



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

Minutes of Third BOS Meeting

Venue

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

Date & Time

28-08-2021 & 10.30 AM

Minutes of Board of Studies

The Third Board of Studies meeting for B.Tech. Biomedical Engineering was held on 28th August 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

Sl.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 Jayanthi Professor Department of Biomedical Engineering SRM Institute of Science and Technology, Kattankulathur	Academic Expert nominated by University Vice-Chancellor
3	Dr.M.Arivamudhan Professor, Department of Electronics and Communication Engineering Government College of Engineering, Dharmapuri-636704	Academic Expert nominated by Academic Council
4	Dr.R.Premkumar Professor Department of Biomedical Engineering, Rajalakshmi Engineering College, Chennai	Academic Expert nominated by Academic Council
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: Biotechnology	Internal Member
9	Ms. A.Kavinilavu	Internal Member

	Assistant Professor Specialization: Biomedical Instrumentation	
10	Dr. S B Lenin Associate Professor Specialization: VLSI Design	Internal Member
11	Mrs S Jayanthi Assistant Professor: Specialization: Communication Systems	Internal Member
12	Mrs. H. Kala Assistant Professor: Specialization: Instrumentation and Control Engineering	Internal Member
13	Mr.M. Egalite Francis Assistant Professor Specialization: Maths	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. : BOS/2021/BME/UG/3.1	
	❖ To discuss about the appraisal of second BoS meeting and Confirmation of minutes of the meeting
Item No. : BOS/2021/BME/UG/3.2	
	❖ To discuss the Curriculum Structure of VII and VIII semester courses for B.Tech - Biomedical Engineering Programme under Regulations R- 2019
Item No. : BOS/2021/BME/UG/3.3	
	❖ To discuss and approve the syllabi for VII and VIII semesters under R- 2019 Regulations for the UG Programme: B.Tech. Biomedical Engineering for the students admitted in the year 2019-20
Item No. : BOS/2021/BME/UG/3.4	
	❖ To discuss and approve the Professional electives and open electives syllabi offered for VII and VIII semesters for the students admitted in the academic year 2019-20
Item No. : BOS/2021/BME/UG/3.5	
	❖ To discuss about the Project work Phase1 and Phase 2, Internship / Inplant training and NPTEL courses for the students admitted in the academic year 2019-20
Item No. : BOS/2021/BME/UG/3.6	
	To Confirm Professional electives, open electives and Employment Enhancement Course for V Semesters under R – 2019
Item No. : BOS/2021/BME/UG/3.7	
	❖ To Confirm the syllabi for I and II Semesters under R - 2020 Regulations for B.Tech. Biomedical Engineering Programme for the students admitted in the academic year 2021-22
Item No. : BOS/2021/BME/UG/3.8	
	❖ To consider and approve the revised list of panel of examiners and question paper setters for the end semester examinations
Item No. : BOS/2021/BME/UG/3.9	
	❖ To discuss the department development activities and academic schedule for the odd semester of the Academic Year 2021-22
Item No. : BOS/2021/BME/UG/3.10	
	❖ Any other item with the permission of chair

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 Third Board of Studies meeting on 28th August 2021.

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

BOS/2021/BME/UG/3.1	<p>The BoS Chairman reviewed the Second BoS meeting with the members, its implementation and confirmed with the approval for the incorporation of minor modifications as mentioned below.</p> <p>In the curriculum structure of Regulations 2019 and 2020</p> <ul style="list-style-type: none">❖ In Bio Statistics course case study is included in Unit 5❖ Biomechanics course unit-4 content is 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❖ In Medical Internet of Things Laboratory Arduino can be used❖ Environmental Biotechnology course unit- 5 should be modified. <p>The above modifications are approved by BoS members.</p>
BOS/2021/BME/UG/3.2	<p>The Curriculum Structure of VII and VIII semester courses for B.Tech - Biomedical Engineering Programme under Regulations R- 2019 were discussed.</p> <p>For Professional Elective-VI, Clinical Engineering course U19BME89 is offered instead of Biomedical Laser Instruments Course and approved by BoS members.</p> <p>The BoS members accept the modification and approved the curriculum structure. (Annexure I)</p>
BOS/2021/BME/UG/3.3	<p>The BoS members discussed the syllabi for VII and VIII Semesters under R - 2019 Regulations for the UG Programme: B.Tech. Biomedical Engineering.</p> <p>The BoS members approved the syllabi.</p>

BOS/2021/BME/UG/3.4	Professional electives and open electives syllabi offered for VII and VIII semesters for the students admitted in the academic year 2019-20 were discussed and suggested the following modifications:					
	S.NO	REGULATION	SEMSETER	SUBJECT WITH CODE	UNIT	PARTICULARS
	1.	R-2019	VII	Physiological System Modelling (U19BME71)	1 - 5	Last few topics can be removed from each unit to reduce the syllabus
	2	R-2019	VII	Dynamics of Biofluids (U19BME75)	1	syllabus is vast and has to be reduced
	3	R-2019	VIII	Human Assist Devices (U19BME81)	1 - 5	unit titles to be changed
	4	R-2019	VIII	Neural Networks (U19BME82)	2	Nerve Excitability
The BoS members resolved R-2019 Seventh and Eight semester Professional electives syllabi with above mentioned changes. The modifications are incorporated and the Syllabi is given in Annexure II and approved by BoS members.						
BOS/2021/BME/UG/3.5	Project work Phase1 and Phase 2, Internship / Inplant training and NPTEL courses offered in VII and VIII semesters for the students admitted in the academic year 2019-20 were discussed and approved by members.					
BOS/2021/BME/UG/3.6	Professional electives, open electives and Employment Enhancement Course offered for V Semesters under R – 2019 were confirmed with the members.					
BOS/2021/BME/UG/3.7	First and Second Semesters Syllabi for R - 2020 Regulations for B.Tech. Biomedical Engineering Programme for the students admitted in the academic year 2021-22 were confirmed with the members.					
BOS/2021/BME/UG/3.8	The revised list of panel of examiners and question paper setters for the end semester examinations were discussed and confirmed with the members. (Annexure - III)					







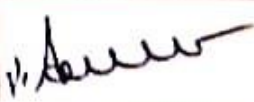
BOS/2021/BME/UG/3.9	<p>The department development activities and academic schedule for the odd semester of the Academic Year 2021-22 were presented and confirmed with the members.</p> <p>Discussed the modification in the Conduction of Continuous Assessment Test for Autonomous Regulations 2019 and 2020 and approved by members</p>
BOS/2021/BME/UG/3.10	<p>The schedule for End semester examinations conducted in online/offline mode for fourth semester of B.Tech. Biomedical Engineering programme under Regulation 2019 and first semester for Regulation 2020 were discussed.</p>

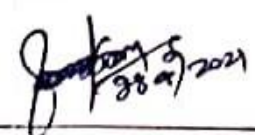


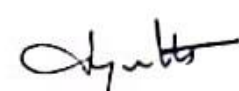




Dr. A.Vijayalakshmi, Chairman – BoS and Head of Department, Biomedical Engineering, concluded the meeting at 12:30 pm with vote of thanks.

Dr. A.Vijayalakshmi
Chairman-BOS/BME

Attendance for BoS3 meeting

Board of Studies Members:

Sl. No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	Dr.A.Vijayalakshmi, Professor and Head Department of Biomedical Engineering, Sri Manakula Vinayagar Engineering College, Puducherry	Chairman	
2	Dr A K Jayanthi Professor Department of Biomedical Engineering SRM Institute of Science and Technology, Kattankulathur	Academic Expert nominated by the University Vice-Chancellor	
3	Dr.M.Arivamudhan Professor, Department of Electronics and Communication Engineering Government College of Engineering, Dharmapuri-636704	Academic Expert nominated by the Academic Council	
4	Dr.R.Premkumar Professor Department of Biomedical Engineering, Rajalakshmi Engineering College, Chennai	Academic Expert nominated by the Academic Council	
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	Internal Member	

	Systems		
8	Dr.S.Senthil Kumar Assistant Professor Specialization: Biotechnology	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	Mrs. H. Kala Assistant Professor: Specialization: Instrumentation and Control Engineering	Internal Member	
13	Mr.M. Egalite Francis Assistant Professor Specialization: Maths	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	

Annexure –I
CURRICULUM STRUCTURE

SEMESTER – VII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P			CAM	ESM
Theory										
1	U19BMT71	Virtual Bioinstrumentation	PC	3	0	0	3	25	75	100
2	U19BMT72	Medical Image Processing	PC	3	0	0	3	25	75	100
3	U19BME7X	Professional Elective – IV	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV	OE	3	0	0	3	25	75	100
Practical										
5	U19BMP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19BMP72	Virtual Bioinstrumentation Laboratory	PC	0	0	2	1	50	50	100
7	U19BMP73	Medical Image Processing Laboratory	PC	0	0	2	1	50	50	100
8	U19BMP74	Comprehensive Viva-voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19BMW71	Project Phase – I	PW	0	0	4	2	50	50	100
10	U19BMW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT81	Biomaterials and Artificial Organs	PC	3	0	0	3	25	75	100
2	U19BME8X	Professional Elective – V	PE	3	0	0	3	25	75	100
3	U19BME8X	Professional Elective – VI	PE	3	0	0	3	25	75	100

Practical										
4	U19BMP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19BMW81	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19BMS81	Skill Development Course 10: NPTEL / MOOC -II	EEC	0	0	0	-	100	-	100
							18	315	285	600

PROFESSIONAL ELECTIVE COURSES

Professional Elective – IV (Offered in Semester VII)		
Sl. No.	Course Code	Course Title
1	U19BME71	Physiological System Modelling
2	U19BME72	Pattern Recognition and Expert Systems in Medicine
3	U19BME73	Radiological Equipments
4	U19BME74	Acoustics and Optical Imaging
5	U19BME75	Dynamics of Biofluids
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	Course Code	Course Title
1	U19BME80	Nanotechnology in Medicine
2	U19BME81	Human Assist Devices
3	U19BME82	Neural Networks
4	U19BME83	Biometric Recognition system
5	U19BME84	Tissue Engineering
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	Course Code	Course Title
1	U19BME85	Brain Computer Interface and Application
2	U19BME86	Rehabilitation Engineering

3	U19BME87	Bio MEMS
4	U19BME88	Wearable Systems
5	U19BME89	Clinical Engineering

OPEN ELECTIVE COURSES

(Courses Offered in Semester VII)		
Sl. No.	Course Code	Course Title
1	U19BMO75	Internet of Things for Healthcare
2	U19BMO76	Telehealth Technology

Annexure –II

PROFESSIONAL ELECTIVE - IV

U19BME71	PHYSIOLOGICAL SYSTEM MODELLING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic modelling of physiological system.
- To get an adequate knowledge of mathematical modelling of static system.
- To perform the time domain analysis of physiological system.
- To gain knowledge in Frequency domain analysis of physiological system.
- To understand the technique of system identification of physiological system.

Course Outcomes

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

CO1 – Understand the basics of physiological system modelling. **(K2)**

CO2 – Apply mathematical modelling of static system. **(K3)**

CO3 – Analyse physiological systems in time domain **(K3)**

CO4 – Explain the frequency domain analysis of the physiological system. **(K3)**

CO5 – Understand the technique of system identification of physiological system **(K2)**

UNIT-I INTRODUCTION

(9 Hrs)

Introduction to physiological system - mathematical modelling of physiological system, classification of model – grey box and black box, characteristic model of physiological system - parametric and non-parametric, lumped versus distributed models, – Laplace transform and Transfer function model of the system, Linear model for respiratory system - derivation of transfer function – Linear model for muscle mechanism.

UNIT II MODELLING OF STATIC ANALYSIS SYSTEM

(9 Hrs)

Static Modelling – Open and Close loop, steady state characteristic – determination of steady state characteristic of a simple model of muscle stretch reflex - steady state analysis of Human body Glucose & Insulin regulatory system – Human body chemical regulation of ventilator system – Respiratory control mathematical modelling - Heart and systemic circulation – Cardiac output – Mathematical Modelling.

UNIT III TIME DOMAIN ANALYSIS OF PHYSIOLOGICAL SYSTEMS

(9 Hrs)

Time domain analysis introduction - Respiratory Mechanics – Linearized respiratory mechanics transient response – first order respiratory mechanics for impulse response of open loop & Close loop – Transient response analysis of step and impulse – Neuromuscular reflex action.

UNIT IV FREQUENCY MODELING OF THE SYSTEM

(9 Hrs)

Frequency Response introduction – open and closed loop frequency response – Relation between transient and frequency response - graphical representation of frequency response –linearized Lungs Mechanics Model for Bode and Nyquist chart – Circulatory system – Frequency response and graphical Representation (Bode & Nyquist) - Frequency response of glucose – insulin model – graphical representation of glucose – insulin model.

UNIT V SYSTEM IDENTIFICATION OF PHYSIOLOGICAL SYSTEM

(9 Hrs)

Basic problem in physiological system – Parametric and nonparametric identification methods – least square estimation - estimation in frequency domain, optimization techniques – parameter estimation problems – identification of closed loop system.

Text Books

1. Micheal C. K. Khoo, "Physiological Control Systems – Analysis, Simulation and Estimation", 2nd Edition, Prentice Hall of India Private Ltd, 2018.
2. V. Z. Marmarlies, "Advanced Methods of physiological system Modelling", Vol. 3, Springer Science & Business Media, 2013.
3. Claudio Cobeli Ewart Carson, "Introduction to Modelling in Physiology & Medicine", 1st Edition, Academic press series, 2008.

Reference Books

1. Johny T. Ottesen, Melte S, Olufsen, Jesper K. Larsen, " Applied Mathematical Models in Human Physiology", Vol. 9, SIAM, 2004.
2. Dorf, "Modern Control Systems", Pearson Education India, 1st Edition 2008.

Web References

1. <https://www.digimat.in/nptel/courses/medical/physiology/PY11.html>
2. <https://m.youtube.com/watch?v=jcA3s9gUAfw>
3. <https://youtu.be/uv91uHHNylg>
4. https://youtu.be/ul-r7zrl_2w
5. <https://www.digimat.in/nptel/courses/medical/physiology/PY12.html>

COs/POs/PSOs Mapping

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	2	-	-	-	-	-	-	-	-	-	3	3	2	-
2	3	1	2	-	-	-	-	-	-	-	-	3	2	2	1
3	3	2	1	-	-	-	-	-	-	-	-	2	3	2	1
4	3	2	1	-	-	-	-	--	-	--	-	2	3	2	-
5	3	2	1	-	-	-	-	-	-	-	-	3	3	-	-

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

Course Objectives

- To get a detailed review about the basic concepts of bio fluid mechanics.
- To get an idea about the Vascular mechanics.
- To describe the rheology of blood and mechanics of blood vessels
- To learn the mathematical modelling of fluid biological systems.
- To understand computational simulations

Course Outcomes

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

CO1 – Understand the basic knowledge of bio fluids. **(K2)**

CO2 – Gain adequate knowledge about the Vascular Mechanics **(K2)**

CO3 – Explain about the rheology of blood. **(K2)**

CO4 – Describe the mathematical modelling of fluid biological system. **(K3)**

CO5 – Gain adequate knowledge in computational simulations **(K2)**

UNIT I FUNDAMENTALS OF BIOFLUID MECHANICS

(9 Hrs)

Intrinsic Fluid Properties: Density, Viscosity, Compressibility, Surface Tension, Hydrostatics - Macroscopic Balances of Mass and Momentum - Microscopic Balance of Mass and Momentum - The Bernoulli Equation - Dimensional Analysis - Fluid Mechanics in a Straight Tube - Flow Stability and Related Characteristics - Effect of Flow Pulsatility - Boundary Layer Separation.

UNIT II VASCULAR MECHANICS

(9 Hrs)

Anatomical Organization of the Vasculature, Mechanical Properties of Blood Vessels, Functional Properties of Blood, Control Aspects of the Vascular System, Hemodynamic of Large Arteries, Ventricular Outflow and the Aorta, Pressure-Flow Relations and Vascular Impedance, Wave Propagation Phenomena- Wave Reflection Phenomena.

UNIT III RHEOLOGY OF BLOOD

(9 Hrs)

Physical Properties of Blood - Viscous Behavior of Blood - Pressure–Flow Relationship for Non-Newtonian Fluids- Viscometry and Theory for Capillary - Capillary Viscometer - Coaxial Cylinder Viscometer - Cone and Plate Viscometer - Hemolysis and Platelet Activation with Fluid – Structural Components of the Blood Vessel - Material Behavior of Blood Vessels.

UNIT IV MODELING

(9 Hrs)

Theory of Models - Computational fluid dynamics - Dimensional analysis and the Buckingham Pi theorem - Synthesizing Pi terms - Geometric Similarity - Dynamic Similarity - Kinematic Similarity - Common Dimensionless Parameters in Fluid Mechanics.

UNIT V COMPUTATIONAL SIMULATIONS

(9 Hrs)

Computational fluid dynamics – Modeling Considerations for Biofluid Mechanical Simulations – 2D&3D modeling - Fluid Dynamic Simulations in the Human Circulation - Human Aorta - Carotid Arterial Bifurcation - Aortoiliac Bifurcation - Coronary Arteries - AAA and Cerebral - Interventional Treatment and Surgical Planning - Simulation of Valvular Dynamics - Future Directions: Multiscale Modelling.

Text Books

1. Krishnan B. Chandran, Ajit P. Yoganathan, Stanley E. Rittgers, "Biofluid Mechanics: The human circulation", 2nd Edition, CRC Press, 2012.
2. Jeffery R. Davis et. Al., "Fundamentals of Aerospace Medicine", Wolter Kluwer Health, Lippincott Williams and Wilkins, 2008.
3. Lee Waite, Jerry Fine, "Applied Biofluid Mechanics", McGraw Hill, 2007.

Reference Books

1. Jung Hee Seo, Vijay Vedula, Theodore Abraham and Rajat Mittal, "Multiphysics computational models for cardiac flow and virtual cardiography", Int. J. Numer. Meth. Biomed. Engineering", Published online in Wiley Online Library, 2013
2. John K-J Li, "Dynamics of Vascular System", World Scientific, 2004.
3. C. Ross Ethier, Craig A Simmons, "Introduction to Biomechanics- From Cells to Organisms", Cambridge Texts in Biomedical Engineering, 2007.

Web References

1. https://m.youtube.com/watch?v=hnWHM_MWCxI
2. <https://youtu.be/meRLirTKkhQ>
3. <https://youtu.be/L4eZ0lOafvc>
4. <https://youtu.be/emmf2JYAD-0>
5. <https://youtu.be/NILy-u61yyk>

COs/POs/PSOs Mapping

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	-	-	-	-	-	-	-	-	-	2	3	1	1
2	3	1	2	1	1	1	-	-	-	-	-	2	3	2	1
3	3	2	2	1	1	1	-	-	-	-	-	2	3	1	1
4	3	2	2	1	1	1	-	-	-	-	-	2	3	1	1
5	3	1	2	1	1	1	-	-	-	-	-	2	3	2	1

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

Professional Electives - V

U19BME81	HUMAN ASSIST DEVICES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Introduce the concepts of Cardiac assist devices.
- To Learn various sensory and renal devices.
- To Apply design tools for ear analysis devices.
- To understand the functions of Prosthetic devices.
- To gain knowledge in nerve stimulator devices

Course Outcomes

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

CO1 – Understand the concepts of Cardiac assist devices **(K2)**

CO2 – Classify the various sensory and renal devices **(K2)**

CO3 – Infer the merits of human assist system and its influence to environment ear devices. **(K2)**

CO4 – Apply processing conditions to functional Prosthetic devices **(K3)**

CO5 – Gain knowledge in nerve stimulator devices **(K2)**

UNIT I CARDIAC ASSIST DEVICES (9 Hrs)

Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II SENSORY AND RENAL DEVICES (9 Hrs)

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired. Artificial Renal: Dialysis action, Membrane, Dialysate, Monitoring Systems, Wearable Artificial Kidney, Implanting Type - Modeling and analysis.

UNIT III HEARING AIDS (9 Hrs)

Hearing aids: Common tests – audiograms, air conduction, bone conduction, masking techniques, hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC DEVICES (9 Hrs)

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V NERVE STIMULATOR DEVICES (9 Hrs)

Electrotherapy, Transcutaneous electrical nerve stimulator, Interferential current, Galvanic stimulation, Uses, safety aspects. Deep brain stimulation. Bio-feedback - Efficacy ratings - Major modalities – Applications.

Text Books

1. Levine S.N. (ed), "Advances in Bio-medical engineering and Medical physics", Vol. I, Inter university publications, New York, 1968
2. R.S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2nd Edition, Edition-2003.
3. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor and Francics, CRC Press,2006

Reference Books

1. Albert M. Cook and Webster J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey, 1982.
2. Soonhwa Seok, Edward L. Meyen, Boaventura DaCosta, "Handbook of Research on Human Cognition and Assistive Technology: Design, Accessibility and Transdisciplinary Perspectives", Paratext, USA, 2010.
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006
4. Short Textbook of Prosthetics and Orthotics- R Chinnathurai- Jaypee Brothers Medical Publishers (P) Ltd,2010
5. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010

Web References

1. https://youtu.be/vM_lxxVLhkg
2. <https://youtu.be/JLVpOsVjieE>
3. <https://youtu.be/d2RHnB5T5eM>
4. <https://youtu.be/oN95ldnh9Q4>
5. <https://youtu.be/ZfLmNOF1JNM>

COs/POs/PSOs Mapping

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	-	1	-	-	1	-	3	-	-	-	3	3	2	2
2	3	1	2	-	1	1	-	3	-	-	-	3	3	2	2
3	3	2	2	-	1	1	-	3	-	-	-	3	3	2	2
4	3	2	2	2	2	1	-	3	-	-	-	3	3	2	2
5	3	2	2	2	2	1	-	3	-	-	-	3	3	2	2

Correlation Level: 1- Low; 2 - Medium; 3 – High.

Course Objectives

- To understand the physiology behind generation of nerve impulses.
- **To** learn the Neuro excitability to evaluate nervous system.
- **To** study various techniques in artificial neural networks system.
- **To** realize the functions of Artificial neural network models
- To know the functions of Self organization maps.

Course Outcomes

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

CO1 - Understand the physiology behind generation of nerve impulses. **(K2)**

CO2 - Explain the Neuro excitability to evaluate nervous system. **(K2)**

CO3 - Describe various techniques in artificial neural networks. **(K2)**

CO4 – Analyze the functions of Artificial neural network models. **(K3)**

CO5 - Realize the functions of Self organization maps. **(K3)**

UNIT I INTRODUCTION**(9Hrs)**

Cellular Physiology of Nerve Cells - Generation of Nerve Action Potential - Ionic Permeability and Membrane Potential - Measuring the Long-distance Signal in Neurons - Changes in Relative Sodium Permeability During an Action Potential - Voltage-dependent Sodium Channels of the Neuron –Molecular Properties of the Voltage-sensitive Sodium Channel - Molecular Properties of Voltage-dependent Potassium - Channels - Calcium-dependent Action Potentials.

UNIT II NERVE EXCITABILITY**(9Hrs)**

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings - Nerve conduction studies - Electro physiologic study of Neuromuscular Junction: H-Reflex and F-Reflex, Blink reflex and other cranial nerve reflexes, Evaluation of autonomic nervous system.

UNIT III ARTIFICIAL NEURAL NETWORKS**(9Hrs)**

Neural networks basics, Biological neuron and their artificial model, McCullohpitts model, Network parameters-weights, activation, threshold function - Hebb rule, delta rule, Perception learning algorithm, Tutorial: Perceptron convergence theorem, MADALINE, ADALINE Problem

UNIT IV ARTIFICIAL NEURAL NETWORK MODELS**(9Hrs)**

Feed forward networks, Back propagation network- structure and algorithm, BPN application - Associative memory, Recurrent network - Hopfield network - Radial basis function network, Matlab programming for back propagation neural network, Tutorial: Boltzman machine, Issues in network design

UNIT V SELF ORGANIZATION MAPS (SOM)**(9Hrs)**

Self-organizing maps-pattern clustering, SOM-topological mapping, kohonen's SOM, Learning vector quantization, Competitive models-min, max net, Adaptive resonance theory (ART)-introduction, network and processing in art, Associative memory model, Basics of support vector machine (SVM) and radial, Tutorial: Self organizing maps in MATLAB, Visualization using U-matrix

Text Books

1. Mathews G.G. "Cellular Physiology of Nerve and Muscle", 4th Edition, Blackwell Science, UK, 2003.
2. Jacek M. Zurada , "Introduction Artificial Neural System" Jaico Pub. House, 2004.
3. LaureneFausett, "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications", Pearson Education India, 3rd Edition, 2008.

Reference Books

1. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer-Verlag, 1st Edition, 2006.
2. S. N. Sivanandam, S. N Deepa, "Introduction to Neural Networks Using Matlab 6.0", Tata McGraw-Hill, 2006.
3. B.Yegnanarayana, "Artificial Neural Networks", Prentice Hall of India, 3rd Edition, 2006.
4. Mohamad H. Hassoun, "Fundamentals of Artificial Neural Network", Cambridge MIT Press, 1st Edition, 1995.
5. Neural Networks and Artificial Intelligence for Biomedical Engineering by - Donna L. Hudson and Maurice E. Cohen, IEEE Press, 2000.

Web References

1. https://youtu.be/LV4A_naqN7g
2. <https://youtu.be/ar7B2E8nDp8>
3. <https://m.youtube.com/watch?v=3l7kIJAi0fk&feature=youtu.be>
4. <https://youtu.be/s8pDf2Pt9sc>
5. <https://youtu.be/xflvfkGnl64>

COs/POs/PSOs Mapping

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	2	2	2	2	1	3	-	-	-	3	3	2	2
2	3	3	2	2	2	2	1	3	-	-	-	3	3	2	2
3	3	3	2	2	2	2	1	3	-	-	-	3	3	2	2
4	3	3	2	2	2	2	1	3	-	-	-	3	3	2	2
5	3	3	2	2	2	2	1	3	-	-	-	3	3	2	2

Correlation Level: 1- Low; 2 - Medium; 3 – High.

Annexure –III



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 Qualification	Specialization	Experience (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, 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.edu 9944929804
4.	Dr.S.J.Thiruvengadam	Ph.D	Signal processing Wireless communication	25	Professor, Department of ECE, Thiagarajar College of Engineering,	sjtece@tce.edu 9865079402

					Thiruparankundram, Madurai Tamil Nadu 625015	
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, Chennai- 603104	vjramece@gmail.co 9444255029, 7358374100
6.	Dr. V.Kamatchi Sundari	Ph.D	Image Processing	22	Professor Department of Electronics and Communication Engineering, SRM Institute of Science and Technology, Chennai	vkamatchisundari@gm ail.com 9952041393
7.	Dr. P. Vijayakumar	Ph.D	Wireless Communication Network Security	13	Associate Professor, Department of Electronics Engineering, Vellore Institute of Technology, Kelambakkam Chennai – 600127	vijayrgcet@gmail.com9 894727271
8.	Dr Jobin Christ	Ph.D	Biomedical signal processing	24	Professor, Department of Biomedical Engineering, Rajalakshmi Engineering College, Rajalakshmi NagarThandalam, Chennai.- 602105	jobinchrist@gmail.com obinchrist.mc@rajalaks hmi.edu.in 9842666844
9.	Dr.M.Vijayakarthish	Ph.D	Electronics and Instrumentation	18	Associate Professor, Department of Electronics and	vijayakarthish@yahoo.co.in 9976995692

					Instrumentation, Madras Institute of Technology, Chennai	
10.	Dr. J. Mohan	Ph.D	Biomedical Signal and Image Processing	18	Valliammai Engineering college, National Highway 45, Potheri, SRM Nagar, Kattankulathur, 603204	mohanjece@valliamma i.co.in, 9840791532
11.	Dr.D.Kathirvelu	Ph.D	Physiology, Image Processing	21	Associate Professor , Department of Biomedical Engineering Kattankulathur Campus, SRM Institute of Science and Technology, Chennai	kathir297@gmail.com 9443283639
12.	Dr.S.Sathish Babu	Ph.D	Biosignals and Systems	26	Associate Professor, Department of Electronics and Communication, ThanthaiPeriyar Government Institute of Technology, Vellore.	sathish3575@gmail.co m 9894235162
13	Dr.RamjiKalidoss	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 9840959832
14	Dr. P. Thirunavukkarasu	Ph.D	Biotechnology	12	Assistant Professor Cancer Biology &Animal tissue culture Department of Biotechnology Dr. MGR Educational and Research University Maduravoyal, Chennai- 600095	pthirunacas@gmail.co m. 9952172249
15	Dr.M.PheminaSelvi	Ph.D	ECE	26	Assistant professor, Department of Electronics	vm.femina@gmail.com 9994267707

					and Communication Engineering, University College of Engineering, Villupuram	
16	Dr. R. Sandanalakshmi	Ph.D	ECE	22	Assistant Professor Department of Electronics and Communication Engineering, Pondicherry Engineering College, Puducherry	sandalakshmi@pec.edu 9790972173
17	Dr. N. M. Hariharan	Ph.D	Biotechnology	12	Professor and Head, Department of Biotechnology, SreeSastha Institute of Engineering and Technology, Chennai - 600 123.	biotechhod@ssiet.in 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	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.	hodbme@kongunadu.ac.in 8012505054
20	Dr.Srigitha.S.Nath	Ph.D	Applied Electronics	22	Associate Professor, Department of Electronics and Communication Engineering Saveetha Engineering college, Chennai-602105	hod.ece@saveetha.ac.in 9840367678
21	Dr.P.Muthu	Ph.D	Biomedical Engineering	16	Assistant Professor Department of Nano science and Technology, SRM Institute of Science and Technology Kattankulathur 603203	muthup@srmist.edu.in 9486338640

22	Dr.Prasath alias surendhar.S	Ph.d	Biomedical Engineering	08	Assistant Professor, Department of Biomedical Engineering Bharath Institute of Higher Education and Research, Chennai	Prasaths.bme@bharathuniv.ac.in 8754581937
----	---------------------------------	------	---------------------------	----	---	--