SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)
(APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO PONDICHERRY UNIVERSITY)
(ACCREDITED BY NBA-AICTE, NEW DELHI, ACCREDITED BY NAAC WITH "A" GRADE)
MADAGADIPET, PUDUCHERRY - 605 107

9th Board of Studies Meeting in the department of

Biomedical Engineering

for the Programme

B.Tech – Biomedical Engineering

Venue

Board Room, Engineering Block
Sri Manakula Vinayagar Engineering College
Madagadipet, Puducherry – 605 107

Date & Time

21.03.2025 & 10.00 a.m

Minutes of Ninth Board of Studies

The Ninth Board of Studies meeting for B.Tech. Biomedical Engineering was held on 21st March 2025 at 10.00 A.M in the Board Room, Engineering Block, 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	Designation
1. Head of the Department concerned (Chairperson)		
1	**Dr. A.Vijayalakshmi,** Professor and Head Specialization: Wireless Sensor Networks, Signal Processing Email: hodbme@smvec.ac.in Mobile: 9486985430	Chairman
2. All faculty members of the Department		
2	Dr.A.V.Srinath, Assistant Professor Specialization: Electronics and Instrumentation, Biomedical Engineering	Member
3	Mr.P.M.Bharath, Assistant Professor Specialization: Embedded System Technologies	Member
4	Mrs. N.Radha, Assistant Professor Specialization: Wireless Communication	Member
5	Mrs. S.Suguna, Assistant Professor Specialization: Digital Signal Processing	Member
6	Mrs.T. Logasundari, Assistant Professor Specialization: Biomedical Engineering	Member
7	Mr.A.Aravind, Assistant Professor Specialization: Nanoscience and Technology	Member
8	Mr.M.Vadivelan, Assistant Professor Specialization: VLSI Design	Member
9	Mr.K.Babu, Assistant Professor Specialization: Communication and Networks	Member
10	Dr.T.Poovaragavan, Assistant Professor Specialization: Mathematics	Member
11	Dr.K.Samuvel, Assistant Professor Specialization: Physics	Member
12	Dr.A.Balamurugan, Assistant Professor Specialization: Chemistry	Member
13	Dr.D.Jaichithra, Professor Specialization: English	Member

3. Two subject experts from outside the Parent University nominated by the Academic Council.		
14	**Dr. Anima Nanda** Dean, IQAC Sathyabama Institute of Science and Technology, Jeppiaar Nagar, Chennai - 600 119. Email: dean.iqac@sathyabama.ac.in Mobile: 9443786840	Subject Expert
15	**Dr. S. Pravin Kumar** Associate Professor Department of Biomedical Engineering, SSN College of Engineering, Chennai. Email : pravinkumars@ssn.edu.in Mobile: 9994246503	Subject Expert
4. One expert nominated by the Vice-Chancellor from a panel of six recommended by the Autonomous College Principal as a University Nominee.		
16	**Dr. Varshini Karthik** Professor and Head, Department of BioMedical Engineering, SRM Institute of Science and Technology, Kattankulathur-603 203 Email : varshink@srmist.edu.in Mobile: 9841582226	University Nominee
5. One representative from industry/corporate sector/allied areas nominated by the Principal as an Industry Nominee.		
17	**Dr. S.Atheena Milagi Pandian** Founder and Chief Executive Officer Atheenapandian Private Limited, Courtallam,Tamilnadu. Email : atheenapandian@gmail.com Mobile: 7502599891	Industry Expert
6. One member of the College alumni nominated by the Principal.		
18	**S.Rosy** Associate Analyst Zifo RnD Solutions,Chennai Email : rosyymaryy200@gmail.com Mobile: 8870890106	Alumni
19	**S.Khiruba Lakshmi** Final Year Student	Member
7. Experts from outside the Autonomous College, whenever special courses of studies are to be formulated, nominated by the Principal.		
20	**Dr. B.Hema Kumar** Associate Dean, Department of Electronics and Instrumentation Engineering, Puducherry Technological University, Puducherry Email: hemakumarb@pec.edu Mobile: 9994196804	Member

Agenda of the Meeting

Item No.	Particulars
BoS/2025/UG/BME/9.1	To Welcome the BoS members.
BoS/2025/UG/BME/9.2	To review and confirm the minutes of Eighth Board of Studies meeting.
BoS/2025/UG/BME/9.3	To discuss and approve the Curriculum and Syllabi of VII Semester courses for B.Tech – Biomedical Engineering under Regulations R-2023.
BoS/2025/UG/BME/9.4	To discuss and approve the Professional Elective and Open Elective courses syllabi offered for VII Semester B.Tech – Biomedical Engineering under Regulations R-2023.
BoS/2025/UG/BME/9.5	To discuss and approve the Regulations, Curriculum and syllabi of Honours / Minor degree programme courses offered to BME Students and the list of students registered for various Honours courses under Regulations R-2023.
BoS/2025/UG/BME/9.6	To discuss and approve the Assessment procedure and passing criteria for the Honours / Minor courses offered under Autonomous Regulations 2023.
BoS/2025/UG/BME/9.7	To apprise and approve the Professional Elective and Open Elective courses, Employability Enhancement and Mandatory courses, NPTEL/MOOC courses offered for VI Semester and Professional Electives, NPTEL/MOOC courses offered for VIII Semester students under Regulations 2020.
BoS/2025/UG/BME/9.8	To apprise and approve the Professional Elective courses offered for IV Semester students,Ability Enhancement and Mandatory courses offered for II and IV Semester students under Regulations 2023.
BoS/2025/UG/BME/9.9	To apprise the Academic Calendar for the Even Semester of the Academic Year 2024-25 and department activities
BoS/2025/UG/BME/9.10	To apprise and approve the End Semester Examinations Nov/Dec 2024 Results under Autonomous Regulations R-2020 and R-2023.
BoS/2025/UG/BME/9.11	To discuss and recommend the panel of examiners to the Academic Council.
BoS/2025/UG/BME/9.12	Any other item with the permission of the chair.

Dr.A.Vijayalakshmi
Chairman-BoS/BME

Minutes of the Meeting

Dr.A.Vijayalakshmi, BoS Chairman started the meeting by a warm welcome and thanked the members for accepting the invitation to conduct Ninth Board of Studies meeting on 21st March 2025.

The Chairman proceeded the meeting with the presentation on the agenda items:

<table>
<tr><td>BoS/2025/UG/BME/9.1</td><td>The BoS Chairman greeted the BoS members and introduced the external experts to all the members.</td></tr>
<tr><td>BoS/2025/UG/BME/9.2</td><td>Reviewed the minutes of Eighth Board of Studies meeting with the members and confirmed the incorporation of minor modifications in V and VI semester courses syllabi of B.Tech BME Curriculum under Regulations 2023.</td></tr>
<tr><td>BOS/2025/UG/BME/9.3</td><td>Discussed the Curriculum and Syllabi of VII Semester courses for B.Tech – Biomedical Engineering under Regulations 2023 and the BoS members suggested the following modifications.
<table>
<tr><th>S.No.</th><th>Semester</th><th>Course Title with Code</th><th>Unit</th><th>Suggestions</th></tr>
<tr><td>1.</td><td>VII</td><td>Rehabilitation Engineering (U23BMT713)</td><td>4</td><td>Suggested to include Speech Augmentative devices and Text to speech</td></tr>
<tr><td>2.</td><td>VII</td><td>Medical Image Processing (U23BMT714)</td><td>3</td><td>Suggested to include Image Registration and Multimodal Image Registration.</td></tr>
<tr><td>3.</td><td>VII</td><td>Bioprinting Laboratory (U23BMP710)</td><td>3</td><td>Suggested to modify the Course Name as “3D Printing in Biomedical Applications”</td></tr>
<tr><td>4.</td><td>VII</td><td>Medical Image Processing Laboratory (U23BMP711)</td><td></td><td>Suggested to incorporate the Watershed Algorithm in the Image Segmentation experiment</td></tr>
</table>
The Suggestions are incorporated, and the Syllabi is given in Annexure I and approved by BoS members</td></tr>
<tr><td>BoS/2025/UG/BME/9.4</td><td>The Professional Elective and Open Elective courses syllabi offered for VII semester B.Tech – Biomedical Engineering under Regulations R-2023 are discussed and the BoS members suggested the following modifications in the course content:
<table>
<tr><th>S.No</th><th>Semester</th><th>Course title with Code</th><th>Unit</th><th>Suggestions</th></tr>
<tr><td>1</td><td>VII</td><td>Virtual Bioinstrumentation (U23BME714)</td><td>5</td><td>Suggested to include Biofeedback system.</td></tr>
<tr><td>2.</td><td>VII</td><td>Nanotechnology In Medicine (U23BME715)</td><td>5</td><td>Suggested to modify the content as Nanobots and Targeted Drug delivery</td></tr>
<tr><td>3.</td><td>VII</td><td>Dynamics of Biofluid (U23BME716)</td><td>5</td><td>Suggested to include Pleural Fever.</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>4.</td><td>VII</td><td>Medical Safety and Standards (U23BME717)</td><td>5</td><td>Suggested to include ISO Standards and CDSCO Standards.</td></tr>
<tr><td>5.</td><td>VII</td><td>Medical Robotics (U23BMOC03)</td><td>2</td><td>Suggested to include Robotic Manipulator.</td></tr>
</table>
The Suggestions are incorporated, and the Syllabi is given in Annexure I and approved by BoS members
</td></tr>
<tr><td>BoS/2025/UG/BME/9.5</td><td>The Regulations, Curriculum and syllabi of Honours / Minor degree programme courses offered to BME Students and the list of students registered for various Honours courses under Regulations R-2023 are discussed and approved by BoS members.
The Curriculum and Syllabi approved by BoS members is given in Annexure II</td></tr>
<tr><td>BoS/2025/UG/BME/9.6</td><td>The Assessment procedure and passing criteria for the Honours / Minor courses offered under Autonomous Regulations 2023 are discussed and approved by BoS members</td></tr>
<tr><td>BoS/2025/UG/BME/9.7</td><td>Apprised and approved the Professional Elective and Open Elective courses, Employability Enhancement and Mandatory courses, NPTEL/MOOC courses offered for VI Semester and Professional Electives, NPTEL/MOOC courses offered for VIII Semester students under Regulations 2020.</td></tr>
<tr><td>BoS/2025/UG/BME/9.8</td><td>Apprised and approved the Professional Elective courses offered for IV Semester students, Ability Enhancement and Mandatory courses offered for II and IV Semester students under Regulations 2023.</td></tr>
<tr><td>BoS/2025/UG/BME/9.9</td><td>Apprised the Academic Calendar for the Even Semester of the Academic Year 2024-25 and department activities</td></tr>
<tr><td>BoS/2025/UG/BME/9.10</td><td>Apprised and approve the End Semester Examinations Nov/Dec 2024 Results under Autonomous Regulations R-2020 and R-2023</td></tr>
<tr><td>BoS/2025/UG/BME/9.11</td><td>The revised list for panel of examiners for the end semester examinations are discussed and confirmed with the members. (Annexure - III)</td></tr>
<tr><td>BoS/2025/UG/BME/9.12</td><td>BoS members recommended incorporating case studies into the syllabus wherever applicable for better understanding.</td></tr>
</table>

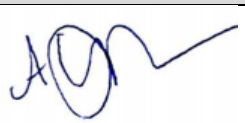
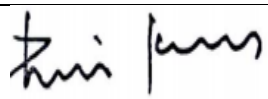
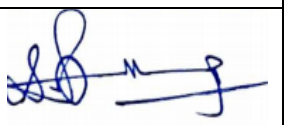
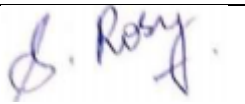
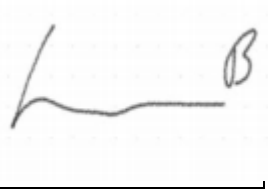
Dr. A.Vijayalakshmi, Chairman-BoS and Head of the Department, Biomedical Engineering concluded the meeting with vote of thanks.

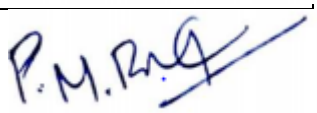
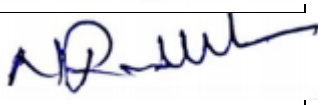
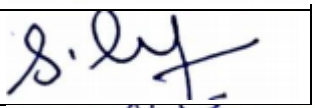
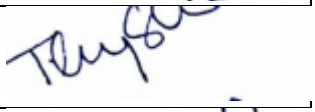
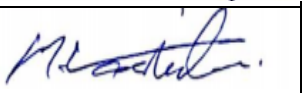
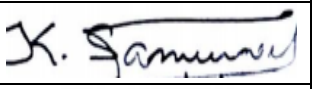
Dr. A.Vijayalakshmi
Chairman-BoS/BME

DEPARTMENT OF BIOMEDICAL ENGINEERING

NINTH BOS MEETING ATTENDANCE

Board of Studies Members:

S.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. Anima Nanda** Dean, IQAC Sathyabama Institute of Science and Technology, Chennai - 600 119.	Academic Expert	
3	**Dr. S. Pravin Kumar** Associate Professor Department of Biomedical Engineering, SSN College of Engineering, Chennai.	Academic Expert	
4	**Dr. Varshini Karthik** Professor and Head, Department of Biomedical Engineering, SRM Institute of Science and Technology, Kattankulathur-603 203	University Nominee	
5	**Dr. S.Atheena Milagi Pandian** Founder and Chief Executive Officer Atheenapandian Private Limited,Courtallam, Tamilnadu.	Industry Expert	
6	**S.Rosy** Associate Analyst Zifo RnD Solutions, Chennai	Alumni Member	
7	**Dr. B.Hema Kumar** Associate Dean, Department of Electronics and Instrumentation **Engineering,** Puducherry Technological University, Puducherry	Subject Expert	

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
8	**Dr.A.V.Srinath**, Assistant Professor Specialization: Electronics and Instrumentation, Biomedical Engineering	Internal Member	
9	**Mr.P.M.Bharath**, Assistant Professor Specialization: Embedded System Technologies	Internal Member	
10	**Mrs. N.Radha**, Assistant Professor Specialization: Wireless Communication	Internal Member	
11	**Mrs.S.Suguna**, Assistant Professor Specialization: Digital Signal Processing	Internal Member	
12	**Mrs.T.Logasundari**, Assistant Professor Specialization: Biomedical Engineering	Internal Member	
13	**Mr.A.Aravind**, Assistant Professor Specialization: Nanoscience and Technology	Internal Member	
14	**Mr.M.Vadivelan**, Assistant Professor Specialization: VLSI Design	Internal Member	
15	**Mr.K.Babu**, Assistant Professor Specialization: Communication and Networks	Internal Member	
16	**Dr.T.Poovaragavan**, Assistant Professor Specialization: Mathematics	Internal Member	
17	**Dr.K.Samuvel**, Assistant Professor Specialization: Physics	Internal Member	
18	**Dr.A.Balamurugan**, Assistant Professor Specialization: Chemistry	Internal Member	
19	**Dr.D.Jaichithra**, Professor Specialization: English	Internal Member	
20	**S.Khiruba Lakshmi** Final Year Student	Member	

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

BIOMEDICAL ENGINEERING

ACADEMIC REGULATIONS 2023
(R-2023)

CURRICULUM AND SYLLABI

Annexure – I

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC01	Engineering Mathematics – I	BS	3	1	0	4	25	75	100
2	U23BSTC01	Physical Science for Engineers	BS	3	0	0	3	25	75	100
3	U23BMT101	Human Anatomy and Physiology	BS	3	0	0	3	25	75	100
4	U23BMT102	Basic Electrical Circuits	ES	3	0	0	3	25	75	100
5	U23ESTC01	Basics of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ENBC01	Communicative English - I	HS	2	0	2	3	50	50	100
Practical										
7	U23BMP101	Physiology Laboratory	BS	0	0	2	1	50	50	100
8	U23BMP102	Basic Electrical Circuits Laboratory	ES	0	0	2	1	50	50	100
9	U23ESPC02	Design Thinking and IDEA Lab	ES	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23BMC1XX	Certification Course - I**	AEC	0	0	4	-	100	-	100
Mandatory Course										
11	U23BMM101	Induction Programme	MC	2 weeks			-	-	-	-
							22	425	575	1000

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC02	Engineering Mathematics – II	BS	3	1	0	4	25	75	100
2	U23CSTC01	Programming in C	ES	3	0	0	3	25	75	100
3	U23BMTC01	Electron Devices and Circuits	PC	3	0	0	3	25	75	100
4	U23BMT203	Biosensors and Transducers	PC	3	0	0	3	25	75	100
5	U23HSTC01	Universal Human Values II	HS	2	0	0	2	25	75	100
Theory cum Practical										
6	U23ENBC02	Communicative English - II	HS	2	0	2	3	50	50	100
Practical										
7	U23ESPC03	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100
8	U23CSPC01	Programming in C Laboratory	ES	0	0	2	1	50	50	100
9	U23BMPC01	Electron Devices and Circuits Laboratory	PC	0	0	2	1	50	50	100
10	U23BMP203	Biosensors and Transducers Laboratory	PC	0	0	2	1	50	50	100

Ability Enhancement Course										
11	U23BMC2XX	Certification Course - II**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23BMM202	Sports Yoga and NSS	MC	0	0	2	-	100	-	100
							22	575	625	1200

***** Certification courses are to be selected from the list given in Annexure III***

SEMESTER – III										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U23MATC03	Probability and Statistics	BS	3	1	0	4	25	75	100
2	U23ADTC01	Programming in Python	ES	3	0	0	3	25	75	100
3	U23BMT304	Biosignals and Systems	PC	2	1	0	3	25	75	100
4	U23ICTC01	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U23ICTC02	Digital Logic Circuits	PC	2	1	0	3	25	75	100
Theory cum Practical										
6	U23BMB301	Pathology and Microbiology	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPC01	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U23MAPC01	Engineering Mathematics Laboratory	BS	0	0	2	1	50	50	100
9	U23ADPC01	Programming in Python Laboratory	ES	0	0	2	1	50	50	100
10	U23ICPC01	Linear and Digital Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23BMC3XX	Certification Course – III******	AEC	0	0	4	-	100	-	100
12	U23BMS301	Skill Enhancement Course-1*****	AEC	0	0	2	**-**	100	-	100
Mandatory Course										
13	U23BMM303	Climate Change	MC	2	0	0	**-**	100	-	100
							23	675	625	1300

SEMESTER – IV										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U23MATC04	Numerical Methods and Optimization	BS	3	1	0	4	25	75	100
2	U23CSTC03	Data Structures	ES	3	0	0	3	25	75	100
3	U23BMT405	Biomechanics	PC	3	0	0	3	25	75	100
4	U23BMT406	Biomedical Instrumentation	PC	3	0	0	3	25	75	100
5	U23BME4XX	Professional Elective – I[#]	PE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23BMB401	Biosignal Processing	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPC02	General Proficiency - II	HS	0	0	2	1	50	50	100

8	U23CSPC02	Data Structures Laboratory	ES	0	0	2	1	50	50	100
9	U23BMP404	Biomedical Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23BMC4XX	Certification Course - IV**	AEC	0	0	4	-	100	-	100
11	U23BMS402	Skill Enhancement Course-2*	AEC	0	0	2	-	100	-	100
Mandatory Course										
12	U23BMM404	Right to Information and Good Governance	MC	2	0	0	-	100	-	100
							22	625	575	1200

[#] Professional Electives are to be selected from the list given in Annexure I

** Skill Enhancement Courses (1 and 2) are to be selected from the list given in Annexure IV*

SEMESTER – V

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC02	Research Methodology	HS	2	0	0	2	25	75	100
2	U23ITTC02	Programming in Java	ES	3	0	0	3	25	75	100
3	U23BMT507	Microcontroller and its Medical Applications	PC	3	0	0	3	25	75	100
4	U23BME5XX	Professional Elective – II[#]	PE	3	0	0	3	25	75	100
5	U23XX05XX	Open Elective – I[$]	OE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23BMB502	Biocontrol Systems	PC	2	0	2	3	50	50	100
Practical										
7	U23ITPC02	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U23BMP505	Microcontroller and its Medical Applications Laboratory	PC	0	0	2	1	50	50	100
9	U23BMP506	Hospital Training	PC	0	0	2	1	50	50	100
Project Work										
10	U23BMW501	Micro Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23BMC5XX	Certification Course – V**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23BMM505	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	625	575	1200

SEMESTER – VI

Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23BMT608	Diagnostic and Therapeutic Equipment	PC	3	0	0	3	25	75	100
2	U23BMT609	Embedded Systems for Healthcare	PC	3	0	0	3	25	75	100
3	U23BMT610	Medical Internet of Things	PC	3	0	0	3	25	75	100

4	U23BMT611	Artificial Intelligence and Machine learning in Healthcare	PC	3	0	0	3	25	75	100
5	U23BME6XX	Professional Elective – III[#]	PE	3	0	0	3	25	75	100
6	U23XX06XX	Open Elective – II[$]	OE	3	0	0	3	25	75	100
Practical										
7	U23BMP607	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	2	1	50	50	100
8	U23BMP608	Embedded Systems for Healthcare Laboratory	PC	0	0	2	1	50	50	100
9	U23BMP609	Medical Internet of Things Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23BMW602	Mini Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23BMC6XX	Certification Course – VI**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23BMM606	Gender Equality	MC	2	0	0	-	100	-	100
							22	600	600	1200

[$] Open electives are to be selected from the list given in Annexure II

SEMESTER – VII

Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23BMT712	Biomaterials and Artificial Organs	PC	3	0	0	3	25	75	100
2	U23BMT713	Rehabilitation Engineering	PC	3	0	0	3	25	75	100
3	U23BMT714	Medical image processing	PC	3	0	0	3	25	75	100
4	U23BME7XX	Professional Elective – IV[#]	PE	3	0	0	3	25	75	100
5	U23XXO7XX	Open Elective III	OE	3	0	0	3	25	75	100
Practical										
6	U23BMP710	3D Printing in Biomedical Applications Laboratory	PC	0	0	2	1	50	50	100
7	U23BMP711	Medical Image Processing Laboratory	PC	0	0	2	1	50	50	100
Project Work										
8	U23BMW703	Project Phase – I	PA	0	0	4	2	50	50	100
9	U23BMW704	Internship/Inplant Training	PA	0	0	2	1	100	-	100
							20	375	525	900

SEMESTER – VIII

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC03	Entrepreneurship and Business Management	HS	3	0	0	3	25	75	100
2	U23BME8XX	Professional Elective – V[#]	PE	3	0	0	3	25	75	100

3	U23BME8XX	Professional Elective – VI[#]	PE	3	0	0	3	25	75	100
Project Work										
4	U23BMW805	Project Phase - II	PA	0	0	16	8	50	100	150
							17	125	325	450

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U23BME401	Medical Physics
2	U23BME402	Environmental Biotechnology
3	U23BME403	Biometric Recognition Systems
4	U23BME404	Hospital Equipment Safety and Management
5	U23BMEC01	Communication Systems
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U23BME505	Laser and Fiber Optics in Medicine
2	U23BME506	Computers in Medicine
3	U23BME507	Transportation in Living Systems
4	U23BME508	Medical Informatics
5	U23BME509	VLSI Systems
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U23BME610	Troubleshooting and Quality Control in Medical Equipment
2	U23ICEC02	Soft Computing Techniques
3	U23BME611	Physiological System Modeling
4	U23BME612	Hospital Engineering and Information Systems
5	U23BME613	Biotelemetry and Telemedicine
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U23BME714	Virtual Bioinstrumentation
2	U23BME715	Nanotechnology in Medicine
3	U23BME716	Dynamics of Biofluids
4	U23BME717	Medical Safety and Standards
5	U23BME718	Cryptography and Network Security
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23BME819	Modeling and Designing of implants

2	U23BMEC02	Wearable Technology
3	U23BME820	Tissue Engineering
4	U23BME821	Pattern Recognition and Expert System in Medicine
5	U23BME822	Bio MEMS
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23BME823	Clinical Engineering
2	U23BME824	Virtual Reality in Medicine
3	U23BME825	Brain Computer Interface and Applications
4	U23BME826	Medical Ethics and Intellectual Property rights
5	U23BME827	Acoustics and Optical Imaging

OPEN ELECTIVE COURSES

S.No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I/ Open Elective – II (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE**)				
1	U23BMOC01	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, Mechatronics, AI&DS CSE&BS
2	U23BMOC02	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, Mechatronics, AI&DS CSE&BS
Open Elective – III (Offered in Semester VII)				
3	U23BMOC03	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, Mechatronics, AI&DS CSE&BS
4	U23BMOC04	Telehealth Technology	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, Mechatronics, AI&DS CSE&BS

-

SEMESTER – VII										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U23BMT712	Biomaterials and Artificial Organs	PC	3	0	0	3	25	75	100
2	U23BMT713	Rehabilitation Engineering	PC	3	0	0	3	25	75	100
3	U23BMT714	Medical image processing	PC	3	0	0	3	25	75	100
4	U23BME7XX	Professional Elective – IV	PE	3	0	0	3	25	75	100
5	U23XXO7XX	Open Elective III	OE	3	0	0	3	25	75	100
Practical										
6	U23BMP710	3D Printing in Biomedical Applications Laboratory	PC	0	0	2	1	50	50	100
7	U23BMP711	Medical Image Processing Laboratory	PC	0	0	2	1	50	50	100
Project Work										
8	U23BMW703	Project Phase – I	PA	0	0	4	2	50	50	100
9	U23BMW704	Internship/Inplant Training	PA	0	0	2	1	100	-	100
							20	375	525	900

Department	**Biomedical Engineering**			Programme: **B.Tech**				
Semester	**VII**			Course Category: **PC**		End Semester Exam Type: **TE**		
Course Code	**U23BMT712**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**BIOMATERIALS AND ARTIFICIAL ORGANS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite	Human Anatomy and Physiology							

Course Outcomes	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Understand the basic knowledge about the biomaterials**.**	**K2**
	CO2 Distinguish the types of Biomaterials	**K2**
	CO3 Analyze the tissue implant materials used in the medical applications.	**K3**
	CO4 Gain adequate knowledge of artificial organs	**K3**
	CO5 Explain the artificial organs implanted in the human body.	**K3**

UNIT-I	**OVERVIEW OF BIOMATERIALS**	**Periods:9**	
Introduction to biomaterials – uses of biomaterials – biomaterials in organ and body systems – materials used in the body – performance of biomaterials. Metallic biomaterials – Introduction – stainless steel – Cobalt – chromium alloy - Titanium alloy – Titanium nickel alloy - dental metals – Corrosion of metallic implant, manufacturing of implant.			**CO1**
UNIT-II	**TYPES OF BIOMATERIALS**	**Periods:9**	
Biomaterials types – Ceramic - non absorbable/relatively bioinert, bio ceramics, biodegradable, bio reactive ceramic – deterioration of ceramics, **Polymeric** –basic structure, polymers used as biomaterials, sterilization, **Composite** – Structure - bounds on properties an isotropy of composites - particulate composites - fibrous composites, porous materials and biocompatibility, biodegradable polymer materials.			**CO2**
UNIT-III	**TISSUE MATERIALS AND TISSUE REPLACEMENT**	**Periods:9**	
Structure and properties of collagen and collagen rich tissue, Resorbable collagen based medical implant, Types of transplants by stem cell, sutures, surgical tapes, Tissue adhesive/glue, effect of materials selection – effect of surface properties. Preservation techniques –non-freezing storage – freeze thaw technology – freeze drying.			**CO3**
UNIT-IV	**ARTIFICIAL ORGANS**	**Periods:9**	
Introduction – Outlook of organ replacement – Design, consideration and evaluation process – overview – immunological consideration – blood transfusion – individual organs – kidney, liver, heart, lungs, bone marrow, cornea.			**CO4**
UNIT-V	**ARTIFICIAL ORGAN IMPLANTS**	**Periods:9**	
Neural and neuromuscular implants – heart valves implant – heart and lungs assist devices – artificial heart, cardiac pacemakers – artificial kidney – dialysis membrane and artificial blood - gastrointestinal system – dentistry – maxillofacial and craniofacial replacement – soft tissue replacement and augmentation.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 45**

A.

Textbooks

1. Lysaght M, Webster T J., “Biomaterials for artificial organs”, Woodhead Publishing Limited, 1st edition, 2011
2. Hench L, Jones J., “Biomaterials, artificial organs and tissue engineering”, Woodhead Publishing Limited, 1st edition, 2005.
3. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain., “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2015

Reference Books

1. Joseph D. Bronzino, Donald R. Peterson., “Biomedical engineering fundamentals”, CRC Press, 4th edition, 2014.
2. R S Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2003
3. David Williams, “Essential biomaterials science”, Cambridge University Press, 1st edition, 2014
4. Yannas, I. V, “Tissue and Organ Regeneration in Adults”, New York, NY: Springer, 2001.
5. Donatella Duraccio , Federico Mussano, Maria Giulia Faga., “Biomaterials for dental implants: current and future trends”, Journal of Materials Science, 2015.

Web References

1. https://youtu.be/jVj1xE5FUMI
2. https://youtu.be/XqFSlG6WKO0
3. https://youtu.be/DsAvyyykwB8
4. https://nptel.ac.in/courses/106/105/106105077/
5. https://nptel.ac.in/courses/102/101/102101068/

*TE –Theory Exam, LE–Lab Exam

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

CorrelationLevel:1-Low,2-Medium,3–High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*****Application oriented/Problem solving /Design/Analytical in content beyond the syllabus

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	**Biomedical Engineering**	Program: **B.Tech.**						
Semester	**VII**	Course Category: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23BMT713**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**REHABILITATION ENGINEERING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite								

Course Outcomes	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Understand the quality and safety standards in design of devices for user needs	**K2**
	CO2 Describe the applications of different orthosis and prosthesis for various disabilities	**K3**
	CO3 Compare the different therapeutic exercises and design an orthopedic wheelchair	**K2**
	CO4 Interpret the techniques and aids for impairments related to sensory and motor functions.	**K3**
	CO5 Explore the use of Robots and Virtual Reality tool in rehabilitative curative care.	**K4**

UNIT – I	**FUNDAMENTALS OF REHABILITATION**	**Periods:9**
Introduction to Rehabilitation Engineering - Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Impairment disability handicap, Primary & secondary Disabilities-Rehabilitation team, Classification of members-The human component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles.		**CO1**
UNIT – II	**PROSTHETIC AND ORTHOTICS DEVICES**	**Periods:9**
Prosthetics: Hand and Arm replacement, body-powered prosthetics, externally powered limb prosthetics, Myoelectric hand and arm prosthetics - FES System: Restoration of hand function; restoration of standing and walking. **Orthotics:** General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO.		**CO2**
UNIT – III	**THERAPEUTIC DEVICES AND WHEELCHAIRS**	**Periods:9**
Therapeutic exercise: Co-ordination exercises, Frenkel's exercises, Gait -Pathological Gaits, Gait Training, Relaxation exercises, Methods for training Relaxation, Strengthening exercises - Strength training, Types of Contraction, Mobilization exercises, Endurance exercises. **Wheelchair:** History and Categories of Wheelchairs, Seating Assessment, Wheelchair Structure and Component Design, Ergonomics of wheel chair propulsion, Power Wheelchair Electrical System- Wheel chair transportation.		**CO3**
UNIT – IV	**MANAGEMENT OF COMMUNICATION IMPAIRMENTS**	**Periods:9**
Speech Impairment: Introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Speech Augmentative Devices and Text-to-Speech (TTS) Systems. **Visual impairment:** Categories of visual impairment - Cortical & retinal implants - Auditory Information Display, Blind mobility aids, reading writing & graphics access, Braille Reader, Tactile devices for visually challenged. **Auditory impairment:** Hearing functional assessment, Types of deafness - Surgical and non-surgical hearing aids, Cochlear implants		**CO4**
UNIT – V	**RECENT TRENDS IN REHABILITATION**	**Periods:9**
Rehabilitation Robots- Automated gait training devices, Automated training devices for the upper extremities**,** Therapeutic and Learning Support Virtual Reality Applications- virtual environments in the treatment of motor skills impairments- VR based tele-rehabilitation.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Text Books

1. Dr. S. Sunder, "Textbook of Rehabilitation", 4th Edition, Jaypee Medical Publications, New Delhi. 2019.
2. Joseph D.Bronzino,"The Biomedical Engineering Handbook", 3rd Edition, CRC Press, 2006.
3. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.

Reference Books

1. Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visually impaired and blind people", Springer Publications, First edition, 2008.
2. Sashi S Kommu; Rehabilitation Robotics,1 edition, CRC Press, 2007.
3. Suzanne Robitaille, "The illustrated guide to Assistive technology and devices–Tools and gadgets for living independently", Demos Health New York, First edition, 2010.
4. Patrice L. (Tamar) Weiss, Emily A. Keshner, Mindy F. Levin, "Virtual Reality for Physical and Motor Rehabilitation", 2014.
5. Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007

Web References

1. https://en.wikipedia.org/wiki/Rehabilitation_engineering
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/rehabilitation-engineering/
3. https://bme.unc.edu/rehabilitation-engineering/
4. https://youtu.be/-y2jDL-diz0
5. https://youtu.be/s3rEAIwLEXM?t=2

*TE –Theory Exam, LE–Lab Exam

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

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	**BME**			Programme: **B.Tech**				
Semester	**VII**			Course Category Code: **PC**		*End Semester Exam Type: **TE**		
Course Code	**U23BMT714**			Periods/Week			Credit	Maximum Marks
				L	T	P	C	CAM	ESE	TM
Course Name	**MEDICAL IMAGE PROCESSING**			**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite										
Course Outcomes	**On completion of the course, the students will be able to**								BT Mapping (Highest Level)	
	CO1	Gain knowledge in fundamentals of digital image processing.							**K2**	
	CO2	Examine image enhancement techniques in medical images.							**K3**	
	CO3	Execute restoration and segmentation techniques in medical images							**K3**	
	CO4	Apply the compression Techniques in medical images							**K3**	
	CO5	Describe the representations of features and recognize the images							**K2**	
UNIT–I	**FUNDAMENTAL OF DIGITAL IMAGE PROCESSING**						**Periods:09**			
Introduction, Steps in Digital Image Processing -Components –Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization -Relationships between pixels - colour models. Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering.										**CO1**
UNIT–II	**FREQUENCY DOMAIN ENHANCEMENT**						**Periods:09**			
Introduction to Fourier Transform — Smoothing and Sharpening frequency domain filters — Ideal, Butterworth andGaussian filters, Wavelets -Sub band coding, Wavelets based image processing.										**CO2**
UNITIII	**MEDICAL IMAGE RESTORATION AND SEGMENTATION**						**Periods:09**			
Image Restoration: Noise Model – Notch Filters– Inverse Filtering – Wiener filtering. **Image Segmentation:** Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Region Growing, Region Splitting, Morphological processing- erosion and dilation – Watershed algorithm.										**CO3**
UNIT –IV	**MEDICAL IMAGE COMPRESSION**						**Periods:09**			
Image Compression models–Error Free Compression–Variable Length Coding–Bit-Plane Coding–Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding –Discrete wavelet transform for image compression-Compression Standards-JPEG, Image Registration (Multimodal Image Registration)										**CO4**
UNIT– V	**MEDICAL IMAGE REPRESENTATION AND RECOGNITION**						**Periods:09**			
Boundary representation- Chain Code-Polygonal approximation, signature, boundary segments-Boundary description –Shape number - Regional Descriptors — Topological feature, Texture –Patterns and Pattern classes. **Image Recognition**: Digital Imaging and Communication (DICOM) in Medicine, Various modalities of Medical Imaging-CT, MRI, PET, Thermography, Angiography.										**CO5**
LecturePeriods:45	**Tutorial Periods:**			**Practical Periods: -**			**TotalPeriods:45**			

Text Books

1. G.R. Sinha, Bhagwati Charen Patel, “Medical Image Processing: Concepts and Applications”, PHI Learningprivatelimited.2014
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw HillPvt.Ltd.,2011
3. Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing",2nd Edition, CRC Press,2005.

Reference Books

1. Anil JainK.“Fundamentals of Digital Image Processing”,PHI Learning Pvt.Ltd.,2011.
2. E.R.Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press,2012.
3. MalayK.Pakhira,“Digital Image Processing and Pattern Recognition”,1st Edition, PHI Learning Pvt.Ltd.,2011.

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

4	Geoff Dougherty, “Medical Image Processing: Techniques and Applications”, Springer Science & BusinessMedia,2011
5	IsaacN.Bankman,“Hand book of Medical Image Processing and Analysis”,Science Direct,2nd Edition,2009.

Web References	
1	https://youtu.be/xUCsfKA8bi0
2	https://youtu.be/0SIPA8TvCbU
3	https://youtu.be/8fBZFjiHw3I
4	https://youtu.be/PqBS3tFZYI8
5	https://m.youtube.com/watch?v=i8a2LdyenoY

*TE –Theory Exam, LE–Lab Exam

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

CorrelationLevel:1-Low,2-Medium,3– High

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE)Marks**	**Total Marks**
	CAT1	**CAT2**	**Model Exam**	**Assignment***	**Attendance**		
Marks	10		5	5	5	75	100

*****Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

Department	**Biomedical Engineering**	Programme: **B.Tech.**						
Semester	**VII**	Course Category Code: **PC** *End Semester Exam Type: **LE**						
Course Code	**U23BMP710**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**3D PRINTING IN BIOMEDICAL APPLICATIONS LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
Prerequisite	**-**							

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand 3D printing principles, techniques, and biomedical applications.	**K2**
	CO2 Operate and calibrate FDM/SLA printers for biomedical model production.	**K3**
	CO3 Analyze print parameters' effects on mechanical properties and accuracy.	**K4**
	CO4 Design patient-specific biomedical models using 3D scanning and modeling.	**K5**
	CO5 Evaluate surface quality and enhance prints with post-processing techniques.	**K6**

List of Experiments:

1. Study of FDM 3D Printer Operation and Calibration
2. 3D Scanning of Biomedical Model of ear and finger Using a Handheld Scanner
3. Scanning and Reconstruction of an artificial Dental Model Using an Intraoral Scanner
4. Conversion of DICOM Images to 3D Printable STL Files
5. Design and Printing of a Patient-Specific Skull Model
6. Study of Layer Thickness and Print Orientation on Mechanical Properties
7. Fabrication of a Dental Crown Using SLA Printing
8. 3D Printing of a Custom Prosthetic Finger Using Flexible Filament
9. Development of a 3D-Printed Microfluidic Device for Biofluid Analysis
10. Evaluation of Surface Roughness in SLA vs. FDM Printing
11. Design and Printing of a Patient-Specific Surgical Guide for nose Placement
12. Fabrication of a 3D-Printed Rehabilitative Orthopedic Cast with Ventilation

Lecture Periods: -0	**Tutorial Periods: -0**	**Practical Periods:30**	**TotalPeriods:30**

Textbook

1. Prosenjit Saha, “3D Bioprinting from Lab to Industry” , Wiley , 2023.
2. Mohamad Zaki Hassan and Ilyas Aufa, “Handbook of 3D Printing in Biomedical Applications”, CRC Press , 2022.
3. Neeta Raj Sharma, Karupppasamy Subburaj, Kamalpreet Sandhu, and Vivek Sharma , “Applications of 3D Printing in Biomedical Engineering”,Springer , 2021.

Reference Books

1. Mohanan, P. V., editor. Compendium of 3D Bioprinting Technology. CRC Press, 2025.
2. BioCraft: Unleashing the Future of Bioprinting. Independently published, 2024.
3. Narayan, Roger J., editor. Advances in 3D Bioprinting. CRC Press, 2024.
4. Crook, Jeremy M., editor. 3D Bioprinting: Principles and Protocols. Humana Press, 2020.
5. Guvendiren, Murat, editor. 3D Bioprinting in Medicine: Technologies, Bioinks, and Applications. Springer

Web References

1. https://link.springer.com/book/10.1007/978-1-0716-0520-2
2. https://en.wikipedia.org/wiki/3D_bioprinting
3. https://www.iipseries.org/assets/docupload/rsl2024F767C1609A33C6E.pdf

4. https://youtu.be/yLaXBQgMdR8
5. https://youtu.be/Y_zQ9B4rWMY

*TE –Theory Exam, LE–Lab Exam

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	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

CorrelationLevel:1-Low,2- Medium,3 –High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**BIOMEDICAL ENGINEERING**	Programme: **B.Tech.**						
Semester	**VII**	Course Category: **PC**			*End Semester Exam Type: **LE**			
Course Code	**U23BMP711**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MEDICAL IMAGE PROCESSING LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
Prerequisite	MATLAB Basics, Image Processing, Mathematics, Signal Processing, Computer Vision.							

Course Outcomes	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Describe digital image fundamentals	**K3**
	CO2 Examine image enhancement techniques in medical images	**K4**
	CO3 Execute restoration and segmentation techniques in medical images	**K4**
	CO4 Apply various transforms to the images	**K3**
	CO5 Describe the representations of features and recognize the images	**K3**

List of Exercises:

1. Image sampling and quantization.
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar).
6. Histogram Processing.
7. Image Enhancement-Spatial filtering.
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection
10. Basic Morphological operations
11. Basic Thresholding functions
12. Analysis of images with different color models
13. Watershed Algorithm for Image Segmentation.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:30**	**TotalPeriods:30**

Text Books

1. G.R. Sinha, Bhagwati Charen Patel, “Medical Image Processing: Concepts and Applications”, PHI Learning private limited,2014.
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, 3rdEdition, Tata McGraw Hill Pvt.Ltd., 2011.Manjunath Aradhya M and Srinivas Subramiam, “C Programming and Data Structures”, CengageIndia1st Edition, 2017.
3. Kayvan Najarian and Robert Splinter,"Biomedical Signal and Image Processing",2nd Edition, CRC Press,2005.

Reference Books

1. AnilJainK.“Fundamentals of Digital Image Processing”,PHI Learning Pvt Ltd,2011.
2. E.R. Davies,“Computer& Machine Vision”, 4th Edition, Academic Press,2012.
3. MalayK.Pakhira,“Digital Image Processing and Pattern Recognition”,1st Edition,PHI Learning Pvt Ltd,2011.
4. Geoff Dougherty, “Medical Image Processing: Techniques and Applications”, Springer Science & BusinessMedia,2011.
5. Isaac N. Bankman, “Handbook of Medical Image Processing and Analysis”, Science Direct, 2nd Edition,2009.

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Web References

1. https://youtu.be/0UPoSdBFD48
2. https://youtu.be/6mXXN1-vHQQ
3. https://youtu.be/8fBZFjiHw3I
4. https://youtu.be/PqBS3tFZYI8
5. https://m.youtube.com/watch?v=i8a2LdyenoY

*TE–Theory Exam, LE–Lab Exam

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

CorrelationLevel:1-Low,2-Medium,3–High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Viva				
Marks	15	5	5	15	10	50	100

Department	**BIOMEDICAL ENGINEERING**	Programme: **B.Tech.**						
Semester	**VII**	Course Category: **PA**			*End Semester Exam Type: **LE**			
Course Code	**U23BMW703**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROJECT PHASE -I**	**0**	**0**	**4**	**2**	**50**	**50**	**100**
Prerequisite								

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester.

In the phase I of the project work, the progress of the work carried out in the 7th semester will be monitored and assessed. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment. The project work and the report will be evaluated by the internal assessment committee by conducting three reviews for a total of 50 marks. The end semester examination which carries a total of 50 marks will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner

CAM and ESM break-up for Project Phase-I

Sl. No	Description			Weightage
1	**Continuous Assessment Marks**			
a	Review1	Review Committee	10	15
		Supervisor	5	
b	Review2	Review Committee	10	15
		Supervisor	5	
c	Review3	Review Committee	15	20
		Supervisor	5	
			Total CAM	50

2	**End Semester Marks**			
	Evaluation of Phase I Report and Viva-voce	Report	15	50
		Presentation and Viva	20	
		Demonstration	15	
			Total ESM	50
			Total Marks	100

Department	**BIOMEDICAL ENGINEERING**	Programme: **B.Tech.**						
Semester	**VII**	Course Category: **PA**			*End Semester Exam Type: **LE**			
Course Code	**U23BMW704**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INTERNSHIP/ INPLANT TRAINING**	**0**	**0**	**2**	**1**	**100**	**-**	**100**
Prerequisite								

Students may undergo Inplant training or internship during summer / winter vacation at Industry/ Research organization for a period of two weeks to four weeks. Students are also permitted to undergo internships during their seventh semester after the theory classes are over. Each student has to submit a detailed report on In-Plant Training which He / She have undergone. The department committee will assess the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of Inplant training or internship.

Assessment method for Industrial Training/Internship

Assessment	**Continuous Assessment Marks (CAM)**		Total Marks
	Report	Presentation	
Marks	50	50	100

PROFESSIONAL ELECTIVE –IV
(Offered in Semester VII)

Department	**Biomedical Engineering**	Program: **B.Tech.**						
Semester	**VII**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23BME714**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**VIRTUAL BIOINSTRUMENTATION**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite								

Course Outcomes		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand the basic concepts of Virtual instrumentation	**K2**
	CO2	Realize the programming language used in VI	**K3**
	CO3	Analyze the concept of data acquisition using VI	**K3**
	CO4	Interpret the interfacing concept used in LabVIEW	**K3**
	CO5	Apply the concept of VI for medical applications	**K4**

UNIT – I	**INTRODUCTION**	**Periods:9**
History of Virtual Instrumentation, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, LabVIEW basics – graphical programming, LabVIEW environment		**CO1**
UNIT – II	**PROGRAMMING TECHNIQUES**	**Periods:9**
VIS and sub-VIS, loops and charts, arrays, clusters, graphs, case and sequence structures, formula modes, local and global variable, string and file input. Publishing measurement data in the web.		**CO2**
UNIT – III	**DATA ACQUISITION**	**Periods:9**
Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input / Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements		**CO3**
UNIT – IV	**INSTRUMENT INTERFACES**	**Periods:9**
Current loop, GPIB, System basics, interface basics: USB, PCMCIA, networking basics for office and industrial application VISA and IVI, image acquisition and processing, Motion Control, waveform generator.		**CO4**
UNIT – V	**BIOMEDICAL APPLICATIONS**	**Periods:9**
Biofeedback systems and its components, Virtual applications for ECG, EEG, EMG signals, Air Flow and Lung Volume, Non-invasive Blood Pressure Measurement, Virtual Reality and 3D graphical modelling, Virtual Prototyping.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Jon B. Olansen, Eric Rosow, “Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW” Prentice Hall PTR, 2001
2. Gary Johnson, “LABVIEW Graphical Programming”, 4th Edition, McGraw Hill, 2006.
3. Ronald W. Larsen, “LabVIEW for Engineers”, Pearson , 1st Edition, 2010

Reference Books

1. Robert H. Bishop,” Learning with LabVIEW” , Pearson, First edition, 2014
2. Jerome, “Virtual Instrumentation Using LabView”, PHI, 2010.
3. Sanjay Gupta and Joseph John, ” Virtual Instrumentation using LabVIEW”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.
4. John Essick,” Hands-on Introduction to LabVIEW for Scientists and Engineers “,Oxford University Press, 4th Edition,2018
5. Kevin James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control”, Newnes, 2000.

Web References

1. https://youtu.be/_2IZVC902kg

2. https://youtu.be/78dZ8ljJ52M
3. https://youtu.be/fIy6XT3CdPQ
4. https://youtu.be/U0bQBOEiBQY
5. https://youtu.be/Q8rFSpaa84Q

*TE–Theory Exam, LE–Lab Exam

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

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Biomedical Engineering**	Program: **B.Tech.**						
Semester	**VII**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23BME715**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**NANOTECHNOLOGY IN MEDICINE**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite								

Course Outcomes		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand the basic concept of nanomaterial synthesis	**K2**
	CO2	Analyze the mechanisms involved in biological nanoparticle formation.	**K3**
	CO3	Evaluate blood-biomaterial interactions, including heparin effects	**K3**
	CO4	Explain the characterization techniques used in nanomaterials	**K3**
	CO5	Assess vascular and lymphatic targeting strategies for nanoparticle drug delivery.	**K4**

UNIT – I	**PHYSICAL AND CHEMICAL PROCESS**	**Periods:9**
Chemical processes: Chemical precipitation and co-precipitation, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Microwave assisted synthesis, Core-Shell nanostructure, Physical Methods: Inert gas condensation, Arc discharge, RF- plasma, Plasma arc technique, Laser ablation, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD) method.		**CO1**
UNIT – II	**BIOLOGICAL METHODS OF SYNTHESIS**	**Periods:9**
Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magneto tactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the nanostructured materials; synthesis process and application, Role of plants in nanoparticle synthesis.		**CO2**
UNIT – III	**BIOLOGICAL INTERACTIONS WITH MATERIALS**	**Periods:9**
Introduction, Biocompatibility, Toxicity, Cytotoxicity, Hypersensitivity, Carcinogenicity, Interaction of Materials with Soft Tissues, Inflammation, Granulation Tissue Formation, Foreign Body Reaction, Fibrosis, Modification of Blood-Biomaterial Interactions, Interaction with Blood by Heparin, Interactions with Proteins, Cell Adhesion, Interactions with Hard Tissues, The Vroman Effect, Adhesion of Osteoblasts, Osseointegration, Fibrous Capsule Formation,		**CO3**
UNIT – IV	**CHARACTERIZATION TECHNIQUES**	**Periods:9**
Nanostructured materials Characterization Techniques X-ray diffraction (XRD), SEM, EDAX, TEM, Elemental mapping, FTIR, UV-Visible spectrophotometer, Nanomechanical Characterization using Nanoindentation, Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermo gravimetric Analysis (TGA), TEM, X-ray Photoelectron Spectroscopy (XPS), ICP-AES chemical analysis.		**CO4**
UNIT – V	**BIOLOGICAL TRANSPORT FOR TARGETED DRUG DELIVERY**	**Periods:9**
Drug transport mechanisms – Passive and active targeting – Nanocarriers (liposomes, dendrimers, polymeric nanoparticles) – Nanobots for precision medicine – Stimuli-responsive drug delivery – Controlled release systems – Tumor-targeted therapy – Blood-brain barrier penetration – Real-time tracking and monitoring of drug delivery.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Harry F. Tibbals, “Medical Nanotechnology and Nanomedicine”, 1st Edition, CRC Press, 2011.
2. Hossein Hossein Khani, “Nanomaterials in Advanced Medicine”, Wiley, 2019.
3. Kirthi, A. Vishnu, Karthik, L., Janarthanan, Pushpamalar, “Nanotechnology in Medicine”, Springer, 2021.

Reference Books

1. BIOMEDICAL NANOSTRUCTURES. Edited by Kenneth E. Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair, WILEY-INTERSCIENCE A JOHN WILEY & SONS, INC., PUBLICATION, 2008

2. Z.L Wang ," Characterization of Nanophase materials", 1st Edition, Wiley-VCH, 2000.
3. G. Schmidt, "Nanoparticles: From theory to applications", 2nd Edition, Wiley Weinheim, 2004.
4. Zoraida Aguilar, "Nanomaterials for Medical Applications", 1st Edition,Elsevier, 2012.
5. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinema 2009.

Web References

1. https://en.wikipedia.org/wiki/Nanomedicine
2. https://www.medicalnewstoday.com/articles/244972
3. https://www.azonano.com/article.aspx?ArticleID=4840
4. https://youtu.be/ZS1QPndpD2w
5. https://youtu.be/iiT_KJJ1Uhs

*TE–Theory Exam, LE–Lab Exam

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

CorrelationLevel:1-Low,2-Medium,3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

Department	**BME**	Programme: **B.Tech**						
Semester	**VII**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23BME716**	Periods/Week			Credit	Maximum Marks		
		L	T	**P**	C	CAM	ESE	TM
Course Name	**DYNAMICS OF BIOFLUID**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand to apply the fluid mechanics principles in bio fluid studies	**K2**
	CO2	Gain adequate knowledge about the Vascular Mechanics	**K2**
	CO3	Comprehend the physical, chemical and rheological properties of blood	**K2**
	CO4	Analyze cardiovascular dynamics, fluid flow, pressure, compliance, elastance, and modeling.	**K4**
	CO5	Comprehend dynamics of cerebrospinal fluid, alveolar mechanics, and synovial fluid.	**K3**

UNIT–I	**FUNDAMENTALS OF BIOFLUID MECHANICS**	**Periods:09**
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.		**CO1**
UNIT–II	**VASCULAR MECHANICS**	**Periods:09**
Anatomical Organization of the Vasculature, Mechanical Properties of Blood Vessels, Functional Properties of Blood, Control Aspects of the Vascular System, Hemodynamic of Large Arteries, Heart Valves, Ventricular Outflow and the Aorta, Pressure-Flow Relations and Vascular Impedance, Wave Propagation Phenomena-Wave Reflection Phenomena.		**CO2**
UNIT–III	**RHEOLOGY OF BLOOD**	**Periods:09**
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.		**CO3**
UNIT –IV	**COMPUTATION FLUID DYNAMICS**	**Periods:09**
Cardiovascular system – Ventricular pressure -volume diagram, Blood flow in arteries-blood vessel bifurcation-Uniform shear hypothesis -Two-element – Electric analogy model for two, three and four element model-Wave Propagation-Review concepts of compliance and Elastance- in arterial circulation-pressure changes in different distance from heart.		**CO4**
UNIT– V	**BIO-FLUID DYNAMIC OF HUMAN BRAIN, RESPIRATORY AND ORTHOPEDIC**	**Periods:09**
Cerebro Spinal Fluid – Cerebral blood flow – Blood brain barrier – Brain diseases. Alveoli mechanics – Interaction of Blood and Lung P-V curve of Lung – Breathing mechanism – Airway resistance – Physics of Lung diseases, Pleural Fever. Synovial joint – Synovial fluid – Diseases affecting synovium.		**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods:45**

Text Books

1. Goyal, M.R., Bhowmik, A., & Chauhan, A. (Eds.). (2025). Biofluid Dynamics of Human Body Systems: Expanded and Revised Edition (1st ed.). Apple Academic Press.
2. Goyal, Megh R., et al. "Introduction and Properties of Biofluids in the Human Body Systems." *Biofluid Dynamics of Human Body Systems*. Apple Academic Press 1-52.

3. Nithiarasu, P. "Biofluid Dynamics." *Chapter* 2 (2022): 20-21.
4. Lauga, Eric. *The fluid dynamics of cell motility*. Vol. 62. Cambridge University Press, 2020.
5. David A. Rubenstein, Weiyin, Mary D. Frame, "Biofluid Mechanics- An Introduction to fluid Mechanics, Macrocirculation and Microcirculation", 2015, 1st Edition, Academic Press, Massachusetts, New York.

Reference Books

1. Taylor, R. L., and P. Nithiarasu. *The finite element method for fluid dynamics*. Elsevier, 2024.
2. Chin, Wilson C., and Jamie A. Chin, eds. *Biofluids Modeling: Methods, Perspectives, and Solutions*. John Wiley & Sons, 2023.
3. Grotberg, James B. *Biofluid mechanics: analysis and applications*. Cambridge University Press, 2021.

*TE –Theory Exam, LE–Lab Exam

Web References

1. https://en.wikipedia.org/wiki/Biofluid_dynamics
2. http://www.dicat.unige.it/rrepetto/linked-files/biofluid-dynamics.pdf
3. https://www.maths.gla.ac.uk/~xl/Arasu-biofluid.pdf
4. https://www.youtube.com/watch?v=6ABq269ALFk
5. https://youtu.be/L4eZ0lOafvc
6. https://youtu.be/emmf2JYAD-0
7. https://youtu.be/NlLy-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

CorrelationLevel:1-Low,2-Medium,3– High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

***Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

Department	**Biomedical Engineering**	Programme: **B.Tech.**						
Semester	**VII**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23BME717**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MEDICAL SAFETY AND STANDARDS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite	-							

Course Outcomes		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Gain knowledge about hospital safety devices necessary for health care system	**K2**
	CO2	Understand the techniques to shield patient from electrical hazards	**K3**
	CO3	Gain knowledge in radiation safety and control measures	**K2**
	CO4	Apply the various methods to monitor and assess quality in healthcare	**K3**
	CO5	Apply the guidelines for medical standards in hospitals	**K3**

UNIT–I	**HOSPITAL SAFETY**	**Periods:09**	
Security and Safety of Hospital -Property, Staff & Patients, Safety precautions, Safe medical devices - device requirements - devices for varying age – initial inspection –maintenance-Safe handling and operation Reporting- Bed rails- Flawed mechanics- removable parts and packaging. Personal protective Equipment.			**CO1**
UNIT–II	**ELECTRICAL SAFETY**	**Periods:09**	
Physiological effects of electricity - Electrical faults in medical devices - Leakage Current-Electrical isolation - Grounding system -Emergency power system - Uninterrupted power supply. IEC Standards for Electrical Safety.			**CO2**
UNIT–III	**RADIOLOGICAL SAFETY**	**Periods:09**	
Fundamentals of radiation detection-Classification of radiation - Biological effects of Ionizing and Non-Ionizing radiation - Hazards associated with UV radiation - UV monitor and control measures, LASER - radiation hazards - control measures, Guidelines for CT installations, MRI safety guidelines.			**CO3**
UNIT–IV	**QUALITY ASSESSMENT IN HEALTHCARE**	**Periods:09**	
Quality management-risk management- types of responsibilities – CSR, Individual and institutional Responsibility- MDRA and medical device standards - ICRP regulations for radiation safety- Methods Adopted to monitor the standards, Evaluation of hospital services – Quality Assurance in Hospitals Sop's -TQM in Health care organization-Quality assurance methods.			**CO4**
UNIT–V	**HOSPITAL ACCREDITATION AND STANDARDS**	**Periods:09**	
Accreditation- JCI Accreditation & its Policies, Patient centered standards, ISO standards and CDSCO Standards for medical safety. Healthcare Organization management standards, Life Safety Standards-Protecting Occupants, Protecting the Hospital from Fire, Smoke, and Heat, Providing and Maintaining Fire Alarm Systems, Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods:45**

Textbooks

1. Barbara J. Youngberg," Patient Safety Handbook "Jones& Bartlett Learning, 2nd Edition, 2013
2. Peter Lachman, Moira Stewart, and Siobhan McQuillan," Safety and Improvement in Primary Care: The Essential Guide", Radcliffe Publishing, 1st Edition,2012.
3. Hani H. Abujudeh, "Quality and Safety in Radiology", Oxford University Press, 1st Edition, 2010.
4. Ronda Hughe, "Patient Safety and Quality: An Evidence-Based Handbook for Nurses" , Agency for Healthcare Research and Quality, 1st Edition, 2008.

Reference Books

1. Peter Lachman, Moira Stewart, and Siobhan McQuillan, “Safety and Improvement in Primary Care: The Essential Guide” , Radcliffe Publishing, 1st Edition , 2012.
2. Lucian L. Leape,” Making Healthcare Safe: The Story of the Patient Safety Movement”, Springer,1st Edition, 2021
3. Pascale Carayon , “ Handbook of Human Factors and Ergonomics in Health Care and Patient Safety” , CRC Press , 2nd Edition, 2011.
4. Robert Wachter and Kiran Gupta, “Understanding Patient Safety”, McGraw-Hill Education,3rd Edition, 2017

Web References

1. www.wma.net/what-we-do/education
2. www.medvarsity.com/courses/certificationcourse
3. www.medscape.com/courses/business
4. www.onlinecourses.swayam2.ac.in
5. www.healthcentral.com/healthcare

*TE–Theory Exam, LE– Lab Exam

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

CorrelationLevel:1-Low,2-Medium,3–High Evaluation

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

Department	**Biomedical Engineering**	Program: **B.Tech.**						
Semester	**VII**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23BME718**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CRYPTOGRAPHY AND NETWORK SECURITY**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite	Network Essential							

Course Outcomes			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Explain the fundamentals of cryptography, including security attacks, encryption techniques, and steganography, to understand data protection principles.	**K3**
	CO2	Compare and analyze symmetric and asymmetric cryptographic algorithms	**K4**
	CO3	Demonstrate knowledge of authentication techniques and their applications in secure communication	**K3**
	CO4	Describe IP security principles and key management strategies for secure networks	**K2**
	CO5	Implement various network security protocols to mitigate security threats.	**K4**

UNIT – I	**INTRODUCTION**	**Periods:9**	
Introduction to cryptography - security attacks - services and mechanism - Conventional Encryption - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography.			**CO1**
UNIT – II	**SYMMETRIC AND ASYMMETRIC CRYPTOGRAPHY**	**Periods:9**	
Symmetric key Ciphers: Block ciphers principles - Data Encryption Standard (DES) - strength of DES - triple DES – Advanced Encryption Standard (AES) **Asymmetric key Ciphers:** Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - Elliptic curve cryptography			**CO2**
UNIT – III	**MESSAGE AUTHENTICATION AND INTEGRITY**	**Periods:9**	
Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions **Integrity:** Message Digest Algorithm (MD5) - Secure Hash Algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - Digital Signature Standards (DSS)			**CO3**
UNIT – IV	**IP SECURITY AND AUTHENTICATION ALGORITHMS**	**Periods:9**	
IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management. Authentication Applications: Kerberos and X.509.			**CO4**
UNIT – V	**WEB AND SYSTEM SECURITY**	**Periods:9**	
Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - electronic mail security-pretty good privacy (PGP). **System Security:** Intruders - Viruses and related threads - firewall design principals – trusted systems			**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. William Stallings: “Cryptography and Network Security”- Principles and Practice, 5th Edition, Pearson/PHI, 2011.
2. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw-Hill,2017
3. Wenbo Mao, —”Modern Cryptography-Theory and Practise”, First Edition Pearson Education 2004

Reference Books

1. William Stallings, “Network Security Essentials (Applications and Standards)”, 4th Edition, Pearson Education. ,2012
2. Atul Kahate, “Cryptography and Network Security”, 4th edition, Tata Mc Grawhill, 2019
3. V.S. Bagad and I.A Dhotre, “Cryptography & Network Security”, 1st edition, 2020.

4. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, “Security in Computing”, Fifth Edition, Prentice Hall, New Delhi, 2015.
5. Buchmann: “Introduction to Cryptography”, 2nd Edition, Springer, 2004

Web References

1. https://www.geeksforgeeks.org/cryptography-introduction/
2. http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf
3. https://nptel.ac.in/courses/106105031

* TE – Theory Exam, LE – Lab Exam

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

CorrelationLevel:1-Low,2-Medium,3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

OPEN ELECTIVE –III
(Offered in Semester VII)

Department	**BIOMEDICAL ENGINEERING**	Programme: **B.Tech.**						
Semester	**VII**	Course Category: **OE**				End Semester Exam Type: **TE**		
Course Code	**U23BMOC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MEDICAL ROBOTICS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to CSE, IT, MECH, MECHATRONICS)

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the basics of robotic systems.	**K2**
	CO2 Explore workspace and related motion of the Robots	**K3**
	CO3 Analyse and extract information from the image using Robots	**K3**
	CO4 Design of task planning and simulating the task.	**K4**
	CO5 Construct Robots for Medical applications	**K4**

UNIT-I	**INTRODUCTION**	**Periods: 9**	
Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot -Five-axis robot - Six-axis robot.			**CO1**
UNIT-II	**KINEMATICS**	**Periods: 9**	
Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations-Robotic Manipulator – Continuous path motion – Interpolated motion – Straight-line motion.			**CO2**
UNIT-III	**ROBOT VISION**	**Periods: 9**	
Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.			**CO3**
UNIT-IV	**PLANNING**	**Periods: 9**	
Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.			**CO4**
UNIT-V	**MEDICAL APPLICATIONS**	**Periods: 9**	
Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Robert Schilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall, January 2019.
2. Paula Gomes,“Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications”,Woodhead Publishing,2012.
3. Klafter, Chmielewski and Negin, “Robotic Engineering - An Integrated approach”,, PHI, first edition, 2009.

Reference Books

1. J.J.Craig, “Introduction to Robotics”, Pearson Education, 2019.

2. Fu, Lee and Gonzalez., “Robotics, control vision and intelligence”, McGraw Hill International, 2nd edition, 2007
3. John J. Craig, “Introduction to Robotics”, Addison Wesley Publishing, 3rd edition, 2010.
4. Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, “Robotics”, McGraw Hill, 2008.

Web References

1.https://nptel.ac.in/courses/112/105/112105249/
2.https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_ robotic_surgery
3.https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
4.https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
5.https://www.worldscientific.com/worldscinet/jmrr

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

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**BME**	Programme: **B.Tech.**						
Semester	**VII**	Course Category:**OE**			End Semester Exam Type: **TE**			
Course Code	**U23BMOC04**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Telehealth Technology**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite								

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the history and evolution of telemedicine.	**K2**
	CO2 Understand the principles of multimedia communication, including text, audio, video, and data.	**K2**
	CO3 Learn about medical information storage and management in telemedicine, including patient information, medical history, test reports, and medical images.	**K3**
	CO4 Analyze the security and confidentiality concerns regarding medical records in telemedicine and understand the relevant cyber laws.	**K2**
	CO5 Focusing on the applications of telemedicine in specialized areas like telecardiology, tele oncology, and neurosciences.	**K3**

UNIT–I	**Telemedicine and Health**	**Periods:9**	
History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.			**CO1**
UNIT –II	Telemedical Technology	**Periods:9**	
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, P0STN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.			**CO2**
UNIT –III	**Mobile Telemedicine**	**Periods:9**	
Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system			**CO3**
UNIT –IV	**Telemedical Standards**	**Periods:9**	
Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine			**CO4**
UNIT–V	**Telemedical Applications**	**Periods:9**	
Telemedicine – health education and self-care. · Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.			**CO5**

Lecture Periods:45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods:45**

TextBooks

1. Haux, R., Heidrich, J.P., & Schleyer, T. "Introduction to Telemedicine", Springer, 2017
2. Krishna, S., & Liss, A. "Telemedicine: A Practical Guide for Professionals", Springer, 2005
3. Norris, A.C. “Essentials of Telemedicine and Telecare”, Wiley, 2002

Reference Books

1. Goetz, S.K. "Telemedicine: The Electronic Practice of Medicine", Springer, 2011
2. Krupinski, C. & Rhoads, J.M. "Telemedicine: Technology and Applications", CRC Press, 2019
3. Ramakrishnan, S. & Chaturvedi, A. "Telemedicine: A Guide to Assessing Telecommunications for Healthcare", Wiley, 2006
4. Gajendra, J.A. & Williams, A.J. "Telemedicine Technologies: Principles and Applications", Wiley, 2008

5. McGonigle, D. & Mastrian, K.G. "Health Informatics: An Interprofessional Approach", Elsevier, 2020

Web References

1. https://www.who.int/health-topics/telemedicine
2. https://www.telemedicine.org
3. https://www.telemedicine.org

COs/POs/PSOs Mapping

*TE–Theory Exam, LE–Lab Exam

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

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Annexure – II

Curriculum

HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY

COURSE DETAILS											
Sl. No.	**Semester**	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
					L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory											
1	IV	U23SXB401	Smart Sensors	PC	3	0	2	4	50	50	100
2	V	U23SXT502	Nano Biosensors*	PC	3	0	0	3	25	75	100
3	VI	U23SXB603	Embedded Sensing Technologies	PC	3	0	2	4	50	50	100
4	VII	U23SXT704	IoT and Sensor Networks*	PC	3	0	0	3	25	75	100
5	VIII	U23SXT805	Wearable Devices and its Applications*	PC	3	0	0	3	25	75	100
6	VIII	U23SXW806	Project / Model Making	PA	0	0	4	2	100	-	100
	Total							**19**	**275**	**325**	**600**
Equivalent NPTEL courses[##]											
1	IV to VII Semester	U23XXXN01	Sensors Technology Equivalent NPTEL Courses					3	12 Week Course		

[##] The student shall be given an option to earn 3 credits through one equivalent 12 week NPTEL course instead of any one course listed for honours / minor degree programme that should be completed before the commencement of eighth semester. The equivalent courses are subject to change based on its availability as per NPTEL course list.

*List of NPTEL Courses

1. Sensors and Actuators
2. Biophotonics
3. Embedded Systems Design
4. Introduction to Industry 4.0 and Industrial Internet of Things
5. Microsensors, Implantable Devices and Rodent Surgeries for Biomedical Applications

Dr. A.Vijayalakshmi

Dr.L.M.Varalakshmi

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**IV**	Course Category Code: PC			*End Semester Exam Type:**TE**			
Course Code	**U23SXB401**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Smart Sensors**	**3**	**1**	**0**	**4**	**50**	**50**	**100**

Common to All Branches

Prerequisite	-	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand smart sensor principles, advantages, and integration challenges.	**K2**
	CO2 Describe the working principles and applications of various sensors.	**K3**
	CO3 Analyze sensor fusion techniques, energy management, and communication protocols.	**K2**
	CO4 Design sensor-based systems for real-time monitoring and automation.	**K2**
	CO5 Develop advanced sensor systems for environmental and health monitoring.	**K2**

UNIT – I	**Introduction to Smart Sensors**	**Periods:10**
Overview of smart sensors, Comparison with traditional sensors, Need for smart sensor and its challenges, Model of a smart sensor. Classification of smart sensors: Temperature and Humidity Sensor (DHT11), pressure sensor (MS5611), Accelerometer sensor(MPU6050), Luminous Sensor(TSL2561), Gas sensor(MQ-135), Optical fingerprint sensor(GT511C3), Sound detection sensor (MAX9814), Digital Image sensor(CCD/CMOS), MEMS Sensor.		**CO1**
UNIT – II	**Sensor Fusion and Communication Protocols**	**Periods:10**
Sensor fusion: Introduction to Sensor Fusion- Types of Level: Data Level, Feature Level and Decision Level in sensor fusion. Energy Management in Smart Sensor Systems -Energy harvesting: solar, thermal, or kinetic energy, Communications for smart sensor: Wired Protocols (CAN,I2C, SPI, UART) Wireless Protocols(Zigbee, Wi-Fi, LoRa, 5G)		**CO2**
UNIT – III	**Applications of Smart Sensors**	**Periods:10**
Case Studies: **Industrial Automation** - Predictive Maintenance - Safety Monitoring. **Healthcare**- Wearable Devices- Remote Patient Monitoring- Smart Prosthetics. **Smart Cities** - Traffic Management, Air Quality Monitoring, Smart Lighting. **Smart Homes**- Home Automation, Voice Assistants, Energy Management.		**CO3**
UNIT – IV	**Sensor-Based Monitoring and Automation Systems**	**Periods:15**
Hardware / Simulation 1. Implementation of an RGB Color Detection System Using the TCS3200 Sensor and Arduino 2. Design and Development of a Fire Detection System Using a Flame Sensor and Arduino 3. Real-Time Temperature Monitoring for HVAC Systems 4. Condition Monitoring of Rotating Equipment Using a Vibration Sensor 5. Development of a Smart Waste Management System Using an Ultrasonic Sensor		**CO4**
UNIT – V	**Advanced Sensor-Based Systems for Environmental and Health Monitoring**	**Periods:15**
Hardware / Simulation 1. Analysis of Ambient Sound Levels Using a Sound Sensor for Event-Triggered Responses 2. Smart Water Leak Detection and Alert System 3. Automated Irrigation System for Precision Agriculture Using Arduino Uno 4. Development of a Wearable Health Monitoring Device Using Accelerometer, Heart Rate (PPG), and SpO_2 Sensors 5. Smart Flood Detection and Management System Using Water Level and Rainfall Sensors		**CO5**

Lecture Periods:45	**Tutorial Periods:-**	**Practical Periods:-15**	**Total Periods:60**

Text Books

1. Randy Frank, “Understanding Smart Sensors”, Artech House, 2013.
2. Gerard Meijer, Kofi Makinwa, Michiel Pertijs, “Smart Sensor Systems Emerging Technologies and Applications”Wiley,2014
3. H. Yamasaki ,“Intelligent Sensors”, Elsevier Science,1996

Reference Books

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 4th edition, Springer, New York, 2014.
2. Wilson Jon, “Sensor Technology Handbook”, Elsevier Inc, 2005.

3. Pavel Ripka, Alois Tipek, 'Modern Sensors Handbook', ISTE LTD, 2007.
4. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
5. Simon Monk, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", O'Reilly Media, 2019.

Web References

1. https://www.elprocus.com/smart-sensor/
2. https://www.fourfaith.com/industry-news/smart-sensor.html
3. https://www.bosch-sensortec.com/products/smart-sensor-systems/
4. https://www.fierceelectronics.com/electronics/what-are-smart-sensors

* TE – Theory Exam, LE – Lab Exam

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

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

Dr.L.M.Varalakshmi

Department	**Biomedical Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**V**	Course Category: PC				*End Semester Exam Type: **TE**		
Course Code	**U23SXT502**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Nano Biosensors**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite	**-**							

Common to All Branches

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the principles underlying nano biosensor design and operation	**K3**
	CO2 Familiarize with the detection mechanisms used in nano biosensors.	**K3**
	CO3 Analyzing the specificity of nano biosensors for target molecules.	**K4**
	CO4 Gain knowledge in describe the recent technology application of nano biosensors.	**K4**
	CO5 Integrate nano biosensors into existing technologies for enhanced functionality.	**K4**

UNIT-I	**Introduction to Biosensors and Nanotechnology**	**Periods: 09**	
Basics of Biosensors - - Definition and historical overview - Components of biosensors: Bioreceptor, transducer, and detector - Overview of biosensor applications. Introduction to nanomaterials and their unique properties - Role of nanotechnology in enhancing biosensor performance.			**CO1**
UNIT-II	**Nanomaterials in Biosensors**	**Periods: 09**	
Types of Nanomaterials - - Carbon-based nanomaterials (e.g., carbon nanotubes, graphene) - Metal nanoparticles (e.g., gold, silver) - Semiconductor nanoparticles (quantum dots) - Conducting polymers. Fabrication Techniques- Top-down and bottom-up approaches - Self-assembly and template synthesis - Surface functionalization strategies.			**CO2**
UNIT-III	**Design of Nano Biosensors**	**Periods: 09**	
Design Principles of Nano Biosensors - Transduction mechanisms (optical, electrochemical, mechanical) - Bioreceptor immobilization techniques - Signal amplification strategies.			**CO3**
UNIT-IV	**Applications of Nano Biosensors**	**Periods: 09**	
Clinical diagnostics and point-of-care testing - Environmental monitoring - Food safety and quality control - Drug discovery and pharmacokinetics.			**CO4**
UNIT-V	**Current Trends and Future Directions**	**Periods: 09**	
Innovations in Nano Biosensor Technology- Wearable biosensors - Lab-on-a-chip devices - Single-molecule detection - Internet of Things (IoT) integration.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Aiguo Wu, "Nano Biosensors: From Design to Applications", Springer, 1st edition, 2016.
2. Sandro Carrara, "Nano biosensors and Nanobioanalyses", Elsevier, 1st edition, 2015.
3. Dmitry Zemlyanov,"Nano biosensors: Carbon Nanotubes and Graphene", CRC Press, 1st edition, 2013.

Reference Books

1. Alexandru Grumezescu, "Nano biosensors: Nanotechnology in the Agri-Food Industry", Academic Press, 1st edition, 2016.
2. Sandro Carrara,"Nano biosensors: Theory and Applications in Healthcare", Springer, 1st edition, 2016.
3. Abhijit Bandyopadhyay,"Nano biosensors: Carbon Nanotubes in Disease Diagnosis", CRC Press, 1st edition, 2012.
4. Krishna KantAmazon, “Nano-Biosensors for Detection and Monitoring, MDPI AG, 2023
5. Jun Li and Nianqiang Wu , “Biosensors Based on Nanomaterials and Nanodevices" , Taylor & Francis, 2013.

Web References

1. https://wires.onlinelibrary.wiley.com/doi/abs/10.1002/wnan.136
2. https://www.ncbi.nlm.nih.gov/
3. https://www.nano.gov/

* TE – Theory Exam, LE – Lab Exam

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

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

Dr. A.Vijayalakshmi

Department	**Instrumentation and Control Engineering**			Programme: **B.Tech. Honours / Minor**			
Semester	**VI**			Course Category Code: PC *End Semester Exam Type:**TE**			
Course Code	**U23SXB603**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Embedded Sensing Technologies**	**3**	**1**	**0**	**4**	**50**	**50**	**100**

Common to All Branches

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand embedded system fundamentals.	**K2**
	CO2	Learn communication protocols and interfaces.	**K3**
	CO3	Explore RTOS concepts and multitasking.	**K2**
	CO4	Interface sensors and actuators in projects.	**K2**
	CO5	Develop real-time embedded applications.	**K2**

UNIT – I	**Embedded System Fundamentals**	**Periods: 10**	
System - Embedded System - Embedded Hardware Units and Devices in System-Embedded Software in a System - Embedded System-On-Chip (SoC) . ADC – DAC – Successive approximation – Timers and Counters – Watch dog Timer –Burn out Reset. Memory - Power Management. Hard and Soft Real-Time Embedded System.			**CO1**
UNIT – II	**Peripherals and Interfaces**	**Periods: 10**	
Embedded Communication Protocols - UART - SPI - I2C - CAN - Wireless Communication – Bluetooth - Zigbee - LoRa . Sensors: Accelerometer, Ultrasonic sensor, Flex sensor, Infrared sensor, PIR and Bio Sensors :(ECG, EEG,EMG,EOG) – Actuators and motor Driver- H bridge.			**CO2**
UNIT – III	**RTOS Based Embedded system design**	**Periods: 10**	
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Introduction to Raspberry pi and Applications			**CO3**
UNIT – IV	**Sensor and Actuators interfacing**	**Periods: 15**	
Hardware / Simulation 1. Gesture Control Vehicle using Accelerometer 2. Light Intensity Control using a Variable Resistor. 3. Automatic Door and Valve Control using Passive Infrared (PIR) Sensor 4. Collision Avoidance Vehicle using Infrared (IR) Sensor. 5. Motor Speed Control Using Pulse width modulation. 6. Patient Monitoring system			**CO4**
UNIT – V	**Real time Applications**	**Periods: 15**	
Hardware / Simulation 1. Embedded Weather Station for Real-Time Climate Data Collection 2. LDR-Based Automatic Street Light System 3. Ultrasonic-Based Distance Measurement 4. USV using Serial Communication 5. Embedded Home Automation System 6. Home Security Email Alert System Using Raspberry Pi			**CO5**

Lecture Periods:45	**Tutorial Periods:-**	**Practical Periods:-15**	**Total Periods:60**

Text Books

1. Embedded System Design-Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things.4th edition .Springer 2021.
2. Hands-On RTOS with Microcontrollers, Brian Amos, 2020.
3. Rajkamal, 'Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017.

Reference Books

1. Shibu. K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2nd edition 2017.

2. Lya B.Das," Embedded Systems" ,Pearson Education, 1st edition 2012.
3. Parag H.Dave,Himanshu B.Dave," Embedded Systems-Concepts ,Design and Programming, Pearson Education,2015, 1st edition.
4. Elicia White, "Making Embedded systems", O'Reilly Series ,SPD,2011, 1st edition.

Web References

1. https://nptel.ac.in/courses/108102045
2. https://www.circuitbasics.com/basics-of-the-i2c-communication-protocol/
3. https://www.tutorialspoint.com/embedded_systems/es_interrupts.htm
4. https://link.springer.com/book/10.1007/978-3-030-60910-8

TE – Theory Exam, LE – Lab Exam

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

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

Dr.L.M.Varalakshmi

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**VII**	Course Category Code: PC			*End Semester Exam Type:**TE**			
Course Code	**U23SXT704**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**IoT and Sensor Networks**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

Common to All Branches

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand the architecture of IoT	**K2**
	CO2	Acquaint on fundamentals of wireless sensor networks	**K2**
	CO3	Interpret the protocols of WSNs	**K2**
	CO4	Gain knowledge on middleware and operating systems for WSNs	**K2**
	CO5	Impart knowledge on case studies on IoT implementations.	**K3**

UNIT – I	**Architecture of IoT**	**Periods:09**	
The History and Reasoning Behind the IoT - The IoT Architectural Reference Model as Enabler - IoT in Practice: Examples: IoT in Logistics and Health – Elements to protect in IoT- Risk sources –Addressing performance and scalability – Addressing – Addressing Security – Addressing Privacy- Addressing Availability and Resilience			**CO1**
UNIT – II	**Introduction to Wireless Sensor Networks(WSN)**	**Periods:09**	
IoT Reference Architecture - Interaction of all sub models – Domain Model – Information Model - Functional Model – Communication Model – Trust, Security and Privacy Background of Sensor Network Technology - Basic Sensor Network Architectural Elements- Brief Historical Survey of Sensor Networks - Challenges and Hurdle - Applications of Wireless Sensor Networks.			**CO2**
UNIT – III	**Protocols for WSNs**	**Periods:09**	
Fundamentals of MAC Protocols - MAC Protocols for WSNs - Sensor-MAC Case Study – Routing Challenges in WSNs - Routing Strategies in WSNs - Transport Protocol Design Issues- Examples of Existing Transport Control Protocols - Performance of Transport Control Protocols			**CO3**
UNIT – IV	**Middleware and Operating systems for WSNs**	**Periods:09**	
WSN Middleware Principles- Middleware Architecture - Existing Middleware : MiLAN - IrisNet - AMF - DSWare - CLMF - MSM – Em –Impala – Dfuse -DDS – Sensor Ware. Operating System- Examples of Operating Systems – TinyOS - Mate – MagnetOS – MANTIS – OSPM - EYES OS – SenOS – EMERALDS – PICOS			**CO4**
UNIT – V	**CASE STUDY – IoT Implementations**	**Periods:09**	
Case study: Smart Grid &IoT, Commercial building automation using IoT, Recent trends in sensor network and Automation in Industrial aspect of IOT.			**CO5**

Lecture Periods:45	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Raj Kamal, "Internet of Things-Architecture and design principles", McGraw Hill Education.
2. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, “Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model”, Springer Open, 2016
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014.
3. Vijay Madisetti, Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally “Internet of Things A Hands-on-Approach” Arshdeep Bahga & Vijay Madisetti, 2014.
4. Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010.

Web References

1. https://www.geeksforgeeks.org/wireless-sensor-network-wsn/

2. https://mrcet.com/downloads/digital_notes/EEE/IoT%20&%20Applications%20Digital%20Notes.pdf
3. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
4. https://www.iotforall.com/wireless-sensors-for-iot
5. https://www.tutorialspoint.com/difference-between-wireless-sensor-networks-and-iot

* TE – Theory Exam, LE – Lab Exam

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

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

Dr.L.M.Varalakshmi

Department	**Biomedical Engineering**			Programme: **B.Tech. Honours / Minor**			
Semester	**VIII**			Course Category: **PC**		*End Semester Exam Type: **TE**	
Course Code	**U23SXT805**	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**Wearable Devices and its Applications**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

Common to All Branches

Prerequisite	**-**	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand design, functionality, applications, and challenges of wearable devices in healthcare and technology.	**K2**
	CO2 Familiarize the smart textiles, signal processing, and energy harvesting for innovative, efficient, and sustainable wearable devices.	**K3**
	CO3 Comprehend the principles, design, and applications of wearable biochemical and gas sensors for healthcare monitoring.	**K2**
	CO4 Comprehend the design and development of various wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications.	**K3**
	CO5 Impart knowledge on IoT integration in wearables, analyze applications, and evaluate real-world case studies effectively.	**K3**

UNIT-I	**Introduction to Wearable Devices**	**Periods: 09**
Wearable Systems- Introduction, Need for Wearable Systems, Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems- Inertia movement sensors, Respiration activity sensor, Wearable ground reaction force sensor.		**CO1**
UNIT-II	**Smart Textile, Signal Processing and Energy Harvesting for Wearable Devices.**	**Periods: 09**
Introduction to smart textile- Passive smart textile, active smart textile- Fabrication Techniques. Wearability issues - physical shape and placement of sensor, sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests.		**CO2**
UNIT-III	**Wearable Biochemical and Gas Sensors**	**Periods: 09**
Wearable Biochemical Sensors: Parameters of interest –Textile based, Microneedle based; Types: Noninvasive Glucose Monitoring Devices, GlucoWatch G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable & wearable; Wearable capnometer for monitoring of expired carbon dioxide. Wearable gas sensors: Metal Oxide (MOS) type, electrochemical type, new materials-CNTs, graphene, Zeolites; Detection of atmospheric pollutants.		**CO3**
UNIT-IV	**Wearable Devices for Healthcare**	**Periods: 09**
Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile, Modality of measurement wearable, adhesive/tattoo type. Conductive textile electrodes, Knitted Piezoresistive Fabric (KPF) sensors.		**CO4**
UNIT-V	**Role of IoT in Wearable Devices and Case Study**	**Periods: 09**
Evolution of wearable technology, Smart connectivity and big picture of IoT-smart devices, networks, Wireless technologies and need for data analysis, Wearable IoT use cases- Smart watches, Android wear, Smart glasses, fitness trackers, health care devices, cameras, smart clothing. Case studies – Health care, fitness and sports, defense and security, fashion and apparel.		**CO5**

Lecture Periods: 45	**Tutorial Periods:-**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Gilmore, Bringers of Order: Wearable Technologies and the Manufacturing of Everyday Life, University of California Press, 2023
2. Charlton, P.H., Signal Processing and Learning for Wearables, 2023
3. Tamura, T., & Chen, W., Seamless Healthcare Monitoring, Springer, 2018.

Reference Books

1. Sazonov, E., & Neuman, M.R., Wearable Sensors: Fundamentals, Implementation and Applications, Academic Press, 2020.
2. Bello, Y., & Figetakis, E., IoT-based Wearables: A Comprehensive Survey, 2023.
3. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
4. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.

Web References

1. https://onlinecourses.nptel.ac.in/noc23_ee95/preview?utm_source
2. https://www.youtube.com/watch?reload=9&v=Sj5yz9hNvoM
3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206 Diagnostic and Therapeutic EquipmentTraining.pdf

* TE – Theory Exam, LE – Lab Exam

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

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

Dr. A.Vijayalakshmi

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**VIII**	Course Category: **PA**			End Semester Exam: **PA**			
Course Code	**U23SXW806**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Project / Model Making**	**0**	**0**	**4**	**2**	**100**	**-**	**100**

Each student is required to undertake a project or develop a model within the domain of Sensors Technology. The student must identify a specific area of specialization within this field, and the project will be carried out under the guidance of a faculty member assigned by the Head of the Department.

Students are expected to address real-world or relevant challenges by applying engineering principles to develop solutions through prototype development, simulations, coding, process establishment, synthesis, or correlation analysis.

The progress of the project will be systematically monitored and evaluated in accordance with established guidelines. Upon completion, students must submit a comprehensive report of at least 20 pages by the end of the eighth semester.

Assessment Guidelines

Student will be evaluated by the Internal Members based on the below criteria.

Criteria	Internal	External
Identification of Problem Domain	5	5
Study of Existing Systems and establishing clear objectives	10	10
Planning of project	10	10
Documentation and Technical Writing	10	10
Demonstration	15	15
Total Marks	**50**	**50**

Dr.L.M.Varalakshmi

Annexure – III

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

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 Contact No 9443275120
2.	Dr. B.Hema Kumar	Ph.D	Biomedical Engineering	21	Associate Professor, Department of Electronics and Instrumentation Pondicherry Technological University, Puducherry	hemakumarb@pec.edu Contact No 9944929804
3.	Dr.K.Kala	Ph.D	Anatomy and Physiology	22	Assistant Professor Department of Biomedical Engineering, Saveetha Engineering College, Chennai-602105	Kala.harishi@gmail.com Contact No 6381089711
4.	Dr.V.Janakiraman	Ph.D	Signal processing	20	Professor Department of Electronics and Communication Engineering Dhanalakshmi Srinivasan College of Engineering and Technology, Chennai- 603104	vjramece@gmail.com Contact No 9444255029, 7358374100
5.	Dr. V.Kamatchi Sund	Ph.D	Image Processing	22	Professor Department of Electronics and Communication Engineering, SRM Institute of Science and Technology, Chennai	vkamatchisundari@gmail.com Contact No 9952041393
6.	Dr. P. Vijayakumar	Ph.D	Wireless Communication Network Security	13	Associate Professor, Department of Electronics Engineering, Vellore Institute of	vijayrgcet@gmail.com Contact No 9894727271

					Technology, Chennai.	
7.	DrJobin Christ	Ph.D	Biomedical signal processing	24	Professor, Department of Biomedical Engineering, Rajalakshmi Engineering College, Chennai.	jobinchrist@gmail.com jobinchrist.mc@rajalakshmi.edu.in Contact No 9842666844
8.	Dr.M.Vijayakarthik	Ph.D	Electronics and Instrumentation	18	Associate Professor, Department of Electronics and Instrumentation, Madras Institute of Technology, Chennai.	vijayakarthick@yahoo.co.in Contact No 9976995692
9.	Dr. J. Mohan	Ph.D	Biomedical Signal and Image Processing	18	Valliammai Engineering college, SRM Nagar, Kattankulathur.	mohanjece@valliammai.co.in, Contact No 9840791532
10.	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 Contact No 9443283639
11.	Dr.S.Sathishbabu	Ph.D	Biosignals and Systems	26	Associate Professor, Department of Electronics and Communication, Thanthai Periyar Government Institute of Technology, Vellore.	sathish3575@gmail.com Contact No 9894235162
12.	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 Contact No 9840959832
13	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.	pthirunacas@gmail.com. Contact No 9952172249

14	Dr. M. PheminaSelvi	Ph.D	ECE	26	Assistant professor, Department of Electronics and Communication Engineering, University College of Engineering, Villupuram	vm.femina@gmail.com Contact No 9994267707
15	Dr. R. Sandanalakshmi	Ph.D	ECE	22	Assistant Professor Department of Electronics and Communication Engineering, Pondicherry Engineering College, Puducherry.	sandanalakshmi@pec.edu Contact No 9790972173
16	Dr. N. M. Hariharan	Ph.D	Biotechnology	12	Professor and Head, Department of Biotechnology, SreeSastha Institute of Engineering and Technology,Chennai.	biotechhod@ssiet.in Contact No 904062599 .
17	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. Contact No 9944567367
18	Dr. Ashokan	Ph.D	Biomedical Engineering	10	Professor and Head, Department of Biomedical Engineering Kongunadu College of Engineering and Technology.	Hodbme@kongunadu.ac.in Contact No 8012505054
19	Dr.Srigitha.S.Nath	Ph.D	Applied Electronics	22	Associate Professor, Department of Electronics and Communication Engineering Saveetha Engineering college,Chennai.	hod.ece@saveetha.ac.in Contact No 9840367678
20	Dr.P.Muthu	Ph.D	Biomedical Engineering	16	Assistant Professor Department of Nano science and Technology, SRM Institute of Science and Technology Kattankulathur.	muthup@srmist.edu.in Contact No 9486338640
21	Dr. Prasath Alias Surendhar. S	Ph.D	Biomedical Engineering	8	Associate Professor Department of Biomedical Engineering Aarupadai Veedu	prasaths.bme@gmail.com Contact No 8754581937

					Institute of Technology Rajiv Gandhi Salai (OMR) Paiyanoor-603 104	
22	Dr. A. Uma Maheswari	Ph.D	Biosignals and Systems	15	Assistant Professor, Department of ECE, University College of Engineering, Panruti.	umamaheswaritrk@gmail.com Contact No 8838553935
23	Dr. S. Ashok	Ph.D	Communication Systems	12	Assistant Professor, Department of ECE,Veltech multitech Dr. Rangarajan Dr. Sakunthala Engineering college, Chennai.	sashok@veltechmultitech.org Contact No - 9994206725
24	Dr. S. Rajalaxmi	Ph.D	Biomedical Instrumentation	15	Associate Professor &Head Department of Biomedical Engineering Mahendra college of Engineering, Salem.	hodbiomed@mahendracollege.com Contact No 9865147730
25	Dr. S. Saranya	Ph.D	Biomechanics	8	Assistant Professor/ BME, Sri Sivasubramaniya Nadar College of Engineering, Chennai.	ssaranya@ssn.edu.in Contact No 9941163265
26	Dr. E. Sathish	Ph.D	Biomechanics	7	Assistant Professor, Dept of BME, Vellore Institute of Technology, Chennai.	sathish.e@vit.ac.in Contact No 9941163265
27	Dr. T. Rajalakshmi	Ph.D	Digital Logic Circuits	13	Assistant Professor,Dept of BME, SRM Institute of Science and Technology, Chennai.	rajalakt@srmist.edu.in Contact No 9884781995
28	Dr. V. Parthasaradi	Ph.D	Biosignals and Systems	7	Assistant Professor, Department of ECE,E.G.SPillay Engineering College, Nagapattinam.	saradi.66@gmail.com Contact No 8838553935
29	Dr. A. Uma Maheswari	Ph.D	Biosignals and Systems	8	Assistant Professor, Department of ECE, University College of Engineering, Panruti.	umamaheswaritrk@gmail.com Contact No 8838553935
30	Dr. D. Ashok Kumar	Ph.D	Diagnostic and Therapeutic Equipments	6	Associate Professor, Department of Biomedical Engineering, SRM Institute of Science and Technology,	ashok.d@ktr.srmuniv.ac.in Contact No 9442139050

					Chennai.	
31	Dr. P.Mathivanan	Ph.D	Medical Image Techniques	7	Assistant Professor, Department of ECE, Amrita Vishwa Vidyapeetham chennai campus, Chennai.	p_mathivanan@ch.amrita.edu Contact No 9840079520
32	Dr.S.Vijayanand	Ph.D	Microcontroller and Embedded Systems	10	Assistant Professor, Department of ECE, Sri Venkateswara college of engineering, Chennai.	vijayanand.s@svce.ac.in Contact No 9840079520
33	Dr. N. Prithiviraj	Ph.D	Diagnostic and Therapeutic Equipment	12	Research Scientist, Centre for Biomedical Research, Aarupadai Veedu Medical College &Hospital, Puducherry	prithivinaga@gmail.com. Contact No 6380400036
34	Dr.R.Naresh	Ph.D	Image Processing	10	Assistant Professor, School of Computing, SRM Institute of Science and Technology, Kattankulathur, Chennai	nareshcsephd@gmail.com Contact No: 8056662701
35	Dr .N. Senthilkumar	Ph.D	Nanotechnoloy	5	Assistant Professor, Department of ECE, M.Kumarasamy College of Engineering, Erode,	Senthilkumarn.ece@mkce.ac.in Contact No:9894856176
36	Dr.Indhumathi	Ph.D	Biomedical Instrumentation	15	Professor/BME Bharath Institute of Technology Chennai.	indhumathir.biomedical@@bharathuniv.ac.in Contact No:9384565205
37	Dr.Sandhiya,	Ph.D	Medical Electronics	8	Assistant Professor/BME, Aarupadai Veedu Institute of Technology, Chennai.	sandhiya.bme@avit.ac.in Contact No:9384565205
38	Dr.A.T.Priyeshkumar	Ph.D	Biomedical Instrumentation	12	Assistant Professor/BME Mahendra College of Engineering, Salem.	priyeshmce.bme@gmail.com Contact No: 8825250302

39.	Dr.K.Saravanan	Ph.D	Applied Electronics	12	Associate Professor/EEE Dr.MGR Educational and Research Institute	saravanan.eee@drmgr.ac.in Contact No:9444579849
40.	Dr.M.Ravi	Ph.D	Human Genetics	11	Professor Department of Human Genetics SRM Institute of Science and Technology, Kattankulathur, Chennai	mravi@sriramachandra.edu.in Contact No:9841486363
41	Dr.P. Baranisrinivasan	Ph.D	Biomedical Engineering	18	Professor, Department of Biomedical Engineering, Rajiv Gandhi college of Engineering and Technology, Puducherry	pbspy01l@gmail.com Contact No: 8778484608
42	Dr.A.Vengadesan	Ph.D	Electrical and Electronics Engineering	16	Assist Professor, Department of Biomedical Engineering, Sri Venkateshwara college of Engineering and Technology, Puducherry	avmithrankavin@svcet.ac.in Contact No: 8838263097
43	Dr. Vijayakumar P	Ph.D	Network Security	14	Professor School of Electronic Engineering, Vellore Institute of Technology, Chennai.	vijayrgcet@gmail.com Contact No: 9894727271
44	Dr.Babu Shanmugham	Ph.D	Electronics Instrumentation	16	Associate Professor, Department of Biomedical Engineering, Rajiv Gandhi college of Engineering and Technology, Puducherry	Babulakshmi2007@gmail.com Contact No: 9884251898

45	Dr.N.Kins Burk Sunil	Ph.D	Biomedical Instrumentation ,Bio Signal Image processing	17	Associate Professor Department of Biomedical Engineering Sethu Institute of Technology, Pulloor, Kariapatti, Virudhunagar District, Tamil Nadu - 626115	kinsburksunil@gmail.com Contact No: 9994045939
46	Dr P Maran	Ph.D	Signal Processing	8	Assistant professor (sr gr) Department of ECE, Amrita Vishwa Vidyapeetham chennai campus, Chennai.	p_marab@ch.amrita.edu Contact No:9884019078
47	Dr. V. Magesh	Ph.D	ECE	20	Assistant Professor Department of ECE Velammal Engineering College, Chennai -66	mahi0437@gmail.com Contact No:8124428388
48	:Dr.R.Annamalai	Ph.D	Artificial Intelligence	15	Associate Professor Department :CSE AI College name :Amrita Vishwa vidyapeetham Chennai	annamalaimtech@gmail.com Contact No: 7449204021
49	Dr.R.Krishnaprasanna	Ph.D	Medical Electronics	13	Assistant Professor Department of ECE Sathyabama institute of science and technology, chennai	krishnaprasanna.ece@sathyabama.ac.in Contact No:9952489022
50	Dr. A. ARANGANATHAN	Ph.D	Image Processing	16	Associate Professor Department of ECE Sathyabama University Institution Address : OMR, Rajiv Gandhi salai, jeppiaar nagar, Sholinganallur, Chennai- 119	aranganathan.etc@sathyabama.ac.in Contact No:9444234224
51	Dr. R. Thamaraiselvi,	Ph.D	Electrical Circuits, Microcontroler and embedded systems	23	Assistant Professor Department of ECE University college of engineering Villupuram	r.thamaraiselvi1@gmail.com Contact No: 9080376056

52	Dr.P.Savaridasan	Ph.D	Image Processing, Cyber Security	16	Assistant Professor,School of Computing, SRM Instutute of Science and Technology, Kattankulathur, Chennai.	savaridp@srmist.edu.in Contact No: 7904461608