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 : BM

Programme Name : B.E-Biomedical Engineering

Regulation : R-2019

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Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

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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.

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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.

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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.

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

Estd. 2000

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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	19HSS01	Business English	HS	3	2	0	0	2
2	19HSS02	English Communicative Skills Laboratory	HS	2	0	0	2	1
3	19HSS03	Life Skills and Workplace Psychology	HS	3	2	0	0	2
4	19HSS04	Technical English For Engineers	HS	3	2	0	0	2
5	19HSS05	Communicative English for Engineers	HS	3	2	0	0	2
6	19HSS06	Basics of Japanese Language	HS	3	2	0	0	2
7	19HSS07	Basics of French Language	HS	3	2	0	0	2
8	19HSS08	Professional Ethics and Human Values	HS	3	3	0	0	3
9	19BSS01	Engineering Physics	BS	4	3	0	0	3
10	19BSS02	Physics and Chemistry Laboratory	BS	2	0	0	2	1
11	19BSS03	Bio and Nanomaterials Sciences	BS	4	3	0	0	3
12	19BSS04	Material Sciences	BS	4	3	0	0	3
13	19BSS05	Physics fir Mechanical Engineers	BS	4	3	0	0	3
14	19BSS11	Engineering Chemistry	BS	4	3	0	0	3
15	19BSS12	Environmental Science and Engineering	BS	4	3	0	0	3
16	19BSS13	Organic Chemistry	BS	4	3	0	0	3
17	19BSS14	Physical Chemistry	BS	4	3	0	0	3

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18	19BSS15	Applied Chemistry	BS	4	3	0	0	3
19	19BSS16	Organic Chemistry Laboratory	BS	3	0	0	3	1
20	19BSS17	Physical Chemistry Laboratory	BS	3	0	0	3	1
21	19BSS21	Algebra and Calculus	BS	5	3	1	0	4
22	19BSS22	Differential Equations and Vector Analysis	BS	5	3	1	0	4
23	19BSS23	Transform and Partial Differential Equations	BS	5	3	1	0	4
24	19BSS24	Discrete Mathematics	BS	5	3	1	0	4
25	19BSS25	Statistical and Queuing Model	BS	5	3	1	0	4
26	19BSS26	Numerical Methods	BS	5	3	1	0	4
27	19BSS27	Probability and Random Processes	BS	5	3	1	0	4
28	19BSS28	Statistic and Numerical Methods	BS	5	3	1	0	4
29	19GES01	Programming for Problem Solving Using C	GES	3	3	0	0	3
30	19GES02	Programming for Problem Solving Technique	GES	3	3	0	0	3
31	19GES03	Programming in C Laboratory	GES	3	0	0	3	1
32	19GES04	Programming in C and Python Laboratory	GES	3	0	0	3	1
33	19GES05	Electrical and Electronic Sciences	GES	3	3	0	0	3
34	19GES06	Mechanical and Building Sciences	GES	3	3	0	0	3
35	19GES07	Computer Aided Drafting Laboratory	GES	3	0	0	3	1
36	19GES08	Python Programming	GES	3	3	0	0	3
37	19GES09	Programming in Python Laboratory	GES	3	0	0	3	1
38	19GES10	Soft Skills Laboratory	GES	3	0	0	3	1
39	19GES11	Electronic Devices	GES	3	3	0	0	3
40	19GES12	Electronic Simulation Laboratory	GES	3	0	0	3	1

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41	19GES13	Electric Circuits	GES	3	2	1	0	3
42	19GES14	Electric Circuits Laboratory	GES	3	0	0	3	1
43	19GES15	Manufacturing Process	GES	3	3	0	0	3
44	19GES16	Manufacturing Process Laboratory	GES	3	0	0	3	1
45	19GES17	Mechanical and Building Sciences Laboratory	GES	3	0	0	3	1
46	19GES18	Construction Materials	GES	3	3	0	0	3
47	19GES19	Concepts in Product Design	GES	3	3	0	0	3
48	19GES20	Renewable Energy Sources	GES	3	3	0	0	3
49	19GES21	Electrical Drives and Control	GES	3	3	0	0	3
50	19GES22	Electrical Drives and Control Laboratory	GES	3	0	0	3	1
51	19GES23	Analog and digital communication	GES	3	3	0	0	3
52	19GES24	Digital Principles and System Design	GES	3	3	0	0	3
53	19GES25	Digital Principles and System Design Laboratory	GES	3	0	0	3	1
54	19GES26	Engineering Drawing	GES	4	1	0	3	3
55	19GES27	Engineering Geology	GES	3	3	0	0	3
56	19GES28	Engineering Mechanics	GES	4	3	1	0	3
57	19GES29	Wireless Communication	GES	4	3	1	0	4
58	19GES30	Electronics and Microprocessor	GES	3	3	0	0	3
59	19GES31	Electronics and Microprocessor Laboratory	GES	2	0	0	2	1
60	19GES32	Data Structures using Python	GES	3	3	0	0	3

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PROFESSIONAL CORE [PC]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	19BMC01	Anatomy and Human Physiology	PC	3	3	0	0	3
2	19BMC02	Biomedical Sensors & Instruments	PC	3	3	0	0	3
3	19BMC03	Digital Electronics	PC	3	3	0	0	3
4	19BMC04	Signals and Systems	PC	5	3	1	0	4
5	19BMC05	Biomechanics & Rehabilitation Engineering	PC	5	3	1	0	4
6	19BMC06	Bio Control System	PC	5	3	1	0	4
7	19BMC07	Analog Electronics	PC	3	3	0	0	3
8	19BMC08	Microprocessor and Microcontrollers In Medicine	PC	3	3	0	0	3
9	19BMC09	Linear Integrated Circuits	PC	3	3	0	0	3
10	19BMC10	Biochemistry	PC	3	3	0	0	3
11	19BMC11	Hospital Management	PC	3	3	0	0	3
12	19BMC12	Biomedical Instrumentation	PC	3	3	0	0	3
13	19BMC13	Medical Signal Processing	PC	5	3	1	0	4
14	19BMC14	Embedded System	PC	3	3	0	0	3
15	19BMC15	Therapeutic Equipments	PC	3	3	0	0	3
16	19BMC16	Digital Image Processing	PC	5	3	2	0	4
17	19BMC17	Medical Imaging Techniques	PC	5	3	2	0	4
18	19BMC18	Electrical Safety and Quality Assurance	PC	3	3	0	0	3
19	19BMC19	Human Assist Devices	PC	3	3	0	0	3
20	19BMC20	Bio Medical Sensors and Instruments Laboratory	PC	3	0	0	2	1
21	19BMC21	Digital Electronics Laboratory	PC	3	0	0	2	1
22	19BMC22	Analog Electronics Laboratory	PC	3	0	0	2	1
23	19BMC23	Linear Integrated Circuits Laboratory	PC	3	0	0	2	1
24	19BMC24	Medical Signal Processing Laboratory	PC	3	0	0	2	1
25	19BMC25	Pathology and Microbiology Laboratory	PC	3	0	0	2	1
26	19BMC26	Biomedical Instrumentation Laboratory	PC	3	0	0	2	1
27	19BMC27	Pathology and Microbiology	PC	3	3	0	0	3

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28	19BMC28	Embedded System Laboratory	PC	3	0	0	2	1
29	19BMC29	Computer Networks	PC	3	3	0	0	3
30	19BMC30	Microprocessor and Microcontrollers Laboratory	PC	3	0	0	2	1

PROFESSIONAL ELECTIVES [PE]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	19BME01	Advanced Bio Analytical And Therapeutic Techniques	PE	3	3	0	0	3
2.	19BME02	Bio Signal Processing	PE	3	3	0	0	3
3.	19BME03	Biomaterials and Artificial Organs	PE	3	3	0	0	3
4.	19BME04	Biomedical Engineering	PE	3	3	0	0	3
5.	19BME05	Biomaterials and Characterization	PE	3	3	0	0	3
6.	19BME06	Body Area Networks	PE	3	3	0	0	3
7.	19BME07	Brain Computer Interface and Applications	PE	3	3	0	0	3
8.	19BME08	Medical Optics	PE	3	3	0	0	3
9.	19BME09	Soft Computing	PE	3	3	0	0	3
10.	19BME10	Neural Engineering	PE	3	3	0	0	3
11.	19BME11	Physiological Modeling	PE	3	3	0	0	3
12.	19BME12	Hospital Waste Management	PE	3	3	0	0	3
13.	19BME13	Virtual Reality	PE	3	3	0	0	3
14.	19BME14	Wearable Systems	PE	3	3	0	0	3
15.	19BME15	Medical Physics	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	19BMS01	Project Work Phase – I	EEC	10	0	0	10	3
2.	19BMS02	Project Work Phase –II	EEC	12	0	0	12	6
3.	19BMS03	Comprehension	EEC	4	3	0	4	2

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4.	19BMS04	Design Project	EEC	3	0	0	3	1
5.	19BMS05	Hospital Training	EEC	4	0	0	4	2

OPEN ELECTIVE:

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.		Analytical Instrumentation	OE	3	3	0	0	3
2.		Power Plant Engineering	OE	3	3	0	0	3
3.		Clinical Trials	OE	3	3	0	0	3
4.		Principles of Food Preservation	OE	3	3	0	0	3
5.		Fundamentals of Nutrition	OE	3	3	0	0	3
6.		Air Pollution and Management	OE	3	3	0	0	3
7.		Industrial Waste Management	OE	3	3	0	0	3
8.		Regulatory requirements in Pharmaceutical Industries	OE	3	3	0	0	3
9.		Municipal Solid Waste Management	OE	3	3	0	0	3
10.		Internet and JAVA Programming	OE	3	3	0	0	3

Mandatory Course(MC) :

S.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/week			Credit
					L	T	P	C
1.	19MDH01	Organizational Behaviour	MC	3	3	0	0	0
2.	19MDH02	India Constitution (Common to All Branches)	MC	3	3	0	0	0
3.	19MDH03	Essence of Indian Traditional Knowledge	MC	3	3	0	0	0

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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

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Department	Biomedical Engineering
Programme	B.E

SEMESTER – I

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19HSS01	Business English	2	0	0	2	2
2.	19BSS21	Algebra and Calculus	3	1	0	4	4
3.	19BSS01	Engineering Physics	3	0	0	3	3
4.	19BSS11	Engineering Chemistry	3	0	0	3	3
5.	19GES02	Programming for Problem Solving Technique	3	0	0	3	3
6.	19GES06	Mechanical and Building Sciences	3	0	0	3	3
PRACTICALS							
7.	19BSS02	Physics and Chemistry Laboratory	0	0	2	1	2
8.	19GES03	Programming in C Laboratory	0	0	3	1	3
9.	19HSS02	Communicative English Laboratory	0	0	2	1	2
		Total Credits				**21**	

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Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – III

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19BSS23	Transforms & Partial Differential Equations	3	1	0	4	5
2.	19BMC04	Signals and Systems	3	1	0	4	5
3.	19BMC07	Analog Electronics	3	1	0	4	5
4.	19BMC03	Digital Electronics	3	0	0	3	3

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Department	Biomedical Engineering
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SEMESTER – II

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19HSS03	Life Skill Psychology and Ethics	2	0	0	2	2
2.	19BSS22	Differential Equations and Vector Analysis	3	1	0	4	4
3.	19BSS03	Bio and Nanomaterials Sciences	3	0	0	3	3
4.	19BSS12	Environmental Science and Engineering	3	0	0	3	3
5.	19GES19	Concepts in Product Design	3	0	0	3	3
6.	19GES11	Electronic Devices	3	0	0	3	3
PRACTICALS							
7	19GES12	Electronic Simulation Laboratory	0	0	3	1	3
8	19GES09	Programming in Python Laboratory	0	0	3	1	3
		Total Credits				**20**	

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5.	19BMC01	Human Anatomy & Physiology	3	0	0	3	3
6.	19HSS08	Professional Ethics and Human Values	3	0	0	3	3
7.	19BMC02	Biomedical Sensors & Instruments	3	0	0	3	3
PRACTICALS							
8.	19BMC22	Analog Electronics Laboratory	3	0	0	1	2
9.	19BMC21	Digital Electronics Laboratory	3	0	0	1	2
10.	19BMC20	Bio Medical Sensors and Instruments Laboratory	3	0	0	1	2
		Total Credits				**27**	

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Programme	BE

SEMESTER – IV

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19BSS27	Probability and Random Processes	3	1	0	4	5
2.	19BMC08	Microprocessor and Microcontrollers in Medicine	3	0	0	3	3
3.	19BMC05	Biomechanics & Rehabilitation Engineering	3	1	0	4	5
4.	19BMC09	Linear Integrated Circuits	3	0	0	3	3
5.	19BMC10	Biochemistry	3	0	0	3	3
6.	19BMC27	Pathology and Microbiology	3	0	0	3	3
PRACTICALS							
7.	19BMC23	Linear Integrated Circuits Laboratory	0	0	2	1	3
8.	19BMC25	Pathology and Microbiology Laboratory	0	0	2	1	3
9.	19BMC30	Microprocessor and Microcontrollers Laboratory	0	0	2	1	3
		Total Credits				**23**	

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Programme	BE

SEMESTER – V

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19BMC11	Hospital Management	3	0	0	3	3
2.	19BMC13	Medical Signal Processing	3	1	0	4	5
3.	19BMC06	Bio control system	3	0	0	3	3
4.	19BMC12	Biomedical Instrumentation	3	0	0	3	3
5.	19BMEXX	Professional Elective -I	3	0	0	3	3
6.	19BMEXX	Professional Elective -II	3	0	0	3	3
PRACTICALS							
7.	19BMC24	Medical Signal Processing Laboratory	3	0	2	1	3
8.	19BMC26	Biomedical Instrumentation Laboratory	3	0	2	1	3
		Total Credits				21	

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Programme	BE

SEMESTER –VI

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19BMC14	Embedded System	3	0	0	3	3
2.	19BMC15	Therapeutic Equipments	3	0	0	3	3
3.	19BMC17	Medical Imaging Techniques	3	0	0	3	3
4.	19BMEXX	Professional Elective -III	3	0	0	3	3
5.	19BMEXX	Professional Elective – IV	3	0	0	3	3
6.	19XXXX	Open Elective – I	3	0	0	3	3
7.	19BMC19	Human Assist Device	3	0	0	3	3
PRACTICALS							
8.	19BMC28	Embedded System Laboratory	0	0	2	1	3
9.	19BMS04	Design Project	0	0	2	1	3
					Total Credits	23	

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Programme	BE

SEMESTER – VII

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19BMC18	Electrical Safety & Quality Assurance	3	0	0	3	3
2.	19BMC29	Computer Networks	3	0	0	3	3
3.	19BMEXX	Professional Elective - V	3	0	0	3	3
4.	19XXXX	Open Elective -II	3	0	0	3	3
5.	19BMEXX	Professional Elective - VI	3	0	0	3	3
PRACTICALS							
6.	19BMS01	Project Work Phase -I	0	0	6	3	6
7.	19BMS05	Hospital Training	0	0	4	1	4
		Total Credits				**19**	

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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 – 2019

Department	BIOMEDICAL ENGINEERING
Programme	BE

SEMESTER – VIII

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19BMXXX	Open Elective –III / NPTEL Course	0	0	0	0	0
PRACTICALS							
2.	19BMS02	Project Work Phase -II	0	0	12	6	12
		Total Credits				**6**	

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Department of Biomedical Engineering
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Rasipuram, Namakkal Dist 637 408.

19BMC01 **HUMAN ANATOMY & PHYSIOLOGY** **L T P C 3 0 0 3**

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. To Know basic structural and functional elements of human body.
2. To Learn organs and structures involving in system formation and functions.
3. To Understand circulatory system.
4. To Learn urinary and special sensory system
5. 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
19BMC01.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC01.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC01.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC01.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC01.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

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.

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TOTAL: 45

REFERENCE BOOK

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 REFERENCE(s)

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

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		L	T	P	C
19BMC02	**BIOMEDICAL SENSORS &INSTRUMENTS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

1. 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
2. To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
3. To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
4. To know the different display and recording devices.
5. To study signal conditioning & signal analyser

COURSE OUTCOMES

1. Comprehend and appreciate the significance and role of this course in the present contemporary world
2. Describe the purpose and methods of measurements
3. Analyze the characteristics of different transducers
4. Explain different display and recording devices for various applications.
5. 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
19BMC02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC02.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC02.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC02.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC02.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

7

UNIT I **SCIENCE OF MEASUREMENT**

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** **11**

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 & 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

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19BMC01	HUMAN ANATOMY & PHYSIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. Know basic structural and functional elements of human body.
2. Learn organs and structures involving in system formation and functions.
3. Understand circulatory system.
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Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC01.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC01.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC01.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC01.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC01.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.

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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.

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TOTAL: 45

REFERENCE BOOK

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
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5.	Midthun Joseph	The Digestive and Urinary Systems	World Book, Inc	2011

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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

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19BMC02	BIOMEDICAL SENSORS &INSTRUMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. 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
2. To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
3. To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
4. To know the different display and recording devices.
5. To study signal conditioning & signal analyser

COURSE OUTCOMES

1. Comprehend and appreciate the significance and role of this course in the present contemporary world
2. Describe the purpose and methods of measurements
3. Analyze the characteristics of different transducers
4. Explain different display and recording devices for various applications.
5. 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
19BMC02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC02.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC02.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC02.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC02.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** **11**

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 & 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

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REFERENCE BOOK

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
3.	A.K.Sawhney	Electrical & Electronics Measurement and Instrumentation	10th Edition, Dhanpat Rai&Co,New Delhi	2000
4.	Ernest o Doebelin and dhanesh N manik	Measuremet systems, Application and design	5th Edition, Mc Graw-Hill	2007.
5.	Khandpur R.S	Handbook of Biomedical Instrumentation	Tata McGraw Hill, New Delhi, 3rd Edition	2014.

WEB REFERENCE(s)

1. http://nptel.ac.in/courses/111108066/ http://www.cs.utexas.edu/~pingali/CS378/2011sp/lectures/chol4.pdf
2. http://www.math.uni-leipzig.de/~miersemann/variabook.pdf
3. http://nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf
4. http://nptel.ac.in/courses/111104027/
5. http://nptel.ac.in/courses/111106046/

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		L	T	P	C
19BMC03	DIGITAL ELECTRONICS	3	0	0	3

COURSE OBJECTIVES

1. To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
2. To outline the formal procedures for the analysis and design of combinational circuits
3. To outline the formal procedures for the analysis and design of sequential circuits
4. To illustrate the concept of synchronous and asynchronous sequential circuits
5. To introduce the concept of Different Logic Families and programmable logic devices.

COURSE OUTCOMES

1. Apply Boolean algebra, Karnaugh map and Tabulation method for simplification of Boolean expressions
2. Design combinational logic circuits for various applications
3. Design shift registers, Modulo-N asynchronous and synchronous counters
4. Design and analyze state machines for the given specifications
5. Discuss different logic families and Implement digital circuit in programmable logic devices

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC03.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC03.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC03.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC03.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC03.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I **BASIC CONCEPTS OF DIGITAL SYSTEMS** 9

Review of Number systems, Number Representation, Boolean algebra, Boolean postulates and laws - De-Morgan's Theorem - Principle of Duality, Simplification using Boolean algebra, Canonical forms - Sum of product and Product of sum - Minimization using Karnaugh map and Tabulation method.

UNIT II **COMBINATIONAL CIRCUITS** 9

Realization of combinational logic using gates , Design of combinational circuits : Adder , Subtractor, Parallel adder Subtractor, Carry look ahead adder, Magnitude Comparator, Parity generator and checker, Encoder, Decoder, Multiplexer. Demultiplexer - Function realization using Multiplexer, Decoder - Code converters.

UNIT III **SEQUENTIAL CIRCUITS** 9

Flip-flops - SR, JK, D and T- Master-Slave – Triggering - Characteristic table and equation – Application table – Asynchronous and synchronous counters - Shift registers - Types – Universal shift registers – Ring counter – Johnson Counters- Serial adder / Subtractor.

UNIT IV **SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS** 9

Mealy and Moore models – State diagram - State table – State minimization – State assignment - Excitation table - Design of Synchronous sequential circuits: Counters and Sequence generators- Circuit implementation - Asynchronous sequential circuits - Hazards and Races, Hazard free combinational circuits

UNIT V **LOGIC FAMILIES AND PROGRAMMABLE DEVICES** 9

Introduction to Logic families – TTL & CMOS Logic and their characteristics – Tristate gates - Programmable Logic Devices – Programmable LogicArray (PLA) - Programmable Array Logic (PAL) ,Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA,PAL.

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION

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1.	Morris Mano M. and **Michael D. Ciletti**	Digital Design	Pearson Education	V Edition, 2013.
2.	Donald D.Givone,	Digital Principles and Design	Tata Mc-Graw Hill Publishing company limited, New Delhi	2002
3.	Thomas L. Floyd	Digital Fundamentals	Pearson Education Inc	10th Edition, 2011
4.	Charles H. Roth Jr,	Fundamentals of Logic Design	Jaico Publishing House	Fifth Edition–, Mumbai, 2003
5.	Leach D, Malvino A P & Saha	Digital Principles and Applications	Tata McGraw-Hill Publishing Company	8th Edition, , 2014

WEB REFERENCE(s)

1. www.nptel.ac.in/courses/117105080/7
2. www.nptel.ac.in/video.php?subjectId=117105080
3. www.nptelvideos.in/2012/12/digital-systems-design.html
4. www.allabout circuits.com
5. www.electronicsforu.com

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19BMC04	SIGNALS & SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC04.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC04.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC04.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC04.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC04.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I SIGNALS AND SYSTEMS 9

Signals- Classification of signals- Continuous –time and Discrete time signals, Deterministic andrandom 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 InverseLaplace 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

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

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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

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

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19BMC05	BIOMECHANICS AND REHABILITATION ENGINEERING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. To understand the rehabilitation concepts and Rehabilitation team members for future development and applications.
2. To study various Principles of Rehabilitation Engineering.
3. To understand different types of Therapeutic Exercise Technique
4. 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
5. To study the various orthotic devices and prosthetic devices to overcome orthopedic problems

COURSE OUTCOMES

1. 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.
2. Ability to analyze the dynamics of human movement flow properties of blood and comprehend the biomechanical principles that relate to movement and communication disabilities.
3. Have an in depth idea about Engineering Concepts in Sensory & Motor rehabilitation.
4. Apply the different types of Therapeutic Exercise Technique to benefit the society.
5. 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
19BMC05.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC05.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC05.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC05.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC05.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

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 TECHNIQUE** 9

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.

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UNIT V **ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES** **9**

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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
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
3.	Schneck and Bronzino	Biomechanics principles and applications	CRC;	2003
4.	Keswick. J	What is Rehabilitation Engineering, Annual Reviews of Rehabilitation	Springer	1982
5.	Warren E. Finn,Peter G. LoPresti	Handbook of Neuroprosthetic Methods	CRC	2002

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2.	https://en.wikibooks.org/wiki/Advanced_Data_Structures_and_Algorithms
3.	https://www.cambridge.org/9780521880374
4.	https://www.coursera.org/specializations/data-structures-algorithms
5.	https://www.cs.auckland.ac.nz/~jmor159/PLDS210/ds_ToC.html

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19BMC06 **BIO CONTROL SYSTEM** **L T P C 3 1 0 4**

COURSE OBJECTIVES

1. To introduce the elements of control system and their modeling using various Techniques.
2. To introduce methods for analyzing the time response, of systems
3. To introduce methods for analyzing, the frequency response of systems
4. To introduce methods for analyzing the stability of systems
5. To introduce the state variable analysis method

COURSE OUTCOMES

1. Analysis the knowledge of various control models
2. Perform time domain control systems required for system analysis.
3. Perform frequency domain analysis of control systems required for system analysis.
4. Performance analysis of control systems required for stability analysis
5. 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
19BMC06.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC06.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC06.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC06.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC06.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** **9**

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 **STABILITY ANALYSIS** **9**

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability, Analysis using MATLAB

UNIT V **STATE VARIABLE ANALYSIS AND BIOMEDICAL APPLICATIONS** **9**

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability – Sampling Theorem – Sampler & Hold – Open loop & Closed loop sampled data systems - Lung mechanics model with proportional control

TOTAL :45

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

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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

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19BMC07 **ANALOG ELECTRONICS** **L T P C**
3 1 0 4

COURSE OBJECTIVES

1. Design and construct amplifiers
2. Construct JFET and MOSFET amplifiers
3. Study rectifiers and power supplies
4. Learn about feedback amplifiers
5. Learn about oscillators

COURSE OUTCOMES

1. To learn about Design and construct amplifiers
2. To Construct JFET and MOSFET amplifiers
3. To Study rectifiers and power supplies
4. ToLearn about feedback amplifiers
5. To Learn about oscillators

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC07.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC07.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	X	x
19BMC07.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	X	x
19BMC07.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	X	x
19BMC07.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	X	x

UNIT I **BJT AMPLIFIERS** **9**

CE, CB and CC amplifiers - Method of drawing small-signal equivalent circuit- Analysis of transistor amplifier Configurations-current and voltage gain, input and output impedance -Differential amplifiers- CMRR- Darlington Amplifier- Bootstrap technique - Multistage amplifiers -Cascaded stages - Cascode Amplifier. Large signal Amplifiers – Class A, Class B and Class C Power Amplifiers

UNIT II **JFET AND MOSFET AMPLIFIERS** **9**

Small signal analysis of JFET amplifiers- Small signal Analysis of MOSFET and JFET, Common source amplifier, Voltage swing limitations, Small signal analysis of MOSFET and JFET Source follower and Common Gate amplifiers, - BiCMOS,Cascode amplifier

UNIT III **RECTIFIERS AND POWER SUPPLIES** **9**

Rectifiers - Half-wave, full-wave and bridge rectifiers – Rectifiers with filters- C, L, and CLC filters Voltage regulators - Zener diode regulator- regulator with current limiting, Over voltage protection, Switched mode power supply (SMPS

UNIT IV **FEEDBACK AMPLIFIERS** **9**

General Feedback Structure – Properties of negative feedback – Basic Feedback Topologies –Feedback amplifiers – Series – Shunt, Series – Series, Shunt – Shunt and Shunt – Series Feedback – Determining the Loop Gain – Stability Problem

UNIT V **OSCILLATORS** **9**

Classification, Barkhausen Criterion - Mechanism for start of oscillation and stabilization of amplitude, General form of an Oscillator, Analysis of LC oscillators - Hartley, Colpitts,Clapp, Tuned collector oscillators, RC oscillators - phase shift –Wienbridge - Twin-T Oscillators, Frequency range of RC and LC Oscillators, Quartz Crystal Construction, Electrical equivalent circuit of Crystal, Miller and Pierce Crystal Oscillators, frequency stability of oscillators.

TOTAL :45

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REFERENCE BOOK

Sl. No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Donald .A. Neamen	Electronic Circuit Analysis and Design	Tata Mc Graw Hill	2nd Edition, 2009
2.	Robert L. Boylestad and Louis Nasheresky	Electronic Devices and Circuit Theory	Pearson Education / PHI	10th Edition 2008
3.	Adel .S. Sedra, Kenneth C. Smith	Micro Electronic Circuits	Oxford University Press	6th Edition, 2010
4.	Behzad Razavi	Design of Analog CMOS Integrated Circuits	Tata Mc Graw Hill,	2007
5.	Paul Gray, Hurst, Lewis, Meyer	Analysis and Design of Analog Integrated Circuits	John Willey & Sons	4th Edition 2005

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1. www.nptel.ac.in/courses/117101106/7
2. www.nptel.ac.in/courses/117101106/9
3. www.nptel.ac.in/courses/117101106/8
4. www.nptel.ac.in/courses/117106088/1
   www.nptel.ac.in/courses/117106088/14
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19BMC08 MICROPROCESSOR AND MICROCONTROLLER IN MEDICINE

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COURSE OBJECTIVES

1. Understand the fundamental concepts of 8086 microprocessors
2. Explain the basic concepts of 8051 microcontroller
3. Obtain knowledge on interfacing devices
4. Familiarize about ARM microcontroller
5. Acquire knowledge on applications of microprocessor and

COURSE OUTCOMES

1. Discuss the various synchronization, scheduling and memory issues
2. Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed Operating system.
3. Discuss the various resource management techniques for distributed systems.
4. Identify the different features of real time and mobile operating systems.
5. Ability To Learn the management aspects of Mobile operating systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC08.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC08.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC08.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC08.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC08.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **Overview of 8086 Microprocessor** 9

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** 9

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

UNIT III **Interfacing Devices** 9

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** 9

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

UNIT V **Application In Medicine** 9

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

TOTAL :45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
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	ARM System Developer's Guide	Elsevier, 1st edition	2007
4.	. Muhammad Ali Mazidi and	The 8051 microcontroller and	Pearson Education	2003

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	JanicaGilliMazidi	embedded systems		
5.	Dang Van Duc	Operating System	Institute of Information Technology	2012

WEB REFERENCE(s)

Sl.No	WEB URL
1.	www.microchip.com/medical.
2.	www.freescale.com/medical.
3.	www.cc.gatech.edu/classes/AY2010/cs4210_fall/
4.	http://www.cs.toronto.edu/~demke/469F.06/
5.	https://www.netcraft.com/

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19BMC09 **LINEAR INTEGRATED CIRCUITS** **L T P C 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
19BMC09.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC09.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC09.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC09.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC09.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I **IC FABRICATION AND OPERATIONAL AMPLIFIER** **9**

Introduction to Integrated Circuits- Classification of ICs- Basic IC Fabrication Planar Process-Fabrication of Diode and BJT - Operational Amplifier: Basic Information of Op-Amp, Ideal Op Amp-Operational Amplifier Internal Circuit-Differential Amplifier- Analysis of current sources-Widlar-Wilson Current Sources

UNIT II **CHARACTERISTICS OF OP- AMP AND APPLICATIONS** **9**

Characteristics of Op- Amp - DC Characteristics, AC Characteristics - Frequency Response- Frequency Compensation - Slew Rate- Applications: Closed Loop Op Amp Configuration - Inverting and Non inverting Amplifiers- Inverter- Voltage Follower-Summing Amplifier, Averaging Circuits - Subtractor- Differential Amplifier- Multiplier- Differentiator- Integrator- Instrumentation amplifier, Precision rectifier- V/I & I/V Converter.

UNIT III **COMPARATOR AND WAVEFORM GENERATORS** **9**

Comparators - Open Loop Op Amp Configuration - Inverting , Non Inverting Comparator- Applications of Comparator- Regenerative Comparator (Schmitt trigger)- Multivibrators - Astable, Monostable-Principles of Sine wave Oscillator- RC Phase Shift, Wien Bridge Oscillator.

UNIT IV **PHASE LOCKED LOOP AND DATA CONVERTER** **9**

Block Diagram of PLL- Principles-Types- Phase Detector- Voltage Controlled Oscillator-IC 566 and IC 565 Internal Block Diagram- PLL Applications - Data Converter - Sample and Hold circuits D/A Techniques: Binary Weighted Resistor- R-2R and Inverted R-2R Ladder DAC- A/D converter: Flash - Counter - Successive Approximation Converter -Single Slope- Dual Slope.

UNIT V **SPECIALIZED IC APPLICATIONS** **9**

555 Timer Internal Architecture- Astable and Monostable Multivibrators using 555 Timer - Applications- Voltage regulators, Fixed and Adjustable Voltage Regulators, Dual Power supply - Universal Active Filter- Switched Capacitor Filter.

TOTAL :45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Sergio Franco	Design with operational amplifiers and analog	3rd Edition, Tata McGraw-Hill	2007

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		integrated circuits		
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

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19BMC10 **BIOCHEMISTRY** **L T P C 3 0 0 3**

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Identify the perspectives of machine learning
2. Apply decision tree and Artificial neural networks for real world problems
3. Design a Bayesian classifier for solving a problem
4. Illustrate the principles of instance based learning and genetic algorithm
5. 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
19BMC10.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC10.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC10.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC10.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC10.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION TO BIOCHEMISTRY** 9

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 of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes

UNIT II **CARBOHYDRATES** 9

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

UNIT III **LIPIDS** 9

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

UNIT IV **NUCLEIC ACID & PROTEIN** 9

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

UNIT V **ENZYME AND ITS CLINICAL APPLICATION** 9

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes – Michaelis-Menten equation.Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non- competitive, irreversible. Enzyme: Mode of action,

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allosteric and covalent regulation. Clinical enzymology. Measurement of enzyme activity and interpretation of units.

TOTAL :45

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
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

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19BMC11 **HOSPITAL MANAGEMENT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand the fundamentals of hospital administration and management.
2. To study the importance of human resource management
3. To know the market related research process
4. To explore various information management systems and relative supportive services.
5. To learn the quality and safety aspects in hospital.

COURSE OUTCOMES

1. Explain the principles of Hospital administration.
2. Identify the importance of Human resource management.
3. List various marketing research techniques.
4. Identify Information management systems and its uses.
5. 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
19BMC11.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC11.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC11.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC11.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC11.CO5	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

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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF

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

				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
3.	Cesar A. Caceres Albert Zara	The Practice of Clinical Engineering	Academic Press, New York	1977
4.	Norman Metzger	Handbook of Health Care Human Resources Management 2nd edition	Aspen Publication Inc. Rockville, Maryland, USA	1990.
5.	Peter Berman	Health Sector Reform in Developing Countries	Harvard University Press	1995

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19BMC12 **BIOMEDICAL INSTRUMENTATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Apply knowledge of mathematics science and engineering
2. fundamentals in designing, analyzing and/or working of biomedical circuits and instruments.
3. Understand the health, safety, Environmental, legal and ethical issues
4. designing/working of a biomedical circuits and instruments.
5. Work, document and present as an individual and as a team-member

COURSE OUTCOMES

1. To design, formulate and implement experiments using modern equipment's & tools.
2. Present in a group and document the findings or suggestions for the problems in the current techniques,
3. To use modern tools and computing practice
4. To improve technology in health care instruments through hospital visits for lifelong learning.
5. To design, formulate and implement experiments using modern equipment's & tools.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC12.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC12.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC12.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC12.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC12.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **Physiological Transducers** 9

Classification of transducers, performance characteristics of transducers. Pressure transducers, transducers for bod temperature measurement, photoelectric transducers, optical fiber sensor, biosensor and smart sensor. Biomedica recorders and biofeedback instruments. Patient Monitoring Systems: System concepts, cardiac monitor, bedside patien monitoring system,central monitors, measurement of heart rate, measurement of pulse rate, blood pressur measurement. measurement of temperature, measurement of respiratory rate, catheterization laboratory instrumentation

UNIT II **Oximeters** 9

Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter. Blood Flow Meters Electromagnetic blood flow meters different types, Ultrasonic blood flow meters. NMR blood flow meters and Lase Doppler blood flowmeters. Cardiac output measurements: Indicator dilution method, Dye dilution method, Therma dilution techniques, Measurement of continuous cardiac output derived from the aortic pressure waveform, Impedanc technique. Pulmonary Function Analyzer: Pulmonary function measurement, Spirometry, Pneumotachomete Measurement ofvolume by Nitrogen washout technique.

UNIT III **Blood Gas Analyzers** 9

Acid-base balance, blood pH measurement, measurement of blood pCO2, intra-arterial blood gas monitoring, complet blood gas analyzer. Audiometer and Hearing Aids: Mechanism of hearing, measurement of sound, basic audiometer pure-tone audiometer, speech audiometer, audiometer system, Bekesyevoked response audiometer system, calibration c audiometer and hearing aids.

UNIT IV **Cardiac Pacemakers and Defibrillators:** 9

Need for cardiac pacemaker, External ace maker, Implantable pacemaker, Types of Implantable pacemakers and recent developments. Programmable pacemaker, Rate-responsive pacemakers, pacing system Analysers,Need for Defibrillator, Dc defibrillators, Implantable Defibrillators, Defibrillator analysers.

UNIT V **Instruments of Surgery** 9

Principles of surgical diathermy, surgical diathermy Machine,Safety aspects in electro- surgical units, surgical diathermy Analyzer. Automated drug delivery Systems: Infusion pumps, components of drug infusion systems andimplantable infusion systems

TOTAL :45

REFERENCE BOOK

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Department of Biomedical Engineering
Muthayammal Engineering College (Autonomous)
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				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

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5. www.nptelvideos.in/2012/11/biochemical-engineering.html

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19BMC13 **MEDICAL SIGNAL PROCESSING**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Choose an filter for the ECG analysis.
2. Write the types of algorithm for data compression.
3. Idea about processing the ECG signal and their estimations.
4. Study about EEG and their parameters.
5. 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
19BMC13.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC13.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC13.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC13.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC13.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

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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE 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

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3.	Willis J.Tompkins	Biomedical Digital Signal Processing	PHI	
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19BMC14 **EMBEDDED SYSTEM** **L T P C 3 0 0 3**

COURSE OBJECTIVES

1. To study the overview of Embedded System Architecture.
2. To study about the ARM Architecture.
3. To learn various embedded communication protocols.
4. To learn the Real Time operating System Concepts.
5. To Study about applications of Embedded System.

COURSE OUTCOMES

1. Able to describe hardware and software architectures of Embedded Systems.
2. Able to understand the functions and syntax used in Embedded C.
3. Able to understand special features of ARM architecture.
4. Able to introduce devices and buses used for Embedded Networking.
5. 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
19BMC14.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC14.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC14.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC14.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC14.CO5	x	x	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 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.

REFERENCE BOOK

Sl. No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION

Chairman
Board of Studies
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Rasipuram, Namakkal Dist 637 408.

1.	Raj Kamal,	Embedded Systems Architectu programming and Design	TMH	Second Edition, 20
2.	Prasad.K.V.K.K,	Embedded Real-Time Systems Concepts, Design & Programm	Dream tech press	2011
3.	Wayne Wolf	Computers as Components - Principles of Embedded Computing System Design	Morgan Kaufman Publishe	Third Edition 201
4.	Steve Furber,	ARM System on Chip Architecture	Addison- Wesley Professi	Second Edition, 2000
5.	Andrew N.Sloss, Dominic Symes, Chris Wright	ARM System Developer's Gui Designing and Optimizing Syst Software	Morgan Kaufmann Publishers, Elsevier	2004

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19BMC15 **THERAPEUTIC EQUIPMENTS** **L T P C**
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
19BMC15.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC15.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC15.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC15.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC15.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **CARDIAC EQUIPMENT** **9**

Cardiac Pacemaker – Need for cardiac pacemaker – External pacemakers- types - voltage pacemakers – current-pacemakers - current limited voltage pacemakers. Internal pacemakers - basic requirement – types: fixed rate, demand pacemakers, R wave triggered, R wave blocked, Atrial triggered pacemakers. Programmable pacemakers - Functional block diagram and description

UNIT II **DEFIBRILLATOR EQUIPMENT** **8**

Defibrillators - Need for a defibrillator- basic principle and comparison of output wave forms of different DC defibrillators - Defibrillator electrodes - DC defibrillator with synchronizer Functional block diagram. Automatic external defibrillators - Block diagram. Implantable defibrillators – components - block diagram defibrillator analyzers - RF ablation treatment for arrhythmia

UNIT III **VENTILATORS AND STIMULATORS** **10**

Ventilators: Physiological factors affecting Volume exchange - Compliance - respiratory resistance. Functional specification - inspiratory phase – change over from inspiratory to expiratory phase – inspiratory phase, expiratory phase Electrical stimulators, nerve and muscle stimulators - - Stimulators for pain and relief- functional electrical stimulation- Ultrasonic stimulator

UNIT IV **DIATHERMY** **10**

Surgical diathermy -Principles and applications, Functional block diagram - monopolar & bipolar techniques, Electrodes and Safety aspects in electrosurgical units, electro surgical analyzers. Principles of short wave and microwave diathermy

UNIT V **ENDOSCOPY AND ANESTHESIA** **8**

Endoscopy – Principles, types & applications. Block diagram of a fiber optic endoscope with integral TV cameras. Anesthetic machines: Need of anesthesia, gas used and their sources, gas blending and vaporizers, anesthesia delivery system, breathing circuits

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Joseph J. Carr John M. Brown	Introduction to Biomedical Equipment Technology	Pearson education	2012
2.	R S Khandpur	Handbook of Bio medical	Tata McRaw Hill	2004

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		Instrumentation		
3.	Bronzino	Hand book of Biomedical Engineering	IEEE press book	2000
4.	Mushin	Automatic Ventilation of Lung	Black Well	1980
5.	Joseph J. Carr, John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2001

WEB REFERENCE(s)

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3. https://www.slideshare.net/RajneeMishra/ventilator-61330983
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19BMC16 **DIGITAL IMAGE PROCESSING** **L T P C**
3 2 0 4

COURSE OBJECTIVES

1. Learn digital image fundamentals.
2. Be exposed to simple image processing techniques.
3. Be familiar with image compression and segmentation techniques.
4 To learn Wavelets and Image compression
5 Learn to represent image in form of features

COURSE OUTCOMES

1. Describe Digital image fundamentals and Image transforms
2. Illustrate Image enhancement
3. Describe Image Restoration and Segmentation
4. Analysis Wavelets and Image compression
5. Describe Image Representation and Recognition

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC16.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC16.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC16.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC16.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC16.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I **DIGITAL IMAGE FUNDAMENTALS** 9

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – color Coordinate Systems –RGB, HSI, L*a*b* and Color conversion, Image Transforms, Introduction to Fourier Transform ,2 D DFT, DCT, Hadamard, Haar, KL Transform

UNIT II **IMAGE ENHANCEMENT** 9

Spatial Domain: Gray level transformations – Contrast Stretching, Digital Negative, Intensity level Slicing, Bit Extraction ,log transformation, Histogram processing , Equalization and Specification, of Spatial Filtering– Smoothing- Smoothing linear filters, Non linear filters, Sharpening Spatial Filtering –Foundation, the Laplacian, Unsharp Masking and High boost filtering, Frequency Domain: Smoothing and Sharpening frequency domain filters – Ideal, Butterworth , Gaussian filters and Homomorphic filtering.

UNIT III **IMAGE RESTORATION AND SEGMENTATION** 9

Image Restoration :Noise models, Degradation model , Algebraic approach to Restoration – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering ,Least Mean Square Filtering, Constrained Least Squares Restoration– Wiener filtering Segmentation: Detection of Discontinuities: Lines and Edges –Edge Linking, Hough Transform and Boundary detection – Region based segmentation- Morphological processing- erosion , dilation, Opening Image Restoration :Noise models, and Closing.

UNIT IV **WAVELETS AND IMAGE COMPRESSION** 9

Wavelets – Sub band coding - Multiresolution expansions - Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding , LZW, Bit-Plane Coding , Lossless Predictive Coding – Lossy Compression. Lossy Predictive Coding – Compression Standards: JPEG, MPEG, Basics of Vector quantization.

UNIT V **IMAGE REPRESENTATION AND RECOGNITION** 9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors –Topological feature, Texture - Patterns and Pattern classes - Recognition based on decision –theoretic methods: Matching, optimum statically classifiers and Neural network

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REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	R.C. Gonzalez & R.E. Woods	Digital Image Processing	Pearson education	2nd Edition, 2015.
2.	A K Jain	Fundamentals of Digital Image Processing	Pearson	2nd Edition,2013
3.	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins	Digital Image Processing Using MATLAB	McGraw Hill	2011
4.	Anil Jain K	Fundamentals of Digital Image Processing	PHI	2011

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3. www.youtube.com/watch?v=gIQ6S8U6Vpc
4. www.youtube.com/watch?v=IcBzsP-fvPo
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19BMC17 **MEDICAL IMAGING TECHNIQUES** **L T P C**
3 2 0 4

COURSE OBJECTIVES

1. To become familiar with X-ray imaging fundamentals
2. To get exposed from isotopic medical imaging techniques Computer Tomography
3. To learn concepts and function of Nuclear imaging techniques.
4. To study the mathematic calculation for image formation.
5. To become familiar with image modeling methods

COURSE OUTCOMES

1. Know and understand the basics and fundamentals X-ray imaging.
2. Operate on CT imaging techniques.
3. Understand the concepts and function of Nuclear imaging techniques
4. Learn the basics of mathematic calculation for image formation.
5. Familiar with medical image modeling methods

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC17.CO1	x	x	x	x	x	-	-	-	-	-	-	x	x	x	x
19BMC17.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC17.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC17.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
19BMC17.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I **DIFFERENT MODES OF MEDICAL RECORDING** 9

Quality assurance and image improvement in diagnostic radiology with X-Rays, specific Quality assurance tests for X-rays, need for sectional images, principles of sectional images recording, computer tomography. Mammographic X-Rays Equipment, Fluoroscopy.

UNIT II **RADIOISOTOPIC IMAGES** 9

Radio isotopic imaging equipments, radiation detectors, radionuclide for imaging, static and dynamic planar scintillography. Gamma Camera –Emission Computed Tomography – Single – Photon Emission Computed Tomography – Positron Emission Tomography – System Components Of Computer Tomography - Patient Dose In CT Scanners..

UNIT III **NUCLEAR MAGNETIC RESONANCE IMAGING** 9

Principles Of NMR Imaging Systems - Image Reconstruction Techniques – NMR Components – Biological Effects Of NMR Imaging - Advantages Of NMR Imaging System. Development of NMR, relaxation processes and their measurements, MRI-Image acquisition and reconstruction, MRI safety

UNIT IV **MATHEMATICS OF IMAGE FORMATION AND IMAGE PROCESSING** 9

Concept of object and image, general image processing problem, discrete fourier representation and models for imaging, image restoration, image sampling, perception of moving images. – Image reconstruction in computed tomography and MRI.

.

UNIT V **COMPUTER REQUIREMENT FOR IMAGING SYSTEM** 9

Image enhancement - Single/ multi user system, transferring of images, processing speed, display of medical images, pixel intensity calculation - 3-D image display and its clinical applications. 3D modeling of display image.

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	Wiley India Pvt Ltd, New Delhi	2015

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		edition		
4.	Joseph J. Carr John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2004

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19BMC18 ELECTRICAL SAFETY AND QUALITY ASSURANCE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To provide electrical protection and maintenance in working environment.
2. To ensure the electrical safety.
3 To learn about Safety Aspects in Medical Imaging systems
4 To study about the Standards and Regulations Background of electrical safety device
5 To gain the knowledge of Diagnostic Medical Devices Directives

COURSE OUTCOMES

1. The purpose of this course is to help students to develop knowledge and insight into theprocedures
2. Knowledge used in quality control and assurance activities as well as safety measures tobe followed in hospitals.
3. Electrical safety and different standards Testing and verification of medical devices.
4. Safety & precautions Safety aspects in electro surgical systems
5. Guidelines on medical devices with the knowledge of Diagnostic Medical DevicesDirectives

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC18.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC18.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC18.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC18.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC18.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I INTRODUCTION 9

Classification of Device: Device classes, types in medical field. **PATIENT SAFETY**: Electric shock hazards, Leakage currents, macro shock, micro shock hazards and preventions, safety codes and analyzer. Safety & precautions Safety aspects in electro surgical systems

UNIT II Safety Aspects in Medical Imaging systems 9

Biological effects of ionizing radiation- Determinants of biological effects, Short term & long term effects Ultrasound bio-effects, Radio biology of nuclear medicine, biological effects of magnetic field Laser safety- fundamentals, safety consideration of lasers

UNIT III Definition 9

Defining the device, The product definition process, Overview of quality function deployment, The QFD process, The business proposals Reliability: Types of Reliability, Optimizingreliability, Reliability"s effects on medical devices. Concept of Failure: Various methods of CAPA Safety and Risk Management: Personnel safety and hygiene, Medical device safety and risk management, The role of each participant/stakeholder, Shared responsibility for medical device safety and performance. Electrical safety and different standards Testing and verification of medical devices.

UNIT IV Standards and Regulations Background 9

Standards: Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems. Identification of standards, Current trends in the use of standards in medical device regulations. The ISO 9000 Series of Standards.

UNIT V The Medical Devices Directives 9

Definition of a medical device, The Medical Devices Directives process, Choosing the appropriate directive,

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Identifying the applicable essential requirements, Identification of corresponding harmonized standards, Essential requirements, Classification of the device based on conformity, Medical Devices Directives, Active Implantable Medical Devices Directives, In–vitro Diagnostic Medical Devices Directives. NABH, NABL, JCI, AERB , WHO guidelineson medical devices

.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Richard Fries	Reliable Design ofMedical Devices	Second Edition by, CRCPress	2006.
2.	Richard CFries, CRCPress	Medical Device Quality Assurance andRegulatory Compliance	**CRC Press**	1998.
3.	Michael Cheng	Medical device regulations: global overview and guiding Principles	World Health Organization	Latest Edition
4.	Gábor Czitán, Attila Gutassy,Ralf Wilde	Product Safety in theEuropean Union	TÜV Rheinland Akadémia	2008.

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19BMC19 **HUMAN ASSIST DEVICES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To introduce the principles of various life- support equipment in clinical use.
2. To familiarize with design and system level analysis different human assist equipments.
3. To familiarize with design human vital organ equipments
4. To design the implantable various types of cells
5. To identify solutions of different implant parameters

COURSE OUTCOMES

1. Describe the principles of various life support equipment for mobility.
2. Students will design and system level analysis different human assist equipments
3. Comprehend the design human vital organ equipments
4. Summarize the implantable various types of cells
5. Explain the solutions of different implant parameters

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC19.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC19.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC19.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC19.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC19.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **ASSISTIVE TECHNOLOGY IN MOBILITY** 9

Basic assessment of evaluation for mobility. Control systems, navigation in virtual space by wheel chairs, wheel chair seating and pressure ulcers. Fuzzy logic expert system for automatic turning of myoelectric prostheses. Intelligent prostheses

UNIT II **ASSIST DEVICES AND SENSORY IMPAIRMENTS** 9

Visual and auditory impairments, assessment methods, Libraille, GRAB, mathematical Braille, Hearing Impairment – alternative methods, Use of multimedia technology to help hard of hearing children.

UNIT III **ASSIST DEVICE - VITAL ORGANS , TRENDS IN TECHNOLOGY** 9

Cardiac assist devices, Intra- Aortic Balloon Pump (IABP), auxiliary ventricles, Dialysis for kidney, feature trends in assistive technology, virtual reality based training system for disabled children

UNIT IV **PRINCIPLES OF IMPLANT DESIGN** 9

Cardiac implants – Clinical problems requiring implants for solutions – permanent versus absorbable devices, the missing organ and its replacements, tissue engineering, scaffolds, cells - criteria for material selections

UNIT V **IMPLANT DESIGN PARAMETERS AND ITS SOLUTIONS** 9

Biocompatibility, local and systemic effects of implants – design, specification for tissue bonding and modulus matching – degradation of devices – natural and synthetic polymers, corrosion, wear and tear – implant for bone – devices for nerve regeneration, dental and otologic implants.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Kenneth J. Turner,	Advances in Home Care Technologies: Results of thematch Project	Springer,	2011
2.	Yannas, I. V,	Tissue and Organ Regeneration in Adults	Springer,	2001

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19BMC20 **BIOMEDICAL SENSORS AND INSTRUMENTS LABOARTORY** **L T P C**
0 0 4 2

Sl.No **List of Experiments**

1. Real Time data Acquisition and Analysis of the following physiological parametersECGs (EKGs), EMGs, and EEGs
2. Measurement of Blood Pressure using Sphygmomanometer & Digital meter.
3. Recording of Electromyogram/ nerve conduction velocity.
4. The Galvanic Skin Response Amplifier
5. Study of lung and cardiovascular models
6. Bridge Amplifier: Testing of various transducers including commonly available i)force, ii)pressure, and iii)displacement transducers, iv)temperature probes, v)light meters,
7. Study and usage of Automatic defibrillators.
8. Measurement of pH of a given solution using pH meter.
9. Determination of solution concentration using Colorimeter/Spectrophotometer

19BMC21 **DIGITAL ELECTRONICS LABORATORY** **L T P C**
0 0 2 1

Sl.No **List of Experiments**

1. Design and implementation of Combinational logic functions
2. Design and implementation of Adders and Subtractors
3. Design and implementation of Code Converters
4. Design and implementation of Parity Generator and Checker
5. Design and implementation of Magnitude Comparator
6. Design and implementation of Multiplexer and De-multiplexer
7. Design and implementation of Encoders and Decoders
8. Design and implementation of Asynchronous Counters
9. Design and implementation of Synchronous Counters
10. Design and implementation of Shift registers

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19BMC22	ANALOG ELECTRONICS LABORATORY	L T P C 0 0 2 1

Sl.No **List of Experiments**

1. Frequency Response of CE amplifier
2. Frequency Response of CS amplifier
3. Frequency response of feedback amplifier circuit-current series
4. Frequency response of feedback amplifier circuit- voltage shunt
5. .Transistor based design of RC phase Shift Oscillator circuit
6. Transistor based design of Wein Bridge Oscillator circuit
7. Power Supply circuit - Half wave rectifier and Full wave rectifier with simple capacitorfilter
8. Mini Project

19BMC23	LINEAR INTEGRATED CIRCUITS LABORATORY	L T P C 0 0 2 1

Sl.No **List of Experiments**

1. Inverting, Non inverting and Differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Schmitt Trigger using op-amp.
5. Phase shift and Wien bridge oscillators using op-amp.
6. Astable and monostable multivibrators using NE555 Timer.
7. Mini Projects

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19BMC24	MEDICAL SIGNAL PROCESSING LABORATORY	L T P C 0 0 2 1

Sl.No	List of Experiments
1.	To simulate Electrocardiogram Waveform
2.	To simulate Electroencephalogram Signal
3.	To simulate Electromyogram Signal
4.	To Simulate Defibrillator
5.	To simulate Pacemaker
6	To simulate Haemodialysis Machine
7	To simulate Biopotential Amplifier
8	To simulate ECG Pulse missing detector
9	To simulate 12 Lead Ecg Signals

19BMC25	PATHOLOGY AND MICROBIOLOGY LABORATORY	L T P C 0 0 2 1

Sl.No	List of Experiments
1.	Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin andblood)
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.

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19BMC26	BIOMEDICAL INSTRUMENTATION LABORATORY	L T P C 0 0 2 1

Sl.No	List of Experiments
1.	Study of ECG Heart rate alarm system.
2.	Detection of QRS complex and heart rate calculation
3.	Study of transmission and Reception of Bio signals using Biotechnology
4.	Study of electrical safety measurement using electrical safety analyser
5.	Study and measurement of respiratory parameters -Lung volume capacities using Spirometer
6	Study of Medical Simulator for Faraday current
7	Study of Medical Simulator for Galvonic current.
8	Recording of Audiogram and Measuring the hearing threshold for air conduction.
9	Recording of Audiogram and Measuring the hearing threshold for bone conduction.
10	Study of Ultrasound Diathermy in Therapeutic applications.
11	Design of ECG amplifier ,recording and analysis using Labview.
12	Design of EEG /EMG amplifier ,recording and analysis using Labview.

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19BMC27 **PATHOLOGY AND MICROBIOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. Gain a knowledge on the structural and functional aspects of living organisms.
2. Know the etiology and remedy in treating the pathological diseases.
3. Empower the importance of public health.
4. To study identification of bacteria
5. To study Antibodies and its types

COURSE OUTCOMES

1. Analyze structural and functional aspects of living organisms.
2. Explain the function of microscope
3. Discuss the importance of public health.
4. Describe methods involved in treating the pathological diseases.
5. 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
19BMC27.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC27.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC27.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC27.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BMC27.CO5	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**

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

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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
3.	Underwood JCE	General and Systematic Pathology	Churchill Livingstone, 3rd edition.	: 2000.

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19BMC28	EMBEDDED SYSTEMS LABORATORY	L T P C 0 0 2 1

Sl.No **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

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19BMC29 **COMPUTER NETWORKS** **L T P C**
3 0 2 4

COURSE OBJECTIVES

1. To introduce the students the functions of Data link layer.
2. To introduce the students the functions of Network and Transport layer.
3. To introduce the students the functions of Transport and Application Layer.
4. To introduce IEEE standard employed in computer networking.
5. To make students to get familiarized with different protocols and network components.

COURSE OUTCOMES

1. Describe network topologies, protocols, standards and models
2. Explain data link layer protocols and LAN standards
3. Analyze routing algorithms and methods to improve QOS
4. Summarize transport layer protocols and congestion controls methods
5. Describe various application layer services

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BMC29.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BMC29.CO2	x	x	x	-	-	X	-	-	x	x	-	x	x	-	-
19BMC29.CO3	x	x	x	-	-	X	-	-	x	x	-	x	x	-	-
19BMC29.CO4	x	x	x	-	-	X	-	-	x	x	-	x	x	-	-
19BMC29.CO5	x	x	x	-	-	X	-	-	x	x	-	x	x	-	-

UNIT I **NETWORK COMPONENTS** **9**

Introduction to networks –Topologies – Protocols and Standards–ISO/OSI model-TCP/IP- Comparison of OSI model and TCP/IP, Introduction to physical layer–Transmission Media – Coaxial Cable–Fiber Optics–Digital-to-digital line Coding.

UNIT II **DATA LINK LAYER** **9**

LAN: Ethernet IEEE 802.3, IEEE802.5, IEEE802.11,Bridges. Error detection and correction–Forward Error Correction –Flow Control and Error control techniques - Stop and wait – Go back N ARQ – Selective repeat ARQ - sliding window techniques – HDLC.

UNIT III **NETWORK LAYER** **9**

Internetworks – Packet Switching and Datagram approach – IP addressing methods – IPv6– Subnetting – Routing – Distance Vector Routing, Link State Routing, Quality of services (QOS) – methods to improve QOS parameters

UNIT IV **TRANSPORT LAYER** **9**

Overview of Transport layer– Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) - Reliable byte stream (TCP) — Connection management -Transmission Control Protocol(TCP) – Congestion Control– RSVP

UNIT V **APPLICATION LAYER AND SECURITY** **9**

Domain Name Space(DNS), Simple Mail Transfer Protocol (SMTP), File Transfer Protocol(FTP), HTTP, WWW Network security and cryptography: Symmetric key cryptography – Data Encryption standard & Advanced Encryption Standard, Asymmetric key cryptography

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Behrouz.A.Foruzan	Data communication and Networking	Tata McGraw-Hill	2013
2.	AndrewS.Tannenbaum	ComputerNetworks	PHI	2003
3.	James.F.Kurouse & W.Rouse	Computer networking: A Top down Approach Featuring	Addison Wesley	2009
4.	Larry.L.Peterson & Peter.S.Davie	Computer Networks	Harcourt Asia Pvt. Ltd	2007
5.	Bhushan Trivedi	Computer Networks	Oxford University	2012

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19BMC30	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L T P C 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

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19BME01 ADVANCED BIO ANALYTICAL & THERAPEUTIC TECHNOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Idea about the imaging techniques in microscopy.
2. Types of techniques in advanced bio analytical.
3. Know about the types of special techniques.
4. Knowledge about the types of respiratory aids.
5. 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
19BME01.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME01.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME01.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME01.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME01.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 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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATI

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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
3.	Albert M.Cook and Webster.J.G	Therapeutic Medical Devices	Prentice Hall Inc., New Jersey	1982

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		L	T	P	C
19BME02	**TISSUE ENGINEERING**	3	0	0	3

COURSE OBJECTIVES

1. Expose to Tissue Engineering
2. • Understand the Cell cycle and differentiation
3. • Be familiar with stem cells.

COURSE OUTCOMES

1. Explain the components of Tissue Engineering
2. Use appropriate materials in tissue engineering
3. Apply Tissue Engineering in different fields

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BME02.CO1	x	x	x	-	-	-	-	-	-	x	-	X	x	-	-
19BME02.CO2	x	x	x	-	-	X	-	-	x	x	-	X	x	-	-
19BME02.CO3	x	x	x	-	-	X	-	-	x	x	-	X	x	-	-
19BME02.CO4	x	x	x	-	-	X	-	-	x	x	-	X	x	-	-
19BME02.CO5	x	x	x	-	-	X	-	-	x	x	-	X	x	-	-

UNIT I FUNDAMENTALS OF TISSUE ENGINEERING **9**

Tissue exchange and tissue development - Objectives of tissue engineering - Laboratory set up for tissue engine cycle and differentiation - cell adhesion - cell adhesion molecules - cell migration - cell aggregation and tissue equiv

UNIT II STEM CELLS **9**

Definition of stem cells – types of stem cells – differentiation, dedifferentiation maturation, proliferation, pluripotency and immortalization. Sources of stem cells: haematopoetic – fetal - cord blood – placenta - bone marrow - primordial germ cells - cancer stem cells - induced pleuripotent stem cells.

UNIT III COMPONENTS OF TISSUE ENGINEERING **9**

Cell and Drug delivery systems - Transplantation – Implantation - Synthetic components – nanotechnology in tissue engineering – Imaging methods: SEM, TEM, Fluorescent and Confocal microscopy.

UNIT IV MATERIALS IN TISSUE ENGINEERING **9**

Biological materials – degradable and non degradable – extra cellular matrix – decellularization - Polymers: synthetic and natural – cell interaction with polymers – applications of polymer.

UNIT V APPLICATION OF TISSUE ENGINEERING **9**

Replacement Engineering: Artificial organs – cartilage, skin blood, pancreas, kidney and liver. Regenerative engineering: Nerve regeneration – cardiac tissue regeneration – muscle regeneration.

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	W. Mark Saltzman	Tissue Engineering – Engineering principles for design of replacement organs and tissue	Oxford University Press Inc New York	2004
2.	CS Potten	Stem cells	Elsevier	1997
3.	Gray E. Wnek, Gray L Browlin	Encyclopedia of Biomaterials and Biomedical Engineering	Marcel Dekker Inc New York	2004
4.	R. Lanza, J. Gearhart et al (Eds),	Essential of Stem Cell Biology	Elsevier Academic press	2006

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19BME03	MEDICAL SCIENCE	L	T	P	C
		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	PSO3
19BME03.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME03.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME03.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME03.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME03.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

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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

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19BME04	BIOMATERIALS & CHARACTERIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To learn characteristics and classification of Biomaterials.
2. To study about the characteristics of thermal & mechanical properties of polymer & plastics.
   To understand the characteristics of ceramic, carbon biomaterials.
   To learn polymeric materials and its combinations that could be used as a tissue replacement implants
   Understand the concept of biocompatibility and the methods for biomaterials testing

COURSE OUTCOMES

1. Know the basic knowledge of biomaterials.
   Identify significant gap required to overcome challenges and further development in metallic and ceramic
2. materials
3. Identify significant gap required to overcome challenges and further development in polymeric materials
4. Create combinations of materials that could be used as a tissue replacement implant.
5. Understand the testing standards applied for biomaterials

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BME04.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME04.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME04.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME04.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME04.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION TO BIO-MATERIALS** 9

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena

UNIT II **POLYMER AND PLASTICS** 9

Classification, thermal properties, factors influencing polymer properties. Polymer compatibility, polymer degradation, restorable polymers, tissue adhesives, dialysis membrane, sutures. . MECHANICAL PROPERTIES AND TESTS: For elasticity, plasticity, and elasticity, dislocation deformation and fracture

UNIT III **METALLIC AND CERAMIC BIOMATERIALS** 9

Properties and use to titanium alloys stainless steel, cobalt based alloys degradable ceramics

UNIT IV **CARBON AND POLYMERIC BIOMATERIALS** 9

Carbon, polythene, polypropylene, silicones rubber, acrylic implants, hydrogels. DENTAL

UNIT V **IMPLANTS** 9

Alveolar bone replacements. Orthopedic implants-types of orthopedic function devices, permanent joint replacements, hip joints, bone cement, Biological testing of biomaterials.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION

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1.	Hench L.L. Ethridge E.C.	Biomaterials, An interfacial Approach	Academic Press,	1982
2.	John G.Webster, Bols	Encylopedia of Medical Devices and Instruments. I-IV		
3.	Bronzins J.D	The Biomedical Engineering Hand book	CRC Press	1995

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19BME05 **PHYSIOLOGICAL MODELING**

L	T	P	C
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
19BME05.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME05.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME05.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME05.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME05.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **APPROACHES TO MODELING** 9

The technique of mathematical modeling, classification of models, characteristics of models. Purpose of physiological modeling and signal analysis, linearization of nonlinear models. Time invariant and time varying systems for physiological modeling

UNIT II **NONPARAMETRIC MODELING** 9

Volterra models. Wiener models. Efficient volterra kernel estimation Analysis of estimation errors. Parametric modeling: Basic parametric model forms and Estimation procedures. Volterra kernels of nonlinear differential equations. Discrete-time volterra kernels of NARMAX models. From Volterra kernel measurements to Parametric models. Equivalence between continuous and Discrete -parametric models.

UNIT III **EQUIVALENT CIRCUIT MODEL** 9

Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of the whole neuron. Huxley model of isotonic muscle contraction, modeling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.

UNIT IV **PHYSIOLOGICAL MODELING** 9

Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria

UNIT V **ELECTRICAL CIRCUIT MODEL OF OXYGENATION** 9

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A model of immune response to disease - Modeling of multi input/multi output systems: The Two-input case. Applications of two-input modeling to physiological systems. The Multi input case spatio temporal and spectro temporal modeling. Applications of Multi-input modeling to physiological systems

TOTAL:45

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.	

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3. https://www.udemy.com/brain-computer-interface/
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19BME06	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		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
19BME06.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME06.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME06.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME06.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME06.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) ,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,

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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), GertPfurtschelle r (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

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19BME07	MEDICAL OPTICS	L	T	P	C
		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
19BME07.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME07.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME07.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME07.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME07.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, Polarizer's, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection.

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

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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

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19BME08 **SOFT COMPUTING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To provide adequate knowledge about neural networks
2. To teach about the concept of fuzzy involved in various systems
3. To provide adequate knowledge about genetic algorithm
4. To gain knowledge on Hybrid Computing Techniques
5. To provide adequate knowledge to modeling the system

COURSE OUTCOMES

1. Describe basics of ANN and its learning algorithms
2. Develop various Fuzzy Models
3. Explain the terminologies associated to Genetic algorithms
4. Develop a hybrid Computing Techniques
5. Apply the concepts to solve real time problems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BME08.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME08.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME08.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME08.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME08.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **NEURAL NETWORKS** 9

Fundamentals of Neural Networks – History- Architectures- Learning methods-XOR problem-Delta rule-derivation-Back propagation- applications- parameters in BPN- Associative memory – Hetero associative- BAM- energy function problems-applications of associative memories- ART1- ART2- applications of adaptive networks.

UNIT II **BASIC CONCEPTS OF FUZZY LOGIC** 9

Introduction to fuzzy logic, Classical sets and Fuzzy sets, Fuzzy relations, Membership function: Features of membership function, Fuzzification, Methods of membership value assignments- Fuzzy rules and reasoning: Fuzzy if-then rules. Fuzzy Inference Systems (FIS): Introduction– Methods of FIS: Mamdani, Sugeno and Tsukamoto. Defuzzification: Lambda-Cuts for fuzzy sets and fuzzy relations, Defuzzification methods.

UNIT III **GENETIC ALGORITHMS** 9

Fundamentals of Genetic Algorithms-Difference between Traditional Algorithms and Genetic Algorithms – creation of off springs – encoding – fitness function reproduction– Crossover- insertion& deletion- mutation- bitwise operators –applications- Multi-objective Genetic Algorithm (MOGA)- genetic algorithms in search and optimization, GA based clustering Algorithm.

UNIT IV **HYBRID SOFT COMPUTING TECHNIQUES** 9

Hybrid systems – Neuro Fuzzy Modelling -Applications of Neural Networks- Pattern Recognition and classification – Neuro Genetic hybrids – fuzzy Genetic hybrids- GA based weight determination and applications- fuzzy BPN – simplified fuzzy ARTMAP.

Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

UNIT V **PROGRAMMING AND APPLICATIONS** 9

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Using Neural Network toolbox – Using Fuzzy Logic toolbox- Using Genetic Algorithm & directed search toolbox Application: Printed Character Recognition, Optimization of travelling salesman problem using genetic algorithm approach. Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	S.N.Sivanandam, S.N.Deepa	Principles of Soft Computing	Wiley	2nd Edition 2014
2.	Rajasekaran.S and VijayalakshmiPai.G.A	Neural Networks, Fuzzy Logic and Genetic Algorithms	PHI	2011
3.	J.S.R.Jang, C.T.Sun, E.Mizutani	Neuro – Fuzzy and Soft Computing	PHI Learning Pvt. Ltd	2012
4.	Timothy J.Ross	Fuzzy Logic with Engineering applications	John Wiley and Sons	2010
5.	Simon Haykin	Neural Networks Comprehensive Foundation	Pearson Education	Second Edition 2005

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19BME09	VIRTUAL REALITY	L	T	P	C
		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
19BME09.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME09.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME09.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME09.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME09.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

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

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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.

TOTAL:45

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	
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	

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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

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19BME10 **WEARABLE SYSTEMS**

L	T	P	C
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
19BME10.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME10.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME10.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME10.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME10.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, Bio compatibility

UNIT II **SIGNAL PROCESSING** 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal 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, Hybrid 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

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

TOTAL:45

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Annalisa	Wearable Monitoring Systems	Springer	2011

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	Bonfiglio, Danilo De Rossi			
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

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3. https://research.monash.edu/en/publications/wireless-body-area-vetworks-technology-implementation-and-applica.
4. http://www.panstanford.com/pdf/9789814241571fm.pdf
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19BME11	INTERNET OF THINGS	L	T	P	C
		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
19BME11.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME11.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME11.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME11.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME11.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 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

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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 Avesand. David Boyle	From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence	Elsevier	2014

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3. https://nptel.ac.in/courses/106105166/
4. https://nptel.ac.in/downloads/106105166/
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19BME12 HOSPITAL WASTE MANAGEMENT

L	T	P	C
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. Handling of biomedical waste.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BME12.CO1	x	x	x	-	-	-	-	-	-	x	-	x	X	-	-
19BME12.CO2	x	x	x	-	-	x	-	-	x	x	-	x	X	-	-
19BME12.CO3	x	x	x	-	-	x	-	-	x	x	-	x	X	-	-
19BME12.CO4	x	x	x	-	-	x	-	-	x	x	-	x	X	-	-
19BME12.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 of transmission of disease, Environmental pollution by biomedical waste-causes, consequences, mitigation and remedies.

UNIT III CONTROL OF HOSPITAL ACQUIRED INFECTION 9

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

UNIT IV TREATMENT TECHNOLOGIES FOR WASTES 9

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

UNIT V LAWS OF BIOMEDICAL WASTE HANDLING 9

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 Health Organization guidelines on Management of wastes from hospital wastes.

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REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Anantpreet Singh, 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.		Environment and Pollution Laws (Containing Acts and Rules)	Universals Legal Manual	
5.	Paul T. Williams	Waste Treatment and Disposal	John Wiley & Sons, Ltd	2005

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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-and-more

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19BME13 **TELEHEALTH TECHNOLOGY**

L	T	P	C
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
19BME13.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME13.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME13.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME13.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME13.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION** **9**

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

UNIT II **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** **9**

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video 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**

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.

TOTAL:45

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Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION

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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)	
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	1. 2006
4.	SasanAdibi	Mobile Health: A Technology Road Map	**Springer Publication**	Mar 2015
5.	Norris, A.C.	Essentials of Telemedicine and Telecare	Wiley	2002

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1.. COMP107x Introduction to Mobile Application Development using Android
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3. https://trove.nla.gov.au/version/45455445
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5. http://www.caltrc.org/telehealth/why-are-telemedicine-and-telehealth-so-important-in-our-healthcare-system/

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19BME14 FIBER OPTICS AND LASERS IN MEDICINE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Able to understand the property of fiber optics
2. Apply lasers in different areas of medicine.
3. Explain the special techniques of Lasers.
4. Study about the endoscopy.
5. 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
19BME14.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME14.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME14.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME14.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME14.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

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

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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

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19BME15 **MEDICAL PHYSICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To study principles and effects of ionizing and non-ionizing radiation in human body
2. To study the intensities of sensory stimuli
3. To discuss the physics of the senses
4. To explore the effects of radiation in matter and how isotopes are produced
5. To understand various detectors for detecting the presence of ionizing radiation

COURSE OUTCOMES

1. Explain about non-ionizing radiation, interaction with tissue and its effects.
2. Define and compare intensities of sensory stimuli
3. Summarizes how ionizing radiation interacts with the human body, how to quantify it and its levels seen in the environment and healthcare
4. Explain the fundamentals of radioactivity and radioactive isotopes
5. Illustrates the methods of detecting and recording the ionizing radiation and its interaction with matter

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19BME15.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
19BME15.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME15.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME15.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
19BME15.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **IONIZING RADIATION AND ITS MEDICAL APPLICATIONS** **9**

Introduction and objectives - Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole–Cole model, Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unit- limits of vision and color vision an overview, Ultraviolet

UNIT II **PHYSICS OF THE SENSES** **9**

Introduction and objectives - Cutaneous sensation - The chemical senses – Audition –Vision - Psychophysics

UNIT III **PRINCIPLES OF RADIOACTIVE NUCLIDES** **9**

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclide's – Cyclotron produced Radionuclide- Reactor produced Radio-nuclide-fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide's, radionuclide Generator-Technetium generator.

UNIT IV **RADIOACTIVE DECAY AND INTERACTIONOF RADIATION WITH MATTER** **9**

Spontaneous Fission- Isomeric Transition-Alpha Decay-Beta Decay-Positron Decay-Electron Capture-Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter-Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

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,

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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.	Gopal B. Saha	Physics and Radiobiology of Nuclear Medicine 4th Edition	Springer	2013
2.	B H Brown, R H Smallwood, D C Barber, P V Lawford D R Hose	Medical Physics and Biomedical Engineering 2nd Edition	IOP Publishers	2001
3.	S.Webb	The Physics of Medical Imaging	Taylor and Francis	1988
4	J.P.Woodcock	Ultrasonic,Medical Physics Handbook series 1	Adam Hilger, Bristol	2002
5	HyltonB.Meire Pat Farrant	Basic Ultrasound	John Wiley & Sons	1995

WEB URL'S

1. http://www.sprawls.org/ppmi2/
2. https://shodhganga.inflibnet.ac.in/bitstream/10603/13696/9/09_chapter%203.pdf
3. https://www.slideshare.net/arundeepa/radioactive-isotopes-72515767
4. https://www.slideshare.net/drarnabradiotherapy/interaction-of-radiation-with-matter-13517926
5. https://www.slideshare.net/GirishpalvaiKumar/radiation-detector

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