

(An Autonomous Institution) Puducherry

2nd Board of Studies Meeting in the department of Biomedical Engineering

for the Programme B.Tech – Biomedical Engineering

Venue Seminar Hall, Department of BME Sri Manakula Vinayagar Engineering College Madagadipet, Puducherry – 605 107

> *Date & Time* 31-03-2021 & 10.30 a.m

Minutes of Board of Studies

The second Board of Studies meeting for B.Tech. Biomedical Engineering was held on 31st March 2021 at 10.30 A.M in the Seminar Hall, Department of BME, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present for the BoS meeting

SI.No	Name of the Member with Designation and official Address	Responsibility in the BoS
1	Dr.A.Vijayalakshmi, Professor and Head Department of Biomedical Engineering, Sri Manakula Vinayagar Engineering College,Puducherry	Chairman
2	Dr A K Jayanthy Professor Department of Biomedical Engineering SRM Institute of Science and Technology, Kattankulathur	Academic Expert
3	Dr.M.Arivamudhan Professor, Department of Electronics and Communication Engineering Government College of Engineering,	Academic Expert

	Dharmapuri-636704	
4	Dr.R.Premkumar Professor Department of Biomedical Engineering, Rajalakshmi Engineering College, Chennai	Academic Expert
5	Mr.V.Ashok Manager(Technical) Intel Technology India Pvt.Ltd. SRR Elite, Bellandur, Bengaluru, Karnataka 560103	Industry Expert
6	Dr.A. Jayachitra Professor Specialization: Process Control and Instrumentation	Internal Member
7	Mr. P Arunagiri Professor Specialization: Communication Systems	Internal Member
8	Dr.S.Senthil Kumar Assistant Professor Specialization: Biomedical Instrumentation	Internal Member
9	Ms. A.Kavinilavu Assistant Professor Specialization: Biomedical Instrumentation	Internal Member
10	Dr. S B Lenin Associate Professor Specialization:VLSI Design	Internal Member
11	Mrs S Jayanthi Assistant Professor: Specialization: Communication Systems	Internal Member
12	MrM.Egalite Francis Assistant Professor Specialization: Maths	Internal Member
13	Ms. R. Sughanya Assistant Professor Specialization:English	Internal Member
14	Dr.S.Savithri Assistant Professor Specialization:Chemistry	Internal Member
15	Mr.S.Gowtham Software Quality Engineer, Rockwell Automation India Pvt.Ltd., Bengaluru- 560 025	Alumni Member

Agenda of the Meeting

Item No.	Particulars
BoS/UG/BME 2.1	To discuss about the appraisal of first BoS meeting and Confirmation of minutes of the meeting.
BoS/UG/BME 2.2	To discuss the Curriculum Structure of V and VI semester courses for B.Tech – Biomedical Engineering under Regulations R2019 and R2020
BoS/UG/BME 2.3	To discuss and approve the syllabi for V and VI semesters under R2019 Regulations for the UG Programme: B.Tech. Biomedical Engineering for the students admitted in the year 2019-20
BoS/UG/BME 2.4	To discuss and approve the syllabi for V and VI Semesters under R - 2020 Regulations for the UG Programme: B.Tech. Biomedical Engineering for the students admitted in the year 2020-21
BoS/UG/BME 2.5	To discuss and approve the Professional electives and open electives syllabi offered for V and VI semester for the students admitted in the academic year 2019-20 and 2020-21
BoS/UG/BME 2.6	To discuss about the Certification and Skill Development Courses for Regulations 2019 and 2020
BoS/UG/BME 2.7	To discuss about the assessment of quality of question papers for end semester examinations
BoS/UG/BME 2.8	To discuss the Students Admission status for the Academic Year 2020-21, academic schedule and To discuss and approve the Eligible Diploma Programmes for the Lateral entry students' admission for Second year under Autonomous Regulations R-2020 for B.Tech Biomedical Engineering programme.
BoS/UG/BME 2.9	To discus and review the Biomedical Engineering Department Vision, Mission, Program Educational Objectives (PEOs) and Program Specific Outcomes (PSOs) from the suggestions received from stakeholders
BoS/UG/BME 2.10	To consider and approve the revised list of panel of examiners and question paper setters for the end semester examinations

Minutes of the Meeting

Dr. A.Vijayalakshmi, Chairman, BoS opened the meeting by a warm welcome and introduced the external experts to the internal members and thanked them for accepting the invitation to conduct second Board of Studies meeting on 31st march 2021.

The Chairman proceeded with the presentation, and the meeting deliberated on agenda items.

BoS/UG/BME 2.1	The BoS Chairman reviewed the first BoS meeting with the
	members, its implementation and confirmed with the approval for
	the incorporation of minor modifications as mentioned below.
	In the curriculum structure of Regulations 2019 and 2020
	 Biosignal Processing course specified in VI semester can be
	moved to fourth semester
	 Biomedical Instrumentation course specified in IV semester
	can be shifted to fifth semester
	Physiological System Modeling in Professional elective I can
	be shifted to Professional Elective III
	 To include 2 more experiments related to human physiology
	in Biochemistry and Human Physiology lab
	The above modifications are approved by BoS members and
	the details are given in Annexure- I.
BoS/UG/BME 2.2	The BoS members reviewed the curriculum structure of V and VI
	semester of B.Tech. Biomedical Engineering
	The BoS members approved the curriculum structure and
	recommended to Academic Council.
BoS/UG/BME 2.3	The BoS members discussed the syllabi for V and VI Semesters
	under R - 2019 Regulations for the UG Programme: B.Tech.
	Biomedical Engineering and suggested the following points.
	Semester – V
	In Bio Statistics course case study can be included in Unit 5
	• Biomechanics course unit-4 content should be reduced
	and unit- 5 can be modified
	Biomedical instrumentation course unit-5 content should not
	be overlapped with diagnostic and therapeutic equipment
	course.
	Statistical laboratory simulation can be done using ANOVA
	tool
	Semester – VI
	• All the courses of sixth semester are approved by the BoS
	members with the following suggestion
	• In Medical Internet of Things Laboratory Arduino can be
	used
	ine boo members resolved R-2019 finn and sixth semester syllable
	with above mentioned changes.
	The modifications are incorporated and the Syllabilis given in

	Annexure II and approved by BoS members.
BoS/UG/BME 2.4	 The BoS members reviewed Syllabi from V to VI semesters for Regulations 2020 (R-2020), B.Tech-Biomedical Engineering and suggested the following points. Semester – V In Bio Statistics course case study can be included in Unit 5 Biomechanics course unit-4 content should be reduced and unit-5 can be modified
	 Biomedical instrumentation course unit-5 content should not be overlapped with diagnostic and therapeutic equipment course. Statistical laboratory simulation can be done using ANOVA
	tool Semester – VI
	 All the courses of sixth semester are approved by the BoS members with the following suggestion
	 In Medical Internet of Things Laboratory Arduino can be used
	The BoS members resolved R-2020 fifth and sixth semester syllabi with above mentioned changes. The modifications are incorporated and the Syllabi is given in Annexure II and approved by BoS members.
BoS/UG/BME 2.5	 The BoS members reviewed the elective courses and suggested the following points for implementation in the syllabi. Environmental Biotechnology course unit- 5 should be modified. The suggestions are incorporated and the Syllabi is given in Annexure III and approved.
BoS/UG/BME 2.6	The BoS Members discussed and approved the list of certification and skill development courses followed in the Regulations 2019 and 2020 and recommended to the Academic Council. The course details are given in Annexure IV .
BoS/UG/BME 2.7	Discussed and approved the assessment of quality of question papers of end semester examinations.
BoS/UG/BME 2.8	The BoS Members reviewed the Admission status and academic activities for the Academic Year 2020-21 The following eligible Diploma Programmes for the Lateral entry student's admission into Second year B.Tech – Biomedical Engineering programme under Autonomous Regulations 2020 are discussed and approved by the BoS members . Applied Electronics Biomedical Engineering Computer Engineering

	Computer Networking Computer Science and Engineering Computer Technology Electrical Engineering Electronics Engineering Electronics and Communication Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Information Technology Instrumentation and Control Engineering Instrumentation Engineering /Technology Mechatronics Engineering Medical Electronics
BoS/UG/BME 2.9	Discussed the suggestions received from stakeholders about Biomedical Engineering Department Vision, Mission, Program Educational Objectives (PEOs) and Program Specific Outcomes (PSOs) and recommended to maintain the same. (Annexure-V)
BoS/UG/BME 2.10	The BoS members discussed the Revised list of panel of examiners and approved. (Annexure-VI)

Dr. A.Vijayalakshmi, Chairman – BoS and Head of Department, Biomedical Engineering, concluded the meeting at 1:00 pm with vote of thanks.

A.60-

Dr. A.Vijayalakshmi Chairman-BOS/BME

Annexure –I

CURRICULUM STRUCTURE

		SEN	IESTER – I	V						
SI.	Course	Course Title	Cotogory	Ρ	eric	ods	Credit	r	Max. Ma	arks
No	Code	Course ritte	Calegory	L	Т	Ρ	s	CAM	ESM	Total
The	ory									
1	U19BMT41	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U19BMT42	Programming in Java	ES	3	0	0	3	25	75	100
3	U19BMT43	Biosignal Processing	PC	2	2	0	3	25	75	100
4	U19BMT44	Analog and Digital Integrated Circuits	PC	3	0	0	3	25	75	100
5	U19BME4X	Professional Elective –I	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective-I	OE	3	0	0	3	25	75	100
Prac	ctical									
7	U19BMP41	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U19BMP42	Biosignal Processing using MATLAB	PC	0	0	2	1	50	50	100
9	U19BMP43	Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Emp	oloyability Enh	ancement Course								
10	U19BMC4X	Certification Course – II	EEC	0	0	4	-	100	-	100
11	U19BMS41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19BMS42	Skill Development Course 4	Skill Development EEC 0 0 2 - 100 -						-	100
Man	datory Course)								
13	U19BMM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

	SEMESTER – V												
SI.	Course		Categor	Periods			Credit	Max. Marks					
NO	Code	Course little	у	L T I		Ρ	s	САМ	ESM	Total			
The	ory								•				
1	U19BMT51	Bio Statistics	BS	2	2	0	3	25	75	100			
2	U19BMT52	Biomechanics	PC	3	0	0	3	25	75	100			
3	U19BMT53	Biomedical Instrumentation	PC	3	0	0	3	25	75	100			
4	U19BMT54	Biocontrol Systems	PC	2	2	0	3	25	75	100			
5	U19BME5X	Professional Elective – II	PE	3	0	0	3	25	75	100			
6	U19XXO5X	Open Elective-II	HS	3	0	0	3	25	75	100			
Prac	ctical												
7	U19BMP51	Statistical Laboratory	BS	0	0	2	1	50	50	100			
8	LI19BMP52	Biomedical Instrumentation	PC	0	0	2	1	50	50	100			
0		Laboratory	10	0	0	2	1	50	50	100			
9	U19BMP53	Computation Laboratory	PC	0	0	2	1	50	50	100			

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10	U19BMP54	Hospital Training	I Training PC 0 0 2 1 50 50							100
Emp	oloyability Enl	nancement Course								
11	U19BMC5X	Certification Course – III EEC 0 0 4 - 100 -							-	100
12	U19BMS51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U19BMS52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Man	datory Cours	e								
14	U19BMM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							22	750	650	1400

PROFESSIONAL ELECTIVE COURSES

Profess	ional Elective – I (Offered in Semester IV)						
SI. No.	Course Code	Course Title						
1	U20BME401	Medical Physics						
2	U20BME402	Hospital Equipment Safety and Management						
3	U20BME403	Environmental Biotechnology						
4	U20BME404	Biometric Reorganization System						
5	U20BME405	Laser and Fiber Optics in Medicine						
Profess	ional Elective – II	(Offered in Semester V)						
SI. No.	Course Code	Course Title						
1	U20BME506	Bio Telemetry and Telemedicine						
2	U20BME507	Transportation in Living Systems						
3	U20BME508	Medical Informatics						
4	U20BME509	VLSI Design						
5	U20BME510	Computers in Medicine						
Profess	ional Elective – III	(Offered in Semester VI)						
SI. No.	Course Code	Course Title						
1	U20BME611	Hospital Engineering and Information Systems						
2	U20BME612	Physiological System Modeling						
3	U20BME613	Soft Computing Techniques						
4	U20BME614	Medical Image Acquisition Techniques						
5	U20BME615	Troubleshooting and Quality Control in Medical Equipment's						

U20BSP112 BIOCHEMISTRY AND HUMAN L T P C Hrs PHYSIOLOGY LABORATORY 0 0 2 1 30

Course Objectives

- To give an insight into the chemical aspects of biological molecules and their importance
- To study the measurements of pH
- To understand the known amount of Macromolecules
- To know the significance of blood and its grouping system
- To understand the counting mechanisms of Blood cells

Course Outcomes

After completion of the course, the students will be able to

- CO1 Evaluate data and design experiments to test relevant to the practice of Biochemistry (K4)
- CO2 Identify the biochemical analyser tools for biological study and research (K4)
- CO3 Apply the principles of blood tests and serum separation from blood (K3)
- CO4 Analyse the type of antigen, antibody and components of blood (K3)
- CO5 Apply the principles of hearing aids to investigate the hearing capabilities of ear (K3)

List of Experiments

- 1. General tests for carbohydrates, proteins and lipids
- 2. Preparation of Serum and Plasma from blood
- 3. Quantitative estimation of Blood Glucose
- 4. Quantitative estimation of Creatinine
- 5. Quantitative estimation of Cholesterol
- 6. Study of Measurement of pH and conductivity of body fluids
- 7. Identification of Blood Groups
- 8. Estimation of Bleeding and Clotting time
- 9. Count RBC
- 10. Count WBC
- 11. Estimation of Haemoglobin
- 12. Estimation of ESR
- 13. Study of Hearing test -Tuning fork

Text Books

- 1. Edward L. Alpen," Radiation Biophysics", Second Edition, Academic Press, 2011
- 2. Glaser, Roland, "Bio-Physics an Introduction", Springer 2012
- 3. Chatterjea M.N ,Rana Shinde, "Textbook of Medical Biochemistry", Jaypee Brothers Medical Publishers, 8th Edition, 2012.

Reference Books

- 1. Donald Voet, Judith .Voet, Charlotte W. Pratt. "Fundamentals of Biochemistry", Fifth Edition, Wiley Publisher, 2016
- 2. U. Satyanarayana and U. Chakrapani. "Biochemistry", Fourth Edition, Elsevier, 2013
- 3. Murray R K, "Harper's Illustrated Biochemistry". 29th Edition, McGraw Hill Professional, 2012.
- 4. Keith Wilson & John Walker, "Practical Biochemistry Principles & Techniques", Oxford university press, 2011
- 5. Michael M. Cox and David L. Nelson, "Lehninger Principles of Biochemistry", W. H. Freeman and Company, Sixth Edition, 2012.

Web References

- 1. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1/
- 2. https://ocw.mit.edu/courses/biology/8-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1
- 3. nptel.ac.in/courses/102105034/

COs/POs/PSOs Mapping

COs		Program Outcomes (POs)													Program Specific Outcomes (PSOs)		
	P01	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	P011	PO12	PSO1	PSO2	PSO3		
1	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1		
2	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1		
3	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1		
4	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1		
5	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1		

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure –II

U19BMT51

BIO STATISTICS

Course Objectives

- To familiarize the concept Mean, median, mode and Standard deviation.
- To understand the concept of Correlation and Regression analysis
- To learn Analysis of variance.
- To learn the concept of testing of hypothesis using statistical analysis.
- To learn the concept of Small sampling. •

Course Outcomes

After completion of the course, the students will be able to

- CO1 Solve problems related to Bar diagrams and Pie diagrams. (K3)
- CO2 Find the nature of correlation and regression. (K3)
- CO3 Know the applications of analysis of variance. (K2)
- CO4 Understand the applications of large samples. (K2)
- CO5 Solve the problems related to testing of hypothesis in small samples. (K3)

UNIT I MEASURE OF DISPERSION

Collection - Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram-Frequency curve and frequency polygon, Ogive, Mean, median, mode, Standard deviation.

UNIT II CORRELATION AND REGRESSION ANALYSIS

Correlation and Regression analysis: Relation between two variables- scatter diagram- definition of correlations - Two regression lines- Karl Pearson's coefficient of correlation, Rank correlation, Tied ranks.

UNIT III DESIGN OF EXPERIMENTS

Analysis of variance - One way and two-way classifications - Completely randomized design -Randomized block design - Latin square design - 22 Factorial design.

UNIT IV LARGE SAMPLES

Curve fitting by the method of least squares - fitting of straight lines - second degree parabolas and more general curves - Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES

Test for single mean - Difference of means and correlations of coefficients - Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. Case study under ttest and Chi square test

Text Books

1.Irfan A Khan, "Fundamentals of Biostatistics", Ukaaz Publication 5th edition, 2016. 2. PSS Sunder Rao, "An introduction to Biostatistics", PHI Learning Pvt Ltd ,2012 3.Moore and McCabe, "Introduction to the Practice of Statistics", WH Freeman, 9th Edition ,2009.

Reference Books

1. Marcello Pagano, "Principles of Biostatistics", 7th edition, 2015.

2. Course Manuals: S-PLUS Command Line Essentials, the Analysis of Microarrays

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(12 Hrs)

(12 Hrs)

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(12 Hrs)

(12 Hrs)

(12 Hrs)

- 3. Richard.A. Johnson, Irwin Miller and John E.Freund ," Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018
- 4. P. Kandasamy K. Thilagavathy and K. Gunavathi.,"Probability and Queuing Theory", S.Chand & Co, Pvt.Ltd.2015
- 5.Dr.G. Balaji," Probability and Statistics", G.Balaji Publishers, 2017

Web Resources

- 1. https://www.youtube.com/watch?v=_e4mwlqCQrc
- 2. https://www.youtube.com/watch?v=IQW_sWL_sfQ
- 3. https://www.youtube.com/watch?v=75pQPB1RF50
- 4. https://www.digimat.in/nptel/courses/video/102101056/L01.html

COs		Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	P01	PO2	PO3	PO4	PO5	P06	P07	P08	PO9	PO10	P011	PO12	PSO1	PSO2	PSO3	
1	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-	
2	3	2	1	1	-	1		-		-	-	1	2	2	-	
3	2	1	-	-	-	1		-		-	-	1	2	2	-	
4	2	1	-	-	-	1		-		-	-	1	2	2	-	
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-	

U19BMT52

Course Objectives

- To understand the basics of biomechanics
- To describe the properties of blood, bone and soft tissues
- To gain knowledge about the mechanics of moving systems
- To be able to understand Cardiac mechanisms
- To study respiratory Biomechanics

Course Outcomes

After completion of the course, the students will able to

- CO1 To describe the fundamental of biomechanics.
- CO2 To Analyse the properties, functions of hard and flexible tissues
- CO3 To describe the types and mechanics of skeletal joints and movement mechanics
- **CO4** To explain the mechanical properties of Cardiac system.
- CO5 To understand the respiratory mechanisms

UNIT I INTRODUCTION TO BIOMECHANICS

Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar and Non coplanar, Concurrent and non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

UNIT II TISSUE BIOMECHANICS

Hard Tissues: Bone structure and properties of bones, cortical and cancellous bones, type of fractures, biomechanics of fracture healing. Soft Tissues: Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle.

UNIT III JOINTS AND MOVEMENT BIOMECHANICS

Joints - forces and stresses in human joints, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle. Body and limbs- mass and motion characteristics actions, forces transmitted by joints. Biomechanics of push - like motions, Biomechanics of throw - like motions.

UNIT IV CARDIAC BIOMECHANICS

Cardiovascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins. artificial heart valves, biological and mechanical valves development, testing of valves.

UNIT V RESPIRATORY BIOMECHANICS

Alveoli mechanics, Interaction of blood and lung, P-V curve of lung, breathing mechanism, Airway resistance, lung diseases.

Text Books

- 1. Gerhard A. Holzapfel, Ray W. Ogden, "Mechanics of Biological Tissue", Springer, 2010.
- 2. Sean P. Flanagan and Flanagan, "Biomechanics: A case based Approach", Jones and Bartlett Publishers, 2018.
- 3. Carol A. Oatis, "The Mechanics and Pathomechanics of Human Movement", Lippincott Williams and Wilkins, 2010.

(9 Hrs)

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L BIOMECHANICS 3

Hrs Т Ρ С 0 0 3 45

Reference Books

- 1. Ozkaya, N, Leger, D, Goldsheyder, D, Nordin, M, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation", 4th edition. Springer International Publishing, 2017.
- 2. Donald R. Peterson and Joseph D. Bronzino," Biomechanics: principles and applications", third edition. CRC Press, 2011.
- 3. Ray W. Ogden, "Biomechanics of Soft Tissue in Cardiovascular Systems", Springer Vienna, 2014.

Web Resources

- 1. https://tinyurl.com/y9bm4f9q
- 2. https://tinyurl.com/y8osnq6d
- 3. https://tinyurl.com/y78y4cvy

COs		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
2	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
3	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
4	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
5	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2

U19BMT53 BIOMEDICAL INSTRUMENTATION

Course Objectives

- To acquire knowledge in the basics of bio medical instrumentation
- To understand the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- Understand the design aspects of various assist and therapeutic devices

Course Outcomes

After completion of the course, students will be able to

- **CO1** Gain knowledge in electrodes and its functions
- CO2- Illustrate different electrode placement for various physiological recordings
- CO3- Design bio amplifier for various physiological recordings
- CO4- Explain various techniques for non-electrical physiological measurements
- CO5- Investigate various assist and therapeutic devices

UNIT I BIOPOTENTIAL ELECTRODES

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG). Electroretinogram (ERG). Recording Electrodes - Electrode-tissue interface. polarization. skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes

UNITII BIOPOTENTIAL MEASUREMENTS

Bio signals characteristics - frequency and amplitude ranges. ECG - Einthoven 's triangle, standard 12 lead system, Principles of vector cardiography.EEG - 10-20 electrode system, unipolar, bipolar and average mode. EMG- unipolar and bipolar mode. Recording of ERG, EOG and EGG

UNIT III SIGNAL CONDITIONING CIRCUITS

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers - transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V ASSIST DEVICES AND RESPIRATORY DEVICES

Pacemakers - Defibrillators - Audiometry - Hearing aid, Ventilators, Spirometer, Lung Volume and capacities, Pneumo tachometers: different types

Text Books

- 1. R. S. Khandpur, "Biomedical Instrumentation Technology and Applications", McGraw-Hill Professional, 2014.
- 2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements". 2nd edition. PHI. 2008.
- 3. Raja Rao, C and Guha S.K, "Principles of Medical Electronics and Biomedical Instrumentation", Orient Longman Publishers, 2001

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Reference Books

- 1. R. Anandanatarajan, "Biomedical Instrumentation", 2nd edition, PHI Learning, 2016.
- 2. Andrew G. Webb, "Principles of Biomedical Instrumentation", Cambridge University Press, 2018.
- 3. John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.
- 4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015
- 5. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, 2002.

Web Resources

- 1. https://apm.iitm.ac.in/biomedical/sai/
- 2. https://www.youtube.com/watch?v=iK-6q4nnmtA
- 3. https://www.youtube.com/watch?v=8m8yNSaCMpg

COs	Program Outcomes (POs)												Progra Outco	am Specific omes (PSOs)		
	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
1	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2	
2	3	3	2	2	2	2	-	-	-	-	-	2	2	-	2	
3	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2	
4	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2	
5	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2	

DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

L T P C Hrs

Course Objectives

U19BMT61

- To impart knowledge on Ultrasonic Techniques.
- To describe patient monitoring and Biotelemetry equipment's.
- To make student understand Diathermy.
- To introduce special diagnostic techniques.
- To study patient safety.

Course Outcomes

After completion of the course, students shall have ability to,

- CO1 Understand Ultrasonic Techniques.
- **CO2** Describe the patient monitoring and Biotelemetry.
- CO3 Learn the basics of Diathermy.
- CO4 Gain knowledge on special diagnostic techniques.
- CO5 Acquire knowledge in patients safely.

UNIT I ULTRASONIC TECHNIQUES

Diagnosis: Basic principles of Echo technique, display techniques A, B and M mode, Application of ultrasound as diagnostic tool – Echocardiogram, abdomen, obstetrics and gynaecology.

UNIT II PATIENT MONITORING AND BIOTELEMETRY

ICU/CCU Equipment's, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

UNIT III DIATHERMY

IR and UV lamp and its application. Thermography – Recording and clinical application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level.

UNIT IV SPECIAL DIAGNOSTIC TECHNIQUES

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameter. Haemo Dialyzer unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laparoscopy.

UNIT V PATIENT SAFETY

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

Text Books

- 1. Leslie Cromwell," Biomedical Instrumentation and Measurement", Second edition. Prentice Hall, 2015.
- 2. John G. Webster, "Medical Instrumentation Application and Design", Fifth edition, John Willey and sons, 2020.

(9Hrs)

(9Hrs)

(9Hrs)

(9Hrs)

(9Hrs)

3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Third edition, John Willey and sons, New York, 2003.

Reference Books

1.Khandpur,R.S,"Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill, 2003 2.Rick Krohn, David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, 2013.

3. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – 2004.

4.John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.

5.Samuel A. Fricker, Christoph Thümmler, Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015

Web Resources

- 1. https://www.nap.edu/read/21794/chapter/7
- 2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems.

					Progr	am O	utcom	nes (P	Os)				Progr	am Sp	Decific
COS	• · · · · · · · · · · · · · · · · · · ·												Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2
2	3	3	2	2	2	2	-	-	-	-	-	2	2	-	2
3	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2
4	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2
5	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2

LIAODMDC2	MEDICAL INTERNET OF THINGS	L	Т	Ρ	С	Hrs
UI9DIMP02	LABORATORY	0	0	2	1	30

Course Objectives

- To study Embedded programming, REST API and its commands.
- To develop systems like human fall detection, ECG system, surgical automation system.
- To introduce students to Thingspeak cloud.
- To integrate Raspberry pi and Thingspeak.
- To train students develop smart and automated systems.

Course Outcomes

After completion of the course, students shall have ability to,

CO1 - Familiarize with Embedded applications.

- CO2 Develop human fall detection, ECG system, surgical automation system.
- CO3 Work with Thing speak cloud.
- **CO4** Integrate Raspberry pi and Thingspeak.
- CO5 Develop smart and automated systems.

List of Experiments

Conduct the Experiments using Arduino / Raspberry pi

- 1. Study of Raspberry pi, UART Communication
- 2. Study of REST and HTTP protocols, PUSH, PUT and GET commands, Linux CLI, Raspbian OS
- 3. Human Fall detection system using an Accelerometer sensor
- 4. Study of ECG system, which gets Heart beat sensor reading from different modes
- 5. Surgical automation system, which runs 2 motor using a Servo Motor based inputs given on console in pc and operates the motor operation.
- 6. Baby Monitoring system, to prevent Sudden Infant Death Syndrome
- 7. Clinical Management system consisting of RFIDs tags and cards which constantly uploads inpatient and outpatient details to Thinkspeak server
- 8. Smart Ventilator system to control through various modes of ventilator connected to Thinkspeak server, and remotely operated.
- 9. Waste Management system consisting of moisture and Gas sensor connected to Thinkspeak server thus remotely indicating the recycle process of medical waste
- 10. Smart watch system, to indicate and alert users of their routine works and also monitor the pulse and temperature readings and display it though LCD display attached to the watch through Thinkspeak server

Text Books

- 1. Hands-on Artificial Intelligence for IoT, Packet Publishing, 2019.
- Smart Medical Data Sensing and IoT Systems Design in Healthcare, Business Science Reference, 1st edition, 2020.

Reference Books

1. Medical Big Data and Internet of Medical Things, CRC Press, 1st ed, 2018.

2. P. Venkata Krishna, Sasikumar Gurumorrthy, Mohammad S.Obaidat, Internet of Things and Personalized Healthcare systems, Springer, 1st ed, 2019.

Web Resources

- 1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
- 2. https://www.digimat.in/nptel/courses/video/108105091/L01.html

COs	Program Outcomes (POs)												Prog Outco	Program Specific Outcomes (PSOs)		
	P01	PO2	PO3	PO4	PO5	P06	P07	P08	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
1	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1	
2	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1	
3	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1	
4	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1	
5	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1	

Annexure -III

	L	Т	Ρ	С	Hrs
O I SDIME 32	3	0	0	3	45

Course Objectives

- To learn about the basic concepts of environmental biotechnology.
- To understand about the biodegradation and bioremediation.
- To understand the scientific and engineering principles of microbiological treatment technologies to clean up contaminated environments.
- To replace of conventional treatment methodologies by using biocatalyst and bioreactors
- To learn about various fermentation process in agricultural, food and beverage industries

Course Outcomes

After completion of the course, the students will be able to

- CO1 -Understand about the role of various environmental pollutants,
- CO2 -Understand about the biodegrading and bioremediation modules and its functions.
- **CO3** -Understand the principles of microbiological treatment technologies to clean up contaminated environments.
- CO4 -Replace of conventional treatment methodologies by using different bioreactors
- **CO5** -Understand the various bioproducts production and composting technology.

UNIT I INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY

Biotechnology in the reduction of carbon dioxide emission- Microbial flora of soil - Microbial treatment of heavy Metal – bioleaching, bioaccumulation, biosorption and bioprecipitation of heavy metals - Soil,water and air - sources and effects - Removal of Pollutants.

UNIT II BIODEGRADATION AND BIOREMEDIATION

Aerobic degradation of aliphatic and aromatics compounds - Anaerobic degradation of aromatic compounds - Biodegradation of herbicides and pesticides - Remediation Technologies - Bioventing, biosparging and bioslurping, phytoremediation - Biodesulphurization of coal and oil - microbial treatment of oil pollution.

UNIT III MICROBIAL TREATMENT OF WASTE AND WASTE WATER

Biological treatment of anaerobic and aerobic- methanogenesis, methanogenic, acetogenic- Use of genetically engineered organisms - Biotechnological Processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.

UNIT IV BIOCATALYSTS AND BIOREACTORS

Enzymes isolation, whole cell systems - Biocatalytic Application - Advantages & Disadvantages-Design of activated sludge process and anaerobic digestion system - Trickling Filter - Rotating biological contactors - Fluidized bed reactor - Up-flow anaerobic sludge blanket reactor (UASB) -High-rate anaerobic wastewater treatment.

UNIT V BIOPRODUCTS AND RENEWABLE SOURCES

(9Hrs)

(9Hrs)

(9Hrs)

(9Hrs)

(9Hrs)

Biofertilizers – Biopesticides - Biofuel production – Bioethanol – Biohydrogen – Biodiesel - Bioplastics and biopolymers - Composting technologies, composting systems, compost quality.

TEXT BOOKS:

- 1. Bhattacharya B. C. and Banerjee R, "Environmental Biotechnology", Oxford University Press, 2017.
- 2. Jordening H. J. and Winter J., "Environmental Biotechnology: Concepts and Application", Wiley , 2015.
- 3. Bruce Rittmann and Perry McCarty," Environmental Biotechnology", McGraw-Hill, 2011.

REFERENCE BOOKS:

- 1. W.D. Grant & P.E. Long, Blakie, Environmental Microbiology, Springer, 2019.
- 2. H. Polasa, Microbial Gene Technology, South Asian Publishers, 2011.
- 3. D. L. Wise, Biotreatment Systems.CRC Press, 2010.

Web Resources

- 1. https://en.wikipedia.org/wiki/Environmental_biotechnology
- 2. http://dbtindia.gov.in/schemes-programmes/research-development/energy-environment-and-bioresource-based-applications-0
- 3. https://www.hindawi.com/journals/scientifica/si/269412/

COs	Program Outcomes (POs)											Progra Outco	ram Specific comes (PSOs)		
	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	2	2	2	-	-	-	-	-	2	2	-	-
2	2	2	2	2	2	2	-	-	-	-	-	2	2	-	-
3	2	2	2	2	2	2	-	-	-	-	-	2	1	-	-
4	2	2	2	2	2	2	-	-	-	-	-	2	1	-	-
5	2	2	2	2	2	2	-	-	-	-	-	2	1	-	-

Annexure -IV

Regulations 2019

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

SI. No.	Course Code	Course Title
1	U19BMCX1	Android Medical app development
2	U19BMCX2	Data Science using R
3	U19BMCX3	Design of Biomedical Devices and Systems
4	U19BMCX4	Embedded system using Arduino
5	U19BMCX5	Fuzzy Logic and Neural Networks
6	U19BMCX6	Introduction to C++ Programming
7	U19BMCX7	Machine Learning for medical Diagnosis
8	U19BMCX8	Medical Robotics
9	U19BMCX9	Python Programming

Regulations 2020

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

SI. No.	Course Code	Course Title						
1	U20BMCX01	3ds Max						
2	U20BMCX02	Advance Structural Analysis of Building using ETABS						
3	U20BMCX03	Advanced Java Programming						
4	U20BMCX04	Advanced Python Programming						
5	U20BMCX05	Analog System Lab Kit						
6	U20BMCX06	Android Medical App Development						
7	U20BMCX07	Android Programming						
8	U20BMCX08	ANSYS -Multiphysics						
9	U20BMCX09	Artificial Intelligence						
10	U20BMCX10	Artificial Intelligence and Edge Computing						
11	U20BMCX11	Artificial Intelligence in Medicines						
12	U20BMCX12	AutoCAD for Architecture						

13	U20BMCX13	AutoCAD for Civil
14	U20BMCX14	AutoCAD for Electrical
15	U20BMCX15	AutoCAD for Mechanical
16	U20BMCX16	Azure DevOps
17	U20BMCX17	Basic Course on ePLAN
18	U20BMCX18	Basic Electro Pneumatics
19	U20BMCX19	Basic Hydraulics
20	U20BMCX20	Bio Signal and Image Processing Development System
21	U20BMCX21	Blockchain
22	U20BMCX22	Bridge Analysis
23	U20BMCX23	Building Analysis and Construction Management
24	U20BMCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20BMCX25	CATIA
26	U20BMCX26	CCNA (Routing and Switching)
27	U20BMCX27	CCNA (Wireless)
28	U20BMCX28	Cloud Computing
29	U20BMCX29	Computer Programming for Medical Equipments
30	U20BMCX30	Corel Draw
31	U20BMCX31	Creo (Modeling and Simulation)
32	U20BMCX32	Cyber Security
33	U20BMCX33	Data Science and Data Analytics
34	U20BMCX34	Data Science using Python
35	U20BMCX35	Data Science using R
36	U20BMCX36	Deep Learning
37	U20BMCX37	Design and Documentation using ePLAN Electric P8
38	U20BMCX38	Design of Biomedical Devices and Systems
39	U20BMCX39	Digital Marketing
40	U20BMCX40	Digital Signal Processing Development System
41	U20BMCX41	DigSILENT Power Factory
42	U20BMCX42	Electro Hydraulic Automation with PLC
43	U20BMCX43	Embedded System using Arduino
44	U20BMCX44	Embedded System using C
45	U20BMCX45	Embedded System with IoT
46	U20BMCX46	ePLAN Data Portal
47	U20BMCX47	ePLAN Electric P8
48	U20BMCX48	ePLAN Fluid
49	U20BMCX49	ePLAN PPE
50	U20BMCX50	Fusion 360
51	U20BMCX51	Fuzzy Logic and Neural Networks
52	U20BMCX52	Google Analytics
53	U20BMCX53	Hydraulic Automation
54	U20BMCX54	Industrial Automation
55	U20BMCX55	Industry 4.0

	56	U20BMCX56	Internet of Things
	57	U20BMCX57	Introduction to C Programming
	58	U20BMCX58	Introduction to C++ Programming
	59	U20BMCX59	IoT using Python
	60	U20BMCX60	Java Programming
	61	U20BMCX61	Machine Learning
	62	U20BMCX62	Machine Learning and Deep Learning
	63	U20BMCX63	Machine Learning for Medical Diagnosis
	64	U20BMCX64	Mechatronics
	65	U20BMCX65	Medical Robotics
	66	U20BMCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
	67	U20BMCX67	Mobile Edge Computing
	68	U20BMCX68	Modeling and Visualization using Micro station
	69	U20BMCX69	MX Road
	70	U20BMCX70	Photoshop
	71	U20BMCX71	PLC
	72	U20BMCX72	Pneumatics Automation
	73	U20BMCX73	Project Management
	74	U20BMCX74	Python Programming
	75	U20BMCX75	Revit Architecture
	76	U20BMCX76	Revit Inventor
	77	U20BMCX77	Revit MEP
	78	U20BMCX78	Robotics
	79	U20BMCX79	Search Engine Optimization
	80	U20BMCX80	Software Testing
	81	U20BMCX81	Solar and Smart Energy System with IoT
	82	U20BMCX82	Solid Works
	83	U20BMCX83	Solid Works with Electrical Schematics
	84	U20BMCX84	Speech Processing
	85	U20BMCX85	STAAD PRO V8i
	86	U20BMCX86	Structural Design and Analysis using Bentley
	87	U20BMCX87	Total Station
	88	U20BMCX88	Video and Image Processing Development System
F	89	U20BMCX89	VLSI Design
	90	U20BMCX90	Web Programming - I
F	91	U20BMCX91	Web Programming - II
L			

Annexure –V

DEPARTMENT OF BIOMEDICAL ENGINEERING

DEPARTMENT VISION AND MISSION

Vision

To provide quality education in Biomedical Engineering focused on promoting continuous enrichment in the relevant research field and innovations in medical diagnosis for human health care.

Mission

M1: Medical science Engineering

To provide quality biomedical engineering education that integrates engineering principles with biomedical sciences

M2: Research and Development

To develop biomedical engineers to apply innovative strategies for the design and development of medical equipments

M3: Industrial Intelligence

To incorporate novel technologies towards the healthcare industrial needs for medical applications and to become an entrepreneur.

M4: Ethical Responsibilities

To impart the desirable skill sets to become a globally competent ethical professionals.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Professional Skills

To become outstanding professionals to demonstrate their skills in solving challenges for healthcare diagnosis

PEO2: Higher Education and Research

Work successfully in multi-disciplinary environments or pursue higher studies

PEO3: Entrepreneurial Competencies

To address the challenges in biomedical engineering that supports employment and entrepreneurship to serve the society.

PEO4: Leadership Quality

To enable the graduates to exhibit leadership, make decisions with ethical responsibilities

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Knowledge in Biomedical Engineering

Comprehending fundamental concepts in biomedical engineering to meet the Emerging trends

PSO2: Problem Solving in Medical Diagnosis

Apply Biosignal and Image processing techniques to solve real time problems in medical field

PSO3: Troubleshooting and Design of Medical Equipment's

Troubleshoot the faulty medical Equipment's used in health care industry.

Annexure –VI



SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE (An Autonomous Institution) (Approved by AICTE, New Delhi & Affiliated to Pondicherry University)

(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade) Madagadipet, Puducherry - 605 107



Department of Biomedical Engineering

Panel of Examiners

S. No.	Name of the Examiner Highest Qualific Spe ation		Specialization	Experi ence (in Years)	Communication Address	Email ID with Mobile Number
1.	Dr.P.Shanmugaraja	Ph.D	Medical Electronics	26	Professor, Department of Electronics and Instrumentation, Annamalai University, Chidambaram	psraja70@gmail.com 9443275120
2.	Dr S Bagyaraj	Ph.D	Biomedical Instrumentation	12	Associate Professor, Department of Biomedical Engineering SSN College of Engineering, Old Mahabalipuram Rd, OMR, Kalavakkam, Chennai	bagyarajs@ssn.edu.in 9841982250
3.	Dr. B.Hema Kumar	Ph.D	Biomedical Engineering	21	Associate Professor, Department of Electronics and Instrumentation Pondicherry Engineering College, Puducherry	hemakumarb@pec.ed u 9944929804
4.	Dr.S.J.Thiruvengadam	Ph.D	Signal processing Wireless communication	25	Professor, Department of ECE, Thiagarajar College of Engineering, Thiruparankundram, Madurai Tamil Nadu 625015	sjtece@tce.edu 9865079402

5.	Dr.V.Janakiraman	Ph.D	VLSI, Signal processing	20	Professor Department of Electronics and Communication Engineering Dhanalakshmi Srinivasan College of Engineering and Technology, East Coast Road, Mallapuram, Chennai, Tamil Nadu 603104	vjramece@gmail.co 9444255029, 7358374100
6.	Dr. V.Kamatchi Sundari	Ph.D	Image Processing	22	Professor Department of Electronics Engineering, SRM Institute of Science and Technology, Chennai,	vkamatchisundari@g mail.com Phone : 9952041393
7.	Dr. P. Vijayakumar	Ph.D	Wireless Communication , Network Security	13	Associate Professor, Department of Electronics Engineering, Vellore Institute of Technology, Kelambakkam - Vandalur Rd, Rajan Nagar, Chennai, Tamil Nadu 600127	vijayrgcet@gmail.com 9894727271
8.	Dr Jobin Christ	Ph.D	Biomedical, signal processing	24	Professor, Department of Biomedical Engineering, Rajalakshmi Engineering College, Rajalakshmi Nagar, Thandalam, Chennai 602105	jobinchrist@gmail.com jobinchrist.mc@rajalak shmi.edu.in 9842666844
9.	Dr.M.Vijaya karthik	Ph.D	Electronics and Instrumentation	18	Associate Professor, Department of Electronics and Instrumentation, Madras Institute of Technology, Chennai	vijayakarthick@yahoo. co.in 9976995692

10.	Dr. J. Mohan	Ph.D	Bio-medical Signal and Image Processing	18	Valliammai Engineering college, National Highway 45, Potheri, SRM Nagar, Kattankulathur, Tamil Nadu 603204	mohanjece@valliammai.c o.in, 9840791532
11.	Dr.D.Kathirvel u	Ph.D	Physiology, Image Processing	21	Associate Professor , Department of Biomedical Engineering Kattankulathur Campus, SRM Institute of Science and Technology, Chennai	: <u>kathir297@gmail.com</u> 9443283639
12.	Dr.S.Sathish Babu	Ph.D	Biosignals and Systems	26	Associate Professor, Department of Electronics and Communication, Thanthai Periyar Government Institute of Technology, Vellore.	sathish3575@gmail.com 9894235162
13	Dr.Ramji Kalidoss	Ph.D	Human Anatomy and Physiology	28	Associate Professor, Department of Biomedical Engineering Bharath Institute of Higher Education and Research, Chennai	ramji.sat@gmail.com 9840959835
14	Dr. P. Thirunavukkar asu	Ph.D	Biotechnology	12	Assistant Professor Cancer Biology &Animal tissue culture Department of Biotechnology Dr. MGR Educational and Research University Maduravoyal, Chennai-600095	ppthirunacas@gmail.com. 9952172249
15	Dr.M.Phemina Selvi	Ph.D	ECE	26	Assistant professor, Department of Electronics and Communication Engineering,	<u>vm.femina@gmail.com</u> 9994267707

					University College of Engineering, Villupuram	
16	Dr. R. Sandanalaksh mi	Ph.D	ECE	22	Assistant Professor Department of Electronics and Communication Engineering, Pondicherry Engineering College, Puducherry	sandanalakshmi@pec.edu 9790972173
17	Dr. N. M. Hariharan	Ph.D	Biotechnology	12	Professor and Head, Department of Biotechnology, Sree Sastha Institute of Engineering and Technology, Chennai - 600 123.	<u>biotechhod@ssiet.in</u> 904062599
18	Dr. C. Siva	Ph.D	Nano- technology	12	Assistant Professor, Department of Nano science and Technology, SRM Institute of Science and Technology Kattankulathur - 603 203, Tamil Nadu, India	chumshiva@gmail.com. 9944567367
19	Dr. Ashokan	Ph.D	Biomedical Engineering	10	Professor and Head, Department of Biomedical Engineering Kongunadu College of Engineering and Technology, 621215.	<u>hodbme@kongunadu.ac.i</u> <u>n</u> 8012505054
20	Dr.Srigitha.S. Nath	Ph.D	Applied Electronics	22	Associate Professor, Department of Electronics and Communication Engineering Saveetha Engineering college, Thandalam, Chennai-602105	hod.ece@saveetha.ac.in 9840367678