

**DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN			
Name of the Programme and Specialization	B.Tech- Instrumentation and Control Engineering		
Course Title	BIOMEDICAL INSTRUMENTATION		
Course Code	ICPE11	Course credits	3
Pre-requisites Course Code	NIL		
Session	July 2018	Section	NIL
Name of Faculty	Dr. R. Periyasamy	Department	ICE
E-mail	periyasamy@nitt.edu	Mobile No.	09179826937
Course Coordinator(s) (if, applicable)	NA	Telephone No.	NA
Other Course Teacher(s)/Tutor(s) E-mail	NA	Mobile No.	NA
Course Type	<input type="checkbox"/> Core course <input checked="" type="checkbox"/> Program Elective course		
Syllabus (approved in BoS)			
<p>Electro physiology: Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and unipolar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems.</p> <p>Bioelectric potential and cardiovascular measurements: Measurement of blood pressure using sphygmomanometer instrument based on Korotkoff sound, indirect measurement of blood pressure, automated indirect measurement, and specific direct measurement techniques. Heart sound measurement -stethoscope, phonocardiograph. EMG -Evoked potential response, EEG, foetal monitor. ECG, phonocardiography, vector cardiograph, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators.</p> <p>Respirator and pulmonary measurements and rehabilitation: Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, Heart lung machine, Haemodialysis, ventilators, incubators, drug delivery devices, therapeutic applications of the laser.</p> <p>Patient monitoring systems: Intensive cardiac care, bedside and central monitoring systems, patient monitoring through telemedicine, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.</p> <p>Medical imaging systems: X ray machine, Computer tomography, ultrasonic imaging system, magnetic resonance imaging system, thermal imaging system, positron emission tomography</p>			
COURSE OBJECTIVES			
<ol style="list-style-type: none"> 1. To educate the students on the different medical instruments. 2. To familiarize the students with the analysis and design of instruments to measure bio-signals like ECG, EEG, EMG, etc. 3. To introduce about the applications of biomedical instrumentation and familiar about imaging system. 			

COURSE OUTCOME (CO)	
On completion of this course the students will be,	
1. To understand, design and evaluate systems and devices that can measure, test and/or acquire bio-signal information from the human body. 2. Familiar with patient monitoring equipment used in hospitals and in telemedicine. 3. Familiar with various Imaging techniques used for diagnosis.	
Course Outcome (CO)	Aligned Program Outcomes(PO)
On completion of this course the students will be,	
1. To understand, design and evaluate systems and devices that can measure, test and/or acquire bio-signal information from the human body.	1, 2, 3,5
2. Familiar with patient monitoring equipment used in hospitals and in telemedicine.	1, 2
3. Familiar with various Imaging techniques used for diagnosis.	1,2,3

COURSE OVERVIEW			
The course introduces the human physiological system with respect to medical instrumentation and its design and instrumentation for measuring and analyzing the physiological parameters.			
COURSE TEACHING AND LEARNING ACTIVITIES			
LECTURE NO.	PERIODS/ Weeks	TOPIC/ CONTENT	Lecture Delivery mode
1 -4	4 periods / 1 week	<u>Electro physiology:</u> <ul style="list-style-type: none"> ▪ Introduction about the course ▪ Review of physiology and anatomy ▪ Resting potential ▪ Action potential 	Chalk and Black board
5-7	3 periods/ 2 nd week	<u>Electro physiology:</u> <ul style="list-style-type: none"> ▪ Bioelectric potentials ▪ Cardiovascular dynamics 	Chalk and Black board/ video graphics
8-12	5 periods/3 rd week	<u>Electro physiology:</u> <ul style="list-style-type: none"> ▪ Electrode theory <ul style="list-style-type: none"> ➤ Bipolar and uni -polar electrodes ➤ Surface electrodes 	Chalk and Black board/ PPT mode
13-16	4 periods/4 th week	<u>Electro physiology:</u> <ul style="list-style-type: none"> ▪ Physiological transducers ▪ Systems approach to biological 	Chalk and Black board/ PPT mode

		systems	
17-21	5 periods/5 th week	<u>Bioelectric potential and cardiovascular measurements:</u> <ul style="list-style-type: none"> ▪ Introduction about Physiology of Blood pressure(BP) ▪ Measurement of blood pressure using <ul style="list-style-type: none"> ➤ Sphygmomanometer instrument based on Korotkoff sound ➤ Indirect measurement of blood pressure ➤ Automated indirect measurement ➤ Specific direct measurement techniques 	Chalk and Black board/ PPT/demo mode
22-24	3 periods/6 th week	<u>Bioelectric potential and cardiovascular measurements:</u> <ul style="list-style-type: none"> ▪ Introduction about Physiology of Heart ▪ Heart sound measurement <ul style="list-style-type: none"> ➤ Stethoscope ➤ Phonocardiograph(PCG) ▪ Electromyography(EMG) 	Chalk and Black board/ PPT mode
25-30	6 periods/7 th and 8 th week	<u>Bioelectric potential and cardiovascular measurements:</u> <ul style="list-style-type: none"> ▪ Electroencephalography (EEG) <ul style="list-style-type: none"> ➤ Evoked potential response ▪ Electrocardiography (ECG) <ul style="list-style-type: none"> ➤ Foetal monitor ➤ Phonocardiography ➤ Vector cardiograph ➤ Impedance cardiology ➤ Cardiac arrhythmia's ➤ Pace makers ➤ Defibrillators 	Chalk and Black board/ PPT mode
31	1 period/8 th week	First Class Test (CT-1) – Written Exam	
32-34	3 periods/9 th week	<u>Respiratory and pulmonary measurements and rehabilitation:</u> <ul style="list-style-type: none"> ➤ Physiology of respiratory system ➤ Respiratory rate measurement ➤ Artificial respirator 	Chalk and Black board/ PPT mode

		<ul style="list-style-type: none"> ➤ Oximeter 	
35-39	5 periods/ 10 th week	<u>Rehabilitation:</u> <ul style="list-style-type: none"> ➤ Hearing aids ➤ Functional Neuromuscular Stimulation (FNS) ➤ Physiotherapy ➤ Diathermy ➤ Nerve stimulator 	PPT mode/video mode
40-45	6 periods/ 11 th and 12 th week	<u>Rehabilitation:</u> <ul style="list-style-type: none"> ➤ Heart lung machine ➤ Haemodialysis ➤ Ventilators ➤ Incubators ▪ Drug delivery devices ▪ Therapeutic applications of the laser 	Chalk and Black board/ PPT mode
46-51	6 periods/12 th and 13 th week	<u>Medical imaging systems:</u> <ul style="list-style-type: none"> ➤ X ray machine ➤ Computer Tomography(CT) ➤ Ultrasonic Imaging System ➤ Magnetic Resonance Imaging (MRI) system ➤ Thermal Imaging System ➤ Positron Emission Tomography (PET) 	PPT mode/ Video mode
52	1 period/13 th week	Second Class Test (CT-2) – Written Exam	
53-55	3 periods/14 th week	<u>Patient monitoring systems:</u> Intensive cardiac care (ICU) <ul style="list-style-type: none"> ▪ Bedside and Central monitoring systems 	Chalk and Black board/ PPT mode
56-60	5 periods/15 th week	<u>Patient monitoring systems:</u> <ul style="list-style-type: none"> ▪ Patient monitoring through telemedicine <ul style="list-style-type: none"> ➤ Implanted transmitters ➤ Telemetering multiple information 	Chalk and Black board/ PPT mode

		Sources of electrical hazards and safety techniques		
61-62	2 periods/16th week	Doubts clarification, Review of class notes		
COURSE ASSESSMENT METHODS				
Sl.No.	Mode of Assessment	Week/Date	Duration	Percentage
1	Class Test- 1	8 th Week	1 hour	20 %
2	Class Test - 2	13 th Week	1 hour	20 %
3	Re –Test *	3 rd week of October	1 hour	
4	Surprise Quiz/ Minor project/ Assignments / Seminar presentation			10%
5	Final Examination*	End of the semester	3 hours	50%
*mandatory; refer to guidelines on page 6 and page 7				
ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc				
<u>Textbooks:</u>				
1 Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements ", 2nd Edition, Prentice Hall, New Delhi, 1998.				
2 Arthur C.Guyton, John E.Hall, "Text Book of Medical Physiology", 111 edition ,Elsevier Saunders , 2006 .				
3 Jerry .L.Prince, Jonathan M.Links, "Medical Imaging Signals and Systems", 2nd edition, Pearson Prentice Hall, 2015.				
4. John G. Webster: Medical Instrumentation Application & Design Haughton Mifflin, Co. Boston. USA, 1978				
5. Shakti Chatterjee and Aubert Miller, "Biomedical Instrumentation Systems", CENGAGE Learning publishing, 2016				
<u>Reference Books:</u>				
1. Geddes L. A. and Baker L. E., " Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley , New York , 1989/				
2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurements ', publishing Company, New York, 1990.				
3. R.S. Khandpur, Hand Book of Biomedical Instrumentation. Tata McGraw Hill, 1975.				
4. Joseph J .Carr and John M.Brown, "Introduction to Biomedical Equipment Technology",4 th edition, Pearson publishing, 2013.				
COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)				

1. Anonymous feedback through minute card.
2. Direct feedback from the students by having face-to-face meeting individually / as the class as a whole.
3. Feedback from the students during the class committee meetings
4. Students' performance in the class tests

COURSE POLICY (preferred mode of correspondence with students, re-assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc) : Email and Phone

Attendance policy:

1. The students should attend all the classes without absence or maintain the sufficient attendance i.e. 75% to 80% of attendance for appearing for the End semester examination.
2. In circumstances with **reasonable cause** for non-attendance, the students should inform the faculty within one week after their absence or feasibly in a week prior.
 - Undergoing intern ship in foreign countries with prior permission
 - Participating in the Institute approved extracurricular activities such as Sports, Games, Cultural meets, Seminar, Workshop, Conference with prior permission
 - Prolonged illness and/or hospitalization and admitted to hospital with appropriate medical certificate

Re-Test policy

1. Students who have missed the first or second-class test can register with the consent faculty for the Re-Test by submitting proper valid justification in written form to write retest.
2. No Re-Test for End semester Exam.

Grading:

1. Relative grading is used to decide the clusters (range) of the total marks scored (class tests, seminar presentation, Assignments/minor project and End Semester Examination put together for each student)
2. The passing minimum should be class average /2 or maximum mark/3, whichever is less.

Re-Assessment Exam

- A student may, for valid reasons on production of valid medical certificate and with the approval of HOD be permitted to withdraw from appearing for the End Sem Examination. Withdrawal application shall be valid only if it is made before the commencement of the examination.
- For students who miss the final Sem Assessment, re-assessment will be conducted for 50% mark and internal marks remain same.
- Those who failed in the subject may register for re-assessment examination which will be conducted for 100% mark (Absolute grading where passing minimum is 35).
- Grades for the students who have withdrawn from writing the End sem exam will be same as the regular assessment grades. For those who are failed or absent and appearing for

reassessment, the maximum grade is restricted to 'E'.

- Re-assessment exam will be conducted in the first week of the next semester or earlier during the vacation.

Formative Assessment (FA):

1. Students who have failed after Re-Assessment Exam of the course will have to register and pass the course by Formative Assessment (FA) only.

Academic honesty & plagiarism :

1. The students have the freedom to do their work meanwhile; they have to obey the institute academic rules.

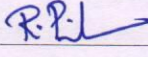
2. The students should have the decorum inside the classroom with the presence of faculty; otherwise, attendance will be denied for that class.

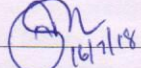
3. The students should not be involved plagiarizing other student's assignment work or any mode of copying other's work. If it is happen, then their name list will be sent to the office of Dean (Academic) for legal action through HOD.

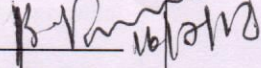
ADDITIONAL INFORMATION

The students are advised to clarify their doubts and discuss during the lecture hour. Other than, for out-of-class discussion, they can email their Queries to the Course faculty directly at periyasamy@nitt.edu.

FOR APPROVAL

Course Faculty: 
(Dr.R.Periyasamy)

CC-Chairperson: 
(Dr. N. Sivakumaran)

HOD: 
(Dr. B. Vasuki)