instruments used in hospital 1.c describe layout of ICCU.	1.1 Introduction - to critical care instrumentation with enlisting different equipments used in critical units of the hospital 1.2 Critical units: basic concepts of NICU, ICU, ICCU
Unit– II Patient monitoring system	2.a Elucidate block diagram of bed side monitor 2.b State principle of central monitor	2.1 Concepts of patient monitoring system- classification-bed side and central monitoring system 2.2. cardiac monitor- 2.2.1 selection of system parameters 2.3 bed side monitor 2.4 central monitor
Unit– III Cardiac care instrumenta tion (Defibrillato r and Pacemaker)	3.a Enlist different equipments used in ICCU. 3.b Describe principle of DC defibrillator 3.c Enumerate types of defibrillator 3.d Define ventricular fibrillation and cardiac arrhythmia 3.e State classification of external pacemaker 3.f Draw and explain block diagram of ventricular synchronous demand type pacemaker 3.g Classify implantable pacemaker. 3.g Explain different leads of pacemaker.	3.1 Defibrillator -ventricular fibrillation, DC defibrillator, defibrillator electrodes, types of defibrillator based on mode of application i.e. AED and implantable defibrillators 3.2 Pacemaker - cardiac arrhythmia, need ,classification such as external pacemaker based on pulses and output waveform, implantable pacemaker and leads

Unit	Major Learning Outcomes (Outcomes' in Cognitive Domain)	Topics and Sub-topics
Unit – IV Life support equipment	4.a Explain artificial ventilation 4.b Describe positive pressure ventilator 4.c Enlist different types of ventilator 4.d Explain microprocessor based ventilator 5.d State principle of heart lung machine 4.e State principle of oxygenator 4.f Elucidate principle of nebulizer 4.g Describe principle of anesthesia machine	4.1 ventilators- mechanism of respiration, artificial ventilation, types of ventilator 4.1.I different measurable parameters-such as lung compliance, mean airway pressure, inspiratory pause time, tidal volume, minute volume, conventional mechanical ventilation, positive end expiratory pressure(PEEP) 4.1.II ventilator modes-such as spontaneous and mandatory ventilation 4.2 oxygenator, heart lung machine, nebulizer, intra aortic ballon pump 4.3 Anesthesia machine- 4.3.I gas supply and delivery, vapor delivery, patient breathing circuit
Unit – V Telemetry	5.a Define telemetry. Enlist types of telemetry system 5.b. Describe principle of single channel and multi channel telemetry.	5.1 telemetry- wireless telemetry, modulation techniques, transmitter and receiver 5.1.I single channel telemetry- ECG telemetry 5.1..II multichannel telemetry- ECG and respiration based telemetry 5.1.III implantable telemetry system-based on blood flow and blood pressure

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (Theory)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I.	Introduction to critical	07	05	04	00	09

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	care instrumentation					
II.	Patient monitoring system	07	03	03	03	09
III.	Cardiac care instrumentation	18	07	09	07	23
IV.	Life support equipment	14	07	05	05	17
V.	Telemetry	10	04	05	03	12
	Total	56	26	26	18	70

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

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.

7. SUGGESTED LIST OF EXERCISES/PRACTICAL/EXPERIMENTS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes

S.No.	Unit No.	Practical /Exercises (Outcomes in Psychomotor Domain)	Approx. Hrs.
1.	I	Identify various instruments used in <i>acquire those Programme Outcomes/Course Outcomes related to affective domain</i> critical care unit in hospitals.	02
2.	II	Identify various parameters of bed side monitor.	02
3.	III	Plot the characteristic of capacitor used in defibrillator- test and .Calibrate the defibrillator	02
4.	III	Plot the characteristic of normal sinus rhythm using pacemaker and identify standard waves, segments, and intervals	02
5.	III	Test brady Tachycardia and corrected bradycardia wave using pacemaker.	02
6.	III	Test the charging, discharging and energy control in dc defibrillators with instant and synchronous mode.	02

S.No.	Unit No.	Practical /Exercises (Outcomes in Psychomotor Domain)	Approx. Hrs.
7.	III	Identify the various electrodes used in defibrillator and maintain them.	02
8.	III	Plot characteristic of temperature control in neonatal incubator and test the annunciating system.	02
9.	IV	Identify different sections of ventilator and operate it in different modes.	02
10.	IV	Identify different sections of nebulizer and operate it.	02
11.	IV	Identify different sections of the heart lung machine.	02
12.	IV	Identify different controls of the bubble oxygenator.	02
13.	IV	Assemble different parts of model of heart lung machine.	02
14.	IV	Test the ventilator for optimum performance and locate the fault of equipment.	02
15.	V	Perform different standard lead configuration using single channel ECG telemetry system Calibrate them.	04
16.	V	Identify different sections of the multichannel telemetry system and find various parameters.	02
Total Hours ((Note: (i) Practical requiring visit to Hospital/Diagnostic Centre may be excluded from external exam, only oral may be taken for such practical(ii) Perform any practical for total 28 hours so that most units are covered)			36

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Collect the images of various critical care instruments from internet and attach their photographs in file/journal.
- ii. Survey the market and collect the specifications of different critical care instruments supplied by reputed companies and compare them with respect to their strengths and shortcomings.
- iii. Visit the ICU and OT of the hospital and list various equipments used in it along with their technical specifications .

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Show the video/animation films and photographs of constructional features, operations, calibrations and maintenance of critical care instruments.
- ii. Arrange a visit to medium or big hospital and show constructional features, operations, calibrations, and maintenance of critical care instruments.

10. SUGGESTED LEARNING ACTIVITIES

A) List of Books

S.No.	Title of Book	Authors	Publications
1.	Handbook of biomedical instrumentation	R.S. Khandpur	Tata McGraw Hill, New Delhi, India
2.	Medical instrumentation application and design	John G. Webster	John Wiley and Sons, New Delhi, India
3.	Biomedical instrumentation and measurements	Lesli P Cromwell	PHI Learning, New Delhi, India
4.	Biomedical equipment technology	Carr and Brown	PHI Learning, New Delhi, India
5	Biomedical signal analysis: contemporary methods and application	Theis and Meyer-Baze	PHI Learning, New Delhi, India

B) List of Major Equipment/Instrument with Broad Specification

- i. Patient monitor
- ii. Defibrillator
- iii. Pacemaker
- iv. Ventilator
- v. Nebulizer
- vi. Heart lung machine
- vii. ECG telemetry system

C) List of Software/Learning Websites

- i. <http://ocw.mit.edu/courses/health-sciences-and-technology/>
- ii. <http://webcast.berkeley.edu/series.html#c,d,Bioengineering>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. A.K. Bula,** Lecturer, Dept. of Biomedical Engineering, G.P.Gandhinagar
- **Prof. S.S. Malkan,** Lecturer, Dept. of Biomedical Engineering, G.G.P.Ahmedabad
- **Prof. M.H. Dave,** Lecturer, Dept. of Instrumentation Engineering, G.P.Gandhinagar
- **Prof. N.D. Makwana,** Lecturer, Dept. of Biomedical Engineering, G.P.Gandhinagar

Faculty Members from NITTTR

- **Prof. (Mrs.) Susan S. Mathew,** Associate Professor, Dept. of Electrical and Electronics Engg.
- **Prof. Joshua Earnest,** Professor, Dept. of Electrical and Electronics Engineering.