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 : MD

Programme Name : B.E-Medical Electronics

Regulation : R-2016

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Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

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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 prepare the students with Engineering and Medical knowledge in developing various supporting systems using various technologies for healthcare applications

DEPARTMENT MISSION

- To establish a unique learning environment for the students to face the challenges in Medical field.
- To enhance inter and intra personal skills among students to make them employable and entrepreneur.
- To transform the students into professionally competent engineers through innovative, training, Internship and collaboration with industry and hospital.

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DEPARTMENT PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

PROGRAM EDUCATIONAL OBJECTIVES

The Medical Electronics Graduates should be able to

PEO1: Graduate should be able to prepare themselves with strong foundation in Engineering ,Science and Technology for a successful career in Medical Electronics field.

PEO2: To identify opportunities and develop the level of competency in technical and communication skills to establish their excellence in professionalism.

PEO3: To provide ethical and value based education for addressing the society needs.

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: Apply the acquired knowledge in the development and test creative solutions for Medical applications.

PSO2: Demonstrate proficiency in ICT and software skills for innovations and solving challenges in health sector.

PSO3: Recognize the importance of ethics, Entrepreneurship and Management skills for Indian Industrial needs.

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Estd. 2000

B.E. MEDICAL ELECTRONICS

GROUPING OF COURSES

FOUNDATION COURSE [FC]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	16SHA01	Technical English	HS	5	3	2	0	4
2.	16SHA02	Communicative English	HS	7	3	0	4	5
8.	16SHA08	Principles of Management and Engineering Ethics	HS	3	3	0	0	3
9.	16SHB01	Matrices, Calculus & Ordinary Differential Equations	BS	5	3	2	0	4
10.	16SHB02	Complex Variables ,Laplace Transforms & Vector Calculus	BS	5	3	2	0	4
11.	16SHB03	Transforms & Partial Differential Equations	BS	5	3	2	0	4
12.	16SHB04	Probability & Random Processes	BS	5	3	2	0	4
13.	16SHB21	Engineering Physics	BS	6	2	0	4	4
14.	16SHB22	Material Science	BS	3	3	0	0	3
15.	16SHB31	Engineering Chemistry	BS	6	2	0	4	4
16.	16SHB32	Environmental Science and Engineering	BS	3	3	0	0	3
17.	16BMC01	Fundamentals of Computing and Programming	ES	6	2	0	4	4
18.	16BMC02	Advanced C Programming	ES	6	2	0	4	4
19.	16BMC04	Basics Electrical and Electronics Engineering	ES	3	3	0	0	3
20.	16BMC09	Microprocessor and Microcontrollers	ES	5	3	0	2	4
21.	16BMC11	Data Structures	ES	6	2	0	4	4
22.	16BMC12	Electron Devices	ES	6	2	0	4	4
23.	16BMC16	Fundamentals of Biochemistry	ES	6	2	0	4	4
24.	16BMC17	Bio Mechanics	ES	3	3	0	0	3
25.	16BMC18	Medical Informatics	ES	5	3	2	0	4

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PROFESSIONAL CORE [PC]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	16MDD01	Anatomy and Human Physiology	PC	3	3	0	0	3
3.	16MDD02	Sensors and Measurements	PC	5	3	2	0	4
4.	16MDD03	Bio Medical Instrumentation and Measurements	PC	3	3	0	2	5
5.	16MDD04	Digital Electronics	PC	5	3	0	2	4
6.	16MDD05	Signals and Systems	PC	5	3	2	0	4
7.	16MDD06	Therapeutic Equipments	PC	5	3	2	0	4
8.	16MDD07	Bio Control System	PC	5	3	2	0	4
9.	16MDD08	Analog Electronics	PC	5	3	0	2	4
10.	16MDD09	Linear Integrated Circuits	PC	5	3	0	2	4
11.	16MDD10	Human Assist Devices	PC	3	3	0	2	4
12.	16MDD11	Pathology and Microbiology	PC	5	3	0	2	4
13.	16MDD12	Hospital Management	PC	3	3	0	0	3
14.	16MDD13	Bio MEMS	PC	3	3	0	0	3
15.	16MDD14	Digital Signal Processing	PC	5	3	0	2	4
16.	16MDD15	Embedded System	PC	5	3	0	2	4
17.	16MDD17	Digital Image Processing	PC	3	3	0	0	3
18.	16MDD18	Medical Imaging Techniques	PC	3	3	0	0	3

PROFESSIONAL ELECTIVES [PE]

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	16MDE01	Advanced Bio Analytical And Therapeutic Techniques	PE	3	3	0	0	3
2.	16MDE02	Bio Signal Processing	PE	3	3	0	0	3
3.	16MDE03	Biomaterials and Artificial Organs	PE	3	3	0	0	3
4.	16MDE04	Biomedical Engineering	PE	3	3	0	0	3
5.	16MDE05	Biomaterials and Characterization	PE	3	3	0	0	3
6.	16MDE06	Physiological Modeling	PE	3	3	0	0	3
7.	16MDE07	Brain Computer Interface and Applications	PE	3	3	0	0	3

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8.	16MDE08	Medical Optics	PE	3	3	0	0	3
9.	16MDE09	Soft Computing	PE	3	3	0	0	3
10.	16MDE10	Intellectual Property Rights	PE	3	3	0	0	3
11.	16MDE11	Physiological Modeling	PE	3	3	0	0	3
12.	16MDE12	Skills in Integrated Product Development	PE	3	3	0	0	3
13.	16MDE13	Rehabilitation Engineering	PE	3	3	0	0	3
14.	16MDE14	Virtual Reality	PE	3	3	0	0	3
15.	16MDE15	Wearable Systems	PE	3	3	0	0	3
16.	16MDE16	Internet of Things	PE	3	3	0	0	3
17.	16MDE17	Medical Expert System	PE	3	3	0	0	3
18.	16MDE18	Hospital Waste Management	PE	3	3	0	0	3
19.	16MDE19	Tele health Technology	PE	3	3	0	0	3
20.	16MDE20	Fiber optics and Lasers in Medicine	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	16MDF01	Project Work Phase - I	EEC	6	0	0	6	3
2	16MDF02	Project Work Phase -II	EEC	30	0	0	30	15
3	16MDF04	Hospital Training	EEC	4	0	0	4	2

COURSE COMPONENT SUMMARY

S. No.	Subject Area	Credits Per Semester								Credits Total	AICTE Credits
		I	II	III	IV	V	VI	VII	VIII		
1	FC	25	25	4	15			4		73	74
2	PC			18	8	18	15	4		63	50
3	PE					6	6	6		18	20
4	OE						3	6		09	12
5	EEC							5	15	20	20
TOTAL		**25**	**25**	**22**	**23**	**24**	**24**	**25**	**15**	**183**	**176**

Total Credits: 183

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Department	Medical Electronics	
Programme	B.E.	
	SEMESTER – I	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHA02	Communicative English	3	0	4	5	7
2.	16SHB01	Matrices,Calculus & Ordinary Differential Equations	3	2	0	4	5
3.	16SHB21	Engineering Physics	2	0	4	4	6
4.	16SHB32	Environmental Science and Engineering	3	0	0	3	3
5.	16MDC01	Fundamentals of Computing and Programming	2	0	4	4	6
6.	16MDC04	Basics Electrical and Electronics Engineering	3	0	0	3	3
7.	16MDC06	Engineering Practices for Electrical Sciences	0	0	4	2	4
		Total Credits				**25**	

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Department	Medical Electronics	
Programme	B.E.	
	SEMESTER – II	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHA01	Technical English	3	2	0	4	5
2.	16SHB02	Complex Variables ,Laplace Transforms & Vector Calculus	3	2	0	4	5
3.	16SHB22	Material Science	3	0	0	3	3
4.	16SHB31	Engineering Chemistry	2	0	4	4	6
5.	16MDC02	Advanced C Programming	2	0	4	4	6
6.	16MDC12	Electron Devices	2	0	4	4	6
7.	16MDC05	Engineering Graphics	0	0	4	2	4
		Total Credits				**25**	

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Department	Medical Electronics	
Programme	B.E.	
	SEMESTER – III	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHB03	Transforms & Partial Differential Equations	3	2	0	4	5
2.	16MDD05	Signals and Systems	3	2	0	4	5
3.	16MDD08	Analog Electronics	3	0	2	4	6
4.	16MDD04	Digital Electronics	3	0	2	4	5
5.	16MDD01	Anatomy and Human Physiology	3	0	0	3	3
6.	16MDD02	Sensors and Measurements	3	0	0	3	3
		Total Credits				**22**	

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Department	Medical Electronics	
Programme	B.E.	
	SEMESTER – IV	

Sl. No.	Course Code	Course Name	Hours/week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16SHB04	Probability & Random Processes	3	2	0	4	5
2.	16MDC09	Microprocessor and Microcontrollers	3	0	2	4	5
3.	16MDC17	Bio Mechanics	3	0	0	3	3
4.	16MDD09	Linear Integrated Circuits	3	0	2	4	5
5.	16MDC11	Data Structures	2	0	4	4	6
6.	16MDD11	Pathology and Microbiology	3	0	2	4	5
		Total Credits				**23**	

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Programme	B.E.	
	SEMESTER – V	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16MDD12	Hospital Management	3	0	0	3	3
2.	16MDD14	Digital Signal Processing	3	0	2	4	5
3.	16MDD07	Bio Control System	3	2	0	4	5
4.	16SHA08	Principles of Management and Engineering Ethics	3	0	0	3	3
5.	16MDD03	Bio medical Instrumentation and Measurements	3	0	2	4	5
6.		Professional Elective -I	3	0	0	3	3
7.		Professional Elective -II	3	0	0	3	3
		Total Credits				24	

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Programme	B.E.	
	SEMESTER – VI	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16MDD10	Human Assist Devices	3	0	2	4	5
2.	16MDD15	Embedded System	3	0	2	4	5
3.	16MDD06	Therapeutic Equipments	3	2	0	4	3
4.	16MDD18	Medical Imaging Techniques	3	0	0	3	3
5.		Professional Elective -III	3	0	0	3	3
6.		Professional Elective -IV	3	0	0	3	3
7.		Open Elective - I	3	0	0	3	3
		Total Credits				24	

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Department	Medical Electronics	
Programme	B.E.	
	SEMESTER – VII	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	16MDC18	Medical Informatics	3	2	0	4	5
2.	16MDF01	Project Work Phase -I	0	0	6	3	6
3.	16MDF04	Hospital Training	0	0	4	2	4
4.	16MDD20	MEMS and its Biomedical Applications	3	2	0	4	5
5.		Professional Elective - V	3	0	0	3	3
6.		Professional Elective - VI	3	0	0	3	3
7.		Open Elective -II	3	0	0	3	3
8.		Open Elective -III	3	0	0	3	3
		Total Credits				**25**	

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Programme	B.E.	
	SEMESTER – VIII	

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
PRACTICAL							
1.	16MDF02	Project Work Phase -II	0	0	30	15	30
		Total Credits				**15**	

Total Credits to Be Earned For the Award of Degree: 183

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16MDD01 **ANATOMY AND HUMAN 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
16MDD01.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD01.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD01.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD01.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD01.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.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Elaine.N. Marieb,	Essential of Human Anatomy and	Pearson	Eight edition,,

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		Physiology	Education NewDelhi,.	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
5.	Arthur C. Guyton	Text book of Medical Physiology	11 th Edition, Elsevier Saunders,	11th Edition, 2006

WEB REFERENCE(s)

1. https://nptel.ac.in/courses/104101093/3
2. https://nptel.ac.in/courses/122103039/19
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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16MDD02 **SENSORS AND MEASUREMENTS**

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

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
16MDD02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD02.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD02.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD02.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD02.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.

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	William D.Cooper.	2007

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		Techniques	Prentice Hall of India,	
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. https://nptel.ac.in/courses/112106139/
2. https://nptel.ac.in/courses/112103174/3
3. https://nptel.ac.in/courses/108105064/24
4. https://nptel.ac.in/courses/108105062/8
5. https://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/.../mod1/10.htm

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16MDD03	BIOMEDICAL INSTRUMENTATION AND MEASUREMENTS	L	T	P	C
		3	0	2	5

COURSE OBJECTIVES

1. To Illustrate origin of bio potentials and its propagations
2. To understand the different types of electrodes and its placement for various recordings
3. To design bio amplifier for various physiological recordings
4. To learn the different measurement techniques for non-physiological parameters.
5. To summarize different biochemical measurements.

COURSE OUTCOMES

1. Differentiate different bio potentials and its propagations.
2. Illustrate different electrode placement for various physiological recordings
3. Design bio amplifier for various physiological recordings
4. Explain various technique for non-electrical physiological measurements
5. Demonstrate different biochemical measurement techniques.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDD03.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD03.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD03.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD03.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD03.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I ELECTROPHYSIOLOGY AND BIOPOTENTIAL ELECTRODES 9

Origin of bio potential, Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - , measurement with two electrodes

UNIT II BIO-POTENTIAL MEASUREMENTS OF PARAMETERS 9

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

UNIT III BIO AMPLIFIER WITH SIGNAL CONDITIONING CIRCUITS 9

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

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

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

UNIT V BIO-CHEMICAL MEASUREMENT 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyzer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description)

LIST OF EXPERIMENTS:

1. Real Time data Acquisition and Analysis of the following physiological parameters ECGs (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

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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.

TOTAL: 30 HRS

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Leslie Cromwell	Biomedical Instrumentation and measurement 2nd edition	Prentice hall of India, New Delhi	2015
2.	Khandpur R.S,	Handbook of Biomedical Instrumentation 3rd edition	Tata McGraw-Hill New Delhi	2014
3.	John G. Webster	Medical Instrumentation Application and Design 4th edition	Wiley India Pvt Ltd, New Delhi	2015
4.	Joseph J. Carr John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2004
5.	Myer Kutz	Standard Handbook of Biomedical Engineering and Design	McGraw Hill Publisher	2003.

WEB REFERENCE(s)

1. https://www.slideshare.net/jineshkj/ec09-l25-biomedical-instrumentation-module-1
2. https://www.slideshare.net/ErFarukBinPoyen/bio-potential-and-bio-electrode
3. https://www.slideshare.net/stootypal/biopotentials
4. https://www.slideshare.net/MariaRominaAngustia/measurement-and-control-of-nonelectrical-quantitie
5. https://www.slideshare.net/ShmmonAhmad/biochemical-analysis-techniques

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16MDD04 **DIGITAL ELECTRONICS**

L	T	P	C
3	0	2	4

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
16MDD04.CO1	x	x	x	x	x	-	-	-	X	-	-	x	x	x	x
16MDD04.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD04.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD04.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD04.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

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

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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

Total:30 Hrs

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
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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16MDD05 **SIGNALS AND SYSTEMS**

L	T	P	C
3	2	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
16MDD05.CO1	x	x	x	x	x	-	-	-	X	-	-	x	x	x	X
16MDD05.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD05.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD05.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD05.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X

UNIT I **FUNDAMENTAL OF SIGNALS AND SYSTEMS** 9

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

UNIT II **ANALYSIS OF CONTINUOUS TIME SIGNALS** 9

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

UNIT III **LINEAR TIME INVARIANT SYSTEMS** 9

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 Z transform, The inverse Z transform, Properties of Z Transform, the unilateral Z transform , Geometric evaluation of the Fourier transform from the pole zero plot, The relationship between Z transform and DTFT.

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

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

REFERENCE BOOK

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

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1.	Alan V. Oppenheim, Alan S. Willsky	Signals and Systems	Pearson education	2nd Edition, 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_puTV198
4. www.youtube.com/watch?v=wG6VUnkrO90
5. www.youtube.com/watch?v=AkBaDKYmQQI

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16MDD06 **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
16MDD06.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD06.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD06.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD06.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD06.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** **9**

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** **9**

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** **9**

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** **9**

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

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 Instrumentation	Tata McRaw Hill	2004
3.	Bronzino	Hand book of Biomedical	IEEE press	2000

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		Engineering	book	
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)

1. https://www.slideshare.net/abhilashachaudhary4/pacemaker-71996509
2. https://www.slideshare.net/niteshkumarsinghh/defibrillator-ppt
3. https://www.slideshare.net/RajneeMishra/ventilator-61330983
4. https://www.slideshare.net/HemangiParmar4/neuromuscular-electrical-stimulation
5. https://www.slideshare.net/UthamalingamMurali/diathermy-in-surgery

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16MDD07	BIO CONTROL SYSTEM	L	T	P	C
		3	0	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
16MDD07.CO1	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD07.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD07.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD07.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD07.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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	J.Nagrath and M.Gopal	J.Nagrath and M.Gopal	New Age International Publishers, 5th Edition	2007.
2.	Benjamin.C.Kuo	Automatic control systems	Prentice Hall of India, 7th Edition	1995
3.	M.Gopal	Control System – Principles and Design	Tata McGraw Hill, 2nd	2002

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			Edition	
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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16MDD08 **ANALOG ELECTRONICS**

L	T	P	C
3	0	2	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
16MDD08.CO1	x	x	x	x	x	-	-	-	X	-	-	x	x	x	X
16MDD08.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD08.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD08.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD08.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.

LIST OF EXPERIMENTS

Frequency Response of CE amplifier

Frequency Response of CS amplifier

Frequency response of feedback amplifier circuit-current series

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Frequency response of feedback amplifier circuit- voltage shunt

Transistor based design of RC phase Shift Oscillator circuit

Transistor based design of Wein Bridge Oscillator circuit

Power Supply circuit - Half wave rectifier and Full wave rectifier with simple capacitor filter

Mini Project

Total: 30 Hrs

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

WEB REFERENCE(s)

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
5. www.nptel.ac.in/courses/117106088/14

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16MDD09 **LINEAR INTEGRATED CIRCUITS**

L	T	P	C
3	0	2	4

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
16MDD09.CO1	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD09.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD09.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD09.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD09.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 CONVETER** **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.

LIST OF EXPERIMENTS

Design and Testing of

1. Inverting, Non inverting and Differential amplifiers.

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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.

Total: 30 Hrs

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Sergio Franco	Design with operational amplifiers and analog integrated circuits	3rd Edition, Tata McGraw-Hill	2007
2.	D.Roy Choudhry, Shail Jain	Linear Integrated Circuits	New Age International Pvt. Ltd	2000
3.	RamakantA.Gayakwad	OP-AMP and Linear IC's	Prentice Hall of India	2002
4.	David L.Terrell	Op Amps-Design, Application, and Troubleshooting	Elsevier publications	2005
5.	Sergio Franco	Design with operational amplifiers and analog integrated circuits	3rd Edition, Tata McGraw-Hill	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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16MDD10 **HUMAN ASSIST DEVICES**

L	T	P	C
3	2	0	4

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
16MDD10.CO1	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD10.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD10.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD10.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD10.CO5	x	x	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.

LIST OF EXPERIMENTS

1. Simulation of ECG – detection of QRS complex and heart rate
2. Study of biotelemetry
3. Electrical safety measurements.
4. Measurement of Respiratory parameters using spirometry.
5. Study of medical stimulator.
6. Study of ESU – cutting and coagulation modes
7. Recording of Audiogram
8. Measurement of Hearing threshold using Audiometer and plot its characteristics.

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9. Design of ECG amplifier, recording and analysis using Lab View

TOTAL HRS : 30

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
3.	Levine S.N.	"Advances in Bio-medical engineering and Medical physics	Interuniversity publications,	1968
4.	Kopff W.J,	Artificial Organs	John Wiley and sons	1976
5.	Daniel Goldstein, Mehmet	Cardiac assist Devices	Wiley	2000

WEB REFERENCE(s)

1. https://www.slideshare.net/hansonk_uwa/assistive-technology-49278658
2. https://www.slideshare.net/jeneane123/sensory-impairments-presentation-7007219
3. https://www.slideshare.net/wonnietonnie/advances-in-medical-technology
4. https://www.slideshare.net/DrShilpaShiv/basic-aspects-of-implants
5. https://www.slideshare.net/iosrjce/a-review-on-design-process-of-orthopedic-implants

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16MDD11 **PATHOLOGY AND MICROBIOLOGY**

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

1. Gain 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
16MDD11.CO1	x	x	x	x	x	-	-	-	X	-	-	x	x	x	X
16MDD11.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD11.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD11.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X
16MDD11.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	X

UNIT I **CELL DEGENERATION, REPAIR AND NEOPLASIA** **9**

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

UNIT II **FLUID AND HEMODYNAMIC DERANGEMENTS** **9**

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

UNIT III **MICROBIOLOGY** **9**

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

LIST OF EXPERIMENTS

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)

2. Study of parts of compound microscope

3. Histopathological slides of benign and malignant tumours.

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4. Manual paraffin tissue processing and section cutting (demonstration)

5. Cryo processing of tissue and cryosectioning (demonstration)

6. Basic staining – Hematoxylin and eosin staining.

7. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS

8. Capsule stain

9. Simple stain.

10. Gram stain.

11. AFB stain.

12. Antigen-Antibody reaction Immuno electrophoresis

13. Slides of malarial parasites, micro filaria and leishmania donovani.

14. Haematology slides of anemia and leukemia.

15. Study of bone marrow charts.

TOTAL : 30 Hrs

REFERENCE BOOK

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.
4.	Dubey RC and Maheswari DK.	A Text Book of Microbiology‖ &	Chand Company Ltd,	2007
5.	Prescott, Harley and Klein	Microbiology‖	10th edition, McGraw Hill	2017

WEB REFERENCE(s)

1. https://nptel.ac.in/courses/102106025/36
2. https://nptel.ac.in/courses/112104118/43
3. https://nptel.ac.in/courses/102103015/
4. https://nptel.ac.in/courses/115103030/9
5. https://nptel.ac.in/courses/102103038/

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16MDD12 **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
16MDD12.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD12.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD12.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD12.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD12.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.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	R.C.Goyal	Hospital Administration and Human Resource Management – Fourth Edition	Academic Press, New York	2006.
2.	G.D.Kunders	Hospitals Facilities Planning and	TMH, New	2007

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		Management Fifth Reprint	Delhi	
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

WEB REFERENCE(s)

1. https://www.slideshare.net/drjayeshpatidar/hospital-administration-53507341
2. https://www.slideshare.net/dharmendragahwai/human-resource-management-in-public-health-ppt
3. https://www.slideshare.net/RajeshKuthalingam/marketing-research-process-9625550
4. https://www.slideshare.net/vijayrajnazzi/information-technology-in-hospitals
5. https://www.slideshare.net/akhileshbhargava/quality-in-health-care

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16MDD13	Bio MEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To introduce various MEMS fabrication techniques.
2. To impart knowledge on different types of sensors and actuators and their principles of operation at the micro scale level.
3. To study the electrostatic and piezoelectric.
4. To discuss the fluid properties and methods.
5. To discuss the applications of MEMS in different fields of medicine

COURSE OUTCOMES

1. Discuss various MEMS fabrication techniques.
2. Elaborate the Sensors and Actuators.
3. Discuss the Bio MEMS.
4. Understand the concepts of microfluid systems.
5. Describe the nanodevices used in medical field for surgery.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDD13.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD13.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD13.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD13.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD13.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **MEMS MATERIALS AND FABRICATION** **9**

Typical MEMs and Microsystems, materials for MEMS - active substrate materials-Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining- photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT II **SENSORS AND ACTUATORS** **9**

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III **BIOMEMS** **9**

Introduction to BioMEMS, BioMEMS for Clinical Monitoring, Lab on a chip, DNA Sensors, E-Nose, E-Tongue, Microsystem approaches to PCR, MEMS based Implantable Drug Delivery System, Emerging BioMEMS Technology

UNIT IV **MICROFLUIDIC SYSTEMS** **9**

Microfluidics- Introduction and Fluid Properties, Applications of MFS- Fluid Actuation Methods- Electrophoresis, Dielectrophoresis, Electrowetting, Optoelectrowetting, Electroosmosis Flow, Electrothermal Flow, Thermocapillary Effect- Microfluidic Channel- Microdispenser- Microneedle- Microfilter

UNIT V **BIOMEDICAL NANOTECHNOLOGY** **9**

Introduction to nanoscale phenomena, Nanoparticles- Nanomaterial characterization – XRD, SAXS, TEM, SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MR Imaging, Nano-devices in biomedical applications.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Chang Liu	Foundations of MEMS	Pearson Education International	2011
2.	Robert .A. Freital.Jr	Nanomedicine	Landes Bioscience Press	2010
3.	Wanjun Wang,	BioMEMs: Technologies	CRC Press	2007

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	Stephen A.Soper	and applications		
4.	Marc J. Madou	Fundamentals of microfabrication: the science of miniaturization	CRC Press	2002
5.	Robert A. Freitas	Nanomedicine, Volume IIA: Biocompatibility	Landes Bioscience	2011

WEB REFERENCE(s)

1. https://www.slideshare.net/AkshayMehta84/recent-development-in-novel-drug-delivery-biomems-a-review-ppt
2. https://www.slideshare.net/Naseemabbas6/sensors-actuators-67272785
3. https://www.slideshare.net/FelixObi/applications-of-microfluidic-systems-in-biomedical-engineering-felix-chibuzo-obi-20144610
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4719786/
5. https://swayam.gov.in/nd1_noc19_bt28

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16MDD14	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To learn discrete Fourier transform and its properties
2. To know the characteristics of IIR and FIR filters
3. To learn the design of infinite and finite impulse response filters for filtering undesired signals
4. To understand Finite word length effects
5. To study the concept of Multi-rate and adaptive filters

COURSE OUTCOMES

1. Apply DFT for the analysis of digital signals & systems
2. Design IIR and FIR filters
3. Characterize finite Word length effect on filters
4. Design the Multi-rate Filters
5. Apply Adaptive Filters to equalization

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDD14.CO1	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD14.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD14.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD14.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD14.CO5	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x

UNIT I **DISCRETE FOURIER TRANSFORM** **9**

Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms.

UNIT II **IIR FILTER DESIGN** **9**

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

UNIT III **FIR FILTER DESIGN** **9**

Structures of Finite Impulse Response Filter – Linear phase Finite Impulse Response Filter –Fourier series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling Method.

UNIT IV **FINITE WORDLENGTH EFFECTS** **9**

Fixed point and floating point number representations – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Round off noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling.

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

Multirate signal processing: Decimation, Interpolation, Cascading Sample Rate Converters , Efficient Transversal Structure for Decimator, Efficient Transversal Structure for Interpolator – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization – Subband Coding - Channel Vocoders

LIST OF EXPERIMENTS

Linear and Circular Convolutions

Spectrum Analysis using DFT

F-filter design

Linear and Circular Convolutions

DSP Processor Based Implementation

5. Study of architecture of Digital Signal Processor
6. Convolution
7. FFT Implementation

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8. Waveform generation
9. Implementation of Filter Design
10. Mini Project

Total: 30 Hrs

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	John G. Proakis & Dimitris G.Manolakis	Digital Signal Processing Principles Algorithms & Applications	Pearson Education / Prentice Hall	Fourth Edition, 2007
2.	Emmanuel C..Ifeachor, & Barrie.W.Jervis	Digital Signal Processing	Pearson Education, Prentice Hall	Second Edition, 2002
3.	B.P.Lathi, ZhiDing. Sanjit K. Mitra	Digital Signal Processing, A Computer Based Approach	Tata Mc Graw Hill	2007
4.	A.V.Oppenheim, R.W. Schafer and J.R. Buck	Discrete-Time Signal Processing	Pearson	8th Indian Reprint, 2004.
5.	Andreas Antoniou	Digital Signal Processing, Tata Mc Graw Hill, 2006.	Prentice-Hall	4th Edition,2001

WEB REFERENCE(s)

1. www.nptel.ac.in/courses/117102060/
2. www.nptel.ac.in/courses/108105055/
3. www.nptelvideos.in/2012/12/digital-signal-processing.html
4. www.nptelvideos.in/2012/11/digital-signal-processing.html
5. www.youtube.com/watch?v=6dFnpz_AEyA

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16MDD15 **EMBEDDED SYSTEM**

L	T	P	C
3	0	2	4

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
16MDD15.CO1	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD15.CO2	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD15.CO3	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD15.CO4	x	x	x	x	x	-	-	-	x	-	-	x	x	x	x
16MDD15.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.

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

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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

Total: 30 Hrs

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Raj Kamal,	Embedded Systems Architecture programming and Design	TMH	Second Edition, 2011
2.	Prasad.K.V.K.K,	Embedded Real-Time Systems: Concepts, Design & Programming	Dream tech press	2011
3.	Wayne Wolf	Computers as Components - Principles of Embedded Computing System Design	Morgan Kaufman Publishers	Third Edition 2013
4.	Steve Furber,	ARM System on Chip Architecture	Addison-Wesley Professional	Second Edition, 2000
5.	Andrew N.Sloss, Dominic Symes, Chris Wright	ARM System Developer's Guide Designing and Optimizing System Software	Morgan Kaufmann Publishers, Elsevier	2004

WEB REFERENCE(s)

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

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16MDD17 **DIGITAL IMAGE PROCESSING**

L	T	P	C
3	0	0	3

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
16MDD17.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD17.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD17.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD17.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD17.CO5	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.

REFERENCE BOOK

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

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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
5.	Willliam K Pratt	Digital Image Processing	Tata McGraw Hill	2002

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1. www.youtube.com/watch?v=CVV0TvNK6pk
2. www.youtube.com/wa
3. www.youtube.com/watch?v=gIQ6S8U6Vpc
4. www.youtube.com/watch?v=IcBzsP-fvPo
5. www.youtube.com/watch?v=IcBzsP-fvPo

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16MDD18 **MEDICAL IMAGING TECHNIQUES**

L	T	P	C
3	0	0	3

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
16MDD18.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDD18.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD18.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD18.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDD18.CO5	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 edition	Wiley India Pvt Ltd, New Delhi	2015

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4.	Joseph J. Carr John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2004
5.	Paul Suetens	Fundamentals of Medical Imaging	Pearson Education	2009

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1. https://www.slideshare.net/Aprnaa/medical-imaging-techniques
2. https://www.slideshare.net/brucelee55/radioisotope-imaging-equipment
3. https://www.slideshare.net/sandeepgupta0491/nuclear-magnetic-resonance-39763597
4. http://www.cse.iitm.ac.in/~vplab/courses/optimization/MAths_IM_DEBLUR_ENH_SD_EDT_2016.pdf
5. https://www.slideshare.net/VictorEkpo2/the-role-of-computers-in-medical-physics

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16MDE01	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
16MDE01.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE01.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE01.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE01.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE01.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 interactions: FRET, FCCS and BiFC - Atomic Force Microscopy - Dynamics methods: photo-bleaching and activation – 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.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Skoog, D.A., Crouch, S.R., and Holler, F.J	Principles of Instrumental Analysis	6th edition, Brooks/Cole, USA	2006

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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
4.	Leslie Cromwell, Fred. J. Weibel, Erich.A.Pferffer	Biomedical Instrumentation and Measurements	Prentice Hall India, NewDelhi	2001
5.	Rangaraj.M.Rangayyan	Biomedical Signal Analysis-A Case Study Approach	IEEE Press-John Wiley&Sons Inc, New York	2002

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

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16MDE02 **BIO SIGNAL PROCESSING**

L	T	P	C
3	0	0	3

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 a 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
16MDE02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE02.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE02.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE02.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE02.CO5	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.

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
3.	Willis J.Tompkins	Biomedical Digital Signal Processing	PHI	1993
4.	Akay.M	Biomedical Signal Processing	Academic: Press	1994

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5.				

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

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16MDE03 **BIO-MATERIALS AND ARTIFICIAL ORGANS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE03.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE03.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE03.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE03.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE03.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **STRUCTURE OF BIO-MATERIALS** **9**

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

UNIT II **IMPLANT MATERIALS** **9**

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

UNIT III **POLYMERIC MATERIALS** **9**

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

UNIT IV **TISSUE REPLACEMENT MATERIALS** **9**

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

UNIT V **ARTIFICIAL ORGANS** **9**

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

REFERENCE BOOK

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

	Blanchard			

WEB REFERENCE(s)

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

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16MDE04 **BIO MEDICAL ENGINEERING**

L	T	P	C
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COURSE OBJECTIVES

1. To Understand the Human physiology and components of biomedical system
2. To get exposed to electro physiological parameter measurements
3. To get exposed to non-electro physiological parameter measurements
4. To know about medical imaging and biotelemetry systems
5. To Understand the principle of operation of Therapeutic equipments

COURSE OUTCOMES

1. Basic knowledge on Human physiology and components of biomedical system
2. Exposure to electro physiological parameter measurements
3. Exposure to non - electro physiological parameter measurements
4. Knowledge of medical imaging and biotelemetry systems
5. Description on the principles of operation of Therapeutic equipments

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE04.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE04.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE04.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE04.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE04.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **PHYSIOLOGY AND TRANSDUCERS** **9**

Cell and its structure - Resting and Action Potential - Nervous system: Functional organization of the nervous system - Structure of nervous system, neurons - synapse - transmitters and neural communication - Cardiovascular system - respiratory system , Basic components of a biomedical system .Transducers - selection criteria – Piezo electric, ultrasonic transducers ,Temperature measurements , Fibre optic temperature sensors.

UNIT II **ELECTRO – PHYSIOLOGICAL MEASUREMENTS** **9**

Electrodes - Limb electrodes-floating electrodes - pregelled disposable electrodes - micro- needle and surface electrodes - Amplifiers: Preamplifiers- differential amplifiers- chopper amplifiers -Isolation amplifier. Physiological measurements-ECG, EEG, EMG, ERG - Lead systems and recording methods-Typical waveforms. Electrical safety in medical environment: shock hazards-leakage current.

UNIT III **NON-ELECTRICAL PARAMETER MEASUREMENTS** **9**

Measurement of blood pressure -Cardiac output -Heart rate-Heart sounds-Pulmonary function measurements – spirometer -Photo Plethysmography- Body Plethysmography-Blood Gas analyzers - pH of blood -measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT IV **MEDICAL IMAGING AND BIOTELEMETRY** **9**

Radio graphic and fluoroscopic techniques -Computer tomography-Magnetic Resonance Imaging - Ultrasonography-A mode,B mode ,M mode- Endoscopy-Thermography-Different types of biotelemetry systems and patient monitoring-Wireless Telemetry,single channel,multi channel,multi patient and implantable telemetry systems.

UNIT V **ASSISTING AND THERAPEUTIC EQUIPMENTS** **9**

Pacemakers-External and internal pacemakers-Defibrillators-DC defibrillator, implantable defibrillators-Ventilators - Nerve and muscle stimulators -TENS-Surgical diathermy machine, safety aspects in Electro surgical units- Heart Lung machine- Audiometers-Dialysers-Lithotripsy.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	R.S.Khandpur	Hand Book of Bio-Medical instrumentation	Tata McGraw Hill Publishing Co Ltd	2004
2.	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer	Bio-Medical Instrumentation and Measurements	Pearson Education	2nd edition, 2002

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3.	M.Arumugam	Bio-Medical Instrumentation	Anuradha Agencies	2003.
4.	L.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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2. www.nptel.ac.in/courses/108102041/
3. www.nptel.ac.in/courses/103105054/
4. www.technicalsymposium.com/alllecturenotes_biomed.html
5. www.nptelvideos.in/2012/11/biochemical-engineering.html

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16MDE05 **BIOMATERIALS & CHARACTERIZATION**

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COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Know the basic knowledge of biomaterials.
2. Identify significant gap required to overcome challenges and further development in metallic and ceramic 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
16MDE05.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE05.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE05.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE05.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE05.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
1.	Hench L.L. Ethridge E.C.	Biomaterials, An interfacial Approach	Academic Press,	1982
2.	Bronzins J.D	The Biomedical Engineering Hand book	CRC Press	1995
3.	John G.Webster, Bols	Encylopedia of Medical Devices and Instruments. I-IV		
4.	J.B. Park	Biomaterials-An Introduction		
5.	L.Hench and E.G.Erhridge	Biomaterials an Interfacial approach		

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2. https://onlinelibrary.wiley.com/doi/abs/10.1002/jbm.820190515
3. https://theeye.eu/public/Books/BioMed/Encyclopedia%20of%20Medical%20Devices%20and%20Instrumentation%202e%20Vol%201%20All-Bra%20%28Wiley%202006%29.pdf
4. http://www.unhas.ac.id/tahir/BAHAN-KULIAH/BIO-MEDICAL/NEW/HANBOOK/13_Bioceramics.pdf
5. https://2019.febscongress.org/abstract_preview.aspx?idAbstractEnc=44241700940980930940944241 70

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16MDE06 **BODY AREA NETWORKS**

L	T	P	C
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COURSE OBJECTIVES

1. To learn about body area networks.
2. To study the different types of hardwares related to it.
3. To gain knowledge in the BAN communications.
4. To analysis about the coexistence issues with BAN.
5. To provide knowledge in the applications of Body Area Networks

COURSE OUTCOMES

1. Explain about working of Body Area Network.
2. Know the types of hardwares.
3. Knowledge about the BAN communication.
4. Analysis about the issues in BAN.
5. Discuss the applications of BAN.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE06.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE06.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE06.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE06.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE06.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

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

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture – Introduction

UNIT II **HARDWARE FOR BAN** **9**

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III **WIRELESS COMMUNICATION AND NETWORK PROTOCOLS** **9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee

UNIT IV **COEXISTENCE ISSUES WITH BAN** **9**

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self protection-Bacterial attacks, Virus infection , Secured protocols, Self protection.

UNIT V **APPLICATIONS OF BAN** **9**

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Annalisa Bonfiglio, Danilo De Rossi	Wearable Monitoring Systems(UNIT I,II,III,V)	Springer	2011
2.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkatasubramanian	Body Area Networks Safety, Security, and Sustainability (UNIT IV)	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	Pan Stanford Publishing	2012

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		Applications	Pvt.Ltd Singapore,	
5.	Guang-Zhong Yang(Ed.),	Body Sensor Networks	Springer	2006

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2. https://ionlarqss.firebaseapp.com/aa620/body-area-networks-by-sandeep-k-s-gupta-tridib-mukherjee-krishna-kumar-venkatasubramanian-b00bm4titm.pdf.
3. https://research.monash.edu/en/publications/wireless-body-area-vetworks-technology-implementation-and-applica.
4. http://www.panstanford.com/pdf/9789814241571fm.pdf
5. http://cdn.intechopen.com/pdfs/9103/InTechWireless_body_area_network_wban_for_medical_applications.pdf.

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16MDE07 **BRAIN COMPUTER INTERFACE AND APPLICATIONS**

L	T	P	C
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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
16MDE07.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE07.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE07.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE07.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE07.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **BASIC NEUROSCIENCES**

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**

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**

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**

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**

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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Rajesh P. N. Rao	Brain-Computer Interfacing: An	Cambridge	Latest Edition

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		Introduction (1st Edition)	University Press	
2.	Bernhard Graimann (Editor), Brendan Z. Allison (Editor), GertPfurtscheller (Editor)	Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction	The Frontiers Collection - Hardcover	Latest Edition
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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2. https://sccn.ucsd.edu/wiki/Introduction_To_Modern_Brain-Computer_Interface_Design
3. https://www.udemy.com/brain-computer-interface/
4. https://towardsdatascience.com/a-beginners-guide-to-brain-computer-interface-and-convolutional-neural-networks-9f35bd4af948
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3497935/

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16MDE08 **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
16MDE08.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE08.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE08.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE08.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE08.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.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Tuan Vo Dirh	Biomedical Photonics	CRC Press	2014
2.	Paras N. Prasad	Introduction to Biophotonics	A. John Wiley and Sons, Inc. Publications	2003
3.	Markolf H.Niemz	Laser-Tissue Interaction Fundamentals and Applications	Springer	2007
4.	G.David Baxter	Therapeutic Lasers— Theory	Churchill	2001

		and practice	Livingstone publications	
5.	Leon Goldman, M.D & R.James Rockwell	Lasers in Medicine	Gordon and Breach, Science Publishers Inc	1975

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

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16MDE09 **SOFT COMPUTING**

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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
16MDE09.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE09.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE09.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE09.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE09.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

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

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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3. http://nptel.ac.in/courses/106106126/15
4. http://nptel.ac.in/courses/108104049/27
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16MDE10 **INTELLECTUAL PROPERTY RIGHTS**

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3	0	0	3

COURSE OBJECTIVES

1. To give an idea about IPR Introduction
2. To give an idea about IPR, registration.
3. To give an idea about IPR agreements & Legislations.
4. To give an idea about IPR, digital products & law.
5. To give an idea about IPR and its enforcement.

COURSE OUTCOMES

1. Knowledge about IPR
2. Know about IPR registration
3. Know about IPR agreements & Legislations
4. Learn about IPR, digital products & law.
5. Learn about IPR and its enforcement.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE10.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE10.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE10.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE10.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE10.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION** 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II **REGISTRATION OF IPRs** 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III **AGREEMENTS AND LEGISLATIONS** 9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV **DIGITAL PRODUCTS AND LAW** 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V **ENFORCEMENT OF IPRs** 9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	V. Scople Vinod	Managing Intellectual Property	Prentice Hall of India pvt Ltd	2012
2.	khushdeep dharni and neeraj pandey	Intellectual Property Rights	Prentice Hall of India pvt Ltd	Latest Edition
3.	Deborah E. Bouchoux,	"Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets",	Cengage Learning, Third Edition,	2012.
4.	Prabuddha Ganguli	Intellectual Property Rights:	McGraw Hill Education,	2011.

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		Unleashing the Knowledge Economy".		
5.	Derek Bosworth and Elizabeth Webster	The Management of Intellectual Property	Edward Elgar Publishing Ltd	2013.

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2. http://www.ipindia.nic.in/
3. https://www.itu.int/en/ITU-T/ipr/Pages/default.aspx
4. https://www.bits-pilani.ac.in/uploads/Patent_ManualOct_25th_07.pdf
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16MDE11 **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
16MDE11.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE11.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE11.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE11.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE11.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

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

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

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3.	Endarle, Blanchard & Bronzino	Introduction to Biomedical Engg	Academic press	2012
4.	Suresh.R.Devasahayam	Signals & Systems in Biomedical Engineering	Kluwer Academic/ Plenum Publishers.	2007
5.	V.Z. Marmarelis	Advanced methods of physiological modeling	Plenum Press	2008

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16MDE12	SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. Understand the global trends and development methodologies of various types of products and services
2. Conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. Understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
4. Understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. Gain knowledge of the Innovation & Product Development process in the Business

COURSE OUTCOMES

1. Define, formulate and analyze a problem
2. Solve specific problems independently or as part of a team
3. Develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer
4. Work independently as well as in teams
5. Manage a project from start to finish

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE12.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE12.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE12.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE12.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE12.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **FUNDAMENTALS OF PRODUCT DEVELOPMENT** **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management

UNIT II **REQUIREMENTS AND SYSTEM DESIGN** **9**

Requirement Engineering - Types of Requirements - Requirement Engineering - Traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design

UNIT III **DESIGN AND TESTING** **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV **SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL)SUPPORT** **9**

Introduction to Product verification processes and stages - Introduction to Product validation processes and stages - Product Testing standards and Certification - Product Documentation - Sustenance - Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management - Configuration Management - EoL Disposal

UNIT V **BUSINESS DYNAMICS ENGINEERING SERVICES INDUSTRY** **9**

The Industry - Engineering Services Industry - Product development in Industry versus Academia - The IPD Essentials - Introduction to vertical specific product development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and S/W systems – Product development Trade-offs - Intellectual Property Rights and Confidentiality - Security and configuration management.

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Karl T Ulrich and Stephen D Eppinger,	Product Design and Development	TataMcGraw Hill, Fifth Edition,	2011
2.	John W Newstorm and Keith Davis,	Organizational Behavior	TataMcGraw Hill, Eleventh Edition,	**2005**
3.	Hiriyappa B,	Corporate Strategy – Managing the Business",	Authorhouse, USA	2013
4.	Peter F Drucker,	People and Performance",	Butterworth – Heinemann [Elsevier],Oxford, UK,	2004
5.	Vinod Kumar Garg and Venkitakrishnan N K,	Enterprise Resource Planning – Conceptsand Practice	Prentice Hall India, New Delhi	2003

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3. https://pursuite-production.s3.amazonaws.com/media/cms_page_media/162/FSIPD%20OBF%20-%202012%20F0_1.pdf
4. https://www.scribd.com/document/335440776/Foundation-Skills-In-Integrated-Product-Development-by-S-Arunprasath-K-Sriram-kumar-P-Krishna-Sankar
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16MDE13 **REHABILIATION ENGINEERING** **L T P C** 3 0 0 3

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. Gain adequate knowledge about the needs of rehabilitations and its future development.
2. Gain various principle of Rehabilitation Engineering
3. Have an in depth idea about Engineering Concepts in Sensory & Motor rehabilitation. Apply the different types of Therapeutic Exercise Technique to benefit the society.
4. Design and apply different types Hearing aids, visual aids and their application in biomedical field and hence the benefit of 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
16MDE13.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE13.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE13.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE13.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE13.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **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 II **REHABILITATION TEAM** **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.

UNIT III **THERAPEUTIC EXERCISE TECHNIQUE** **9**

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.

UNIT IV **MANAGEMENT OF COMMUNICATION & VIRTUAL REALITY** **9**

Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids. Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

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).

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Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Sunder	Textbook of Rehabilitation 2nd Edition	Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi	2007rint
2.	Joseph D. Bronzino	The Biomedical Engineering Handbook - Third edition	Pearson Education	2006
3.	Horia- Nocholai Teodorecu, L.C.Jain	Intelligent systems and technologies in rehabilitation Engineering	CRC;	2000
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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3. https://www.slideshare.net/drdsabat/orthotics-and-prosthetics-ug-lecture
4. https://www.slideshare.net/sundarganeshkandaswamy/therapeutic-exercise-physiotherapy
5. https://www.slideshare.net/kpml419/orthotics-15550568

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16MDE14 **VIRTUAL REALITY**

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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
16MDE14.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE14.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE14.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE14.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE14.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

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.

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Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	John Vince	Virtual Reality Systems	Pearson Education Asia	2007.
2.	Anand R	Augmented and Virtual Reality	Khanna Publishing House, Delhi	Latest Edition
3.	Adams	Visualizations of Virtual	Tata McGraw Hill	2000

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		Reality		
4.	Grigore C. Burdea, Philippe Coiffet	Virtual Reality Technology	Wiley Inter Science, 2nd Edition,	2006
5.	William R. Sherman, Alan B. Craig	Understanding Virtual Reality: Interface, Application and Design	Morgan Kaufmann	2008

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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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16MDE15 **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
16MDE15.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE15.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE15.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE15.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE15.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.

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Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
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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	Pan Stanford Publishing	2012

		Applications	Pvt.Ltd Singapore,	
5.	Guang-Zhong Yang(Ed.),	Body Sensor Networks	Springer	2006

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

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16MDE16 **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
16MDE16.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE16.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE16.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE16.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE16.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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things	Cisco Press,	2017
2.	Maciej Kranz	Building the Internet of	John Wiley & Sons	Latest Edition

		Things: Implement New Business Models, Disrupt		
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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2. https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet
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16MDE17 **MEDICAL EXPERT SYSTEM**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To develop informed opinions about the present and past opinion leaders in the artificial intelligence
2. To develop a simple, informal expert system in medical field.
3. To Perform an effort of knowledge engineering of a real, human expert.
4. To develop a series of Web pages that will serve as a current "state of the art" review of the various AI application areas,
5. To study the areas which may be suggested by the instructor or brought to the course by participants.

COURSE OUTCOMES

1. Explain the role of Artificial Intelligence, Expert Systems and Decision Models in managerial decision-making.
2. Learn about data structures.
3. Study the basic concepts of multimedia
4. Apply, build and modify decision models to solve real problems
5. Design and develop Artificial Intelligence Based Decision Support Systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE17.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE17.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE17.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE17.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE17.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION TO DATA STRUCTURES** **9**

Elements, arrays, records, sets, tables etc. Singly and doubly linked data, stacks, queues, trees etc. Introduction to database, data models, Relational, distributed and other types of databases, data indexing and structuring techniques: data independence, data definition language and data manipulation language. E –R diagram with examples. Relational model, structure of Relational databases, Query language, views, Examples.

UNIT II **RELATIONAL DATABASE DESIGN** **9**

Normalisation – 1NF, 2NF and 3NF. Indexing and Hashing. Security of databases. Design example on a popular RDBMS package. Miniaturized data storage and retrieval system like CD-ROM, Magneto Optical Discs, optical juke boxes, write many read many devices and miniature magnetic tape devices. Interfacing and retrieval details.

UNIT III **EXPERT SYSTEMS** **9**

Introduction – basic concepts – structure of expert systems – types of expert systems – knowledge engineering – methods & difficulties in knowledge acquisition – Search and real time search – constraint satisfaction – robot motion planning. Medical data acquisition and database systems. Visual programming concepts; Visual Basic environment, tools and controls; Dynamic data exchange; VB based Medical information System

UNIT IV **BASIC CONCEPTS OF MULTIMEDIA** **9**

Design of Multimedia information systems; Components of virtual reality; Virtual reality applications in medicine. Medical Informatics and its levels; Design and development of educational packages on medical sciences; Integrated design concepts; Interactive multimedia, Virtual and digital libraries; Internet and its applications

UNIT V **DECISION MAKING METHODS FOR BIOMEDICINE** **9**

Bayesian statistics – decision analysis – Bayesian belief networks – Markov models – Markov decision Process – Applications to speech recognition, medical diagnosis. Hospital information System its design and functional characteristics; Principles and applications of Artificial Intelligence, Pattern Recognition, Neural Network and Fuzzy Logic in Medicine

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	J. Van Bemmel, Mark A. Musen	Handbook of Medical Informatics	Springer Publications (UNITS III, IV & V)	Latest Edition
2.	Date C J	An introduction to Database Systems	Addison Wesley Publication (UNITS I, II)	Latest Edition

3.	M F Collen	Hospital Computer Systems	Addison Wesley	Latest Edition
4.	Lee	Computers in Medicine	Mc Graw Hill	Latest Edition
5.	H Dominic Covvey et al	Computer in the practice of, medicine	Addison Wesley	Latest Edition

WEB REFERENCE(s)

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2. https://link.springer.com/article/10.1007/BF02718262
3. https://pdfs.semanticscholar.org/48b7/a833992e9f5117614c9eb808942c614e2328.pdf
4. https://worldwidescience.org/topicpages/m/medical+expert+systems.html
5. https://www.expertsystem.com/expert-system-artificial-intelligence-public-health/

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16MDE18 **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.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16MDE18.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE18.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE18.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE18.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE18.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

REFERENCE BOOK

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

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1. https://www.slideshare.net/zulfiquer732/hospital-waste-management-93579083
2. http://www.ihatepsm.com/blog/hospital-waste-management-bio-%E2%80%93-medical-waste-management
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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16MDE19 **TELE HEALTH 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
16MDE19.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE19.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE19.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE19.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE19.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I **INTRODUCTION** **7**

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

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** **11**

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

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

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

REFERENCE BOOK

Sl.No	AUTHOR(s)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Robert E. Hoyt and Ann K. Yoshihashi	Lasers and Optical Fibers in Medicine	Health Informatics: Practical Guide for Healthcare and Information Technology Professionals (Sixth Edition)	Latest Edition
2.	Phillip Olla.	Mobile Health Solutions for Biomedical	Hershey, Pa. : Information Science Reference, c	2009

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		Applications		
3.	I stepanian, Robert, Laxminarayan, Swamy, Pattichis, Constantinos	M-Health- Emerging Mobile Health Systems	Springer Publications	2006
4.	SasanAdibi	Mobile Health: A Technology Road Map	Springer Publication	Mar 2015
5.	Norris, A.C.	Essentials of Telemedicine and Telecare	Wiley	2002

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

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16MDE20 **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
16MDE20.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16MDE20.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE20.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE20.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16MDE20.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**

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.

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	Latest Edition
2.	John Crisp	Introduction to fiber optics	Mc Graw Hill, 2nd Edition	2001

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3.	G.DavidBaxterr Churchill Livingstone	Therapeutic Lasers - Theory and practice	Addison Wesley	Latest Edition

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