



Pune District Education Association's  
**Baburaoji Gholap College**  
Sangvi, Pune 411 027, Maharashtra.

## Proposed Syllabus

for

## Post Graduate Diploma in Biomedical Instrumentation (Semester I and II)

Submitted to

**University Grant Commission**  
Bahadur Shah Zafar Marg,  
New Delhi - 110002.

## **Details about Structure/Pattern of Syllabus**

1. **Title of the Course:** Post Graduate Diploma in Biomedical Instrumentation
2. **Course Level:** Level 8: Post Graduate Diploma
3. **Syllabus to be implemented from the Academic year:** 2020 – 2021

### **4. Preamble of the Syllabus:**

The Post Graduate Diploma in Biomedical Instrumentation (PGDBI) NSQF level 8 exit course leading to Post Graduate Diploma, in Biomedical Instrumentation after the successful completion of one year. This credit system based curriculum, would develop a strong fundamentals and specialization in the discipline of Biomedical Instrumentation. The students pursuing different qualifications in Biomedical Instrumentation need to develop in depth understanding various aspects of the subject. The principles and fundamental concepts in Biomedical Instrumentation will be studied in details. The students will have deeper understanding of service sector rules and regulation. The course proposes to skill based education due to which the student's ability of problem solving will be enhanced.

### **Objective of the course:**

1. To provide skills relating to a Biomedical Instrumentation profession and appropriate content of General Education.
2. To ensure that the students will get adequate knowledge and skills at exit point of the programme.
3. To provide flexibility to the students by means of pre-determined entry and exit points as per the National Skills Qualification Framework (NSQF) guidelines.
4. To enhance employability of the graduates and meet industry requirements and are also expected to be equipped to become part of global workforce.
5. To provide vertical mobility to students coming out of 10+2+3 with vocational subjects.

### **Introduction:**

Salient Features of the Credit System:

- a) PGDBI has been designed as per the guidelines and objective of UGC, New Delhi, NSDC, New Delhi and NSQF to cater skill force to Biomedical Instruments.

- b) PGDBI course is NSQF 8 level exist program, which leads Post Graduate Diploma after completion of first year.
- c) PGDBI one year course in 'Biomedical Instrumentation' is of 60 credits, where one credit theory course is of one clock hour per week running for 15 weeks and one credit for practical course will consist of 10 of laboratory exercise including the revision and setting up the practical. Thus, each credit is equivalent to 15 hours.
- d) In one credit, 10 lectures are assigned for actual teaching in the classroom and 5 lectures are for seminars, discussions, home assignments and library work.
- e) Every student shall complete 30 credits in a minimum of two semesters. All semesters will have 30 credits each.
- f) The student will be declared as failed if s/he does not pass in all credits within a total period of three years. After that such students will have to seek fresh admission as per admission rules prevailing at that time.
- g) In every year, the academic calendar showing dates for commencement and end of each semester, internal assessment examinations and term end examination will be prepared and duly notified before starting of each semester.
- h) Student has to complete internship every year to complete the Diploma / Post graduate Diploma Course.

The students seeking admission to PGDBI are hereby informed that they are supposed to adhere to the following rules:

- a) A minimum of 75 % attendance for lectures / practical is the pre-requisite for grant of each semester.
- b) There shall be tutorial / practical / surprise test / home assignment / review of article / seminar / industrial visits / training course as a part of internal assessment in each semester. The students are supposed to attend all the examinations. The re-test will not be taken for the student absent for the any examination.
- c) The students opting for project course shall follow the rules framed for the same.

## **5. Faculty of the Course: Science**

## **6. Eligibility for Admission:**

The eligibility condition for admission to PGDBI programme shall be from science stream.

## **Duration of the Course:**

Award	Duration	Corresponding NSQF level
Post Graduate Diploma		8

**7. Intake capacity of students: 50 students at entry level**

**8. Examination:**

- a) The assessment and evaluation for the PGDBI programme will be as per the guidelines of Savitribai Phule Pune University for credit based system.
- b) The assessment for the general education component should be according to the guidelines of Savitribai Phule Pune University as per their prevailing standards and procedures.
- c) The assessment for the skill development components will focus on practical demonstrations of the skills acquired. This may be by the consultation with respective Sector Skill Council for designing the examination and assessment pattern for the skill development components. This may be considered by using the designated assessors of Sector Skill Councils/industry associations for the conduct of practical assessment.

**I. Pattern of Examination**

- i. Internal examination, Term end examination, Practical, Oral and Project
- ii. Pattern of the question paper: As per university rules

**Evaluation of Students:**

- 1 Assessment will consist of (a) in-semester continuous assessment and (b) end-semester assessment with an equal weightage of 50 % marks each.
- 2 Minimum 30 % marks are required for passing the both in semester examination and end semester examination separately. However, minimum 40 % mark is required for passing in the combined examination of in-semester and end-semester examination.
- 3 A student cannot take admission for the next year if s/he fails to complete 50% credits of the previous two semesters. The internal marks will not change and student cannot reappear for internal examination. If student missed the internal examination, s/he will have second chance with the permission of the only concerned teacher. It will be the discretion of concerned teacher and internal departmental assessment committee. In case, s/he wants to repeat internal, s/he can do so only by registering for the said courses during 5<sup>th</sup>/6<sup>th</sup> semester whichever is applicable.
- 4 The answer scripts for the only internal examination and not for end semester examination may be shown to the concerned student.

5 There shall be revaluation of answer script of end semester examination only, but not of internal examination.

- **In-semester examination:**

The internal assessment for each course would be continuous and dates for all tests will be pre-notified in the time table. The internal assessment committee will coordinate this activity.

- **Theory Courses:**

The students should be encouraged to conduct various academic activities. A teacher must select a variety of the methods for internal assessment like: mid-semester test, online test, computer based examination, open book test (by the concerned teacher choice of allowed books), tutorial, surprise test, oral, assignments, review of article, Seminar presentation and journal / lecture / library notes. It is the responsibility of the student to preserve the documentation of the internal assessment except midterm test answer script.

- **Practical courses:**

It is a continuous evaluation process and practical courses will be evaluated on the basis of following points.

- 1 Performance assessment of each experiment on the basis of attendance, punctuality, journal completion, practical skills, results, oral and analysis.
- 2 Test on practical may be conducted before the end-semester examination.
- 3 Assessment of each experiment shall be done for each practical weekly.
- 4 The student strength of practical batch should be twenty. One practical session is of 3 hour duration for one practical batch.

- **Project Course:**

The project work will be evaluated by incharge of project batch in consultation with project guide. The assessment of project work will be done weekly in the respective batch and evaluation will be on the basis of weekly progress of project work, referencing, oral, results and documentation.

- **End-semester examination:**

The end-semester examination for 50 marks for all courses would be held nearly two weeks after the completion of teaching for that semester. The paper setting and assessment for all courses would be the responsibilities respective course in-charges. The all activities related to examination like paper setting, evaluation, assessment, preparation of marks-sheets etc. would be coordinated by the examination committee of department.

## **II. Standard of Passing**

Minimum 30 % marks are required for passing the both in semester examination and end semester examination separately. However, minimum 40 % mark is required for passing in the combined examination of in-semester and end-semester examination.

### **III. ATKT Rules**

A student cannot take register for the next year if s/he fails to complete 50 % credits of the previous two semesters.

### **IV. Award of Class**

Grades will be awarded from grade point average (GPA) of the credits.

#### **GPA Rules:**

1. The formula for GPA will be based on Weighted Average. The final GPA will not be printed unless a student passes courses equivalent to minimum 180 credit hours. Total credits hours means the sum of credit hours of the courses which a student has passed.
2. A seven point grade system [guided by the Government of Maharashtra Resolution No. NGO-1298/[4619]/UNI 4 dated December 11, 1999 and University regulations] will be followed.
3. If the GPA is higher than the indicated upper limit in the third decimal digit then the student be awarded higher final grade (e.g. a student getting GPA of 4.492 may be awarded 'A')
4. For semester I, II, III, IV and V examinations, only the grade points will be awarded for each subject. Final GPA along with final grade will be awarded only at the end of VI<sup>th</sup> semester. In case of verification, the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10 % marks and in the grade of the course.
5. After the declaration of result, for the improvement of grade, the student can reappear for the examination of 30 credits worth theory courses.
6. A student can go for the grade improvement program only after the declaration of final semester examination i.e. at the end of next academic year after passing B.Voc. examination and within three years of completion of B.Voc. A student can appear for grade improvement programme only once.

### **V. External Students**

There shall be no external students.

### **VI. Setting of Question Paper/Pattern of Question Paper**

All general and skill education components based end-semester question papers will be set by the college and centralized assessment of all papers will be done as per the guideline of SavitribaiPhule Pune University. The Questions should be designed to test the conceptual

knowledge and understanding of the basic concepts of the subject. Theory examination will be of 2 hours duration for each theory course. There shall be 4 questions each carrying marks as shown below. The pattern of question papers shall be:

Question 1 (10 Marks) 5 out of 10 answer in 20 words each of 2 marks

Question 2 (10 Marks) 2 out of 4 short note/answer in 50 words each of 5 marks

Question 3 (15 Marks) 2 out of 3 answer in 150 words each of 7.5 marks

Question 4 (15 Marks) 1 out of 3- answer in 300 words each of 15 marks

## **VII. Verification/Revaluation**

There is also a provision for verification and revaluation. In case of verification, the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10 % marks and in the grade of the course. There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

## **9. Structure of the Course:**

The basic structure (Framework) of the proposed Diploma syllabus for the one year, Advance Diploma for the two years and Degree for three years integrated course ('Retail Management') leading to B.Voc. in 'Retail Management' at Baburaoji Gholap College, Sangvi, Pune 411 027 affiliated to Savitribai Phule Pune University is given at the end of the Annexure - II.

**I. Compulsory Paper:** All papers are compulsory.

**II. Optional Paper:** No optional paper.

**III. Question Paper and Papers:** As mentioned above in the examination section.

**IV. Medium of Instructions:** English

## **10. Equivalence of previous syllabus along with proposed syllabus**

This course is sanctioned from academic year 2018-2019. So new syllabus has been proposed. Hence no previous syllabus is available.

## **11. University Terms:**

Diploma course contains total 2 Semesters. Advance Diploma course contains total 4 Semesters and the degree course contains total 6 Semesters.

## **12. Subject wise Detailed Syllabus:**

A copy of subject wise detailed syllabus is attached with this Annexure - II.

### 13. Recommended Books:

The list of recommended books is given at the end of syllabus.

### 14. Qualification of Teacher:

The qualification of faculty will be as per guidelines and norms of University Grant Commission, New Delhi and National Skill Development Council.

Pune District Education Association's  
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## Structure of Syllabus Post Graduate Diploma in Biomedical Instrumentation

Syllabus to be implemented from academic year 2020 - 2021

Year – I			Semester - I
Course	Course type	Course Name	No. of Credits
PGDBM - 101	Theory 1	Fundamentals of biomedical instrumentation	3
PGDBM - 102	Theory 2	Recording Systems and Signal Analysis	3
PGDBM - 103	Theory 3	Cardiovascular systems and measurements	3
PGDBM - 104	Theory 4	Patient Monitoring systems	3
PGDBM - 105	Practical 1	Experiments	6
PGDBM - 106	Practical 2	Project	6
PGDBM - 107	Practical 3	Health check up camps and hospital visits	6



<b>Total number of credits</b>	<b>30</b>
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<b>Year – I</b>			<b>Semester - II</b>
<b>Course Code</b>	<b>Course type</b>	<b>Course Name</b>	<b>No. of Credits</b>
PGDBM - 201	Theory 5	Computer in biomedical instrumentation, telemetry and telemedicine	3
PGDBM - 202	Theory 6	Medical imaging techniques I - X ray machine , digital radiography and computed tomography	3
PGDBM - 203	Theory 7	Medical Imaging techniques II- Nuclear medicine, NMR, Sonography	3
PGDBM - 204	Theory 8	Clinical laboratory instruments and lasers in medicine	3
PGDBM - 205	Practical 4	Experiments	6
PGDBM - 206	Practical 5	Project	6
PGDBM - 207	Practical 6	Health check up camps and hospital visits	6
<b>Total number of credits</b>			<b>30</b>

Admission criterion: Any science graduate

Term of course: One year (Two semesters)

Exam criterion: 100 marks per course. Total 1200 marks (50 % Internal and 50% external for each course)

Passing criteria: 40% in each course.

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Fundamentals of biomedical instrumentation</b>		
<b>Course Code</b>	PGDBM - 101		
<b>Class</b>	<b>PGDBI Sem - I</b>	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>To understand the basic of biomedical instrumentation system</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>Introduction to various biosignals and their origin</li> <li>Understanding of electrode theory</li> <li>Use of transducers in biomedical instrumentation</li> <li>Patient safety while using biomedical instrumentation</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>Students will acquire Basic knowledge of using instruments , selection of electrode and precaution while measuring human body</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>

Unit I	<p>Bioelectric signals and electrodes</p> <ul style="list-style-type: none"> <li>• Sources and characteristics of bio-signals.</li> <li>• Resting and action potential, propagation of action potential, Passive and active conduction.</li> <li>• Basics of signal measuring system</li> <li>• Basic and essentials of biomedical instrumentation system.</li> <li>• Problems faced when measuring on human body.</li> <li>• Electrode Theory and equivalent circuits</li> <li>• Bio potential Electrodes: types and Characteristics</li> <li>• Electrodes for ECG, EEG, EMG.</li> </ul>	1	15
Unit II	<p>Physiological transducers</p> <ul style="list-style-type: none"> <li>• Introduction to physiological transducers</li> <li>• Classification of Transducer</li> <li>• Performance characteristic of transducer.</li> <li>• Displacement, position and motion transducer.</li> <li>• Pressure transducer for blood pressure measurement</li> <li>• Transducer for Body temperature measurement</li> <li>• Biosensors</li> <li>• Smart sensors</li> </ul>	1	15
Unit III	<p>Patient Safety</p> <ul style="list-style-type: none"> <li>• Leakage currents</li> <li>• Safety codes for electromedical equipments</li> <li>• Electrical safety analyzer</li> <li>• Testing of biomedical equipment</li> <li>• Precautions and safety conditions of biomedical instruments, grounding</li> <li>• Electric shock hazards-Gross shock-Micro current shock</li> </ul>	1	15

**References:**

1. Biomedical Instrumentation and Measurements (Second edition)  
By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
5. A textbook of Biomedical engineering edited by R.M. Kenedi, blackie (Glasgow & London)
6. Medical instrumentation: Application and design (Third edition) John G.Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Recording Systems and Signal Analysis</b>		
<b>Course Code</b>	PGDBM - 102		
<b>Class</b>	<b>PGDBM SEM - I</b>	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim: To develop knowledge of recording systems</b>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Defining basic recording system and types of recorder</li> <li>• Analysis of the signal</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will get idea about different recording systems and their use along with signal analysis techniques</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	Recording systems <ul style="list-style-type: none"> <li>• Basic recording system.</li> <li>• General consideration for signal conditioners</li> <li>• Preamplifiers, Differential, Instrumentation, Isolation amplifier.</li> <li>• Direct writing recorders</li> <li>• The ink jet recorders</li> <li>• Potentiometric recorders</li> <li>• Digital recorders</li> <li>• Instrumentation tape recorders</li> </ul>	1	15
Unit II	Biomedical recorders <ul style="list-style-type: none"> <li>• Electrocardiograph</li> <li>• Vectorcardiograph</li> <li>• Phonocardiograph</li> <li>• Electroencephalograph</li> <li>• Electromyography</li> <li>• Other biomedical recorders</li> <li>• Biofeedback instrumentation</li> </ul>	1	15
Unit II	Signal analysis <ul style="list-style-type: none"> <li>• Biomedical signal analysis techniques</li> <li>• Signal processing techniques</li> <li>• Time and frequency domain analysis of biosignals using Fourier transform</li> <li>• Source of noise in low level measurement.</li> <li>• The main amplifier and driver stage</li> </ul>	1	15

	<ul style="list-style-type: none"> <li>• Writing system</li> </ul>		
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**References:**

1. Biomedical Instrumentation and Measurements (Second edition)
2. By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
3. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
4. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
5. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
6. A textbook of Biomedical engineering edited by R.M. Kenedi, blackie (Glasgow & London)
7. Medical instrumentation: Application and design (Third edition) John G.Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Cardiovascular systems and measurements</b>		
<b>Course Code</b>	PGDBM - 103		
<b>Class</b>	PGDBM SEM I	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim:</b> To develop knowledge of cardiovascular system before measurement			
<b>Objectives</b> <ul style="list-style-type: none"> <li>• Discussion of cardiovascular system</li> <li>• Basics of ECG recording</li> <li>• Understanding of pacemakers</li> </ul>			
<b>Course Outcomes</b> <ul style="list-style-type: none"> <li>• Students will acquire knowledge of cardiovascular system and its measurements</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	The heart and cardiovascular system <ul style="list-style-type: none"> <li>• Heart and Cardiovascular system</li> <li>• Electro conduction system of heart</li> <li>• Blood Pressure measurement</li> <li>• Heart Sounds, Phonocardiography</li> <li>• Pulse oximetry</li> </ul>	1	15
Unit II	Electrocardiography <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Interpretation of Electrocardiogram</li> </ul>	1	15

	<ul style="list-style-type: none"> <li>• Block diagram of electrocardiograph, ECG machine maintenance and trouble shooting</li> <li>• The ECG leads</li> <li>• Effect of artifacts on ECG recording</li> <li>• ECG recorder principle</li> <li>• Types of ECG recorders</li> <li>• Holter Monitoring</li> </ul>		
Unit III	<b>Pacemakers</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Heart as a natural pacemaker</li> <li>• Pacemaker and natural arrhythmias</li> <li>• Need for pacemaker, pacing leads</li> <li>• Interference with a pacemaker</li> <li>• Pacemaker systems</li> <li>• Types of pacemakers</li> </ul>	1	15
<b>References:</b> <ol style="list-style-type: none"> <li>1. Biomedical Instrumentation and Measurements (Second edition), By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.</li> <li>2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).</li> <li>3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.</li> <li>4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition</li> <li>5. A textbook of Biomedical engineering edited by R.M. Kenedi, blackie (Glasgow &amp; London)</li> <li>6. Medical instrumentation: Application and design (Third edition) John G.Webster, Willey India Education</li> </ol>			

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Patient Monitoring systems</b>		
<b>Course Code</b>	PGDBM - 104		
<b>Class</b>	PGDBM SEM I	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim :</b> To understand the use of different monitoring systems used in ICU			
<b>Objectives</b> <ul style="list-style-type: none"> <li>• Defining different monitoring systems and its use</li> </ul>			
<b>Course Outcomes</b> <ul style="list-style-type: none"> <li>• Students will acquire knowledge of different patient monitoring systems</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	Patient monitoring systems	1	15

	<ul style="list-style-type: none"> <li>• System concepts</li> <li>• Cardiac monitors</li> <li>• Bedside patient monitoring systems</li> <li>• Central monitors</li> <li>• Measurement of heart rate, pulse rate, temperature, respiration rate</li> <li>• Catheterization laboratory instrumentation</li> </ul>		
Unit II	Arrhythmia and Ambulatory monitoring instruments <ul style="list-style-type: none"> <li>• Cardiac arrhythmias</li> <li>• Arrhythmia monitor</li> <li>• QRS detection techniques</li> <li>• Exercise stress testing</li> <li>• Ambulatory monitoring instruments</li> </ul>	1	15
Unit III	Foetal monitoring instruments <ul style="list-style-type: none"> <li>• Cardiotocograph</li> <li>• Methods of monitoring foetal heart rate</li> <li>• Monitoring labour activity</li> <li>• Recording system</li> </ul>	1	15

**References:**

1. Biomedical Instrumentation and Measurements (Second edition), By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
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6. Medical instrumentation: Application and design (Third edition) John G. Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Experiments</b>		
<b>Course Code</b>	PGDBM - 105		
<b>Class</b>	PGDBM SEM I	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>06</b>	<b>Contact Hours</b>	<b>90</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To develop instrument handling capacity</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Basic requirement knowledge about systems used in biomedical instrumentation</li> </ul>			

	<ul style="list-style-type: none"> <li>Actual measurement of signals</li> </ul>		
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>Students will be able to design various filters used in biomedical instrumentation system</li> <li>Students will be trained in recording and analysis of biological data</li> </ul>			
<b>Unit</b>	<b>Topics (Any 15 experiments)</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	<ol style="list-style-type: none"> <li>Errors in instruments and minimization of errors.</li> <li>Statistical analysis of biological data(Mean, standard deviation, coefficient of variance etc)</li> <li>Use of statistical tool for biological data (p value, t value, correlation)</li> <li>Active filters for Bio-signals- Design and Filtering (Low pass and High pass filter)</li> <li>Design and build a Notch filter (To reduce noise of 50 Hz).</li> <li>ECG preamplifier-Instrumentation amplifier and testing.</li> <li>Use of sphygmomanometers for measurement of blood pressure.</li> <li>Concept of ECG, system and placement of electrodes ECG signal recording with surface electrodes.</li> <li>ECG analysis and abnormalities</li> <li>Design and build a Wide/ Narrow band pass filters for measurement for Bio-signals</li> <li>To study Thermistor Characteristic.</li> <li>To study Infrared sensor</li> <li>Measurement of physical parameter using embedded system</li> <li>Measurement of pulse parameter using pulse oxymetry/pulse measuring instrument.</li> <li>EEG placement of electrodes</li> <li>Measurement of skin resistance</li> <li>Use of biosensor (sugar level measurement).</li> <li>Strain gauge measurement.</li> <li>Electrical testing and grounding</li> <li>Study of recorders</li> <li>Pacemaker designing and study</li> <li>Study of multipara system and its use</li> <li>Study of FFT for signal analysis</li> <li>Speech analysis</li> <li>Study of LVDT</li> <li>Medical waste management in pathology lab</li> </ol>	6	90

**References:**

1. Biomedical Instrumentation and Measurements (Second edition), By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
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6. Medical instrumentation: Application and design (Third edition) John G. Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
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<b>Course Name</b>	<b>Project</b>		
<b>Course Code</b>	PGDBM - 106		
<b>Class</b>	PGDBM SEM I	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>06</b>	<b>Contact Hours</b>	<b>90</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To develop the research interest in students</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Ability to improve the research techniques</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will get ideas new techniques to be implemented in research</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	<ul style="list-style-type: none"> <li>• Students should do actual survey of different biomedical recording with the help of instruments , statistical analysis is to be done, Project thesis and ppt presentation</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>• Design and built up of any useful instrument and take reading for statistical analysis, Project thesis and ppt presentation</li> </ul>	6	90

<b>PG Diploma in Biomedical Instrumentation</b>			
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<b>Course Name</b>	<b>Health check up camps and hospital visits</b>		
<b>Course Code</b>	PGDBM - 107		
<b>Class</b>	PGDBM SEM I	<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>06</b>	<b>Contact Hours</b>	<b>90</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To impart knowledge to society</li> </ul>			



<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Actual working of instruments in hospitals</li> <li>• Use of abilities in front of society</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will be focused in society for their knowledge</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	<ul style="list-style-type: none"> <li>• Students need to take active part in organization of various health check up camps and write report on that</li> <li>• Hospital internship as well as visits to be done</li> <li>• Pathological Lab Visit-2</li> <li>• Visit to Cardio units</li> <li>• Visits to general wards and ICU wards in hospital for patient monitoring.</li> <li>• Visit to eye clinic</li> </ul>	6	90

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Computer in biomedical instrumentation, telemetry and telemedicine</b>		
<b>Course Code</b>	PGDBM - 201		
<b>Class</b>	PGDBM SEM II	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To understand the use of computers in biomedical instrumentation</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Use of digital computer in instrumentation</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will get biological data easily, can store the data and use it for further procedure for diagnosis and analysis</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	Computer in biomedical instrumentation <ul style="list-style-type: none"> <li>• The digital computer-computer hardware-Computer Software.</li> <li>• Microprocessors –Types of Microprocessors, Microprocessors in Biomedical instrumentation</li> <li>• Interfacing the computer with medical instrumentation and other equipment.</li> <li>• Biomedical computer applications</li> </ul>	1	15

Unit II	Audiometers and hearing aids <ul style="list-style-type: none"> <li>• Mechanism of hearing</li> <li>• Measurement of sound</li> <li>• Basic audiometer</li> <li>• Pure tone audiometer</li> <li>• Speech audiometer</li> <li>• Audiometer system Bekesy</li> <li>• Evoked response audiometry system</li> <li>• Calibration of audiometers</li> </ul>	1	15
Unit III	Biomedical telemetry and telemedicine <ul style="list-style-type: none"> <li>• Wireless telemetry</li> <li>• Single channel telemetry system</li> <li>• Multichannel wireless telemetry system</li> <li>• Multipatient telemetry</li> <li>• Implantable telemetry system</li> <li>• Transmission of analog physiological signals over telephone</li> <li>• Telemedicine</li> </ul>	1	15

**References:**

1. Biomedical Instrumentation and Measurements (Second edition)  
By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
5. A textbook of Biomedical engineering edited by R.M. Kenedi, blackie (Glasgow & London)
6. Medical instrumentation: Application and design (Third edition) John G. Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Medical Imaging techniques I - X ray machine , digital radiography and computed tomography</b>		
<b>Course Code</b>	PGDBM - 202		
<b>Class</b>	PGDBM SEM II	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To use radiography techniques</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Using this technique we can detect any flaws , injuries or any in functionality in organs (Bones , cartilage, tissues)</li> </ul>			

<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will get entire knowledge about use of radiography</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	X ray machine <ul style="list-style-type: none"> <li>• Basic of diagnostic radiology</li> <li>• Nature and production of x ray</li> <li>• X ray machine</li> <li>• Visualization of x rays</li> <li>• Dental x ray machines</li> <li>• Portable and mobile x ray units</li> <li>• Physics parameters for x ray detectors</li> <li>• X ray hazards</li> </ul>	1	15
Unit II	Digital radiography <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Ionizing Radiation and sources</li> <li>• Biological effects of radiation</li> <li>• Interaction of radiation with Bio system</li> <li>• Radiotherapy and Brachytherapy : Treatment Planning</li> <li>• Radiation protection in therapy.</li> <li>• Radiotherapy equipments</li> </ul>	1	15
Unit III	X ray computed tomography <ul style="list-style-type: none"> <li>• Computed tomography</li> <li>• System components</li> <li>• Gantry geometry</li> <li>• Patient dose in CT scanners</li> </ul>	1	15
<b>References:</b> <ol style="list-style-type: none"> <li>1. Biomedical Instrumentation and Measurements (Second edition) By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.</li> <li>2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).</li> <li>3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.</li> <li>4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition</li> <li>5. A textbook of Biomedical engineering edited by R.M. Kenedi, blackie (Glasgow &amp; London)</li> <li>6. Medical instrumentation: Application and design (Third edition) John G.Webster, Willey India Education</li> </ol>			

<b>Course Name</b>	<b>Medical Imaging techniques II- Nuclear medicine, NMR , Sonography</b>		
<b>Course Code</b>	PGDBM - 203		
<b>Class</b>	PGDBM SEM II	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>To acquire basic knowledge about imaging systems</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>Disorders/ in functionality in various organs can be detected</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>Students will get information about benefits and demerits of imaging systems</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	Nuclear medical imaging systems <ul style="list-style-type: none"> <li>Radioisotopes in medical diagnosis</li> <li>Radiation detectors</li> <li>Pulse height analyzer</li> <li>Uptake monitoring equipment</li> <li>Radio isotope rectilinear scanner</li> <li>The gamma camera</li> <li>Multi crystal gamma cameras</li> <li>Emission computed tomography</li> <li>Single photon emission computed tomography</li> <li>Positron emission tomography</li> </ul>	1	15
Unit II	Magnetic resonance imaging systems <ul style="list-style-type: none"> <li>Principle of NMR imaging systems</li> <li>Image reconstruction techniques</li> <li>Basic NMR components</li> <li>Biological effects of NMR imaging</li> <li>Advantages of NMR imaging systems</li> </ul>	1	15
Unit III	Ultrasonic imaging systems <ul style="list-style-type: none"> <li>Diagnostic ultrasound</li> <li>Medical ultrasound</li> <li>Basic pulse echo apparatus</li> <li>Scanning modes</li> <li>Real time ultrasonic imaging systems</li> <li>Multi element linear array scanners</li> <li>Digital scan converter</li> <li>Biological effects of ultrasound</li> </ul>	1	15

**References:**

1. Biomedical Instrumentation and Measurements (Second edition) By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
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6. Medical instrumentation: Application and design (Third edition) John G.Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Clinical laboratory instruments and lasers in medicine</b>		
<b>Course Code</b>	PGDBM - 204		
<b>Class</b>	PGDBM SEM II	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>03</b>	<b>Contact Hours</b>	<b>45</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To introduce clinical instruments and use of laser in medicine</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Introduction to various clinical laboratory instruments</li> <li>• Knowledge about its use</li> <li>• Use of laser in medicine</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will get knowledge regarding use of various instruments and use of lasers</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	Clinical laboratory instruments <ul style="list-style-type: none"> <li>• Medical diagnosis with chemical tests</li> <li>• Spectrophotometry</li> <li>• Spectrophotometer type instrument</li> <li>• Calorimeters, spectrophotometers</li> <li>• Automated biochemical analysis systems</li> <li>• Clinical flame photometers</li> </ul>	1	15
Unit II	Instruments for surgery <ul style="list-style-type: none"> <li>• Principle of surgical diathermy</li> <li>• Surgical diathermy machine</li> <li>• Safety aspects in electro surgical units</li> <li>• Surgical diathermy analysers</li> </ul>	1	15

Unit III	Laser applications in biomedical fields <ul style="list-style-type: none"> <li>• The laser</li> <li>• Types of laser</li> <li>• Laser safety</li> <li>• Applications</li> </ul>	1	15
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**References:**

1. Biomedical Instrumentation and Measurements (Second edition) By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
5. A textbook of Biomedical engineering edited by R.M. Kenedi, blackie (Glasgow & London)
6. Medical instrumentation: Application and design (Third edition) John G. Webster, Willey India Education

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Experiments</b>		
<b>Course Code</b>	PGDBM - 205		
<b>Class</b>	PGDBM SEMII	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>06</b>	<b>Contact Hours</b>	<b>90</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To develop instrument handling capacity</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Basic requirement knowledge about systems used in biomedical instrumentation</li> <li>• Actual measurement of signals</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will be able to design various filters used in biomedical instrumentation system</li> <li>• Students will be trained in recording and analysis of biological data</li> </ul>			
<b>Unit</b>	<b>Topics (Any 15 experiments)</b>	<b>Credit</b>	<b>Lectures</b>

Unit I	<ol style="list-style-type: none"> <li>1. Measurement of BMR, BMI and fats using fat monitor</li> <li>2. To study Lead I , II and III of standard bipolar Lead configuration</li> <li>3. To study AVR, AVF and AVL lead of standard unipolar leads configuration</li> <li>4. To study the abnormalities present in Human Cardiovascular System</li> <li>5. To study operating principles and characteristics of the DAC</li> <li>6. To study respiration rate monitor</li> <li>7. Medical informatics</li> <li>8. Transmittance of X ray films</li> <li>9. Study of microprocessor unit</li> <li>10. Study of sound pressure level meter</li> <li>11. Study of audiometer</li> <li>12. Measurement of human audibility</li> <li>13. Application of Telemedicine</li> <li>14. Measurement of elastic constant of bone</li> <li>15. Study of x ray machine</li> <li>16. Study of x ray film by changing voltage and contrast</li> <li>17. Linear coefficient absorption using beta source</li> <li>18. Comparison of linear absorption coefficient of various absorbers</li> <li>19. Measurement of distance using sonometer</li> <li>20. Use of spectrophotometer for absorbance</li> <li>21. Study of Ph using Ph meter</li> <li>22. Use of calorimeter</li> <li>23. Laser characteristics</li> <li>24. Effect of Laser on blood</li> <li>25. Clinical flame photometer</li> <li>26. Medical waste management in imaging techniques</li> </ol>	6	90
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**References:**

1. Biomedical Instrumentation and Measurements (Second edition), By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer Pearson education.
2. Handbook of Biomedical Instrumentation (Second Edition) by R. S. Khandpur (Tata McGraw Hill).
3. Biomedical Instrumentation and Measurement by Carr and Brown-Pearson.
4. Biomedical instruments and measurements (Second edition), by R. Ananda Natarajan Eastern economy edition
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6. Medical instrumentation: Application and design (Third edition) John G.Webster, Willey India Education

**PG Diploma in Biomedical Instrumentation**

<b>Course Name</b>	<b>Project</b>		
<b>Course Code</b>	PGDBM - 206		
<b>Class</b>	PGDBM SEM II	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>06</b>	<b>Contact Hours</b>	<b>90</b>

**Aim**

- To develop the research interest in students

<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Ability to improve the research techniques</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will get ideas new techniques to be implemented in research</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	<ul style="list-style-type: none"> <li>• Students should do actual survey of different biomedical recording with the help of instruments , statistical analysis is to be done, Project thesis and ppt presentation</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>• Design and built up of any useful instrument and take reading for statistical analysis, Project thesis and ppt presentation</li> </ul>	6	90

<b>PG Diploma in Biomedical Instrumentation</b>			
<b>Course Name</b>	<b>Health check up camps and hospital visit</b>		
<b>Course Code</b>	PGDBM - 207		
<b>Class</b>	PGDBM SEM II	<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>06</b>	<b>Contact Hours</b>	<b>90</b>
<b>Aim</b>			
<ul style="list-style-type: none"> <li>• To impart knowledge to society</li> </ul>			
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>• Actual working of instruments in hospitals</li> <li>• Use of abilities in front of society</li> </ul>			
<b>Course Outcomes</b>			
<ul style="list-style-type: none"> <li>• Students will be focused in society for their knowledge</li> </ul>			
<b>Unit</b>	<b>Topics</b>	<b>Credit</b>	<b>Lectures</b>
Unit I	<ul style="list-style-type: none"> <li>• Students need to take active part in organization of various health check up camps and write report on that.</li> <li>• Hospital internship as well as visits to be done</li> <li>• Visit to computer unit of hospital</li> <li>• Visit CT department of hospital</li> <li>• Visit to nuclear medicine department</li> <li>• Visit to PET department</li> <li>• Visit to NMR department</li> <li>• Visit to ultrasonic department</li> </ul>	6	90