Estd. 2000

MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University) Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Curriculum/Syllabus

Programme Code : **BME**

Programme Name : **B.E-Biomedical Engineering**

Regulation : **R-2021**

MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, Accredited by NAAC & NBA, Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

MUTHAYAMMAL ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University) Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

INSTITUTION VISION &MISSION

INSTITUTION VISION

To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

INSTITUTION MISSION

- To prepare the students with high professional skills and ethical values
- To impart knowledge through best practices
- To instill a spirit of innovation through Training, Research and Development
- To undertake continuous assessment and remedial measures
- To achieve academic excellence through intellectual, emotional and social stimulation

INSTITUTION MOTTO

Rural upliftment through Technical Education.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autor...
Rasipuram, Namakkal Dist. 637...

MUTHAYAMMAL ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University) Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

DEPARTMENT VISION & MISSION

DEPARTMENT VISION

To empower the students with Engineering and Medical knowledge in both theoretical and experimental practices with research attitude and ethics for healthcare applications.

DEPARTMENT MISSION

- To develop the technical skills with Engineering knowledge and enhance the clinical solutions in healthcare sector.
- To establish the state of art laboratories in preparing the students for facing the challenges in medical field.
- To enhance the students with highly skilled ethical social and economic implications of their work.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist. 637 408

MUTHAYAMMAL ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University) Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

DEPARTMENT PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

PROGRAM EDUCATIONAL OBJECTIVES

The Biomedical Engineering Graduates should be able to

PEO1: Graduate should be able to apply the principles and tools from physical science to engineering and medical sciences.

PEO2: Graduate should be able to create innovations that analyze real time problems and meet desire needs in healthcare sector.

PEO3: Graduate should be able to accomplish professional success with promise to the social responsibilities and engaging in lifelong learning

PROGRAM OUTCOMES

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
3. **Design/Development solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist. 637 408

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1: Acquire essential knowledge and basic skills in addition to in depth knowledge of engineering sciences and medical sciences

PSO2: Apply ICT tools and skills in multi disciplinary environment to develop innovative diagnostic and therapeutic devices for better healthcare

PSO3: Develop algorithms for analyze, measurements and interpret data in medicine and life sciences

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Estd. 2000

MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

B.E - BIOMEDICAL ENGINEERING

GROUPING OF COURSES

1. Foundation Courses (FC):

S.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	21HSS01	Business English	HS	3	2	0	0	2
2	21HSS02	Communicative English Practices Laboratory	HS	2	0	0	2	1
3	21HSS03	Life Skills and Workplace Psychology	HS	3	2	0	0	2
4	21HSS04	Technical English For Engineers	HS	3	2	0	0	2
5	21HSS05	Communicative English for Engineers	HS	3	2	0	0	2
6	21HSS06	Basics of Japanese Language	HS	3	2	0	0	2
7	21HSS07	Basics of French Language	HS	3	2	0	0	2

2. Basic Sciences Courses (BS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	21BSS01	Engineering Physics	BS	4	3	0	0	3
2.	21BSS02	Physics and Chemistry Laboratory	BS	2	0	0	2	1
3.	21BSS03	Bio and Nanomaterials Science	BS	4	3	0	0	3
4.	21BSS04	Materials Science	BS	4	3	0	0	3
5.	21BSS05	Physics for Mechanical Engineers	BS	4	3	0	0	3
6.	21BSS11	Engineering Chemistry	BS	4	3	0	0	3
7.	21BSS12	Environmental Science and	BS	4	3	0	0	3

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist. 637 408

		Engineering						
8.	21BSS13	Applied Chemistry	BS	4	3	0	0	3
9.	21BSS21	Algebra and Calculus	BS	5	3	1	0	4
10.	21BSS22	Advanced Calculus and Complex Analysis	BS	5	3	1	0	4
11.	21BSS23	Transforms and Partial Differential Equations	BS	5	3	1	0	4
12.	21BSS24	Discrete Mathematics	BS	5	3	1	0	4
13.	21BSS25	Statistic and Queuing Model	BS	5	3	1	0	4
14.	21BSS26	Numerical Methods	BS	5	3	1	0	4
15.	21BSS27	Probability and Random Processes	BS	5	3	1	0	4
16.	21BSS28	Statistics and Numerical Methods	BS	5	3	1	0	4

3. General Engineering Science Courses (GES)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	21GES01	Programming for Problem Solving Using C	GES	3	3	0	0	3
2.	21GES02	Programming for Problem Solving Techniques	GES	3	3	0	0	3
3.	21GES03	Programming in C Laboratory	GES	3	0	0	2	1
4.	21GES04	Programming in C and Python Laboratory	GES	3	0	0	2	1
5.	21GES05	Electrical and Electronic Sciences	GES	3	3	0	0	3
6.	21GES06	Mechanical and Building Sciences	GES	3	3	0	0	3
7.	21GES07	Computer Aided Drafting Laboratory	GES	3	0	0	3	1
8.	21GES08	Python Programming	GES	3	3	0	0	3
9.	21GES09	Programming in Python Laboratory	GES	3	0	0	2	1
10.	21GES10	Soft Skills Laboratory	GES	3	0	0	2	1
11.	21GES11	Electronic Devices	GES	3	3	0	0	3
12.	21GES12	Electronic Simulation Laboratory	GES	3	0	0	2	1
13.	21GES13	Electric Circuits	GES	3	2	1	0	3
14.	21GES14	Electric Circuits Laboratory	GES	3	0	0	2	1
15.	21GES15	Manufacturing Processes	GES	3	3	0	0	3

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Auton
Rasipuram Namakkal Dist

16.	21GES16	Manufacturing Processes Laboratory	GES	3	0	0	2	1
17.	21GES17	Mechanical and Building Sciences Laboratory	GES	3	0	0	2	1
18.	21GES18	Fundamentals of Civil Engineering	GES	3	3	0	0	3
19.	21GES19	Concepts in Product Design	GES	3	3	0	0	3
20.	21GES20	Renewable Energy Sources	GES	3	3	0	0	3
21.	21GES21	Electrical Drives and Controls	GES	3	3	0	0	3
22.	21GES22	Electrical Drives and Controls Laboratory	GES	3	0	0	2	1
23.	21GES23	Analog and digital communication	GES	3	3	0	0	3
24.	21GES24	Digital Principles and System Design	GES	3	3	0	0	3
25.	21GES25	Digital Principles and System Design Laboratory	GES	3	0	0	2	1
26.	21GES26	Engineering Drawing	GES	4	1	0	2	2
27.	21GES27	Engineering Geology	GES	3	3	0	0	3
28.	21GES28	Engineering Mechanics	GES	4	3	1	0	4
29.	21GES29	Wireless Communication	GES	4	3	0	0	3
30.	21GES30	Electronics And Microprocessors	GES	3	3	0	0	3
31.	21GES31	Electronics And Microprocessors Laboratory	GES	2	0	0	2	1
32.	21GES32	Data Structure using Python	GES	3	3	0	0	3
33.	21GES33	Electronic Devices And Circuits	GES	3	3	0	0	3
34.	21GES34	Electronic Simulation Laboratory	GES	2	0	0	2	1

PROFESSIONAL CORE [PC]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	21BMC01	Human Anatomy & Physiology	PC	3	3	0	0	3
2	21BMC02	Biomedical Sensors & Instruments	PC	3	3	0	0	3
3	21BMC03	Fundamentals of Biochemistry	PC	3	3	0	0	3
4	21BMC04	Analog and Digital Integrated	PC	4	4	0	0	4

Chairman
Board of Studies
Department of Biomedical Engineeri
Muthayammal Engineering College (Auton
Rasipuram Namakkal Dist 63

5	21BMC05	Pathology and Microbiology	PC	3	3	0	0	3
6	21BMC06	Hospital Management	PC	3	3	0	0	3
7	21BMC07	Biomedical Instrumentation – I	PC	3	3	0	0	3
8	21BMC08	Signals and Systems	PC	4	4	0	0	4
9	21BMC09	Biomedical Instrumentation – II	PC	3	3	0	0	3
10	21BMC10	Control System for Biomedical Engineering	PC	4	4	0	0	4
11	21BMC11	Medical Signal Processing	PC	4	4	0	0	4
12	21BMC12	Microprocessors and Microcontrollers In Medicine	PC	3	3	0	0	3
13	21BMC13	Basic Clinical Sciences - I	PC	3	3	0	0	3
14	21BMC14	Biomechanics & Rehabilitation	PC	3	3	0	0	3
15	21BMC15	Embedded Systems and IoMT	PC	3	3	0	0	3
16	21BMC16	Basic Clinical Sciences - II	PC	3	3	0	0	3
17	21BMC17	Medical Image Processing	PC	3	3	0	0	3
18	21BMC18	Advanced Therapeutic Equipment	PC	3	3	0	0	3
19	21BMC19	Analytical & Diagnostic	PC	3	3	0	0	3
20	21BMC20	Bio Medical Sensors and Instruments Laboratory	PC	2	0	0	2	1
21	21BMC21	Biochemistry and Human Physiology Laboratory	PC	2	0	0	2	1
22	21BMC22	Analog and Digital Integrated Circuits laboratory	PC	2	0	0	2	1
23	21BMC23	Pathology and Microbiology Laboratory	PC	2	0	0	2	1
24	21BMC24	Medical Signal Processing Laboratory	PC	2	0	0	2	1
25	21BMC25	Biomedical Instrumentation Laboratory	PC	2	0	0	2	1
26	21BMC26	Microprocessor and Microcontrollers Laboratory	PC	2	0	0	2	1
27	21BMC27	Embedded System Laboratory	PC	2	0	0	2	1

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist. 637 408

28	21BMC28	Medical Image Processing Laboratory	PC	2	0	0	2	1

PROFESSIONAL ELECTIVES [PE]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	21BME01	Biomaterials and Artificial Organs	PE	3	3	0	0	3
2.	21BME02	Biostatistics	PE	3	3	0	0	3
3.	21BME03	Medical Science	PE	3	3	0	0	3
4.	21BME04	Sports Physical Therapy	PE	3	3	0	0	3
5.	21BME05	Telemedicine	PE	3	3	0	0	3
6.	21BME06	Brain Computer Interface and Applications	PE	3	3	0	0	3
7.	21BME07	Medical Optics	PE	3	3	0	0	3
8.	21BME08	AI & Medical Informatics	PE	3	3	0	0	3
9.	21BME09	Virtual Reality	PE	3	3	0	0	3
10.	21BME10	Wearable Systems	PE	3	3	0	0	3
11.	21BME11	Internet of Things	PE	3	3	0	0	3
12.	21BME12	Hospital Waste Management	PE	3	3	0	0	3
13.	21BME13	LABVIEW for Healthcare applications	PE	3	3	0	0	3
14.	21BME14	Fiber optics and Lasers in Medicine	PE	3	3	0	0	3
15.	21BME15	Medical Robotics & Automation	PE	3	3	0	0	3

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram Namakkal Dist 637 4

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	21BMS01	Project Work Phase – I	EEC	10	0	0	10	3
2.	21BMS02	Project Work Phase –II	EEC	12	0	0	12	6
3.	21BMS03	Summer Internship	EEC	4	3	0	4	2
4.	21BMS04	Design Project	EEC	3	0	0	3	1
5.	21BMS05	Hospital Training	EEC	4	0	0	4	2

COURSE COMPONENT SUMMARY

S. No.	Subject Area	Credits Per Semester								Credits Total	AICTE Credits
		I	II	III	IV	V	VI	VII	VIII		
1	FC	21	20	7	4	-	-	-	-	52	66
2	PC	-	-	20	19	15	13	6	-	73	55
3	PE	-	-	-	-	6	6	6	-	18	12
4	OE	-	-	-	-	-	3	3	-	6	12
5	EEC	-	-	-	-	-	1	4	6	11	15
TOTAL		21	20	27	23	21	23	19	6	**160**	**160**

Total Credits: 160

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist.

	MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R – 2021
Department	BIOMEDICAL ENGINEERING	
Programme	BE	

SEMESTER – III

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	21BSS23	Transforms & Partial Differential Equations	4	1	0	4	5
2.	21BMC01	Human Anatomy & Physiology	3	0	0	3	3
3.	21BMC02	Biomedical Sensors & Instruments	3	0	0	3	3
4.	21BMC03	Fundamentals of Biochemistry	3	0	0	3	3
5.	21GES20	Renewable Energy Sources	3	0	0	3	3
PRACTICALS							
6.	21BMC20	Bio Medical Sensors and Instruments Laboratory	0	0	3	1	3
7.	21BMC21	Biochemistry and Human Physiology Laboratory	0	0	3	1	3
Total Credits						**18**	

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R – 2021

Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – IV

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	21BMC04	Analog and Digital Integrated Circuits	3	1	0	4	5
2.	21BMC05	Pathology and Microbiology	3	0	0	3	3
3.	21BSS27	Probability and Random Process	3	1	0	4	5
4.	21BMC10	Control System for Biomedical Engineering	3	1	0	4	5
5.	21BMC08	Signals and Systems	3	1	0	4	5
6.	21GES23	Analog and Digital Communication	3	0	0	3	3
7.	21GES33	Electronic Devices and Circuits	3	0	0	3	3
PRACTICALS							
7.	21BMC22	Analog and Digital Integrated Circuits laboratory	0	0	3	1	3
8.	21BMC23	Pathology and Microbiology Laboratory	0	0	3	1	3
Total Credits						**27**	

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R – 2021

Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – V

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	21BMC07	Biomedical Instrumentation - I	3	0	0	3	3
2.	21BMC09	Biomedical Instrumentation - II	3	0	0	3	3
3.	21BMC11	Medical Signal Processing	3	1	0	4	5
4.	21BMC12	Microprocessors and Microcontrollers In Medicine	3	0	0	3	3
5.	21BMC06	Hospital Management	3	0	0	3	3
6.		PE – I	3	0	0	3	3
7.		OE-I	3	0	0	3	3
PRACTICALS							
8.	21BMC24	Medical Signal Processing Laboratory	0	0	3	1	3
9.	21BMC25	Biomedical Instrumentation Laboratory	0	0	3	1	3
10.	21BMC26	Microprocessor and Microcontroller laboratory	0	0	3	1	3
Credits					**Total**	**25**	

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R – 2021

Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – VI

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	21BMC13	Basic Clinical Sciences – I	3	0	0	3	3
2.	21BMC14	Biomechanics & Rehabilitation Engineering	3	0	0	3	3
3.	21BMC15	Embedded Systems and IoMT	3	0	0	3	3
4.	21BMC16	Basic Clinical Sciences – II	3	0	0	3	3
5.		PE-II	3	0	0	3	3
6.	21BMC17	Medical Image Processing	3	1	0	4	3
PRACTICALS							
7.	21BMC27	Embedded System Laboratory	0	0	3	1	3
8.	21BMC28	Medical Image Processing Laboratory	0	0	3	1	3
Total Credits						**21**	

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R – 2021

Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – VII

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	21BMC18	Advanced Therapeutic Equipment	3	0	0	3	3
2.	21BMC19	Analytical & Diagnostic Equipments	3	0	0	3	3
3.		PE-III	3	0	0	3	3
4.		PE-IV	3	0	0	3	3
5.		OE-II	3	0	0	3	3
6.		OE-III	3	0	0	3	3
PRACTICALS							
7.	21BMS04	Design Project Laboratory	0	0	3	1	3
8.	21BMS01	Project Work Phase -I	0	0	6	3	6
Total Credits						**21**	

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R – 2021

Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – VIII

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
PRACTICALS							
1.	21BMS02	Project Work Phase -II	0	0	12	6	12
2.	21BMS03	Summer Internship (Minimum 8 Weeks)	0	0	0	3	0
Total Credits						**09**	

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC01	**Human Anatomy & Physiology**	3	0	0	3

OBJECTIVES:

- Know basic structural and functional elements of human body.
- Learn organs and structures involving in system formation and functions.
- Understand circulatory system.
- Learn urinary and special sensory system
- Study about nervous system

COURSE OUTCOME

- To Know basic structural and functional elements of human body.
- To Learn organs and structures involving in system formation and functions.
- To Understand circulatory system.
- To Learn urinary and special sensory system
- To Study about nervous system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC01.CO1	x	X	X	-	-	-	-	-	-	x	-	x	x	-	-
21BMC01.CO2	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC01.CO3	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC01.CO4	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC01.CO5	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I Basic Elements of Human Body **9**

Cell: Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane – origin of cell membrane potential – Action potential Tissue: Types – Specialized tissues – functions, Types of glands.

UNIT II Skeletal System: **9**

Bone, Types of bone, structure, bone cells, functions of bone. Axial skeleton- skull, sinuses, Fontanelles, vertebral column- characteristics of typical vertebra, different parts of vertebral column (parts only), features of vertebral column, movements and functions of vertebral column, sternum, ribs, shoulder girdle and upper limb, pelvic girdle and lower limb

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

UNIT III Circulatory System 9

Blood composition - functions of blood – functions of RBC. WBC types and their functions Blood groups – importance of blood groups – identification of blood groups. Blood vessels - Structure of heart – Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – ECG - Heart sound - Volume and pressure changes and regulation of heart rate –Coronary Circulation. Factors regulating Blood flow.

UNIT IV Urinary And Nervous System 9

Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base regulation – Urinary reflex – Homeostasis and blood pressure regulation by urinary system. - Structure of a Neuron – Types of Neuron. Synapses and types. Conduction of action potential in neuron Brain – Divisions of brain lobes - Cortical localizations and functions - EEG. Spinal cord – Tracts of spinal cord - Reflex mechanism – Types of reflex. Autonomic nervous system and its functions.

UNIT V Muscles And Joints : 9

Muscle tissue:Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue, muscle tone and fatigue. Types of joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radioulnar joint, wrist joint, joints of hands and fingers, Hip joint, Knee joint, ankle joint, joints of foot and toes.

TOTAL: 45 HRS

TEXT BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Elaine.N. Marieb,	Essential of Human Anatomy and Physiology	Pearson Education NewDelhi,.	Eight edition,, 2007.
2.	Gillian Pocock, Christopher D. Richards	The Human Body An introduction for Biomedical and Health Sciences	Oxford University Press,USA	2009

REFERENCE BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William F.	Review of Medical	Mc Graw Hill New Delhi	22nd edition

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	Ganong	Physiology		
2.	Eldra Pearl Solomon	Introduction to Human Anatomy and Physiology	W.B.Saunders Company	2003
3.	Arthur C. Guyton	Text book of Medical Physiology	11 th Edition, Elsevier Saunders,	11th Edition, 2006
4.	Juergen Mai George Paxinos	The Human nervous System	Academic Press 3rd Edition	2011
5.	Midthun Joseph	The Digestive and Urinary Systems	World Book, Inc	2011

WEB URLs

1.https://nptel.ac.in/courses/104101093/3

2.https://nptel.ac.in/courses/122103039/16

3.https://nptel.ac.in/noc/individual_course.php?id=noc18-ch11

4.https://nptel.ac.in/courses/102104058/19

5.https://nptel.ac.in/courses/102104058/19

Chairman
Board of Studies
Department of Biomedical Engineeri.
Muthayammal Engineering College (Autonomou.
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC02	**Biomedical Sensors & Instruments**	3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
- To know the different display and recording devices.
- To study signal conditioning & signal analyser

OUTCOMES

- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Describe the purpose and met hods of measurements
- Analyze the characteristics of different transducers
- Explain different display and recording devices for various applications.
- To study signal conditioning & signal analyser

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC02.CO1	x	X	X	-	-	-	-	-	-	x	-	x	x	-	-
21BMC02.CO2	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC02.CO3	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC02.CO4	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC02.CO5	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I Science of Measurement 7

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II Displacement, Pressure, Temperature Sensors

Chairman
Board of Studies
Department of Biomedical Engineeri
Muthayammal Engineering College (Autonomou
Rasipuram, Namakkal Dist 637 408

Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement & pressure transducers, RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple – characteristics.

UNIT III Photoelectric and Piezo Electric Sensors **9**

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

UNIT IV Signal Conditioning and Signal Analyser **9**

AC and DC Bridges –wheat stone bridge, Kelvin, Maxwell, Hay, Schering – Concepts of filters, Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

UNIT V Display and Recording Devices **9**

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Demonstration of the display and recording devices.

TOTAL: 45 HRS

TEXT BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	L.A Geddes and L.E.Baker.	Principles of Applied Biomedical Instrumentation	Third Edition, – John Wiley and sons,	Reprint 2008
2.	Albert D.Helfrick	Modern Electronic Instrumentation and Measurement Techniques	William D.Cooper. Prentice Hall of India,	2007

REFERENCE BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.K.Sawhney	Electrical & Electronics Measurement and	10th Edition, Dhanpat Rai&Co,New Delhi	2000

Chairman Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

		Instrumentation		
2.	Ernest o Doebelin and dhanesh N manik	Measuremet systems, Application and design	5th Edition, Mc Graw-Hill	2007.
3.	Khandpur R.S	Handbook of Biomedical Instrumentation	Tata McGraw Hill, New Delhi, 3rd Edition	2014.
4.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer	Biomedical Instrumentation and Measurement	Prentice Hall India Pvt. Ltd. , New Delhi, 2nd Edition, Reprint	2013
5.	John G.Webster	'Medical Instrumentation Application and Design'	4th edition, John Wiley and Sons, New York	2009.

WEB URLs

1. https://nptel.ac.in/courses/112106139/
2. https://nptel.ac.in/courses/112103174/3
3. https://nptel.ac.in/courses/108105064/24
4. https://nptel.ac.in/courses/108105062/8
5. https://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/.../mod1/10.htm

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC03	**Fundamentals of Biochemistry**	3	0	0	3

COURSE OBJECTIVES

To learn the concept of how to learn patterns and concepts of molecules

To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances
Explore supervised and unsupervised learning paradigms of machine learning
To explore Deep learning technique and various feature extraction strategies
To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes

COURSE OUTCOMES

Identify the perspectives of machine learning
Apply decision tree and Artificial neural networks for real world problems
Design a Bayesian classifier for solving a problem
Illustrate the principles of instance based learning and genetic algorithm
Describe the algorithms for rule and reinforcement learning

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC03.CO1	x	X	X	-	-	-	-	-	-	x	-	x	x	-	-
21BMC03.CO2	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC03.CO3	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC03.CO4	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-
21BMC03.CO5	x	X	X	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I Introduction to Biochemistry

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties water and their applications in biological systems. Introduction to Biomolecules, Biological membrai Clinical application of Electrolytes and radioisotopes

UNIT II Carbohydrates

Classification of carbohydrates – mono, di, oligo and polysaccharides. Structure, physical and chemi properties of carbohydrates Isomerism, racemisation and mutarotation. Digestion and absorptio carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation. Biochemi aspect of Diabetes mellitus and Glycogen storage Disease.

Chairman
Board of Studies
Department of Biomedical Enginee
Muthayammal Engineering College (Autonomo
Rasipuram, Namakkal Dist 637 408

UNIT III Lipids

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical a chemical properties of fat..Metabolic pathways: synthesis and degradation of fatty acid (beta oxidatio hormonal regulation of fatty acid metabolism, ketogenesis, Biosynthesis of Cholesterol. Disorders of lip metabolism.

UNIT IV Nucleic Acid & Protein

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, chargoffs ru Watson and crick model of DNA. Structure of RNA and its type. Metabolism and Disorder of purines a pyrimidines nucleotide Classification, structure and properties of proteins, structural organization proteins, classification and properties of amino acids. Separation of protein, Inborn Metabolic error amino acid metabolism

UNIT V Enzyme and Its Clinical Application

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes Michaelis-Menten equation.Factors affecting enzymatic activity: temperature, pH, substrate concentrati and enzyme concentration. Inhibitors of enzyme action: Competitive, non- competitive, irreversib Enzyme: Mode of action, allosteric and covalent regulation. Clinical enzymology. Measurement of enzyr activity and interpretation of units.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	RAFI MD	Text book of biochemistry for Medical Student	Second Edition, University Press	2014.
2.	David.W.Martin, Peter.A.Mayes , Victor. W.Rodwell,.	Harper's Review of Biochemistry	LANGE Medical Publications	1981
3.	Keith Wilson & John Walke	Practical Biochemistry – Principles & Technique	Oxford University Press	2009
4.	Pamela.C.Champe & Richard.A.Harvey,	Lippincott Biochemistry	Lippincott's Illustrated Reviews, Raven publishers	1994

WEB REFERENCE(s)

1. https://study.com/academy/lesson/what-is-system-analysis-in-software-engineering.html

Chairman
Board of Studies
Department of Biomedical Engineeri
Muthayammal Engineering College (Autonomous
Rasipuram, Namakkal Dist 637 408

2. https://onlinelibrary.wiley.com/doi/abs/10.1002/spe.4380220402
3. https://medium.com/the-andela-way/system-design-in-software-development-f360ce6fcbb9
4. https://searchcio.techtarget.com/definition/change-management

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC04	Analog and Digital Integrated Circuits	3	0	0	3

COURSE OBJECTIVES

1. To Demonstrate the IC fabrication steps and basic building blocks of linear integrated circuits.
2. To Design and analyze the linear and non-linear applications of operational amplifiers.
3. To Illustrate the operating principle of PLL, Data Converters and various special function ICs.
4. To design waveform generating circuits
5. To design simple filter circuits for particular application and to gain knowledge in designing a stable voltage regulators

COURSE OUTCOMES

1. Illustrate the Circuit Fabrication Process and internal structure of operational amplifiers
2. Characterize and design real time operational amplifiers applications
3. Design comparator and generate waveforms using operational amplifier
4. Demonstrate the functioning of PLL and Data converters
5. Acquire knowledge about special function ICs and its application in modern electronic equipment

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC04.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC04.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC04.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC04.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC04.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I - Diode Circuits:

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, clamping and clipping circuits. Input output characteristics of BJT in CB, CE, CC configurations, biasing circuits, Load line analysis, common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits

UNIT II – Introduction To Operational Amplifier and its Applications:

Amplifier -Ideal Characteristics, Performance Parameters, Linear and Nonlinear Circuits and Their Analysis- Voltage Follower, Inverting Amplifier, Noninverting Amplifiers, Differentiator, Integrator, Voltage To Current Converter, Instrumentation Amplifier, Low Pass, High Pass Filter and Band Pass Filters, Comparator, Multivibrator and Schmitt Trigger, Triangular Wave Generator.

Unit III - The Basic Gates and Combinational Logic Circuits

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1″s and 2″s complements, Codes -Binary, BCI Excess 3, Gray, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums,

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Minterms and Maxterms, Karnaugh map and Tabulation methods. Logic families- TTL, MOS, CMOS, BiCMOS -Comparison of Logic families.

Unit IV - Sequential Logic Circuits

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In – Serial Out, Serial In – Parallel out, Parallel In -Serial Out, Parall In – Parallel Out, Universal Shift Register.

UNIT-V Data Converters

Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Sergio Franco	Design with operational amplifiers and analog integrated circuits	3rd Edition, Tata McGraw-Hill	2007
2.	D.Roy Choudhry, Shail Jain	Linear Integrated Circuits	New Age International Pvt. Ltd	2000
3.	RamakantA.Gayakwad	OP-AMP and Linear IC's	Prentice Hall of India	2002

WEB REFERENCE(s)

1. www.nptel.ac.in/courses/117107094/
2. www.youtube.com/watch?v=clTA0pONnMs
3. www.youtube.com/watch?v=7beZocF34AU
4. www.youtube.com/watch?v=7xVSL93ZZq8
5. www.youtube.com/watch?v=xki9taCqsWY

Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC05	**Pathology and Microbiology**	3	0	0	3

OBJECTIVES:

Gain a knowledge on the structural and functional aspects of living organisms.

Know the etiology and remedy in treating the pathological diseases.

Empower the importance of public health.

To study identification of bacteria

To study Antibodies and its types

OUT COMES :

Analyze structural and functional aspects of living organisms.

Explain the function of microscope

Discuss the importance of public health.

Describe methods involved in treating the pathological diseases.

Able to know study Antibodies and its types

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC05.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC05.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC05.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC05.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC05.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I Cell Degeneration, Repair and Neoplasia 9

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT II Fluid and Hemodynamic Derangements 9

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders- Bleeding disorders, Leukaemias, Lymphomas Haemorrhage. .

UNIT III Microbiology 9

Chairman
Board of Studies
Department of Biomedical Engineer
Muthayammal Engineering College (Autonomou
Rasipuram, Namakkal Dist 637 408

Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

UNIT IV Microscopes **9**

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining.

UNIT V Immunopathology **9**

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation., Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE.Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

TOTAL : 45

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ramzi S Cotran, Vinay Kumar & Stanley L Robbins,	Pathologic Basis of Diseases‖,	7th edition,WB Saunders Co	2005 (Units I & II).
2.	Ananthanarayanan & Panicker,	Microbiology‖	Orientblackswan,10th edition. (Units III,IV and V).	2017

REFERENCE BOOKS

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Underwood JCE	General and Systematic Pathology	Churchill Livingstone, 3rd edition,	: 2000.
2.	Dubey RC and Maheswari DK.	A Text Book of Microbiology‖ &	Chand Company Ltd,	2007
3.	Prescott, Harley and	Microbiology‖	10th edition, McGraw	2017

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	Klein		Hill	
4.	Jens Rietdorf	Microscopy Techniques	Springer	2005
5.	Parker, George	Immunopathology in Toxicology and Drug Development: Volume 2, Organ Systems	Humana Press	2017

WEB URLs

1. https://nptel.ac.in/courses/102106025/36

2 https://nptel.ac.in/courses/112104118/43

3. https://nptel.ac.in/courses/102103015/

4 https://nptel.ac.in/courses/115103030/9

5. https://nptel.ac.in/courses/102103038/

Chairman
Board of Studies
Department of Biomedical Engineeri
Muthayammal Engineering College (Autonomou
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC06	Hospital Management	3	0	0	3

OBJECTIVES:

To understand the fundamentals of hospital administration and management.

To study the importance of human resource management

To know the market related research process

To explore various information management systems and relative supportive services.

To learn the quality and safety aspects in hospital.

OUTCOMES:

Explain the principles of Hospital administration.

Identify the importance of Human resource management.

List various marketing research techniques.

Identify Information management systems and its uses.

Understand safety procedures followed in hospitals

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC06.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC06.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC06.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC06.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC06.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I Overview of Hospital Administration 9

Hospital and Industry relationship, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning – Organizing - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management. – Color coding

UNIT II Human Resource Department Management 9

Principles & Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Departments - Hospital, Recruitment, Selection, Training Guidelines –Methods & Evaluation of Training – Leadership, Promotion & Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III Marketing Research Process 9

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV Hospital Information Systems & Supportive Services 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems - Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services

UNIT V Quality And Safety Aspects In Hospital 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 HRS

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.C.Goyal	Hospital Administration and Human Resource Management – Fourth Edition	Academic Press, New York	2006.
2.	G.D.Kunders	Hospitals Facilities Planning and Management Fifth Reprint	TMH, New Delhi	2007

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Cesar A. Caceres	The Practice of Clinical	Academic Press, New	1972

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	Albert Zara	Engineering	York	
2.	Norman Metzger	Handbook of Health Care Human Resources Management 2nd edition	Aspen Publication Inc. Rockville, Maryland, USA	1990.
3.	Peter Berman	Health Sector Reform in Developing Countries	Harvard University Press	1995
4.	William A. Reinke	Health Planning For Effective Management	Oxford University Press	1988
5.	Blane, David, Brunner	Health and SOCIAL Organization: Towards a Health Policy for the 21st Century	Eric Calrendon Press	2002

URL Webs:

https://www.slideshare.net/drjayeshpatidar/hospital-administration-53507341

https://www.slideshare.net/dharmendragahwai/human-resource-management-in-public-health-ppt

https://www.slideshare.net/RajeshKuthalingam/marketing-research-process-9625550

https://www.slideshare.net/vijayrajnazzi/information-technology-in-hospitals

https://www.slideshare.net/akhileshbhargava/quality-in-health-care

.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC07	**Biomedical Instrumentation - I**	3	0	0	3

Course Objectives:

To understand the importance of electrical safety and metrology of medical Equipment.

To familiarize the students with the operating principles of a wide range of biomedical equipment.

To enable the students to gain knowledge on the applications of various medical equipment.

Course Outcomes:

Learn the electrical safety aspects and measurement errors in medical equipment.

Assess the need and operating principle of equipment used in surgery, physiotherapy and audiometry.

Gain the knowledge and functionality of medical equipment used in Neonatology and drug delivery.

Perceive the governing principles and functions of respiratory equipment and ventilators.

Comprehend the principles of anaesthesia machine and sterilization equipment.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC07.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC07.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC07.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC07.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC07.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT-I General Metrology:

Global metrology scenario, Measurement units, Measurement standards, Measurement traceability. Measurement Units: Base SI units, Derived SI units, SI multipliers and conversions, Fundamental constants, Common measurements. Electrical Safety: physiological effects of electricity, macro-shock and micro-shock hazards, electrical safety codes and standards, electrical safety analyzers, testing the electrical systems, Electrical safety analyzer.

Chairman
Board of Studies
Department of Biomedical Engineer
Muthayammal Engineering College (Autonomou
Rasipuram, Namakkal Dist 637 408

UNIT-II Electrosurgical Equipment:

ESU, principles of cutting and coagulation, spark gap, valve and solid state generators, safety features. Physiotherapy Equipment-Short Wave, Microwave and Ultrasound Diathermy, Audiometry: Common tests and procedures, audiometer.

UNIT-III Neonatal instrumentation:

Incubators, baby warmers, apnea monitor, calibration of warmers, and phototherapy devices. Drug delivery systems: Infusion pumps, components of drug infusion system, syringe pump, peristaltic pump, Implantable infusion system, closed loop control in infusion systems, examples of typical infusion pumps, Insulin pumps, Calibration of infusion systems.

UNIT-IV Respiratory measurements:

Principles and techniques of impedance Pneumography and pneumotachograph. Ventilators: Artificial Ventilation, Types of ventilators, Modern Ventilators, High frequency Ventilators, Humidifiers, Nebulizers and Aspirators, calibration of a ventilator.

UNIT-V General anesthesia:

Medical gases and vacuum systems, Humidification, patient breathing circuit, ventilator & scavenging system, monitoring system, capnography, anesthesia equipment. Boyle's apparatus, Block diagram & principle of operation. Liquid medical –O2 systems, vaporizers, Theatre sterility practices, CSSD equipment.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	R.S.Khandpur	Hand Book of Bio-Medical instrumentation	Tata McGraw Hill Publishing Co Ltd	2004
2.	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer	Bio-Medical Instrumentation and Measurements	Pearson Education	2nd edition, 2002
3.	M.Arumugam	Bio-Medical Instrumentation	Anuradha Agencies	2003.
4.	A. Geddes and L.E.Baker	Principles of Applied Bio-Medical Instrumentation	John Wiley & Sons	1975
5.	J.Webster	Medical Instrumentation	John Wiley & Sons	1995

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

WEB REFERENCE(s)

1.
2. www.nptel.ac.in/courses/108102041/
3. www.nptel.ac.in/courses/103105054/
4. www.technicalsymposium.com/alllecturenotes_biomed.html
5. www.nptelvideos.in/2012/11/biochemical-engineering.html

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC08	**Signals and Systems**	3	0	0	3

COURSE OBJECTIVES

To understand the basic properties of signal & systems and the various methods of classification.
To learn Laplace Transform &Fourier transform and their properties.
To Learn Continuous Time LTI System.
To know Z transform & DTFT and their properties.
To characterize LTI systems in the Time domain and various Transform domains.

COURSE OUTCOMES

Able to describe classification of signals and systems
Analyze the Laplace transform, Fourier transform
Ability to analyze continuous time LTI systems using Fourier and Laplace Transforms
Analyze Z Transform and DTFT
Ability to analyze discrete time LTI systems using Z transform and DTFT

UNIT-I SIGNALS & SYSTEMS 9

Signals- Classification of signals- Continuous –time and Discrete time signals, Deterministic and random signal, even and odd signals, periodic and periodic signals, energy and power signals, Basic Continuous –time and Discrete time signals- Unit step, Unit impulse, Unit Ramp, Exponential, sinusoidal ,Exponentially damped sinusoidal signals, Pulse signals, Transformation of independent variables, Basic operations on signals-amplitude scaling ,addition, multiplication, differentiation and integration, Representation of signals in terms of impulses, Systems- Classification of systems - Static & Dynamic, Linear & Nonlinear, Time-variant & Time- invariant, Causal & Non causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

The Laplace Transform : The region of convergence for Laplace Transforms, The Inverse Laplace Transform, Properties of the Laplace Transform, Fourier series analysis-spectrum of Continuous - Time (CT) signals, Continuous- time Fourier Transform : Representation of A periodic signal , The Fourier transform for periodic signals, Properties of the continuous- time Fourier transform, The convolution property, The multiplication property, Application of Fourier Transform, the relationship between Laplace transform and Fourier transform.

UNIT III LINEAR TIME INVARIANT SYSTEMS 9

Chairman
Board of Studies
Department of Biomedical Engineeri
Muthayammal Engineering College (Autonomou
Rasipuram, Namakkal Dist 637 408

Continuous –time LTI systems: Block diagram representation-impulse response, Convolution integrals, Properties of Linear Time Invariant Systems, Casual LTI systems Described by differential equations, Fourier and Laplace transforms in Analysis of CT systems

UNIT IV **ANALYSIS OF DISCRETE TIME SIGNALS** **9**

DTFT-- Properties of DTFT, Application of DTFT, Discrete Time Fourier series – Definition, properties ,Sampling theorem, Z Transform- The region of convergence for Ztransform, The inverse Z transform, Properties of Z Transform, the unilateral Z transform , Geometric evaluation of the Fourier transform from the pole zero plot, The relationship between Z transform and DTFT

UNIT V **LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS** **9**

Casual LTI system described by difference equation, solving differential equation using Z transform, Block diagram representation-Impulse response - Convolution sum, Discrete Fourier and Z Transform Analysis of Recursive & Non-Recursive systems .

TOTAL :45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Rangaraj.M.Rangayyan	Biomedical signal processing	Wiley-IEEE press, 2ndedition,	2015.
2.	P. Ramakrishna Rao	Signals and Systems	McGraw Hill	2ndEdition,2013
3.	B P Lathi	Signals and Systems	B S Publisher	2001
4.	Nagrath ,Sharan	Signals and Systems	McGraw Hill	2009
5.	S.Salivahanan, N.Sureshkumar and A.Vallavaraj	Signals and Systems	Tata McGraw Hill	2011

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

WEB REFERENCE(s)

1. www.youtube.com/watch?v=oJpUbfwvzKA
2. www.youtube.com/watch?v=oJpUbfwvzKA
3. www.youtube.com/watch?v=ghz_puTV168
4. www.youtube.com/watch?v=wG6VUnkrO90
5. www.youtube.com/watch?v=AkBaDKYmQQI

Chairman
Board of Studies
Department of Biomedical Engine
Muthayammal Engineering College (Autonome
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC09	**Biomedical Instrumentation - II**	3	0	0	3

Course Objectives:

To make the students understand the need for several Biomedical Equipments.

To make the students understand the operating principles of a wide range of Biomedical Equipment.

Course Outcomes:

Learn about the cardiac assist devices and ICU layout.

Assess use of electrical stimulation principles to overcome cardiac rhythm disturbances

Gain the knowledge about various defibrillators along with their working principles

Perceive the governing principles of oxygenators and ophthalmic instruments.

Comprehend the principles of hemodialysis machine and lithotripter

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC09.CO1	X	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC09.CO2	X	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC09.CO3	X	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC09.CO4	X	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC09.CO5	X	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT-I Critical physiological parameters

Critical physiological parameters to be monitored. Intensive coronary care unit layout. Assist devices of the heart: Principles of external counter pulsation techniques. Intra-aortic Balloon pump.Prosthetic heart valves, Mechanical and tissue Valves. Types of mechanical valves: Ball and Cage, tilting disc and Bileaflet valves. Types of tissue valves: Homografts or Allografts (human cadaver) and Heterografts or Xenografts (Porcine or Bovine), Testing of prosthetic heart valves.

UNIT-II Cardiac Pacemakers:

Need for a Pacemaker, Types-Asynchronous, Synchronous, External and implantable. Asynchronous pacemakers: Working principle, block diagram. Synchronous/Demand Pacemaker: Modes of triggering-ventricular triggered and atrio-ventricular synchronized pacemaker, Programmable pacemaker, Implantable Pacemaker: Technical and qualitative requirements of

power supplies, lead wires and electrodes, packaging. Microprocessor based implantable pacemaker, Rate responsive pacemaker.

UNIT-III Defibrillators:

Need for Defibrillators, D.C. Defibrillator, Need for Synchronous Defibrillators, Types of electrodes and their features, Types of Waveforms, Automatic/Advisory External Defibrillators (AED), Implantable defibrillators. Cardioverters: Working principle, Defibrillator analyzers.

UNIT-IV Heart lung Machine:

Governing principles, Qualitative requirements, Functional details of Bubble, Thin Film and membrane-type of blood oxygenators. Ophthalmic Instruments - Intraocular Pressure Measurement, Contacting and Non-Contacting types, Refractometer, Ophthalmoscope, Retinoscope, Keratometer.

UNIT-V Haemodialyzer:

Artificial Kidney, Dialyzers, Membranes for Haemodialysis, Haemodialysis Machine, Monitoring circuits for hemodialysis machine, Portable Kidney Machines. Lithotriptors: Principles and Applications, Need for Lithotriptor, First Lithotriptor Machine, Modern Lithotriptor Systems, Extra-corporeal shock-wave Therapy

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	R.S.Khandpur	Hand Book of Bio-Medical instrumentation	Tata McGraw Hill Publishing Co Ltd	2004
2.	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer	Bio-Medical Instrumentation and Measurements	Pearson Education	2nd edition, 2002
3.	M.Arumugam	Bio-Medical Instrumentation	Anuradha Agencies	2003.
4.	A. Geddes and L.E.Baker	Principles of Applied Bio-Medical Instrumentation	John Wiley & Sons	1975
5.	J.Webster	Medical Instrumentation	John Wiley & Sons	1995

WEB REFERENCE(s)

1. vw.nptelvideos.in/2012/11/biochemical-engineering.html
2. www.nptel.ac.in/courses/108102041/
3. www.nptel.ac.in/courses/103105054/
4. www.technicalsymposium.com/alllecturenotes_biomed.html

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC10	Control System for Biomedical Engineering	3	0	0	3

OBJECTIVES:

To introduce the elements of control system and their modeling using various Techniques.

To introduce methods for analyzing the time response, of systems

To introduce methods for analyzing, the frequency response of systems

To introduce methods for analyzing the stability of systems

To introduce the state variable analysis method

COURSE OUTCOMES:

Analysis the knowledge of various control models

Perform time domain control systems required for system analysis.

Perform frequency domain analysis of control systems required for system analysis.

Performance analysis of control systems required for stability analysis

Design the state variable analysis method.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC10.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC10.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC10.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC10.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC10.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I CONTROL SYSTEM MODELING 9

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph

UNIT II TIME RESPONSE ANALYSIS 9

Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis using MATLAB

UNIT III FREQUENCY RESPONSE ANALYSIS

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol"s Chart - Use of Nichol"s Chart in Control System Analysis.

UNIT-IV APPLICATIONS - I

Difference between general control systems and physiological control systems, examples of positive and negative feedback physiological control systems. Body temperature Regulation, Blood glucose regulation, Pupil Control System. Visual Fixation System, Oculo-Motor System.

UNIT-V APPLICATIONS - II

Muscle stretch reflex, skeletal muscle Servo-mechanism. Cardiovascular Control Systems-Regulation of heart rate, blood pressure and cardiac output. Respiratory Control system-Chemical regulation of ventilation, Cheyne Stokes breathing.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	J.Nagrath and M.Gopal	J.Nagrath and M.Gopal	New Age International Publishers, 5th Edition	2007.
2.	Benjamin.C.Kuo	Automatic control systems	Prentice Hall of India, 7th Edition	1995
3.	M.Gopal	Control System – Principles and Design	Tata McGraw Hill, 2nd Edition	2002
4.	Schaum"s Outline Series	Feed back and Control Systems	Tata Mc Graw-Hill	2007
5.	John J.D"Azzo & Constantine H.Houpis	**Linear Control System Analysis and Design**	Tata Mc Graw-Hill, Inc.,	1995

WEB REFERENCE(s)

1. https://www.javatpoint.com/control-system-tutorial
2. https://lecturenotes.in/notes/6579-notes-for-control-system-engineering-cse-by-gyana-ranjan-biswal
3. https://nptel.ac.in/courses/108101037/
4. https://nptel.ac.in/noc/individual_course.php?id=noc18-ee41
5. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC11	**Medical Signal Processing**	3	0	0	3

OBJECTIVES:

- To study about the adaptive filters and their analysis.
- To discuss the Data Compression Techniques.
- To study about the Cardio-logical Signal Processing.
- To learn about the Neurological signal processing.
- To study about the sleeping modes of EEG.

OUTCOMES:

- Choose an filter for the ECG analysis.
- Write the types of algorithm for data compression.
- Idea about processing the ECG signal and their estimations.
- Study about EEG and their parameters.
- Study about the sleeping modes of EEG.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC11.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
21BMC11.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC11.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC11.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
21BMC11.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I Adaptive filters: 9

Introduction, Principle of an adaptive filter, the steepest descent algorithm, adaptive noise canceller, cancellation of interference in electrocardiography, applications of adaptive filters. Canceling Donor heart Adaptive filters, high frequency noise in ECG, motion artifact in ECG, cancellation of ECG signal from the electrical activity of the chest muscles, cancellation of high frequency noise in Electro-surgery.

UNIT II Data Compression Techniques: 9

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Introduction, Loss and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, FAN coding techniques.

UNIT III Cardio-logical Signal Processing: **9**

Introduction, ECG Parameters and their estimations: ECG QRS Detection techniques, estimation of R-R interval, estimation of ST segment inclination, Rhythm analysis, arrhythmia analysis monitoring, and long term continuous ECG recording.

UNIT IV Neurological signal processing: **9**

Introduction, Linear prediction theory, the Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, EEG Transient detection and elimination in epileptic patients and its overall performance.

UNIT V Sleep EEG: **9**

Introduction, Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, Event history analysis for modeling sleep.

Total:45 Hrs

TEXTBOOKS:

S.no	Author	Title of book	Publisher	Year of publication
1.	D.C.Reddy	Biomedical Signal Processing- principles and techniques	Tata McGraw-Hill	2005
2.	Rangaraj M. Rangayyan	Biomedical Signal Analysis	IEEE Press	2001

REFERENCE BOOKS:

S.no	Author	Title of book	Publisher	Year of publication
1.	Willis J.Tompkins	Biomedical Digital Signal Processing	PHI	LATEST EDITION
2.	Akay.M	Biomedical Signal Processing	Academic: Press	1994

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

WEB URL'S:

1. ocw.mit.edu › Courses › Health Sciences and Technology MIT Open Course War http://ocw.mit.edu
2. www.vub.ac.be/en/study/fiches/30340/biomedical-signals-and-images
3. www.crcpress.com › Biomedical Science › Biomedical Imaging
4. http://www.swbh.nhs.uk/wp-content/uploads/2012/07/What-is-a-sleep-EEG-ML3791.pdf
5. http://www.cns.iisc.ernet.in/~sray/E9282.html

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC12	Microprocessors and Microcontrollers in Medicine	3	0	0	3

OBJECTIVES

- Understand the fundamental concepts of 8086 microprocessors
- Explain the basic concepts of 8051 microcontroller
- Obtain knowledge on interfacing devices
- Familiarize about ARM microcontroller
- Acquire knowledge on applications of microprocessor and
- microcontroller in biomedical domain.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC12.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC12.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC12.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC12.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC12.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I: Overview of 8086 Microprocessor

Evolution of Microprocessor and its importance in biomedical domain, Architecture and signal description of 8086, Minimum and maximum mode, addressing modes, Instruction set, Programs

UNIT II: 8051 Microcontroller

Introduction to 8 bit microcontroller, signal descriptions of 8051-Architecture of 8051-Register set of 8051-Instruction set-Addressing mode

UNIT III: Interfacing Devices

Timer-serial communication-interrupts programming - Interfacing to external memory- Basic techniques for reading & writing from I/O port pins- Interfacing 8051 to ADC-Liquid crystal display (LCD), keyboard-Stepper motor

UNIT IV: Arm Microcontroller

Fundamentals: registers, current program status register - Pipeline, exceptions- Interrupts and vector table-ARM architecture - ARM instruction set, thumb instruction set.

Chairman
Board of Studies
Department of Biomedical Engineer
Muthayammal Engineering College (Autonomou
Rasipuram, Namakkal Dist 637 408

UNIT V: Application In Medicine

Mobile phone based bio signal recording - Design of pulse oximeter circuit using ARM microcontroller- Design of EOG based home appliances using PIC microcontroller - Design of heart rate monitoring circuit using ARM Microcontroller

LEARNING RESOURCES

TEXT BOOKS

1. A.K.Ray, K.M.Bhurchandi, "*Advanced Microprocessor and Peripherals*", Tata McGraw Hill, 3rdedition, 2013.

2. Douglas V. Hall, "Microprocessor and Interfacing:Programming and Hardware",Glencoe, 2nd edition,

2006.

3. Andrew N.Sloss,DonimicSymes, Chris Wright, "*ARM System Developer's Guide*", Elsevier, 1st edition,

2007.

4. Muhammad Ali Mazidi and JanicaGilliMazidi, '*The 8051 microcontroller and embedded systems*',

Pearson Education, 5th Indian reprint, 2003.

5. www.microchip.com/medical.

6. www.freescale.com/medical.

7. Microprocessor systems in medicine lab manual.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC13	Basic Clinical Sciences – I - Nephrology	3	0	0	3

COURSE OBJECTIVES

Know basic structural and functional elements of human body.
Learn organs and structures involving in system formation and functions.
Understand circulatory system.
Learn urinary and special sensory system

Study about nervous system

COURSE OUTCOMES

To Know basic structural and functional elements of human body.
To Learn organs and structures involving in system formation and functions.
To Understand circulatory system.
To Learn urinary and special sensory system
To Study about nervous system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC13.CO1	X	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC13.CO2	X	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC13.CO3	X	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC13.CO4	X	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC13.CO5	X	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT-I

Laboratory evaluation of the kidney. Diagnostic application of Radio Nuclides in Renal Medicine. Acute Renal failure. Chronic Renal Failure.

UNIT-II

Haemodialysis, Acetate dialysis. Bicarbonate dialysis. Peritoneal dialysis. Chronic Ambulatory peritoneal dialysis. Haemoperfusion, sequential ultra-filtration. Haemofiltration, Adequacy of dialysis. Clearance, Dialysance.

UNIT-III

Components of dialysing system. Dialysate, composition of dialysate. Types of dialysers. Controls and monitoring devices of dialysers. Clinical significance.

UNIT-IV

Treatment of city water for Haemodialysis usage. Types of water purification systems. Water softeners. De-ionisers. Reverse osmosis.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

UNIT-V

Renal transplantation. Basic Principles, Cadaver and donor types of transplantation, Tissue typing tests.

TEXT BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Elaine.N. Marieb,	Essential of Human Anatomy and Physiology	Pearson Education NewDelhi,.	Eight edition,, 2007.
2.	Gillian Pocock, Christopher D. Richards	The Human Body An introduction for Biomedical and Health Sciences	Oxford University Press,USA	2009

REFERENCE BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William F. Ganong	Review of Medical Physiology	Mc Graw Hill New Delhi	22nd edition
2.	Eldra Pearl Solomon	Introduction to Human Anatomy and Physiology	W.B.Saunders Company	2003
3.	Arthur C. Guyton	Text book of Medical Physiology	11 th Edition, Elsevier Saunders,	11th Edition, 2006
4.	Juergen Mai George Paxinos	The Human nervous System	Academic Press 3rd Edition	2011
5.	Midthun Joseph	The Digestive and Urinary Systems	World Book, Inc	2011

WEB URLs

1.https://nptel.ac.in/courses/104101093/3

2.https://nptel.ac.in/courses/122103039/16

3.https://nptel.ac.in/noc/individual_course.php?id=noc18-ch11

4.https://nptel.ac.in/courses/102104058/19

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

5.https://nptel.ac.in/courses/102104058/19

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC14	**Biomechanics & Rehabilitation Engineering**	3	0	0	3

OBJECTIVES:

- To understand the rehabilitation concepts and Rehabilitation team members for future development and applications.
- To study various Principles of Rehabilitation Engineering.
- To understand different types of Therapeutic Exercise Technique
- To understand the tests to assess the hearing loss, development of electronic devices to compensate for the loss and various for visually and auditory impaired.
- To study the various orthotic devices and prosthetic devices to overcome orthopedic problems.

COURSE OUTCOMES

- Ability to apply knowledge of mathematics, science and engineering to understand the fundamentals of moving systems and familiarity with human anatomy to competently analyze the movement of the human body.
- Ability to analyze the dynamics of human movement flow properties of blood and comprehend the biomechanical principles that relate to movement and communication disabilities.
- Have an in depth idea about Engineering Concepts in Sensory & Motor rehabilitation.
- Apply the different types of Therapeutic Exercise Technique to benefit the society.
- Gain in-depth knowledge about different types of models of Hand and arm replacement.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC14.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC14.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC14.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC14.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC14.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

UNIT I INTRODUCTION TO BIOMECHANICS 9

What Is Biomechanics, Mechanics in Physiology Definition of Stress ,Strain and Strain Rate ,The Non viscous Fluid, Newtonian Viscous Fluid, The Hookean Elastic Solid, Viscoelasticity, Response of a Viscoelastic Body to Harmonic Excitation, Use of Viscoelastic Models ,Methods of Testing .

UNIT II THE FLOW PROPERTIES OF BLOOD 9

Blood rheology,the constitutive equation of blood based on viscometric Data and casson's equation, Laminar flow of blood in tube, blood with viscosity described by casson's equation. **Bioviscoelastic fluids**:Introduction, small deformation experiments, mucus from the respiratory tract, saliva, cervical mucus and semen, synovial fluid, flow properties of synovial fluid,

UNIT III INTRODUCTION TO REHABILITATION 9

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities

UNIT IV REHABILITATION TEAM & THERAPEUTIC EXERCISE TECHNIQUE9

Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer, Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.

UNIT V ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES9

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myo-electric controlled prosthetics and externally powered limb prosthetics. Functional Electrical Stimulation systems- Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

TOTAL: 45 PERIODS

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication

Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

1.	Y.C.Fung	Biomechanics-Mechanical Properties of Living tissues	Springer Verlag.	2nd Edition
2.	Sunder	Textbook of Rehabilitation 2nd Edition	Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi	2007

REFERENCES:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Schneck and Bronzino	Biomechanics principles and applications	CRC;	2003
2.	Keswick. J	What is Rehabilitation Engineering, Annual Reviews of Rehabilitation	Springer	1982
3.	Warren E. Finn,Peter G. LoPresti	Handbook of Neuroprosthetic Methods	CRC	2002
4.	Rory A Cooper Hisaichi Ohnabe Douglas A. Hobson	An Introduction to Rehabilitation Engineering	CRC	2006

Web urls

1. http://www.profedf.ufpr.br/rodackibiomecanica_arquivos/Books/Introduction%20to%20Sports%20Biomechanics.pdf
2. http://www.profedf.ufpr.br/rodackibiomecanica_arquivos/Books/Duane%2Knudson%20Fundamentals%20of%20Biomechanics%202ed.pdf
3. Visual3D 3D Biomechanics: Adwww.c-motion.com/
4. https://rerc-aac.psu.edu/dissemination/webcasts/
5. https://ep.jhu.edu/programs-and-courses/585.414-rehabilitation-engineering

Chairman
Board of Studies
Department of Biomedical Engine
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC15	Embedded Systems and IoMT	3	0	0	3

OBJECTIVES

- To study the overview of Embedded System Architecture.
- To study about the ARM Architecture.
- To learn various embedded communication protocols.
- To learn the Real Time operating System Concepts.
- To Study about applications of Embedded System.

COURSE OUTCOMES

- Able to describe hardware and software architectures of Embedded Systems.
- Able to understand the functions and syntax used in Embedded C.
- Able to understand special features of ARM architecture.
- Able to introduce devices and buses used for Embedded Networking.
- Able to interpret the concepts of a Real Time Operating System.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC15.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC15.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC15.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC15.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC15.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I ARCHITECTURE OF EMBEDDED SYSTEMS 9

Architecture of Embedded Systems -Categories of embedded systems – specialties of embedded systems – Recent trends in embedded systems –Hardware architecture –Software architecture –Communication software – Process of generation of executable image – development/testing tools.

UNIT II ARM ARCHITECTURE 9

Advanced RISC Machine – Architecture Inheritance – ARM Programming Model – ARM Development Tools – 3 and 5 stages Pipeline ARM Organization – ARM Instruction Execution and

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Implementation – ARM Co-Processor Interface - Thumb bit in the CPSR – Thumb programmer's model.

UNIT III EMBEDDED COMMUNICATION PROTOCOLS **9**

Serial/Parallel Communication - Serial communication protocols - UART - RS232 standard - Serial Peripheral Interface - Inter Integrated Circuits – Ethernet - Universal serial Bus - Controller Area Network - Parallel communication protocols – ISA / PCI Bus protocols, Internet of Things-Overview and Architecture.

UNIT IV REAL-TIME OPERATING SYSTEM CONCEPTS **9**

Architecture of the Kernel– Foreground/Background Systems- Critical Sections of Code-Resources- Shared Resources- Multitasking- Tasks- Context Switches- Kernels- Schedulers-Non-Preemptive Kernels- Preemptive Kernels-Task Priorities-Static Priorities-Dynamic Priorities-Priority Inversion- Mutual Exclusion- Deadlock-Event Flags- Inter task Communication- Message Mailboxes- Message Queues- Interrupts- Interrupt Latency-Interrupt Response- Interrupt Recovery-RTOS: RT Linux - VX Works - μCOS.

UNIT V APPLICATIONS **9**

Working Principle, State Diagram ,Architecture, Digital camera-washing machine-cell phones-home security systems-finger print identifiers-cruise control- printers -Automated teller machine-Washing machine-Software Modem-Audio Player.

Total: 45 Hrs

TEXT BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Raj Kamal,	Embedded Systems Architecture programming and Design	TMH	Second Edition, 2011
2.	Prasad.K.V.K.K,	Embedded Real-Time Systems: Concepts, Design & Programming	Dream tech press	2011

REFERENCE BOOKS BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Wayne Wolf	Computers as Components - Principles of Embedded Computing	Morgan Kaufman Publishers	Third Edition 2013

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

		System Design		
2.	Steve Furber,	ARM System on Chip Architecture	Addison- Wesley Professional	Second Edition, 2000
3.	Andrew N.Sloss, Dominic Symes, Chris Wright	ARM System Developer's Guide Designing and Optimizing System Software	Morgan Kaufmann Publishers, Elsevier	2004
4.	A.P.Godse & A.O.Mulani	Embedded Systems	Technical publications	Third Edition,2009
5.	B.Kanth Rao,	Embedded Systems	PHI Learning Private Limited	2011

WEB URLs

1. http://www.nptel.ac.in/courses/108102045/
2. http://freevideolectures.com/Course/2341/EmbeddedSystems
3. nptel.ac.in/courses/108105057/Pdf/Lesson-3.pdf
4. nptel.ac.in/downloads/108105057/
5. nptel.ac.in/courses/108102045/5

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC16	Basic Clinical Sciences – II - Anaesthesia	3	0	0	3

COURSE OBJECTIVES

Know basic structural and functional elements of human body.
Learn organs and structures involving in system formation and functions.
Understand circulatory system.
Learn urinary and special sensory system

Study about nervous system

COURSE OUTCOMES

To Know basic structural and functional elements of human body.
To Learn organs and structures involving in system formation and functions.
To Understand circulatory system.
To Learn urinary and special sensory system
To Study about nervous system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC16.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC16.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC16.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC16.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC16.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT-I

General anesthesia. The uptake of anesthetic gases and vapours. Pre-anesthetic care and preparation. Clinical signs of anesthesia. Post-operative care. Laws of gases. Fires and Explosions. Recommendations for prevention.

UNIT-II

Anesthetic gases. Equipment. Components. Gas delivery systems. Testing Choice of anesthetic hypnosis. Electrical anesthesia. Regional Spinal. Care and sterilization of equipment. Patient monitoring during surgery- Invasive and non invasive. Organization of theaters.

UNIT-III

Hypoxia, Artificial respiration. Diagnostic and therapeutic indications. Study of ventilators. Humidifiers. Constant pressure and constant volume types. Selection Criteria. Premature baby incubators.

UNIT-IV

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Gas pipe lines. Gas flow meters of various types. Boyles machine. Warning devices. Anesthesia circuits. Vaporizers. Principles of operation. Calibration. Repairs. Recalibration. Scavenging systems. Oxygen therapy and blood gas analysis.

UNIT-V

Measurement of Intra-vascular pressures. Blood flows. Plethysmography. Humidity and temperature measurements. Clinical significance.

TEXT BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Elaine.N. Marieb,	Essential of Human Anatomy and Physiology	Pearson Education NewDelhi,.	Eight edition,, 2007.
2.	Gillian Pocock, Christopher D. Richards	The Human Body An introduction for Biomedical and Health Sciences	Oxford University Press,USA	2009

REFERENCE BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William F. Ganong	Review of Medical Physiology	Mc Graw Hill New Delhi	22nd edition
2.	Eldra Pearl Solomon	Introduction to Human Anatomy and Physiology	W.B.Saunders Company	2003
3.	Arthur C. Guyton	Text book of Medical Physiology	11 th Edition, Elsevier Saunders,	11th Edition, 2006
4.	Juergen Mai George Paxinos	The Human nervous System	Academic Press 3rd Edition	2011
5.	Midthun Joseph	The Digestive and Urinary Systems	World Book, Inc	2011

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

WEB URLs

1.https://nptel.ac.in/courses/104101093/3

2.https://nptel.ac.in/courses/122103039/16

3.https://nptel.ac.in/noc/individual_course.php?id=noc18-ch11

4.https://nptel.ac.in/courses/102104058/19

5.https://nptel.ac.in/courses/102104058/19

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC17	**Medical Imaging Techniques**	3	0	0	3

Course Objectives:

To familiarize the students with various medical imaging modalities.

To make learners understand the principles, detectors and operating procedures of X-ray, CT, MRI, ultrasound, PET and SPECT.

To make the students learn the advantages, disadvantages and hazards of various medical imaging equipment.

Course Outcomes:

Interpret the working principle and operating procedure and applications of X-ray equipment.

Understand the image reconstruction techniques and applications of CT.

Summarize the image acquisition and reconstruction techniques in MRI.

Comprehend the working principle, modes and medical applications of ultrasound imaging.

Examine the operation and applications of PET, SPECT and radio nuclide instrumentation.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC17.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC17.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC17.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC17.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC17.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT-I X Ray Imaging:

Electromagnetic spectrum, Production of X-rays, X-ray tubes- Stationary and Rotating Anode types, Block diagram of an X-Ray Machine, Collimators and Grids, Timing and Exposure controls. X-Ray Image visualization-Films, Fluorescent screens, Image Intensifiers. Dental X-Ray machines, Portable and mobile X-Ray units, Mammographic X-Ray equipment, Digital Radiography and flat panel detectors. Radiation safety, ALARA principle, Dose units and dose limits, Radiation dosimeters and detectors.

UNIT-II Computed Tomography:

Basic principles, CT number scale, CT Generations. Major sub systems- Scanning system, processing unit, viewing unit, storage unit. Need and Principle of sectional imaging, 2D image

reconstruction techniques - Iteration and Fourier methods. Applications of CT - Angio, Osteo, Dental, Perfusion (Body & Neuro), Virtual Endoscopy, Coronary Angiography.

UNIT-III Magnetic Resonance Imaging:

Principles of NMR imaging systems, Image reconstruction techniques-Relaxation processes, imaging/ pulse sequences. Sub systems of an NMR imaging system, NMR detection system, types of coils, biological effects and advantages of NMR imaging. Functional MRI - The BOLD effect, intra and extra vascular field offsets, source of T2* effects, Creating BOLD contrast sequence optimization sources and dependences of physiological noise in fMRI.

UNIT- IV Ultrasound Imaging: -

Principles of image formation -Imaging principles and instrumentation of A-mode, B-Mode, Gating Mode, Transmission mode and M-mode. Basics of multi-element linear array scanners, Digital scan conversion. Doppler Ultrasound and Colour Doppler imaging, Image artifacts, Biological effects, Ultrasound applications in diagnosis, therapy and surgery.

UNIT-V Nuclear Medicine–

Radioisotopes in medical diagnosis, Basic instrumentation- Radiation detectors, Pulse height analyzer, Rectilinear scanner, Gamma camera. Emission Computed Tomography (ECT), Principle and instrumentation of Single Photon Emission Computed Tomography(SPECT) and Positron Emission Tomography (PET). Comparison of SPECT, PET and combined PET/ X-ray CT.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	K.kirk shung, Michael b.smith Benjamin tsui	Principles of Medical Imaging	Academic Press, New York	2010
2.	Khandpur R.S,	Handbook of Biomedical Instrumentation 3rd edition	Tata McGraw-Hill New Delhi	2014
3.	John G. Webster	Medical Instrumentation Application and Design 4th edition	Wiley India Pvt Ltd, New Delhi	2015
4.	Joseph J. Carr John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2004

WEB REFERENCE(s)

1. https://www.slideshare.net/Aprnaa/medical-imaging-techniques
2. https://www.slideshare.net/brucelee55/radioisotope-imaging-equipment
3. https://www.slideshare.net/sandeepgupta0491/nuclear-magnetic-resonance-39763597
4. http://www.cse.iitm.ac.in/~vplab/courses/optimization/MAths_IM_DEBLUR_BNH_SDMD T_2016.pdf
5. https://www.slideshare.net/VictorEkpo2/the-role-of-computers-in-medical-physics

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC18	**Advanced Therapeutic Equipment**	3	0	0	3

OBJECTIVES:

- To study about the microscopy
- To learn about the hybrid techniques and types of chromatography
- To study about the special techniques in advanced bio analytical.
- To learn the radiation therapy and radiation safety.
- To analysis about the basics of respiratory aids

OUTCOMES:

- Idea about the imaging techniques in microscopy.
- Types of techniques in advanced bio analytical.
- Know about the types of special techniques.
- Knowledge about the types of respiratory aids.
- Know about the radiation & safety of radiation.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC18.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC18.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC18.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC18.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC18.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I-ADVANCED IMAGING TECHNIQUES IN MICROSCOPY 9

Live cell imaging, Confocal microscopy and sample preparation for fluorescence microscopy - High content/throughput screening - Basics of SEM & Specimen preparation for SEM - Basics of TEM & Specimen preparation for TEM. Advanced EM techniques: Electron tomography and Serial block face imaging using SEM – CryoEM - Methods to study STED - Structured Illumination Microscopy – Multi-photon microscopy and In vivo imaging.

UNIT-II ANALYTICAL HYBRID TECHNIQUES 9

Gas chromatography with mass spectrometric detection (GC-MS), liquid chromatography with mass spectrometric detection (LC-MS), inductively coupled plasma with mass spectrometric

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Auton.)
Rasipuram, Namakkal Dist 637 408

detection (ICP-MS). Metal analysis by ICP-MS; Analysis of data: HPLC chromatograms, including trouble shooting – how to achieve good separation on HPLC; GC-MS data; LC-MS spectra.

UNIT III - ANALYTICAL SPECIAL TECHNIQUES **9**

Flow Cytometer: Introduction to flow cytometry- Fluorochromes and fluorescence - Experimental design and fluorescence quantitation Compensation and gating – Normalization - Comparing Univariate Cell Distributions - Probability Binning - Readings on flow cytometry data analysis. isoelectric focusing and 2-Dimensional polyacrylamide gel electrophoresis and their uses in protein research. Protein crystallization; Theory and methods.

UNIT IV RESPIRATORY AIDS **9**

korotkoff's method measurement of respiratory rate: Impedance Pneumograpy. OXIMETERS: Principle, pulse oximeter, Ventilator- Need, Types, Intermittent positive pressure, breathing apparatus operating sequence, electronic IPPB unit with monitoring for all respiratory parameters, Humidifier, Nebulizer, Aspirator.

UNIT V RADIATION THERAPY AND RADIATION SAFETY **9**

Effects of ionising radiation, Radiation therapy – Cobalt Cesium therapy, linear accelerator, betatron, cyclotron, brachy-therapy, , Radiation protection in medicine- radiation protection principles.

Total:45 Hrs

TEXT BOOK:

S.NO	AUTHOR	TITLE OF BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Skoog, D.A., Crouch, S.R., and Holler, F.J	Principles of Instrumental Analysis	6th edition, Brooks/Cole, USA	2006
2.	R.S.Khandpur	Hand book of Biomedical Instrumentation	Tata McGraw Hill, NewDelhi	1998

REFERENCE BOOKS:

S.NO	AUTHOR	TITLE OF BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Albert M.Cook and	Therapeutic Medical Devices	Prentice Hall Inc., New Jersey	1982

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Auton.)
Rasipuram, Namakkal Dist 637 408

	Webster.J.G			
2.	Leslie Cromwell, Fred. J. Weibel, Erich.A.Pferffer	Biomedical Instrumentation and Measurements	Prentice Hall India, NewDelhi	2001
3.	Rangaraj.M.Rangayyan	Biomedical Signal Analysis-A Case Study Approach	IEEE Press- John Wiley&Sons Inc, New York	2002
4.	Freifelder D., Physical Biochemistry	Application to Biochemistry and Molecular Biology	2nd Edition, W.H. Freeman & Company, San Fransisco	1982
5.	Williams, D. and Fleming, I	Spectroscopic Methods in Organic Chemistry	6th edition, McGraw-Hill Higher Education, Maidenhead, UK	2008
6.	Joseph .J.Carr and John .M.Brown	Introduction to Biomedical Equipment Technology	John Wiley&Sons Inc, New York	2002

WEB URL'S:

1. https://analytika.pharmaceuticalconferences.com/events-list/advance-bio-analytical-techniques
2. https://onlinelibrary.wiley.com/doi/book/10.1109/9780470544204
3. http://www.biomedicahelp.altervista.org/SecondoAnno/StatisticaSegnali/Segnali/Segnali_BiomedicalSignalAnalysisBook_Libro.pdf
4. https://people.ucalgary.ca/~ranga/enel563/Lectures1stEdCh1-2-3.pdf
5. http://www.naweb.iaea.org/nahu/DMRP/documents/slides/Chapter_16_Radiation_protection_and_safety.pdf

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC19	**Analytical & Diagnostic Equipments**	3	0	0	3

COURSE OBJECTIVES

1. To Familiarize the working of cardiac equipments and use
2. To introduce the principles of life- support and arrhythmia equipment in clinical use.
3. To familiarize with design and system level analysis different therapeutic equipments.
4. To identify the application and safety aspects of different equipments
5. To learn the different monitoring techniques for internal organs

COURSE OUTCOMES

1. Describe the working setup of all basic cardiac equipment.
2. Students will have acquired thorough life support equipment in clinical use.
3. Learned the design and system level analysis different therapeutic equipments
4. Analyzing the application and safety aspects of different equipments
5. Studied various internal organ monitoring devices

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BMC19.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BMC19.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC19.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC19.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BMC19.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I - Introduction:

Analytical equipment used in the clinical environment Beer-Lambert's Law, Colorimeters, Spectrophotometers: Instrumentation - Filters-Monochromators -Detectors –UV & Visible, IR Spectrophotometer – Instrumentation- Radiation Source -Monochromators & Detectors-Applications, Electrolyte Analysers-Measurement methods -Ion selective electrode method (ISE) - Solid state ISE -Ion-Selective Optodes, Lab On a Chip (LOC) biochemical sensor, Miniaturized Systems for (Bio)Chemical analysis and synthesis- glucometer-Point Of Care Test equipment(POCT)

UNIT II - Audiometers:

Audiometers – Pure tone - speech audiometers and impedance audiometry. Respiratory measurements: Spirometry – Basic system and applications- Pulmonary function measurements: Respiratory volumes, lung capacity -different volume measurement. Blood flowmeters - Electromagnetic – Ultrasonic Doppler blood flowmeters. Introduction to wearable

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Autono
Rasipuram, Namakkal Dist 637 408

health monitors.

Unit III - **Sensory Measurement**

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses – Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

Unit IV - Respiratory Measurement and Assist Systems

Lung Volume and vital capacity, Spirometer, measurements of residual volume. pneumotachometer – Airway resistance measurement, Whole body plethysmography. Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

Unit V - Robotics In Medicine:

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric-, and General- Surgery, Gynecologic Surgery, General Surgery and Nano robotics.

REFERENCE BOOKS:

S.NO	AUTHOR	TITLE OF BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Albert M.Cook and Webster.J.G	Therapeutic Medical Devices	Prentice Hall Inc., New Jersey	1982
2.	Leslie Cromwell, Fred. J. Weibel, Erich.A.Pferffer	Biomedical Instrumentation and Measurements	Prentice Hall India, NewDelhi	2001
3.	Rangaraj.M.Rangayyan	Biomedical Signal Analysis-A Case Study Approach	IEEE Press- John Wiley&Sons Inc, New York	2002
4.	Freifelder D., Physical	Application to Biochemistry and	2nd Edition, W.H. Freeman & Company, San	1982

Chairman
Board of Studies
Department of Biomedical Engine
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

	Biochemistry	Molecular Biology	Fransisco	
5.	Williams, D. and Fleming, I	Spectroscopic Methods in Organic Chemistry	6th edition, McGraw-Hill Higher Education, Maidenhead, UK	2008
6.	Joseph .J.Carr and John .M.Brown	Introduction to Biomedical Equipment Technology	John Wiley&Sons Inc, New York	2002

WEB URL'S:

1. https://analytika.pharmaceuticalconferences.com/events-list/advance-bio-analytical-techniques
2. https://onlinelibrary.wiley.com/doi/book/10.1109/9780470544204
3. http://www.biomedicahelp.altervista.org/SecondoAnno/StatisticaSegnali/Segnali/Segnali_BiomedicalSignalAnalysisBook_Libro.pdf
4. https://people.ucalgary.ca/~ranga/enel563/Lectures1stEdCh1-2-3.pdf
5. http://www.naweb.iaea.org/nahu/DMRP/documents/slides/Chapter_16_Radiation_protection_and_safety.pdf

Chairman
Board of Studies
Department of Biomedical Engine
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC20	**Bio Medical Sensors and Instruments Laboratory**	0	0	2	1

LIST OF EXPERIMENTS:

1. Characteristics of strain gauges.
2. Displacement measurement using LVDT & LVRT
3. Characteristics of temperature sensor-thermistor
4. Characteristics of temperature sensor-RTD.
5. Characteristics of thermocouple
6. Characteristics of Light sensors-LDR, Photo Diode, Photo Transistor.
7. Characteristics of Piezoelectric Transducer.
8. Wheatstone Bridge and Kelvins Bridge for Measurement of Resistance.
9. Measurement of capacitance using bridge circuits.
10. Measurement of inductance using bridge circuits.
11. Characteristics of passive filters.
12. Force measurement using force sensor and calibration.
13. Study of Multimeter and Medical Oscilloscope.
14. Study of Input / Output characteristics using X – Y oscilloscope.

TOTAL: 30 HRS

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC21	**Biochemistry and Human Physiology Laboratory**	**0**	**0**	**2**	**1**

LIST OF EXPERIMENTS:

1. General guidelines for working and functional component of biochemistry lab
2. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
3. Standardization of pH meter, preparation of buffers, emulsions.
4. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
5. General tests for carbohydrates, proteins and lipids.
6. Identification of Blood Collection Tubes and Phlebotomy equipments
7. Preparation of serum and plasma from blood.
8. Estimation of Hemoglobin
9. Estimation of blood glucose.
10. Estimation of creatinine.
11. Estimation of urea.
12. Estimation of Uric acid
13. Estimation of cholesterol
14. Assay of SGOT/SGPT.
15. ELISA test
16. Separation of proteins by SDS electrophoresis (Demo)
17. Separation of amino acids by thin layer chromatography (Demo).

Chairman
Board of Studies
Department of Biomedical Engineer
Muthayammal Engineering College (Autonomo
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC22	**Analog and Digital Integrated Circuits laboratory**	0	0	2	1

List of Experiments

Implementation and testing of code converters.

Implementation and testing of multiplexers & demultiplexer

Implementation of 4-Bit shift registers using flip flops

Design and testing of first order Low Pass and High Pass Active filters

Design and testing of Phase shift Oscillators and Wein bridge oscillators

Design and testing of Monostable and Astable Multivibrator using NE555 Timer

Inverting, non-inverting amplifier and comparator

Integrator and Differentiator

Instrumentation amplifier using operational amplifier

Simulation and analysis of circuits using software

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC23	**Pathology and Microbiology Laboratory**	0	0	2	1

LIST OF EXPERIMENTS:

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope
3. Histopathological slides of benign and malignant tumours.
4. Manual paraffin tissue processing and section cutting (demonstration)
5. Cryo processing of tissue and cryosectioning (demonstration)
6. Basic staining – Hematoxylin and eosin staining.
7. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS
8. Capsule stain
9. Simple stain.
10. Gram stain.
11. AFB stain.
12. Antigen-Antibody reaction Immuno electrophoresis
13. Slides of malarial parasites, micro filaria and leishmania donovani.
14. Haematology slides of anemia and leukemia.
15. Study of bone marrow charts.

Chairman
Board of Studies
Department of Biomedical Engine
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC24	**Medical Signal Processing Laboratory**	0	0	2	1

LIST OF EXPERIMENTS:

1. Representation of basic discrete time signals
2. Computation of convolution -linear convolution
3. Response of a difference equation to initial conditions; stability
4. DFT and FFT computation
5. FIR filter design using windowing techniques
6. IIR filters design-digital Butterworth filter and Chebyshev filter
7. Simulation of Bio-signals.
8. Analysis of ECG signals.
9. Analysis of EEG signals
10. Analysis of EMG signals

Following National Instrument (NI)"s products will be used as a supplement:

11. NI Vision Development Module
12. NI Vision Acquisition Software
13. Vision Builder for Automated Inspection tools

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC25	**Biomedical Instrumentation Laboratory**	0	0	2	1

List of Experiment

1. Simulation of ECG – detection of QRS complex and heart rate
2. Study of biotelemetry
3. Electrical safety measurements.
4. Measurement of Respiratory parameters using spirometry.
5. Study of medical stimulator.
6. Study of ESU – cutting and coagulation modes
7. Measurement and Recording of Hearing threshold using Audiometer and plot its characteristics.
8. Design and Analysis of ECG, EEG,EMG amplifier, recording and analysis using Lab View
9. Measurement of Blood Pressure using Sphygmomanometer & Digital meter.
10. Recording of Electromyogram/ nerve conduction velocity.
11. The Galvanic Skin Response Amplifier
12. Study of lung and cardiovascular models
13. Hospital department facility layout for installation and maintenance of biomedical equipment/systems in reference to regulatory guidelines.
14. Measurements using patient monitoring systems (BIOPAC).

Chairman
Board of Studies
Department of Biomedical Engi...
Muthayammal Engineering College (Auton...
Rasipuram, Namakkal Dist 637 40...

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC26	**Microprocessor and Microcontroller Laboratory**	0	0	2	1

Sl.No	List of Experiments
1.	Addition, subtraction, multiplication, division using 8086 processor 5 C,I 1 1,7
2.	Sorting of numbers in ascending order using 8086 processor 1 C,I 1 1
3.	Sorting of numbers in descending order using 8086 processor 1 C,I 1 1
4.	Palindrome and Fibonacci series using 8086 processor 1 C,I 1 1
5.	Sorting of even numbers in an array using 8086 processor 1 C,I 1 1
6	Finding the largest and smallest number in an array using 8086 processor 1 C,I 1 1
7	Addition of two numbers using 8051 processor 2 C,I 2 7
8	Subtraction of two numbers using 8051 processor 2 C,I 2 7
9	Multiplication of two numbers using 8051 processor 2 C,I 2 7
10	. Sorting of numbers in ascending order using 8051 processor 2 C,I 2
11	Sorting of numbers in descending order using 8051 processor 2 C,I 2 7
12	Palindrome and fibonacci series using 8051 processor 2 C,I 2 7
13	Sorting of even numbers in an array using 8051 processor 3 C,I 2 7
14	Basic programs using ARM controller 5 C,I 3 7

Chairman
Board of Studies
Department of Biomedical Engg.
Muthayammal Engineering College (Auton.)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC27	**Embedded System & IOMT Laboratory**	0	0	2	1

LIST OF EXPERIMENTS

1. Interface Switches and LED's
2. Interface Switches
3. Interface LCD and Display "Hello World"
4. Interface 4*4 Matrix Keyboard
5. Interface Stepper Motor
6. Interface 7 Segment Display using I2C
7. Interfacing Analog to Digital Converter
8. Interface Digital to Analog Converter
9. Implementing Real Time Clock
10. Mini Project

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BMC28	**Medical Image Processing Laboratory**	0	0	2	1

List of Experiments:

1. Display of color and grayscale Images.
2. Conversion between color spaces
3. Histogram Equalization.
4. Spatial filtering
5. Non-linear Filtering.
6. Edge detection using Operators.
7. 2-D DFT and DCT.
8. Filtering in frequency domain.
9. DWT of images.
10. Segmentation using watershed transform.
11. Steganography
12. Feature extraction in medical images.
13. Medical Image Compression techniques.
14. Medical image fusion
15. Study of DICOM standards.

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME01	BIO-MATERIALS AND ARTIFICIAL ORGANS	3	0	0	3

COURSE OBJECTIVES

1. To learn characteristics and classification of Biomaterials.
2. To understand different metals and ceramics used as biomaterials.
3. To learn polymeric materials and combinations
4. To study about tissue replacement implants.
5. To know artificial organ developed using these materials.

COURSE OUTCOMES

1. Analyze different types of Biomaterials and its classification.
2. Understand different metals and ceramics used as biomaterials.
3. Learn about the polymeric materials and combinations.
4. Perform combinations of materials that could be used as a tissue replacement implant.
5. Know about the artificial organ development.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME01.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME01.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME01.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME01.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME01.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I STRUCTURE OF BIO-MATERIALS 9

Definition and classification of bio-materials, mechanical properties, visco-elasticity, wound healing process, body response to implants, blood compatibility

UNIT II IMPLANT MATERIALS 9

Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyl-apatite glass ceramics carbons, medical applications

UNIT III POLYMERIC MATERIALS 9

Polymerization, polyamides, Acryrilic polymers, rubbers, high strength thermoplastics, medical applications. Bio polymers: Collagen and Elastin.

UNIT IV TISSUE REPLACEMENT MATERIALS 9

Soft-tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

UNIT V ARTIFICIAL ORGANS 9

Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants – Artificial limb & hand. Ethical, Environmental and Safety issues in the implantation of artificial organs.

REFERENCE BOOK

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Auton..
Rasipuram, Namakkal Dist 637 408

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Sujata V. Bhatt	Biomaterials Second Edition	Narosa Publishing House	2005
2.	JoonB.Park Joseph D. Bronzino	Biomaterials - Principles and Applications	CRC Press	2003
3.	Park J.B	Biomaterials Science and Engineering	Plenum Press	1984
4.	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw-Hill	2003
5.	John Enderle, Joseph D. Bronzino, Susan M. Blanchard	Introduction to Biomedical Engineering	Elsevier	2005

WEB REFERENCE(s)

1. https://www.elsevier.com/books/biomaterials-artificial-organs-and-tissueengineering/
2. https://sites.google.com/site/.../seweh/Biomaterials-An-Introduction.pdf
3. http://ocw.uc3m.es/ciencia-e-oin/materials-science-and-engineering/lecture-notes-1/Chapter_7_1.pdf
4. https://emedicine.medscape.com/article/843730-overview
5. https://www.mirm.pitt.edu/our-research/focus-areas/medical-devices-and-artificial-organs/

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Auton...
Rasipuram, Namakkal Dist 637 40...

COURSE CODE	COURSE TITLE	L	T	P	C
21BME02	BIOSTATISTICS	3	0	0	3

OBJECTIVES:

To introduce the techniques used in statistical & regression analysis.
To compare the various parameters used in statistical significance
To interpret regression analysis
To introduce data tables and community health
To measure statistical and epidemiologic measures

COURSE OUTCOMES:

CO1: Classify common statistical tests and tools.
CO2: Distinguish between p-values and confidence intervals as measures of statistical significance.
CO3: Interpret commonly used regression analysis.
CO4: Explain the data tables and its interpretations in community health.
CO5: Evaluate commonly used statistical and epidemiologic measures

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME02.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME02.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME02.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME02.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I INTRODUCTION 9

Biostatistics - Statistical problems in Biomedical research– Basic concepts: Population, Samples and Variables - Basic probability, likelihood & odds, distribution variability

UNIT II STATISTICAL PARAMETERS 9

Statistical parameters p-values, computation and level chi square test and distribution.

UNIT III REGRESSION ANALYSIS 9

Regression – Linear regression – Multiple linear regression – Multiple colinearity, Determining Best regression – Nonlinear regression – Logistic regression – Poison regression.

UNIT IV INTERPRETING DATA 9

Life table: Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V META ANALYSIS 9

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Auton.
Rasipuram, Namakkal Dist 637 408

META analysis for research activities, purpose and reading of META analysis, Forest graph, Funnel plots, Radial plots, L'Abbe plots, Criticisms of Meta analysis.

TOTAL:45 PERIODS

TEXT BOOKS:

1.Joseph A. Ingel finger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware 'Biostatistics in Clinical Medicine', Singapore, 3 rd Edition, 1994.

2.Gerald van Belle, Lloyd D. Fisher, Patrick J. Heagerty, Thomas Lumley, 'Biostatistics: A Methodology For the Health Sciences', John Wiley & Sons, 2004.

REFERENCES:

1.Julien I.E. Hoffman, 'Biostatistics for Medical and Biomedical Practitioners', Elsevier Press, 2015.

2.James F. Jekel, 'Epidemiology, Biostatistics, and Preventive Medicine', Elsevier Health Sciences, 2007.

3.Ray M. Merrill, 'Fundamentals of Epidemiology and Biostatistics, Jones & Bartlett Learning, 2013.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME03	MEDICAL SCIENCE	3	0	0	3

COURSE OBJECTIVES

1. To identify the various function and basics of tissues, cartilage propagation of action potential
2. To identify the functional component and basics of Nervous system.
3. To identify and understand complete cardiovascular system from blood vessel to parts of heart and also know about function of all parts of digestive system.
4. To identify the function of all the parts of respiratory system
5. To identify the importance function of skeletal system and various types of joints.

COURSE OUTCOMES

1. Essentials of structural and functional anatomy of the human body
2. Anatomy and physiology of various nervous system
3. Anatomy and physiology of various cardiovascular system,
4. Anatomy and physiology of digestive system
5. Anatomy and physiology of respiratory system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO
21BME03.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME03.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME03.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME03.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME03.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I INTRODUCTION: HOMEOSTASIS, TISSUE, CARTILAGE 9

The internal environment and homeostasis, movement of substances within the body, body fluids, action potential, propagation of action potential. Epithelial tissue- simple epithelium, stratified epithelium, connective tissue- cells of connective tissue, loose connective tissue, Adipose tissue, Dense connective tissue, Lymphoid tissue, Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage

UNIT II NERVOUS SYSTEM 9

Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: neuroglia, meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum. Brainstem: Cerebellum, Spinal cord- grey matter, white matter, motor nerve tracts.

spinal nerves: nerve roots, plexuses, cranial nerves. Autonomic nervous system - functions and effects

UNIT III CARDIOVASCULAR SYSTEM **9**

Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, capillaries and sinusoids, control of blood vessel diameter, blood supply- internal respiration, cell nutrition. Heart- position, structurepericardium, myocardium, endocardium, interior of the heart, flow of blood through the heart, blood supply to heart, Conducting system of the heart, factors affecting heart rate, the Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the bloodpulmonary circulation, systemic circulation, aorta, circulation of blood to head and neck, circulation of blood to upper limb, portal circulation.

UNIT IV DIGESTIVE SYSTEM **9**

Introduction, Organs of the digestive system- mouth: tongue, teeth, salivary glands, pharynx, oesophagus, stomach, gastric juice and functions of stomach- small intestine: structure, chemical digestion in small intestine, large intestine: structure, functions of the large intestine, rectum and anal canal. Pancreas, Liver

UNIT V RESPIRATORY SYSTEM **9**

Introduction, Nose and Nasal cavity- position, structure and functions, pharynx, position, structure, functions. Larynx: position, structure and functions. Trachea, bronchi, bronchioles and alveoli, lungs- position, associated structure, pleura and pleural cavity. Respiration-muscles of respiration cycle of respiration, variables affecting respiration, lung volumes and capacity.

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Elaine.N. Marieb,	Essential of Human Anatomy and Physiology	Pearson Education NewDelhi, .	Eight edition,, 2007.
2.	Gillian Pocock, Christopher D. Richards	The Human Body An introduction for Biomedical and Health Sciences	Oxford University Press,USA	2009
3.	William F. Ganong	Review of Medical Physiology	Mc Graw Hill New Delhi	22nd edition
4.	Eldra Pearl Solomon	Introduction to Human Anatomy and Physiology	W.B.Saunders Company	2003

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

WEB URLs

1.https://nptel.ac.in/courses/104101093/3
2.https://nptel.ac.in/courses/122103039/16
3.https://nptel.ac.in/noc/individual_course.php?id=noc18-ch11
4.https://nptel.ac.in/courses/102104058/19
5.https://nptel.ac.in/courses/102104058/19

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME04	SPORTS PHYSICAL THERAPHY	3	0	0	3

COURSE OBJECTIVES

1. To understand and appreciate the value and application of Physiological models and Vital organs.
2. To model dynamically varying physiological system
3. To understand methods and techniques for analysis and synthesis of dynamic models
4. To develop differential equations to describe the dynamic models, simulate and visualize,
5. To analysis the dynamic responses of physiological models using software.

COURSE OUTCOMES

1. Explain application of Physiological models.
2. Model dynamically varying physiological system
3. Discuss methods and techniques to analyze and synthesis dynamic models
4. Develop differential equations to describe the dynamic models, simulate and visualize
5. Implement physiological models using software to get dynamic responses

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME04.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME04.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME04.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME04.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME04.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I: Massage

Massage Historical development, Definition and classification of massage techniques, Physiological effects of massage, Description of the techniques of the classical massage. Connective tissue massage, physiological basis of sports massage and various categories, underwater massage, mechanical devices of massage, therapeutic applications and contraindications of massage.

UNIT II: Heat Therapy

Heat Therapy Production, Physiological effects, indications, contraindications and specific uses in sports of the following: Infrared rays, Parafin Wax Bath, Steam Bath, Sauna Bath, Moist Heat Pack, Fluidotherapy, Mud Bath and Pelloids.

UNIT III: Hydrotherapy

History & introduction, Effects of simple baths, raising temperature baths, baths with additives, Aromatic baths, Mineral baths, physical baths, Hydroelectric baths, Stammer baths, whirl pool bath, showers and steam showers

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

UNIT IV: Cryotherapy

Physiological effects, Use of cold therapy in acute phase, rehabilitative phase, preventive phase of athletic injury, Methods of application, Indications and contraindications

UNIT V: Manual Therapy

Introduction to manual therapy techniques, joint techniques, manual joint therapy, traction, basic principles of manipulation for various disorders of the spine and extremities. Clinical Reasoning and decision making

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Michel C Khoo	Physiological Control Systems - Analysis, simulation and estimation	Prentice Hall of India	2001
2.	David T. Westwick, Robert E. Kearney	Identification of Nonlinear Physiological Systems	Wiley-IEEE Press	2003
3.	V.Z. Marmarelis	Advanced methods of physiological modeling	Plenum Press	
4.	J. Candy	Signal Processing: The Model Based approach	Mc. Graw Hill.	
5.	L.Stark,	Neurological Control System	Plenum Press.	

WEB URL'S

1. https://en.wikibooks.org/wiki/Biomedical_Engineering_Theory_And_Practice/Physiological_Modeling_and_Simulation
2. https://www.researchgate.net/publication/262185321_Physiological_Systems_Modeling_Simulation_and_Control.
3. https://nsec.lab.uconn.edu/home/courses-2/bme-3100-physiological-modeling/.
4. https://indico.egi.eu/indico/event/1222/session/22/contribution/34/material/slides/0.pdf.
5. https://epubs.siam.org/doi/pdf/10.1137/1.9780898718287.ch8

Chairman
Board of Studies
Department of Biomedical Engg.
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME05	TELEMEDICINE	3	0	0	3

COURSE OBJECTIVES

1. To learn the key principles for telemedicine and health.
2. To study about electronic health recorders
3. To understand mobile health technology.
4. To know tele-medical standards, mobile telemedicine standards.
5. To know tele-medical standards, mobile telemedicine and it applications

COURSE OUTCOMES

1. Apply multimedia technologies in telemedicine.
2. Explain Protocols behind encryption techniques for secure transmission of data.
3. Apply tele-health in healthcare.
4. Apply mobile-health in healthcare.
5. Learn tele-medical standards.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME05.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME05.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME05.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME05.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME05.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION** 7

Overview of Health Informatics, Healthcare Data, Information and Knowledge, Healthcare Data Analysis

UNITII **ELECTRONIC HEALTH RECORDS** 9

Electronic Health Records, Health Information Exchange, Health Data Standards, Architectures of Information Systems, Consumer Health informatics.

UNIT III **MOBILE HEALTH** 9

Mobile Technology and mHealth, Online Medical Resources, Medical Information Retrieval, Disease Management and Disease Registries, Telemedicine, Medical Imaging Informatics, Bioinformatics, Public Health Informatics

UNIT IV **TELEMEDICAL STANDARDS** 11

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 phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT V **TELEMEDICAL APPLICATIONS** 9

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Telemedicine access to health care services - health education and self care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Robert E. Hoyt and Ann K. Yoshihashi	Lasers and Optical Fibers in Medicine	Health Informatics: Practical Guide for Healthcare and Information Technology Professionals (Sixth Edition)	Latest Edition
2.	Phillip Olla.	Mobile Health Solutions for Biomedical Applications	Hershey, Pa. : Information Science Reference, c	2009
3.	I stepanian, Robert, Laxminarayan, Swamy, Pattichis, Constantinos	M-Health-Emerging Mobile Health Systems	Springer Publications	2006
4.	SasanAdibi	Mobile Health: A Technology Road Map	Springer Publication	Mar 2015
5.	Norris, A.C.	Essentials of Telemedicine and Telecare	Wiley	2002

WEB REFERENCE(s)

1. COMP107x Introduction to Mobile Application Development using Android
2. https://www.coursera.org/course/introbiomedhlthinfo
3. https://trove.nla.gov.au/version/45455445
4. https://www.who.int/sustainable-development/health-sector/strategies/telehealth/en/
5. http://www.caltrc.org/telehealth/why-are-telemedicine-and-telehealth-so-important-in-our-healthcare system/

Chairman
Board of Studies
Department of Biomedical Engg.
Muthayammal Engineering College (Auton.)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME06	BRAIN COMPUTER INTERFACE AND APPLICATIONS	3	0	0	3

COURSE OBJECTIVES

1. To apply the knowledge of mathematics science and engineering fundamentals to understand the Brain Organization, Anatomy, and Function.
2. To analyze and study the Signal Processing for BCI's
3. To develop the basic understanding in Building a BCI
4. To study about the human devices
5. To learn about the real-time Medical Applications.

COURSE OUTCOMES

1. Equips the students with the knowledge of Brain Organization, Anatomy, and Function.
2. Analyze and process the brain signals for artifact reduction.
3. Understand types of BCI, in the Neurosciences domain.
4. Understand the principles and its applications in the Neurosciences domain.
5. Ability to have the ideas of human assist device with Medical Applications

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME06.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME06.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME06.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME06.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME06.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I Basic Neurosciences 9

Basic Neuroscience: Neurons, Action Potentials or Spikes, Dendrites and Axons, Synapses, Spike Generation, Adapting the Connections: Synaptic Plasticity – LTP, LTD, STDP, Short-Term Facilitation and Depression, Brain Organization, Anatomy, and Function. Recording Signals from the Brain: Invasive Techniques &Noninvasive Techniques. Stimulating the Brain - Neurochip

UNIT II Signal Processing for BCI's 9

Time Domain Analysis: Hjorth Parameters , Fractal Dimension , Autoregressive (AR) Modeling, Bayesian Filtering, Kalman Filtering, Particle Filtering, Spatial Filtering : Bipolar, Laplacian, and Common Average Referencing ,Principal Component Analysis (PCA)

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

,Independent Component Analysis (ICA) , Common Spatial Patterns (CSP) Thresholding, Band-Stop and Notch Filtering

UNIT III **Building a BCI** **9**

Major Types of BCIs, Brain Responses Useful for Building BCIs, Conditioned Responses, Population Activity, Imagined Motor and Cognitive Activity, Stimulus-Evoked Activity. Invasive BCIs: Two Major Paradigms in Invasive Brain-Computer Interfacing: BCIs Based on Operant Conditioning, BCIs Based on Population Decoding.

UNIT IV **Invasive BCIs in Humans** **9**

Cursor and Robotic Control Using a Multi electrode Array Implant, Cognitive BCIs in Humans, Long-Term Use of Invasive BCIs, Long-Term BCI Use and Formation of a Stable Cortical Representation, Long-Term Use of a Human BCI Implant ECoG BCIs in Humans, BCIs Based on Peripheral Nerve Signals, Nerve-Based BCIs, Targeted Muscle Innervation (TMR). Sensory Restoration, Restoring Sight: Cortical and Retinal Implants, Motor Restoration, Deep Brain Stimulation (DBS), Sensory Augmentation

UNIT V **Medical Applications** **9**

Sensory Restoration, Motor Restoration, Cognitive Restoration, Rehabilitation, Restoring Communication with Menus, Cursors, and Spellers, Brain- Controlled Wheelchairs, Nonmedical Applications: Web Browsing and Navigating Virtual Worlds, Robotic Avatars, High Throughput Image Search Lie Detection and Applications in Law, Monitoring Alertness, Estimating Cognitive Load, Education and Learning, Security, Identification, and Authentication, Physical Amplification with Exoskeletons, Mnemonic and Cognitive Amplification , Brain-Controlled Art.

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Rajesh P. N. Rao	Brain-Computer Interfacing: An Introduction (1st Edition)	Cambridge University Press	
2.	Bernhard Graimann (Editor), Brendan Z. Allison (Editor), GertPfurtscheller (Editor)	Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction	The Frontiers Collection - Hardcover	13 Dec 2010
3.	Anton Nijholt, José Del R. Millán, Stephen Dunne	Towards Practical Brain-Computer Interfaces: Bridging the Gap from Research to Real-World Applications	Springer Science & Business Media	2012

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

4.	Mehmet R. Yuce,Jamil Y.Khan	Wireless Body Area Networks Technology, Implementation and Applications	Pan Stanford Publishing Pvt.Ltd Singapore,	2012
5.	Guang-Zhong Yang(Ed.),	Body Sensor Networks	Springer	2006

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 406

COURSE CODE	COURSE TITLE	L	T	P	C
21BME07	MEDICAL OPTICS	3	0	0	3

COURSE OBJECTIVES

1. The optical properties of the tissues and the interactions of light with tissues.
2. The instrumentation and components in Medical Optics.
3. The Medical Lasers and their applications
4. The optical diagnostic applications
5. The emerging optical diagnostic and therapeutic techniques

COURSE OUTCOMES

1. Demonstrate knowledge of the fundamentals of optical properties of tissues
2. Analyze the components of instrumentation in Medical Photonics and Configurations
3. Describe surgical applications of lasers.
4. Describe photonics and its diagnostic applications.
5. Investigate emerging techniques in medical optics

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME07.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME07.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME07.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME07.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME07.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Fundamental Properties of light - Refraction, Reflection, Laws (Snell's law and Fresnel law) Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology, Laser tissue Interactions – Photo chemical, Photo thermal and Photo mechanical interactions, Fluorescence, Speckles, Photo ablative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, Scattering and emission measurements, Excitation light sources – high pressure arc lamps, LEDs, Lasers, Optical filters – Prism and Mono-chromators, Polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection.

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

UNIT III **SURGICAL THERAPEUTIC APPLICATIONS OF LASERS** **9**

Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

UNIT IV **NON THERMAL DIAGNOSTIC APPLICATIONS** **9**

Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and Speckle applications of lasers in biology and medicine.

UNIT V **DIAGNOSTIC AND THERAPEUTIC TECHNIQUES** **9**

Near field imaging of biological structures, *In vitro* clinical diagnostics, Phototherapy, Photodynamic therapy (PDT) -Principles and mechanisms - Oncological and non-oncological applications of PDT – Bio-stimulation effect – applications - Laser Safety Procedures

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Tuan Vo Dirh	Biomedical Photonics	CRC Press	, 2014
2.	Paras N. Prasad	Introduction to Biophotonics	A. John Wiley and Sons, Inc. Publications	2003
3.	Markolf H.Niemz	Laser-Tissue Interaction Fundamentals and Applications	Springer	2007
4.	G.David Baxter	Therapeutic Lasers—— Theory and practice	Churchill Livingstone publications	2001
5.	Leon Goldman, M.D & R.James Rockwell	Lasers in Medicine	Gordon and Breach, Science Publishers Inc	1975

WEB URL'S

1. https://www.slideshare.net/ChintanMorsiya/optical-properties-71404985
2. https://www.slideshare.net/ErFarukBinPoyen/optical-instrumentation-7-laser
3. https://www.slideshare.net/abhaydhanorkar5/advanced-diagnostic-tecniques
4. https://www.slideshare.net/priyanka1194/thermal-imaging-and-its-applications
5. https://www.slideshare.net/abhaydhanorkar5/advanced-diagnostic-tecniques

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Autono
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME08	AI & MEDICAL INFORMATICS	3	0	0	3

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME08.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME08.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME08.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME08.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME08.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT 1 AI & INTERNAL REPRESENTATION **9**

The AI problem–What is AI technology–Level of the Model–Criteria for Success problems, Problem paces & Searches & Heuristic Search Technology Problem as a State Space Search–Production Systems– production System Characteristics– Generate & Test–Hill Climbing–Best First Search–Constraint Satisfaction– Means End Analysis.

UNIT 2 KNOWLEDGE REPRESENTATION **9**

Issues in Knowledge Representation – Using Predicate Logic –Representing Simple Facts in Logic, Representing Instance & is a Relationship Computable Functions & PredicatesRepresentingKnowledgeUsingRules:ProceduralVs.DeclarativeKnowledgeForwardVs.BackwardReasoning.

UNIT 3 SLOT & FILLERSTRUCTURES **9**

Weak Slot & Filler – Semantic Nets – Frames Strong & filler Structures – Scripts – CYC-CYCL

UNIT 4 EXPERTSYSTEMS **9**

WhatareExpertSystems–KnowledgeRepresentationinExpertSystems–SymbolicComputation–Rule based Systems

UNIT 5 TOOLS FOR BUILDING EXPERT SYSTEMS **9**

UsingDomainKnowledge–KnowledgeAcquisition–DesignforExplanation–BlackBoardArchitecture–

Truth Maintenance Systems–Machine Learning–Case based Reasoning

Chairman
Board of Studies
Department of Biomedical Engg.
Muthayammal Engineering College (Auton.)
Rasipuram, Namakkal Dist 637 408

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Rajesh P. N. Rao	Brain-Computer Interfacing: An Introduction (1st Edition)	Cambridge University Press	
2.	Bernhard Graimann (Editor), Brendan Z. Allison (Editor), GertPfurtscheller (Editor)	Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction	The Frontiers Collection - Hardcover	13 Dec 2010
3.	Anton Nijholt, José Del R. Millán, Stephen Dunne	Towards Practical Brain-Computer Interfaces: Bridging the Gap from Research to Real-World Applications	Springer Science & Business Media	2012
4.	Mehmet R. Yuce,Jamil Y.Khan	Wireless Body Area Networks Technology, Implementation and Applications	Pan Stanford Publishing Pvt.Ltd Singapore,	2012
5.	Guang-Zhong Yang(Ed.),	Body Sensor Networks	Springer	2006

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME09	VIRTUAL REALITY	3	0	0	3

COURSE OBJECTIVES

1. To introduce the relevance of this course to the existing technology through demonstrations.
2. To study the case studies and applications with a futuristic vision along with socio-economic impact and issues.
3. To understand virtual reality, augmented reality and using them to build Biomedical engineering applications.
4. To know the intricacies of these platform to develop PDA applications with better optimality.
5. To learn about the application used in medical terms.

COURSE OUTCOMES

1. Analyze & Design a system or process to meet given specifications with realistic engineering constraints.
2. Identify problem statements and function as a member of an engineering design team.
3. Utilize technical resources
4. Propose technical documents and give technical oral presentations related to design mini project results.
5. Application used in medical terms.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME09.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME09.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME09.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME09.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME09.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I INTRODUCTION TO VIRTUAL REALITY 9

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR; Scientific Landmark.

UNIT II 3D COMPUTER GRAPHICS 9

Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

UNIT III VIRTUAL ENVIRONMENT 9

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in betweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

UNIT IV **VR HARDWARE AND SOFTWARE** **9**

Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML

UNIT V **APPLICATIONS** **9**

Use of Analysis Tools, Fourier transforms Power spectrum, Correlation methods, windowing & flittering. Application of VR: Medical applications-military applications-robotics applications-Advanced Real time tracking other applications- simulations, therapy.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	John Vince	Virtual Reality Systems	Pearson Education Asia	2007.
2.	Anand R	Augmented and Virtual Reality	Khanna Publishing House, Delhi	Latest Edition
3.	Adams	Visualizations of Virtual Reality	Tata McGraw Hill	2000
4.	Grigore C. Burdea, Philippe Coiffet	Virtual Reality Technology	Wiley Inter Science, 2nd Edition,	2006
5.	William R. Sherman, Alan B. Craig	Understanding Virtual Reality: Interface, Application and Design	Morgan Kaufmann	2008

WEB REFERENCE(s)

1. http://www.vresources.org/
2. http://www.vrac.iastate.edu/
3. http://www.w3.org/MarkUp/VRM
4. http://interscience.in/IJESS_Vol2Iss2-3-4/71-75.pdf
5. https://aabme.asme.org/categories/augmented-and-virtual-reality

Chairman
Board of Studies
Department of Biomedical Eng
Muthayammal Engineering College (Auton
Rasipuram, Namakkal Dist 637 40

COURSE CODE	COURSE TITLE	L	T	P	C
21BME10	Wearable Systems	3	0	0	3

COURSE OBJECTIVES

1. To study about need for wearable systems
2. To gain knowledge about sensors in wearable systems.
3. To acquaint with signal processing and Wearability issues
4. To handle with the energy harvesting for wearable devices
5. Learn about applications of wearable systems.

COURSE OUTCOMES

1. Enables the need for wearable devices.
2. Know about the basic principles of sensors and with the input signal
3. Provides idea with the energy management for wearable devices.
4. Explain need of wireless health systems
5. Equips with the knowledge of application with wearable systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME10.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME10.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME10.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME10.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME10.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I SENSORS 9

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor GSR, Radiant thermal sensor, Wearable motion sensors, CMOS – Based Biosensors, E-Textiles, Bic compatibility

UNIT II SIGNAL PROCESSING 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signa acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing Rejection of irrelevant information, Data mining

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES 9

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybric thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT IV WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges System security and reliability, BAN Architecture – Introduction, Wireless communication techniques

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Board of Studies
Department of Biomedical Engine
Muthayammal Engineering College (Autonom
Rasipuram, Namakkal Dist 637 408

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Mult parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICAT
1.	Annalisa Bonfiglio, Danilo De Rossi	Wearable Monitoring Systems	Springer	2011
2.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkatasubramanian	Body Area Networks Safety, Security, and Sustainability	Cambridge University Press	2013
3.	Hang,Yuan-Ting	wearable medical sensors and systems	Springer	2013
4.	Mehmet R. Yuce,Jamil Y.Khan	Wireless Body Area Networks Technology, Implementation and Applications	Pan Stanford Publishing Pvt.Ltd Singapore,	2012
5.	Guang-Zhong Yang(Ed.),	Body Sensor Networks	Springer	2006

WEB REFERENCE(s)

1. https://www.springer.com/gp/book/9781441973832
2. https://ionlarqss.firebaseapp.com/aa620/body-area-networks-by-sandeep-k-s-gupta-tridib-mukherjee-kri kumar-venkatasubramanian-b00bm4titm.pdf.
3. https://research.monash.edu/en/publications/wireless-body-area-vetworks-technology-implementation-a applica.
4. http://www.panstanford.com/pdf/9789814241571fm.pdf
5. http://cdn.intechopen.com/pdfs/9103/InTechWireless_body_area_network_wban_for_medical_applicati f.

Chairman
Board of Studies
Department of Biomedical Engi...
Muthayammal Engineering College (Auton...
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME11	INTERNET OF THINGS	3	0	0	3

COURSE OBJECTIVES

1. To understand Smart Objects and IoT Architectures
2. To learn about various IOT-related protocols
3. To build simple IoT Systems using Arduino and Raspberry Pi.
4. To understand data analytics and cloud in the context of IoT
5. To develop IoT infrastructure for popular applications

COURSE OUTCOMES

1. Explain the concept of IoT.
2. Analyze various protocols for IoT.
3. Design a PoC of an IoT system using Rasperry Pi/Arduino
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME11.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME11.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME11.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME11.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME11.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips, IoT system

Chairman Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV **DATA ANALYTICS AND SUPPORTING SERVICES** 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning - No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework - Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V **CASE STUDIES/INDUSTRIAL APPLICATIONS** 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things	Cisco Press,	2017
2.	Maciej Kranz	Building the Internet of Things: Implement New Business Models, Disrupt	John Wiley & Sons	Latest Edition
3.	Arshdeep Bahga, Vijay Madisetti	Internet of Things – A hands-on approach	Universities Press	2015
4.	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet of Things – Key applications and Protocols	Wiley, (for Unit 2).	2012
5.	Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan	From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence	Elsevier	2014

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408

	Avesand. David Boyle			

WEB URL'S

1. https://www.arduino.cc/
2. https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet
3. https://nptel.ac.in/courses/106105166/
4. https://nptel.ac.in/downloads/106105166/

https://nptel.ac.in/noc/individual_course.php?id=noc19-cs31

Chairman
Board of Studies
Department of Biomedical Eng
Muthayammal Engineering College (Auto
Rasipuram, Namakkal Dist 637 40

COURSE CODE	COURSE TITLE	L	T	P	C
21BME12	HOSPITAL WASTE MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

1. To know the basic knowledge of healthcare waste.
2. To create the awareness of hazard of biomedical waste.
3. To study about the hospital management and controlling of the wastages.
4. To learn about the types of treatment technologies for wastes.
5. To study about the professional ethics of biomedical waste handling.

COURSE OUTCOMES

1. Handling of biomedical waste.
2. Importance of the biomedical waste disposal in the society.
3. Know about the types of treatment technologies for wastes.
4. Learn the laws of biomedical waste handling and the Healthcare waste Management.
5.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME12.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME12.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME12.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME12.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME12.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I INTRODUCTION 9

Definition of general and hazardous healthcare waste, Infectious waste, geno-toxic waste, waste sharps, categorization and composition of Biomedical waste, major and minor sources of biomedical waste, Segregation of waste, Color coding, waste handling and disposal.

UNIT II HAZARD OF BIOMEDICAL WASTE 9

Need for disposal of biomedical waste, Specifically Communicable diseases, Diseases epidemiology and mode o transmission of disease, Environmental pollution by biomedical waste-causes, consequences, mitigation anc remedies.

UNIT III CONTROL OF HOSPITAL ACQUIRED INFECTION 9

Types of infection – Common Nosocomial infection and their Causative Agents– Prevention of hospital acquirec infection–Role of central sterile supply department–Infection control committee –Monitoring and controller o cross infection-Staff health.

UNIT IV TREATMENT TECHNOLOGIES FOR WASTES 9

Mechanical Treatment & Chemical Disinfections, Conventional Treatment Technologies: Wet therma technology, Incineration, Microwave Technology, Autoclave system, Hydroclave system, Electro Therma Reactivation (ETP), Treatment Process Electron beam Technology, Plasma Pyrolysis / Gasification systems

UNIT V LAWS OF BIOMEDICAL WASTE HANDLING 9

Chairman
Board of Studies
Department of Biomedical Eng
Muthayammal Engineering College (Auton
Rasipuram, Namakkal Dist 637 40

Biomedical wastes ,Disposal of biomedical waste products and deep burial, Segregation, Packaging Transportation, Storage Legislation, policies and law regarding environment on Healthcare waste Management Biomedical waste management and handling rules 1998 and its amendment. CPCB guidelines. World Healtl Organization guidelines on Management of wastes from hospital wastes

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATI
1.	AnantpreetSingh, SukhjitKaur	Biomedical Waste Disposal	Jaypee Publishers (P) Ltd, India	2012
2.	Sushma Sahai	Bio-Medical Waste Management	APH Publishing Corporation, India	2009
3.	Sanskriti Sharma	Hospital Waste Management and Its Monitoring	Jaypee Publishers (P) Ltd, India	2002
4.	Paul T. Williams	Waste Treatment and Disposal	John Wiley & Sons, Ltd	2005
5.				

WEB REFERENCE(s)

1. https://www.slideshare.net/zulfiquer732/hospital-waste-management-93579083
2. http://www.ihatepsm.com/blog/hospital-waste-management-bio-%E2%80%93-medical-waste-managem
3. https://www.biomedicalwastesolutions.com/medical-waste-disposal/
4. http://www.wastemanagement.in/what-is-hospital-waste-management.html
5. https://www.medprodisposal.com/what-is-medical-waste-medical-waste-definition-types-examples.

Chairman
Board of Studies
Department of Biomedical Engi
Muthayammal Engineering College (Auton.
Rasipuram, Namakkal Dist 637 408

COURSE CODE	COURSE TITLE	L	T	P	C
21BME14	FIBER OPTICS and LASERS IN MEDICINE	3	0	0	3

COURSE OBJECTIVES

Be familiar with objective property of fiber optics.
To study about the losses in optics.
To gain the knowledge in application of lasers in therapy and diagnosis.
Be exposed to basic of endoscopy.
To know about the clinical applications of fiber optic laser systems.

COURSE OUTCOMES

Able to understand the property of fiber optics
Apply lasers in different areas of medicine.
Explain the special techniques of Lasers.
Study about the endoscopy.
Study about clinical applications of fiber optic laser systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21BME14.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21BME14.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME14.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME14.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
21BME14.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources – Optical detectors

UNIT II LOSSES AND DISPERSION IN FIBER OPTICS 9

Absorption, Rayleigh scatter, Fresnel Reflection, Bending losses, dispersion Graded Index fiber, Single mode fiber, cables for fiber optics, Problems occurring in connecting optical fibers, Cleaving Process, Connectors and couplers Medical Laser: Introduction, Laser physics, medical lasers, Laser safety fundamentals

UNIT III APPLICATION OF LASERS IN THERAPY AND DIAGNOSIS 9

Introduction, laser assisted diagnosis and therapy fundamentals, Interaction of Laser beams and materials principles, Laser interaction with tissue, application of Lasers in Diagnosis and Imaging, Laser surgery and therapy, thermal interaction between laser and Tissue. Integrated laser-fiber systems and their applications, Complications in the use of Laser fiber optic system.

UNIT IV ENDOSCOPY 9

Chairman
Board of Studies
Department of Biomedical Engg
Muthayammal Engineering College (Auton.)
Rasipuram, Namakkal Dist 637 408

Endoscopic imaging system fundamentals, Angioscope, Videoscopy, Fluorescence endoscopy, Endoscopic therapy, Endoscopic ultrasound imaging principles. Fiber Optic Medical Diagnosis: introduction, fundamentals, fiber optic biomedical sensor-principles, Direct-indirect Sensor principles

UNIT V **CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS** **9**

Fiber optic Laser system in cardiovascular disease, Fiber optic Laser system in Gastroenterology, Fiber optic Laser system in general and thoracic surgery, Fiber optic Laser system in Neurosurgery, Fiber optic Laser system in Oncology, Fiber optic Laser system in Opthalmology, Fiber optic Laser system in Orthopedics, Fiber optic Laser system in Otolaryngology, Fiber optic Laser system in Urology, Flow chart diagrams for clinical applications of laser –fiber systems.

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Abraham Katzir	Lasers and Optical Fibers in Medicine	Academic press Inc	
2.	John Crisp	Introduction to fiber optics	Mc Graw Hill, 2nd Edition	2001
3.	G.DavidBaxterr Churchill Livingstone	Therapeutic Lasers - Theory and practice	Addison Wesley	

WEB URL'S

1) https://books.google.co.in/books/about/Lasers_and_Optical_Instrumentation.html
2) https://www.elsevier.com/books/lasers-and-optical...in-medicine/.../978-0-08-092397-3.http://www.nitttrchd.ac.in/sitenew1/app_sc/ppts/Optical%20Fibers/Medical%20Apps%20of%20optical%20Fibers_JKC.pdf
4. https://www.lasercomponents.com/de-en/news/optical-fibers-in-medical-technology/
5. https://www.elsevier.com/books/lasers-and-optical-fibers-in-medicine/katzir/978-0-08-092397-0

Chairman
Board of Studies
Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
Rasipuram, Namakkal Dist 637 408