INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Marching Beyond 30 Years Successfully
INSTITUTION WITH UGC 12B STATUS

SCHOOL OF ENGINEERING

Department of Biomedical Engineering

6th BOARD OF STUDIES – MINUTES OF MEETING

Venue

Biosciences Laboratory

APJ Abdul Kalam Block,

Vels Institute of Science, Technology and Advanced Studies,

Date & Time

16.06.2022 & 10.00 AM

VELS
INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
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Date: 16.06.2022

MINUTES OF MEETING OF 6th BOARD OF STUDIES
DEPARTMENT OF BIOMEDICAL ENGINEERING

The meeting of the Board of Studies in School of Engineering of the Department of Biomedical Engineering was held on 16.06.2022 at 10 A.M in the Biosciences Laboratory, APJ Abdul Kalam block Room No. 102 **to discuss the revision of UG Program Curriculum & Syllabi** of B.E.BIOMEDICAL ENGINEERING for the regulation 2022 which to be followed from the academic year 2022-2023.

The following members were present for the BoS meeting

S.No	Name & Designation	Address	Role
1	Dr.R.J. Hemalatha Associate Professor and Head	Department of Biomedical Engineering,VISTAS	HOD & Chairperson
2	Dr.Varshini Karthick Professor & Head	SRM Institute of Science and Technology	Academic Expert (External Member)
3	Dr. K. Venkatraman Managing Partner	Biovision Medical Systems, Chennai.	Industry Expert (External Member)
4	Ms.T.R. Thamizhvani Assistant Professor	Department of Biomedical Engineering,VISTAS	Internal Member
5	Ms.A.Josephin Arockia Dhivya Assisatant Professor	Department of Biomedical Engineering,VISTAS	Internal Member
6	Ms.Syed Uzma Farheen	Sales and Solutions Developer, Laerdal Medical India Pvt Ltd, Chennai.	Alumni Member

AGENDA OF THE MEETING

Item No.	Particulars
BoS / 2022 / BME/ UG / 6.1	Review and confirm minutes of 6th BOS meeting for Regulation 2022 held on 16.06.2022
BoS / 2022 / BME/ UG / 6.2	Review the curriculum based on Choice Based Credit System (CBCS) and Outcome based Education (OBE).
BoS / 2022 / BME/ UG / 6.3	To review Revision for new syllabus for B.E Biomedical Engineering for regulation 2022
BoS / 2022 / BME/ UG / 6.4	To review the feedback from stakeholders to ensure that the syllabus of the course include skill development, employability, and entrepreneurship
BoS / 2022 / BME/ UG / 6.5	To review the AICTE Policy, for CBCS and OBE curriculum.

MINUTES OF MEETING

Dr. R.J.Hemalatha, Associate Professor and HoD, Biomedical Engineering, Chairman, BoS initiated the meeting with a warm welcome and introduced the external members, the internal and co-opted members, and thanked them for accepting the invitation to the 6th BoS meeting.

Item No:1 BoS/2022/BME/UG/6.1

The first BoS Meeting for B.E. Biomedical Engineering under regulation 2022 was held on 16-06- 2022 and confirmed the following points

- To implement the guidelines of AICTE and the principles of Outcome-Based Education (OBE)/Learning Outcome Based Curriculum Framework (LOCF)and suggestions of the new education policy
- Syllabi for the Open Elective offered by the Biomedical Engineering Department
- Value Added Courses for First- and Second-Year Students
- Admission Details
- Department Vision and mission in line with the Institute's vision and Mission

Minutes are Reviewed and Confirmed

Item No :BoS / 2022 / BME/ UG / 6.2

- To develop the curriculum and syllabi based on the guidelines of Choice Based Credit System(CBCS) and Outcome based Education Curriculum (OBE) shown in annexures.

Item No :BoS / 2022 / BME/ UG / 6.3

Objective of the Revision for the new syllabus

- To develop the curriculum and syllabi based on the guidelines of AICTE and the principles of Outcome-Based Education (OBE)/Learning Outcome Based Curriculum Framework (LOCF).
- To implement the guidelines and suggestions of the new education policy and meet the needs of society in the field of healthcare as Biomedical Engineers.
- To consider the Competencies and Performance Indicators of the B.E. Biomedical Engineering program defined as per the recommendations of the AICTE Examination Reforms Policy.
- To enhance the Course Outcomes (CO) of all the courses by focusing on skill development, employability, entrepreneurship, and social needs of the medical environment.
- To consider the mapping of CO to the Program Outcomes (PO) and Programme Specific Outcomes (PSO) of all the courses using the defined Competencies and Performance Indicators to enhance the ability of Biomedical Engineers.

- % of Syllabus Revision in the Program
- B.E Biomedical Engineering – 25.4%

S. No.	Available Course		Revised Course		% of Syllabus Revised
	Code	Name	Code	Name	
1	18CBBM11	Mathematics-I (Calculus and Linear Algebra)	22CBBM13	Mathematics-I (Calculus and Linear Algebra)	42
2	18PBBM11	ENGLISH LABORATORY	22PBBM11	ENGINEERING PRACTICAL - ENGLISH	81
3	18PBBM12	PHYSICS LABORATORY	22PBBM12	ENGINEERING PRACTICAL - PHYSICS	75
4	18PBBM21	CHEMISTRY LABORATORY	22GCCE21	ENGINEERING PRACTICAL - CHEMISTRY	47
5	18CBBM21	Mathematics -II (Probability and Statistics)	22MAGE21	Mathematics -II (Probability and Statistics)	26
6	18PBBM23	WORKSHOP/MANUFACTURING PRACTICES	22CBBM23	WORKSHOP AND MANUFACTURING PRACTICES	28
7	18PBBM31	Anatomy and Physiology Laboratory	22PBBM31	Human Anatomy and Physiology Laboratory	26
8	18CBBM36	Biomechanics and Biofluids	22CBBM44	Biomaterials and Biomechanics	32
9	18CBBM44	Biomaterials and Artificial Organs	22CBBM44	Biomaterials and Biomechanics	26
10	18CBBM43	Microprocessor and Microcontroller	22CBBMXX	Microprocessor and Microcontroller	56
11	18PBBM42	Microprocessor and Microcontroller Laboratory	22PBBMXX	Microprocessor and Microcontroller Laboratory	40
12	18CBBM52	Biosignal Processing	22CBBMXX	Biosignal Processing	38
13	18PBBM51	Diagnostic Instrumentation Laboratory	22PBBM51	Diagnostic Instrumentation Laboratory	55
14	18PBBM61	Therapeutic Equipments Laboratory	22PBBM61	Therapeutic Equipments Laboratory	53

	NEW COURSES INTRODUCED
1	Biochemistry (Blended)
2	Biomaterials and Biomechanics
3	Internet of Medical Things
4	Gender Culture and Technology
5	Troubleshooting of Medical Equipment's
6	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/Coursera/ Mathworks) - Minimum 4 weeks

7	Summer Internship (4 weeks)
8	Medical imaging techniques
9	Advanced Medical imaging laboratory
10	Biosimulation Laboratory
11	Regulatory aspects in bioscience
12	Basics of Biomedical Engineers
13	Artificial Intelligence and Deep learning
14	Real-time signal Acquisition and Analysis
15	Principles of 3D printing technology
16	Robotics in medicine (blended)
17	Pattern recognition and neural networks (Blended)
18	Basics of Civil and Mechanical Engineering
19	Electronics in healthcare industry
20	Analog and Digital Communciation (blended)
21	Analog and Digital Integrated circuits

Item No:BoS / 2022 / BME/ UG / 6.4

Feedback from Stakeholders

S. No	Name & Designation	Comments	Role
1	**Dr. Varshini Karthick** Professor & Head, Department of Biomedical Engineering, SRM Institute of Science and Technology	The curriculum and syllabi have been framed according to the current trends and industrial requirements. Inclusions have been suggested and done	Academic Expert
2	**Mr. K.Venkatraman** Managing partner, Biovision Medical Systems, Chennai.	The curriculum and syllabus well designed to enhance skills and employability	Industrial Expert
3	**Ms.Syed Uzma Farheen** Sales and Solutions Developer, Laerdal Medical India Pvt Ltd, Chennai.	The curriculum has been framed to meet the market needs of the Biomedical Engineer	Alumni

Minutes are Reviewed and Confirmed

Item No BoS / 2022 / BME/ UG / 6.5

AICTE Examination Reforms Policy, effective from the Academic Year 2022-2023 be approved.

Resolved that the Competencies and Performance Indicators defined for the PO and PSO's of the B.E. Biomedical Engineering programme as per the recommendations of the AICTE Examination Reforms Policy, effective from the Academic Year 2022-2023 be approved.

Resolved that the Curriculum & Syllabus for the (Regulation 2022), designed as per the Learning outcome-based curriculum framework (LOCF) guidelines of UGC and Model Curriculum of AICTE, effective from the Academic Year 2022-2023 be approved.

Resolved that the Course Outcomes (CO) that are defined by focusing on skill development, employability and entrepreneurship, effective from the Academic Year 2022-2023 be approved

Resolved that the Course Outcome (CO) – Programme Outcome (PO) and Programme Specific Outcome (PSO) Mapping (CO-PO/PSO Mapping) done in accordance with the defined Competencies and Performance Indicators, effective from the Academic Year 2022-2023 be approved.

Minutes are Reviewed and Confirmed

New Curriculum & Syllabi of UG programme courses focused on Activities / content with direct on Employability / Competency / Entrepreneurship / skill development / cross cutting Issues /Interdisciplinary enclosed in Annexures

Signature of the Members:

External Member
Academic Expert

1. Dr.Varshini Karthick
Professor & Head
SRM Institute of Science and Technology
Internal Member

External Member
Industrial Expert

2. Dr. K. Venkatraman
Managing Partner
Biovision Medical Systems, Chennai.
Internal Member

Chairperson

3. Dr.R.J. Hemalatha
Associate Professor and Head
Department of Biomedical Engineering

Alumni Member

4. Ms.T.R. Thamizhvani
Assistant Professor
Department of Biomedical Engineering,VISTAS

5. Ms.A.Josephin Arockia Dhivya
Assisatant Professor
Department of Biomedical Engineering,VISTAS

6. Ms.Syed Uzma Farheen
Sales and Solutions Developer, Laerdal Medical India Pvt Ltd, Chennai.
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B.E
Biomedical
Engineering

Curriculum and Syllabus

Effective from the Academic year
2022 - 2023

Department of Biomedical Engineering
School of Engineering

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

B.E. BIOMEDICAL ENGINEERING DEGREE COURSE

COURSES OF STUDY AND SCHEME OF ASSESSMENT

(MINIMUM CREDITS TO BE EARNED: 170)

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
		SEMESTER I						
HSC	English	2	-	-	2	40	60	100
BSC	Physics	3	-	-	3	40	60	100
BSC	Mathematics II	3	1	-	4	40	60	100
ESC	Basic Electrical and Electronics Engineering	3	-	-	3	40	60	100
ESC (Blended)	Engineering Graphics and Design	1	-	4	3	40	60	100
HSC	English Laboratory	-	-	2	1	40	60	100
BSC	Physics Laboratory	-	-	2	1	40	60	100
ESC	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1	40	60	100
MC	Constitution of India	**2**	-	-	-			100
MC	Student Induction Program	-	-	-	-	-	-	-
		14	**1**	**10**	**18**			
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
		SEMESTER II						
BSC	Chemistry	3	-	-	3	40	60	100
BSC	Mathematics I	3	1	-	4	40	60	100
ESC	Programming for Problem Solving	3	-	-	3	40	60	100
ESC	Basics of Civil and Mechanical Engineering	3	-	-	3	40	60	100
ESC (Blended)	Workshop and Manufacturing Practices	1	-	4	3	40	60	100
BSC	Chemistry Laboratory	-	-	2	1	40	60	100
ESC	Programming for Problem Solving Laboratory	-	-	2	1	40	60	100
MC	Universal Human Values - 2	2	-	-	-			100
		15	**1**	**8**	**18**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER III							
BSC	Mathematics III	3	1	-	4	40	60	100
ESC	Electronic Devices and Circuits	3	-	-	3	40	60	100
PCC	Human Anatomy and Physiology	3	-	-	3	40	60	100
PCC	Bioinstrumentation and measurements	3	-	-	3	40	60	100
PCC (Blended)	Biochemistry	3	-	2	4	40	60	100
PCC (Practical)	Human Anatomy and Physiology Laboratory	-	-	2	1	40	60	100
PCC (Practical)	Electronic Devices and Circuits Laboratory	-	-	2	1	40	60	100
HSC	Personality Development I (Effective Technical Communication)	2	-	-	2	40	60	100
MC	Basic Life Skills	2	-	-	-			100
		19	**1**	**6**	**21**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER IV							
BSC/PCC	Biocontrol systems	3	-	-	3	40	60	100
PCC/ESC	Microprocessor and Microcontroller	3	-	-	3	40	60	100
PCC	Biosensors and Transducers	3	-	-	3	40	60	100
PCC	Biomaterials and biomechanics	3	-	-	3	40	60	100
PCC (Blended)	Internet of Medical Things	3	-	2	4	40	60	100
PCC (Practical)	Biosensors and Transducers Laboratory	-	-	2	1	40	60	100
PCC (Practical)	Microprocessor and Microcontroller Laboratory	-	-	2	1	40	60	100
HSC	Personality Development II	2	-	-	2	40	60	100
BSC	Environmental Science and Engineering	3	-	-	3	40	60	100
MC	Gender Culture and technology	2	-	-	-			100
		22	**0**	**6**	**23**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER V							
PCC	Diagnostic Instrumentation	3	-	-	3	40	60	100
PCC	Biosignal Processing	3	-	-	3	40	60	100
PEC	Professional Elective -I	3	-	-	3	40	60	100
OEC(Technical)	Open Elective -I	3	-	-	3	40	60	100
PCC (Blended)	Troubleshooting of Medical Equipments	3	-	2	4	40	60	100
PCC (Practical)	Diagnostic Instrumentation Laboratory	-	-	3	2	40	60	100
PCC (Practical)	Bio signal Processing Laboratory	-	-	2	1	40	60	100
HSC	Personality Development III	2	-	-	2	40	60	100
PCC	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/ Mathworks) - Minimum 4 weeks	-	-	4	2			100
		17	**0**	**11**	**23**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER VI							
PCC	Therapeutic Equipments	3	1	-	4	40	60	100
PCC	Medical Image Processing	3	-	-	3	40	60	100
PEC	Professional Elective -II	3	-	-	3	40	60	100
PEC (Blended)	Professional Elective -III	3	-	2	4	40	60	100
OEC(Technical)	Open Elective -II	3	-	-	3	40	60	100
PCC (Practical)	Therapeutic Equipments Laboratory	-	-	2	1	40	60	100
PCC (Practical)	Medical Image Processing Laboratory	-	-	3	2	40	60	100
HSC	Personality Development - IV	2	-	-	2	40	60	100

	Summer Internship (4 weeks)							
PCC		-	-	4	2			100
		17	**1**	**11**	**24**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER VII							
PCC	Medical Imaging techniques	3	-	-	3	40	60	100
OEC (Technical)	Open Elective -III	3	-	-	3	40	60	100
OEC (Technical/ Management)	Open Elective -IV	3	-	-	3	40	60	100
PEC	Professional Elective -IV	3	-	-	3	40	60	100
PEC (Blended)	Professional Elective -V	3	-	2	4	40	60	100
PCC (Practical)	Advanced Medical imaging laboratory	-	-	2	1	40	60	100
PCC (Practical)	Biosimulation Laboratory	-	-	3	2	40	60	100
Project	Project Phase I	-	-	10	5	40	60	100
		12	**-**	**17**	**24**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER VIII							
PEC	Professional Elective -VI	3	-	-	3	40	60	100
OEC (Technical)	Open Elective -V	3	-	-	3	40	60	100
OEC (Technical/ management)	Open Elective -VI	3	-	-	3	40	60	100
Project	Project Phase II	-	-	20	10	40	60	100
		9	**0**	**20**	**19**			

LIST OF ALL PROFESSIONAL ELECTIVE COURSES

S.NO	COURSE TITLE
	PROFESSIONAL ELECTIVE -I
1	Medical Physics
2	Analog and Digital Integrated Circuits
3	Medical Optics
4	Biology for Engineers
5	Wearable Medical Systems
	PROFESSIONAL ELECTIVE -II
6	Rehabilitation Engineering
7	Effects of Radiation and Radiation safety
8	Telehealth Technology
9	Biophotonics
10	Clinical Engineering
	PROFESSIONAL ELECTIVE -III
11	Basics of Python and MATLAB Software
12	Robotics in medicine
13	Pattern Recognition and Neural Networks
14	Pathology and Microbiology
15	Analog and Digital Communications
	PROFESSIONAL ELECTIVE -IV
16	Hospital Management
17	Neuroscience for Biomedical Applications
18	Biomems and Nanotechnology
19	Biological Effects of Radiation
20	Biometrics Systems
	PROFESSIONAL ELECTIVE -V
21	Artificial Intelligence and Deep learning
22	Virtual Instrumentation in medicine
23	Human Assist Devices
24	Principles of 3D Printing Technology
25	Real time signal Acquisition and Analysis
	PROFESSIONAL ELECTIVE -VI
26	Physiological Modelling and Simulation
27	Cryptography and Network Security
28	Regulatory Aspects in bioscience
29	Advanced Bioanalytical and Therapeutic Techniques
30	Body Area Networks

LIST OF ALL OPEN ELECTIVE COURSES

	Course
OE-T1	Fibre optics and lasers in Medicine
OE-T2	Biomedical Informatics
OE-T3	Electronics in Healthcare Industry
OE-T4	Basics of Biomedical Engineers
OE-M1	Health Policy and Equipment Management

SEMESTER III

BSC – 07 **MATHEMATICS – III** **3 1 0 4**
(NUMERICAL METHODS)

COURSE OBJECTIVE:

- Using appropriate numerical methods, determine approximate solutions to ordinary differential equations.
- Analyse the errors obtained in the numerical solution of problems.

UNIT I: Solution Of Equations And Eigenvalue Problems **12**

Solution of algebraic and transcendental equations –iteration method – Newton Raphson method – Solution of linear system of equations- Gauss elimination method –- Gauss-Jordon method–Matrix Inversion by Gauss Jordon method – Eigen value of a matrix by power method .

UNIT II : Interpolation And Approximation **12**

Interpolation with unequal intervals- Lagrange's interpolation – Newton's Divided difference interpolation– Interpolation with equal intervals- Newton's forward and backward difference formulae.

UNIT III : Numerical Differentiation And Integration **12**

Approximation of derivatives using interpolation polynomials- Numerical integration using trapezoidal and Simpson's 1/3 and 3/8 rule – Romberg's method

UNIT IV: Initial Value Problems For Ordinary Differential Equations **12**

Single step methods: Taylor series method – Euler's method-Modified Euler's method– Fourth order Runge – Kutta method for solving first order equations

UNIT V: Boundary Value Problems In Ordinary And Partial Differential Equations **12**

Finite difference methods for solving two-point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain

COURSE OUTCOME:

CO1: Apply appropriate algorithms to solve selected problems based on numerical methods
CO2: Compare different algorithms with respect to accuracy and efficiency of solution.
CO3: Appropriate numerical methods, determine the solutions to given equations.
CO4: Determine Approximate illustration for numerical equations using different methods
CO5: Demonstrate the use of numerical methods to find values in given graphical and/or tabulated data.

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science ", 9th Edition, Khanna Publishers, New Delhi, 2012.
2. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education, Asia, New Delhi, 2006.
3. Sivaramakrishna Das.P and Vijayakumari.C, Numerical Analysis, 2014, Pearson Eduaction limited in south Asia.

REFERENCE BOOKS:

1. Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 5th Edition, 2007.
2. Sankara Rao K, "Numerical Methods for Scientists and Engineers", Prentice Hall of India, New Delhi, 3rd Edition,20

ESC – 07 **ELECTRONIC DEVICES AND CIRCUITS** **3 0 0 3**

COURSE OBJECTIVE

To help the student understand the basics of the principles of circuit analysis and design

- To understand the basic concepts and characteristics of the electronic devices and circuits.
- To impart a sound knowledge about the Basic Concepts of semiconductor devices – PN Junction Diode Characteristics and Field effect Transistors.
- To impart knowledge about the design of Rectifiers and Amplifiers.
- To study and design the applications of Oscillators and its Medical Applications.

UNIT 1 SEMICONDUCTOR DIODE **9**

Intrinsic and Extrinsic semiconductor, PN junction Diode: Construction, Working and VI Characteristics, Application of diode: Diode switch, Clipper, Clamper and Voltage multipliers - Zener diode - Zener voltage regulators.

UNIT II FIELD EFFECT TRANSISTORS **9**

JFET: Construction, Operation and Characteristics, Expression for pinch off voltage and drain current, MOSFET: Enhancement mode and Depletion mode MOSFET operation and characteristics, handling precautions of MOSFET, FET as VVR - Comparison of MOSFET and JFET - Comparison of BJT and JFET**.**

UNIT III RECTIFIERS AND POWER SUPPLIES **9**

Half Wave and Full Wave Rectifier, Bridge rectifier - performance measures of rectifiers, filters: Full Wave rectifier with inductive filter, capacitive filter, LC filter, Regulators-Shunt and series voltage regulators - Performance measures of regulators - Simple power supply circuits for medical instruments.

UNIT IV MULTISTAGE AMPLIFIERS AND POWER AMPLIFIERS **9**

Introduction to multistage amplifiers, Two stage RC Coupled amplifier, Darlington emitter follower amplifier, Bootstrap amplifier Introduction, Power Amplifiers: Class A Power Amplifier, Push Pull Principle, Class B push pull amplifier and complementary symmetry amplifier, Class C amplifier, Distortion in amplifiers - Medical applications.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Effects of negative feedback, Voltage series, voltage shunt, current series and current shunt feedback amplifiers, Barkhausen Criterion for Oscillation, Construction and working of RC, Wein bridge oscillator, Hartley Oscillator, Colpitt's Oscillator, Crystal Oscillator - Medical applications.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Understand the Basics of electronic devices like diodes, transistors and amplifiers
CO2: Develop knowledge about the principles, construction, characteristics and functioning of different semiconductor devices
CO3: Determine a deep knowledge about the basic circuits in electronics
CO4: Articulate knowledge about the special behavior of various devices
CO5: Analyse and understand the design of electronic amplifiers.

TEXT / REFERENCE BOOKS

1. Robert L. Boystead and Louis Nashelky, Electronic Devices and Circuits, 8th Edition, PHI, 2005.
2. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits, PPH, 2004.
3.Millman& Halkias, Integrated Electronics, McGraw Hill International Edition. 1991
4. David A. Bell, Electronic Devices and Circuits, PHI

PCC – 01 **HUMAN ANATOMY AND PHYSIOLOGY** **3 0 0 3**

COURSE OBJECTIVES

The students will be able:

- To learn to appreciate the fascinating and ancient branch of science because it unfolds the mystery of complicated and functional aspects of individual organs of the body.
- The learning provides a solid foundation for understanding the structure and function of the human body. It also explains how body systems function to maintain homeostasis on day-to-day basis through the process of circulation, respiration, digestion, cellular metabolism, urinary functions and buffer systems.
- It is geared to preparing students for careers in health related professions.

UNIT 1 CARDIOVASCULAR SYSTEM **9**

Blood, Blood groups, Blood coagulation, structure and function of hemoglobin. Heart - Anatomy of heart; origin, conduction and regulation of heart beat, Cardiac cycle, Electrocardiogram, Blood pressure, regulation of blood pressure.

UNIT 2 DIGESTIVE AND EXCRETORY SYSTEM **9**

Overview of organs of digestive system-mouth, stomach, Small intestine, large intestine, Liver, Structure of Kidney, Physiology of urine formation, Role of the kidney in the regulation of water, salt and acid base balance.

UNIT 3 ENDOCRINE AND NERVOUS SYSTEM **9**

Endocrine System - Hormones - Pituitary Gland,Pineal Gland, Thyroid Gland, Pancreas, Adrenal Glands, Neuron, Organization of Nervous System - Brain and Spinal cord, Synapse, Reflex activity, Pain, EEG.

UNIT 4 RESPIRATORY AND SENSORY SYSTEM **9**

Physiology of Respiration, Pulmonary Function tests, Exchange and transport of gases in the Blood, Regulation of respiration.Structure of eye and ear, physiology of vision, Mechanism of hearing.

UNIT 5 BONES AND MUSCLE PHYSIOLOGY **9**

Bones - types, formation, Development and growth of bone, Axial and Appendicular Skeleton, Joints of Skeleton, Types of muscles - Skeletal, Cardiac and Smooth muscle structure. Changes during muscular contraction.Structure of neuro muscular junction.Electromyogram.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, student will be able to

CO1: Analyse the various concepts of cell tissues of human body.
CO2: Examine various parts of formation and analysis of human body.
CO3: Illustrate the basic knowledge of human anatomy and physiology.
CO4: Explain the various functions of the individual organs of the body.
CO5: Explain about the structure and function of human body.

TEXT / REFERENCE BOOKS

1. Ross and Wilson, Anatomy and Physiology in Health and Illness, Churchill Livingstone, 9th Edition.2001
2. Gerard. J. Tortora. Principles of Human Anatomy and physiology, Harper Collins College Publishers, 7th Edition.2005
3. Arthur C. Guyton & John E. Hall, Text Book of Medical Physiology, W.B.Saunders Company, London, 12th Edition.1996.
4. P. Saraswathi, Handbook of Anatomy for Nurses Jaypee Brothers Medical Publishers (P) Ltd, 1st Edition.2014.
5. K Sembulingam and Prema Sembulingam, Essentials of Medical Physiology, Jaypee Brothers Medical Publishers P Ltd., 2nd Edition, 2001.

PCC – 02 **BIOINSTRUMENTATION AND MEASUREMENTS** **3 0 0 3**

COURSE OBJECTIVES

The students will be able to learn:

- The purpose of learning the course onIntegrated circuit design for bioinstrumentation for biomedical engineering students is to enable the students to understand the fundamentals of linear integrated circuits and to implement and study in relation to the various medical related applications
- To study the static and dynamic behavior of analog and digital instruments and basic construction and working of AC and DC instruments for measurement of Voltage and Current.
- To obtain basic knowledge of digital instruments for measurement of voltage and current.
- To study signal generator and signal analysis. Also to study the different output devices analog and digital recorders.

UNIT 1 INTRODUCTION **9**

Function elements of measuring instrument, Error in Measurement, Sources of Error, Static Characteristics: Accuracy, Sensitivity, Reproducibility, Drift, Static error types and Dead zone, Dynamic Characteristics: Speed of Response, Fidelity, Lag and Dynamic Error, Dynamic response of different order systems.

UNIT 2 BASICS OF ANALOG INSTRUMENTS **9**

D'arsonval Galvanometer, Moving coil Instruments: Permanent magnet moving coil instrument, PMMC ammeter and PMMC voltmeter, Ohmmeter: Shunt type and Series type.Basic Electrodynamomter type instrument, Electrodynamometer type Ammeter and Electrodynamometer type voltmeter - Construction and working principle-Wheatstone's Bridge-Kirchoff's Law.

UNIT 3 BASICS OF DIGITAL INSTRUMENTS **9**

Basic building block of a digital instrument, Ramp type digital voltmeter, Digital frequency meter, Digital phase meter and Digital storage oscilloscope, Comparison between analog and digital instruments.

UNIT 4 SIGNAL GENERATION AND SIGNAL ANALYSIS **9**

Standard signal generator, AF Sine and square wave generator, Function generator, RF generator, Basic Wave Analyzer, Heterodyne wave analyzer Spectrum analyzer and Harmonic distortion analyzer.

UNIT 5 DISPLAY DEVICES AND RECORDERS **9**

Digital Display System and Indicators: Classification of display devices, DOT MATRIX display, LED Seven Segment display, LED matric display, LCD seven segment display, Recorders: Graphic Recorders - Strip chart recorders, Galvanometer type recorders and Self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1: Explain the introduction and characteristics of instruments.
CO2: Illustrate the basic working of Analog instruments and digital instrumenmts.
CO3: Examine the basic characteristics of digital instruments uses and its advantages.
CO4: Explain the working of devices and its applications.
CO5: Explain the techniques of differentiating the analog and digital equipments.

TEXT / REFERENCE BOOKS

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai sons, 1991.
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995
3. W.D cooper and A. D. Helfrick, Electronic Instruments and Measurements Techniques, Prentice Hall of India-1991
4. E. O. Doeblin, Measurement System - Application & Design, Mc Graw Hill, 1990

PCC – 03 **BIOCHEMISTRY (BLENDED LEARNING)** **3 0 2 4**

COURSE OBJECTIVE

The students will be able to

- Understand the insight into the chemical aspects of biological macromolecules and their importance
- Analyze the basics of biochemistry, i.e, synthesis and carbohydrates, lipids etc
- Understand the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzymes

UNIT 1 CARBOHYDRATES **9**

Introduction.Classification, Properties and Biological importance.Isomers, epimers, enantiomers, mutarotation, open chain and closed chain structures of glucose.

UNIT 2 AMINOACIDS AND PROTEINS **9**

Aminoacids: classification- essential and non-essential amino acids, protein and non-protein amino acids, Zwitter ions. Proteins: Classification- based on i) shape and solubility and ii) increasing complexity of structure. Structure of proteins: primary, secondary, tertiary and quaternary, biological significance. Concept of isoelectric point and its significance.

UNIT 3 LIPIDS **9**

Introduction, Classification, Properties and Biological importance. Fatty acid nomenclature and structure, Lipids in cell membrane Cholesterol and Steroids, Hormones - structure and function.

UNIT 4 NUCLEIC ACIDS **9**Introduction-

Nitrogeneous bases - Purines and Pyrimidines - Nucleosides and Nucleotides -- Structure of nucleic acids - DNA, RNA: m-RNA, t-RNA, r-RNA - Biological importance of nucleic acids. 16s rRNA and its significance.

UNIT 5 VITAMINS AND MINERALS **9**

Vitamins: fat soluble and water soluble vitamins. Minerals: Micro and Macro minerals. Biological importance of vitamin and minerals, deficiency symptoms

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the student will learn the:

CO1: Explain the chemical aspects of classification of biological molecules in a human body.
CO2: Illustrate the basic concepts principles of various fields of chemistry and biology
CO3: Examine the properties of common biochemical products
CO4: Explain the deficiencies and reactions of biochemical compounds
CO5: Examine the significance of biochemical compounds and its properties.

PRACTICAL:

1. Analysis of Carbohydrates tests
2. Analysis of Protein tests
3. Analysis of Lipid tests
4. Study of blood glucose
5. Study of cholesterol and urea
6. Physical examination of Urine
7. Blood group identification
8. Measurement of Clotting time and Bleeding time

TOTAL:30 HOURS

TEXT / REFERENCE BOOKS

1. Lehninger, Nelson and Cox, Principles of Biochemistry, W.H.Freeman, 4th Edition, 2005
2. Donald Voet, Judith Voet and Charlotte Pratt, Principles of Biochemistry, John Wiley and Sons, 2008
3. Pamela C.Champe, Richard A.Harvey and Denise R.Ferrier, Biochemistry, Lippincott's Illustrated reviews, 4th edition, 2007
4. Stryer, L., Biochemsitry, 4th Edition, W.H. Freeman & Co., 2000.

PCC – 04 **HUMAN ANATOMY AND PHYSIOLOGY LAB** **0 0 2 1**

COURSE OBJECTIVE:

- **To provide the students the exposure to the fundamentals in human anatomy and physiology.**

LIST OF EXPERIMENTS

1. Identification and study of human eye
2. Identification and study of human brain
3.Identification and study of human heart
4.Identification and Study of Human Skull
5. Study of ECG.
6. Blood Pressure Monitoring.
7. Auscultation for Heart Sounds(Sthethescope)
8.Identification and study of human bones
a.Upper limb bones
b.Lower limb bones
9.Study and Identification of Human Skeleton System
10.Working of Galvanic Skin Resistance(GSR)
11.Measurement of Human Body Temperature

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the students would

CO1: Analyse the various Anatomical and physiological structures
CO2: Examine various physiological functions and principles of human body
CO3: Determine various illustrations of human anatomical system and physiological parameters of the body
CO4: Distinguish various types of bones, organs, biochemical parameters and biosignals
CO5: Explain and understand the anatomy and physiology of the human system and its functions

PCC – 05 **ELECTRONIC DEVICES&CIRCUITS LAB** **0 0 2 1**

COURSE OBJECTIVE:

The student should be able to

- Describe principles and applications of different ammeters and voltmeters
- Explain the types and working of watt meters and energy meters
- Learn the types, construction, and working of different types of potentiometers
- Describe in detail the different methods of resistance measurements
- Describe in detail the different methods of impedance measurements

LIST OF EXPERIMENTS

1. Rectifiers – HWR and FWR (with & without capacitor filter)
2. Zener diode as regulator
3. Study of biasing circuits a. i). Fixed bias, ii). Self bias, iii). collector to base bias
4. FET amplifier
5. Differential amp – CMRR and determination of Gain
6. Design of RC coupled amplifier
7. Design of Voltage series feedback amplifier
8. Design of Class A and Class B amplifier
9. Design of RC phase shift oscillator
10. Design of Hartley Oscillator
11. Design of Colpitts's oscillator
12. Study of pulse shaping circuits i). AstableMultivibrator ii). MonostableMultivibrator

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Articulate knowledge about the simple and basic circuits

CO2: Develop knowledge about responses and design of the basic electronic devices

CO3: Analyse and understand the basic design of electronic circuits

CO4: Categorise and define the designs and techniques for analysis of electronic devices and circuits

CO5: Analyse and determine the applications of electronic circuits

HSC – 03 **PERSONALITY DEVELOPMENT I** 2 0 0 2

COURSE OBJECTIVES:

- To nurture and develop winning personalities and eventually leading them to become dynamicand socially responsible leaders
- To avoid negative spiritual experiences it's important to keep the balance between spiritual and physical life.
- To guide and orient students into becoming effective and exceptional communicators

UNIT I SOFT SKILLS I
6

Introduction to Personality Development – Meaning-Features of personality=Dimensions of Personality=Determinants of Personality-Features and Traits- Components of self concept-Barriers-Self analysis

UNIT II SOFT SKILLS II
6

Importance of Soft Skills – First impression-Work Place requirements-Discipline-Cleanliness-Hygiene-general Appearance--Building Confidence—Concept of Thinking and Usage-Value of Time-Focus & Commitment.

UNIT III SOFT SKILLS IN ACTION 6

Grooming – Attire – Understanding others- – Stability & Maturity Development – Strength s – Weakness –Opportunities-threats -Merits of SWOT Analysis-Components-how to convert weakness into strengths-Goal settings

UNIT IV SELF AWARENESS AND SELF ESTEEM 6

Definitions-Components of self awareness-Developing Self awareness-Self esteem-meaning-Steps to improve self esteem

UNIT V SELF MOTIVATION 6

Motivation –Meaning-Techniques of self motivation-Motivation & goal setting – Motivation and emotion – Motivation at work.

Total: 30 Hours

COURSE OUTCOME

At the end of this course the students will be able to,

CO1: Understand the basic, email, business, telephone and meeting etiquettes.

CO2: Understand the role of leadership in team management and development.

CO3: Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance.

CO4: Solve problems and develop personal skills

CO5: Determine and develop self-esteemed capability

REFERENCES:

1. Personality Development And Soft Skills---Barun K Mitra, Oxford Publication
2. Seven habits of Higly Effective people – Stephen R. covey

3. Emotion, motivation and Self regulation - Nathan C. Hall , McGill University, Canada, Thomas Goetz, University of Konstanz, Germany
4. http://www.emeraldgrouppublishing.com/
5. Psychology of Selfesteem – Nathaniel Branden, Nash (1st edition), Jossey-Bass (32nd anniversary edition

MC – 04 **2 0 0 0**

BASIC LIFE SKILLS

COURSE OBJECTIVE:

Providing value education to improve the students' character - understanding of principled life and physical health - maintaining youthfulness - measures and methods in five aspects of life

UNIT I: PHYSICAL HEALTH **6**

1. Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.
2. Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.
3. Yogasanas: Pranamasana - Hastha Uttanasana - Pada Hasthasana – AswaSanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana.
4. Pranayama :Naddi suddi - Clearance Practice - Benefits.

UNIT II: LIFE FORCE **6**

1. Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds)
2. Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind.
3. Maintaining youthfulness : Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid –
4. Measure and method in five aspects of life - Controlling undue Passion.
5. Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III: MENTAL HEALTH **6**

1) Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits.
2) Shanthi Meditation explanation - Benefits
3) Thuriya Meditation explanation - Benefits
4) Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV: VALUES **6**

- Human Values:
  1) Self control - Self confidence - Honesty
  2) Contentment - Humility - Modesty
  3) Tolerance - Adjustment - Sacrifice - Forgiveness
  4) Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity
- Social Values:
  1) Non violence - Service
  2) Patriotism - Equality
  3) Respect for parents and elders - care and protection - Respect for teacher
  4) Punctuality - Time Management

UNIT V: MORALITY (VIRTUES) **6**

1) Importance of Introspection - I - Mine (Ego, Possessiveness).
2) Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.
3) Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).
4) Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity.
5) Improved Memory Power - Success in the Examination.

Total: 30 HOURS.

COURSE OUTCOME

At the end of this course the students will be able to,

CO1: Acquire knowledge about the interconnections between the body, the breath, the mind, and the emotions in the context of maintaining resilience and well-being.

CO2: Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.

CO3: Demonstrate foundational standing, sitting , balance postures with proper alignment.

CO4: Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them.

CO5: Apply the principles of yoga in a personal way outside of yoga practice and Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga.

REFERENCE BOOKS:

1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U.pope, 2016, Thirukkural, Giri Trading Agency,
5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
6. Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
7. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,

SEMESTER IV

PCC – 06 **BIOCONTROL SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES:

- To study concept and different mathematical techniques applied in analyzing any given system
- To learn to do the analysis of given system in time domain and frequency domain
- To study the techniques of plotting the responses in both domain analysis
- To study techniques of modeling the physiological systems

UNIT I CONTROL SYSTEM MODELLING **9**

Terminology and basic structure of control system, example of a closed loop system, transfer functions, modeling of electrical systems, translational and rotational mechanical systems, electromechanical systems, block diagram and signal flow graph representation of systems, conversion of block diagram to signal flow graph, reduction of block diagram and signal flow graph.

UNIT II RESPONSE ANALYSIS **9**

Step and Impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses. definition of steady state error constants and its computation, definition of stability, Routh Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability .

UNIT III FREQUENCY RESPONSE ANALYSIS
9

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, definition of gain margin and phase margin, Bode plot, determination of gain margin and phase margin using Bode plot, use of Nichol's chart to compute resonance frequency and band width.

UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS
9

Block diagram representation of the muscle stretch reflex, difference between engineering and physiological control systems, generalized system properties , models with combination of system elements, introduction to simulation.

UNIT V PHYSIOLOGICAL SYSTEM MODELING
9

Linear model of respiratory mechanics, model of chemical regulation of ventilation, linear model of muscle mechanics, model of regulation of cardiac output, model of Neuromuscular reflex motion.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students will be able :

CO1: Make use mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems
CO2: Analyze the time response of various systems and discuss the concept of system stability
CO3: Analyze the response characteristics of various systems using different charts
CO4: Apply the concept of modeling basic engineering systems in time domain and frequency domain
CO5: Comprehend the application aspects of time and frequency response analysis in physiological control systems.

TEXT BOOKS:

1. M. Gopal "Control Systems Principles and design", Tata McGraw Hill ,2002
2. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 1995
3. Michael C K Khoo, "Physiological control systems", IEEE press, Prentice –Hall of India, 2001.

REFERENCES

1. John Enderle, Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering" second edition, Academic Press, 2005.
2. Richard C. Dorf, Robert H. Bishop," Modern control systems",Pearson, 2004

PCC – 07 **MICROPROCESSOR AND MICROCONTROLLER** **3 0 0 3**

COURSE OBJECTIVE

The students will be able to learn:

- The prime objective of this course is to introduce to the students the fundamentals of microprocessor and microcontroller.
- The students will be equipped with the basic knowledge of microprocessor and microcontroller interfacing and their applications.

UNIT 1 INTRODUCTION TO INTEL 8085 **9**

Evolution of Microprocessor - Architecture of 8085 - Instruction format - Addressing modes - Basic timing diagram of opcode fetch, memory read, memory write, I/O read and I/O write - Interrupts of 8085 - Software interrupts, Hardware interrupts, Priorities of interrupts8085 based system design-Example programming 8085.

UNIT II INTEL 8086 MICROPROCESSOR **9**

Architecture of 8086 ,Addressing Modes,Assembly Language Programming,Procedure,Macros-Interrupts and its applications.Example programming-8086

UNIT III PERIPHERAL INTERFACING **9**

Interfacing devices- 8255 Programmable Peripherals Interface- Architecture & various modes of operation - 8251
keyboard display controller (8279), ADC, DAC Interface, Programmable Timer Controller (8254).

UNIT IV MICROCONTROLLER
9

Architecture of 8051 Microcontroller- Instruction Set – Assembly Language Programming – Branching, I/O and ALU Instructions. Programming 8051 - Timers, Serial Port, Interrupts. C programming for 8051.

UNIT V APPLICATIONS **9**

Application of microprocessors: Stepper Motor Control, Temperature control, TTL to RS232 Conversion - RS232 to TTL Conversion - Interfacing Biosignal to Microprocessor- block diagram. –Working-Applications.

TOTAL: 45 HOURS

COURSE OUTCOMES

At the end of the course, student will be able to

CO1: Understand the fundamental concepts of intel microprocessors
CO2: Analyse the application the assembly language microprocessors
CO3: Determine the basic concepts of microcontroller
CO4: Articulate the knowledge of Interfacing Peripheral devices with Microprocessor and Micro controller
CO5: Apply microprocessor and microcontroller in Biomedical Applications.

TEXT / REFERENCE BOOKS

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 4 th Edition, Penram International Publishing, New Delhi, 2000
2. Kennith J. Ayala, 8051 Microcontroller, Thomson, 2005.
3. Dougles V. Hall, Microprocessor and Interfacing, Tata MC Graw Hill Publication, 2nd Edition, 1992.
4. Charless M. Gilmore, "Microprocessor Principle and application, McGraw Hill publication, 1995.
5. A.NagoorKani, Microprocessor & Microcontroller, Tata Mc Graw Hill, 3rd Edition, 2012
6. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001

PCC – 08 **BIOSENSORS AND TRANSDUCERS** **3 0 0 3**

COURSE OBJECTIVES

- To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- To know about the types of transducers available and their applications in different fields.

UNIT 1 INTRODUCTION **9**

General measurement system - purpose, structure and elements-Transducers - Definition, Classification. Resistance type- strain gauges, thermometers, potentiometers. Capacitive type, Inductive type- variable reluctance and LVDT. Biomedical Applications.

UNIT 2 TRANSDUCERS **9**

Temperature transducers, Piezoelectric transducers, Piezo resistive transducers, Photoelectric transducers, Pressure transducers, Magnetostrictive transducers Biomedical applications.

UNIT 3 BIO POTENTIAL ELECTRODES **9**

Half cell potential (or) Electrode potential, Types of Electrodes - Micro electrodes, Depth and needle electrodes, Surface electrodes, and Chemical electrodes. Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

UNIT 4 BIOMEMS & NANO SENSORS **9**

Introduction, biological elements, immobilization of biological components. Micro machined biosensor - cantilever based chemical sensors - Biosensors for diabetes mellitus, FAB. Biochip - introduction, gene chip.

UNIT 5 APPLICATIONS OF BIOSENSORS **9**

ISFET for glucose and urea. IMFET, MOSFET biosensors, affinity biosensor (catalytic biosensor), Enzyme electrodes, Ion exchange membrane electrodes.

COURSEOUTCOMES:

Upon completion of the course, the student should be able to:

CO1: Explain the introduction and characteristics of biosensors and transducers
CO2: Illustrate the types of transducers used in biomedical field.
CO3: Examine the basic characteristics of electrodes used in sensors and transducers.
CO4: Explain the structure of biosensors and transducers in detail
CO5: Explain the working and applications of Biosensors

TEXT / REFERENCE BOOKS

1. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995.
2. Brain R Eggins, Biosensors: An Introduction", John Wiley Publication.1996.
3. A. K.Sawhney, A course in Electronic Measurements and Instruments, Dhapat Rai & sons, 1991
4. John G Webster, Medical Instrumentation: Application and design, John Wiley Publications.2007.
5. John P Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education Asia, (2000 Indian reprint)
6. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

PCC – 09 **BIOMATERIALS AND BIOMECHANICS** **3 0 0 3**

UNIT 1 BIOMECHANICS
9

Biomechanics- Definition and perspective, Fundamental Mechanical Concepts- Kinetics and Kinematics, Newton's Laws, Mechanical Properties -Stress, Strain, Elasticity, Shear, Tension,Forces, Compression, Plastic Deformation, Creep, and Fatigue. Mechanical testing of biomaterials.

UNIT 2 BIOMATERIALS
9

Biomaterials - Overview, Classification of biomaterials, Interfacial Phenomena and tissue response to biomaterials, Metals and alloys for orthopedic implants-Stainless steel, Cobalt chromium alloy, Titanium and its alloys, Precious metal alloys, Other metal alloys. Dental implants - materials, types and designs.

UNIT 3 HUMAN LOCOMOTION
9

Anthropometric Characteristics of human body. Types of motion in humans, Gait analysis. Goniometry. Accelerometer, Foot Pressure Measurements-Pedobarographic-Force platform. Mechanics of foot.

UNIT 4 ARTIFICIAL ORGANS & IMPLANTS **9**

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants. Polymerization, polyamides, Acryrilic polymers, rubbers, high strength Thermoplastics, medical applications. Bio polymers: Collagen and Elastin. Medical Textiles: Silica, Chitosan, PLA composites, Sutures, wound dressings

UNIT 5 SPORTS MECHANICS **9**

Application of biomechanics to neuromuscular fitness, gymnastics, Application of aerodynamics in sports, hydrodynamics in swimming. Analysis of throw and push patterns. Sports Medicine

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, student will be able to

CO1: Understand the principles of mechanics and Mechanical testing of biomaterials
CO2: Analyze the uses and need of biomaterials.
CO3: Explain the fundamentals of Human Locomotion and its measuring techniques
CO4: Apply the knowledge of biomaterials used in various organs.
CO5: Apply the principles of the mechanics in all fields

TEXT / REFERENCE BOOKS

1. Susan J Hall, Basic Biomechanics, Mc Graw Hill, 1999.
2. Y. G. Fung, Biomechanics, Springer-verlag New York Inc, 1990
3. Ellen Kreighbaum, Barthels, Biomechanics - A qualitative approach for studying human movement, Macmillan,2nd Edition,1985.
4. Joseph Bronzino Hand book of Biomedical Engineering, Springer,2nd Edition,2000. 5. Buddy Ratner etal., Biomaterials Science - An Introduction to Materials in Medicine, Academic Press, San Diego, 1996

PCC – 10 **INTERNET OF MEDICAL THINGS** **3 0 2 4**
(BLENDED)

COURSE OBJECTIVES

Assess the genesis and impact of IoT applications, architectures in real world.

- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT.
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

UNIT I INTRODUCTION **9**

Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device

UNIT II IoT SENSORS **9**

Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics– Polytonic Systems – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap

UNIT III NETWORK& COMMUNICATION ASPECTS **9**

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

UNIT IV CHALLENGES IN IOT **9**

Design challenges, Development challenges, Security challenges, Other challenges

UNIT V APPLICATIONS OF IoMT **9**

Chronic disease management, Remote assisted living (Tele health), Wellness and preventive care (Lifestyle assessment), Remote intervention, Improved drug management. **TOTAL:45 HOURS**

COURSE OUTCOMES:

After studying this course, students will be able to

CO1: Explain the introduction and importance of internet of things

CO2: Illustrate the principle and significance of iot sensors

CO3: Examine the basic fundamentals and working of networking and communication aspects

CO4: Explain the significance of IOT

CO5: Explain advanced applications of IOMT in various fields.

PRACTICAL:

1. Study and introduction of IoT platform
2. Execution of a medical parameter using think speak module
3. Study of Data logging in think speak and Beagle bone black
4. Study and execution of applications using Online Cloud Platforms.
5. Study and uses of Biomedical Engineering
6. List out the different IoT applications and importance of IoT in the present scenario.
7. List the application of Arduino and Node MCU
8. Design a system to control the traffic signals through IoT
9. Understand the different sensors available to measure the current and voltage
10. Model a system to control the railway gate using stepper motors. **TOTAL:30HOURS**

TEXTBOOK:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
2. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017

REFERENCE BOOKS:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224

PCC – 11	BIO SENSORS AND TRANSDUCERS LABORATORY	0 0 2 1

COURSE OBJECTIVE:

- To study and analyze the theory and practical characteristics of the various transducers for the measurement of the vital physiological signals.
- To get familiar with the various types of transducers and to study the compatibility for any clinical measurements.

LIST OF EXPERIMENTS

1. Characteristics of pressure transducer
2. Measurement of displacement capacitive transducer, LVDT and Inductive transducer
3. Characteristics of optical transducer for SpO2 measurement
4. Measurement of skin temperature by both contact and non-contact method
5. Study of the characteristics of capacitor level sensor for saline level measurement in a I-V set.
6. Data acquisition of physiological signals
7. Study of hot-wire anemometry
8. Study of amperometric sensor for blood glucose measurement
9. Electronic weighing machine for the measurement of chemical compounds
10. Non-invasive gas analyzer as an electronic nose.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the student will be able

CO1: Analyze about various theory, practical characteristics and conversions of the various transducers

CO2: Evaluate the measurement of the parameters using different sensors and transducers

CO3: Analyze various types of transducers

CO4: Test compatibility for different measurement techniques

CO5: Apply and understand the biosensors in different measurement techniques

PCC – 12 **MICROPROCESSOR AND MICROCONTROLLER LABORATORY** **0 0 2 1**

COURSE OBJECTIVE:

The student should be made to:

- Program the 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Practically interface the communication and bus interfacing.
- Implement the programming of 8051 microcontroller.

LIST OF EXPERIMENTS

Assembly Language Programming of 8085 /8086 based experiments

1. Programs for 16 bit Arithmetic, Sorting, Searching and String operations,
2. Programs for Digital clock, Interfacing ADC and DAC
3. Interfacing and Programming 8279, 8259, and 8253.
4. Serial Communication between two Microprocessor Kits using 8251.
5. Interfacing and Programming of Stepper Motor and DC Motor Speed control and Parallel Communication between two Microprocessor Kits using Mode 1 and Mode 2 of 8255.
6. Macroassembler

Programming for 8086/ 8051 based experiments

1. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051 microcontroller.
2. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller.
3. Interfacing – DAC and ADC and 8051 based temperature measurement
4. Interfacing – LED and LCD
5. Interfacing – stepper motor traffic light control
6. Communication between 8051 Microcontroller kit and PC.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1: Design and implement programming in Microprocessor & microcontroller

CO2: Analyse and implement operational functions of the Microprocessor & microcontroller

CO3: Design and analyse the assembly languages of Microprocessor & microcontroller

CO4:Design and implement the instruction sets of Microprocessor & microcontroller

CO5: Illustrate and Implement the use of pneumonics & Opcode

HSC– 04 **PERSONALITY DEVELOPMENT II** 2 0 0 2

COURSE OBJECTIVES:

- Socially responsible and ethical citizens.
- Corporate readiness and continuous employability.
- To inculcate the need to lead a healthy lifestyle and manage stress
- To improve leadership quality
- To improve physical aspects of personality/posture & Good team spirit

UNIT I SOFT SKILLSIII

6

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

UNIT II QUANTITATIVE APTITUDE I

6

Percentage – Profit Loss -Discount – Ratio Proportion – Time & Work – Time, Speed & Distancel. Problems relating to ages- Permutation &Combination-Probability

UNIT III QUANTITATIVE APTITUDE II 6

Mensuration Clocks and Calendars- Boats-Simple Interest –Compound Interest- Fractions and Decimals – Square roots – Functions.

UNIT IV ANALYTICAL PROBLEMS

6

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

UNIT V LOGICAL PROBLEMS 6

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

TOTAL: 30 Hours

COURSE OUTCOME

At the end of this course the students will be able to,

CO1: Understand the basic, email, business, telephone and meeting etiquettes.

CO2: Understand the role of leadership in team management and development.

CO3: Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance.

CO4: Solve Analytical problems

CO5: Solve logical problems

REFERENCES:

1. Personality Enrichment--K R Dhanalakshmi And N S Raghunathan, Margham Publications
2. Personality Development --Dr V M Selvaraj Bhavani Publications
3. Quantitative Aptitude – R. S Aggarwal
4. Logical and Analytical Reasoning (English) 30th Edition – A.K Gupta

BSC – 08 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **3 0 0 3**

COURSE OBJECTIVE

- To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
- The student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.
- The role of government and non – governmental organization in environmental managements.

UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY
9

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT IIENVIRONMENTAL POLLUTION **9**

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES **9**

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT
9

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics- Issues and Possible

Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT
9

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

Total: 45 HOURS

COURSE OUTCOME

At the end of this course, the Student will be able to

CO1: Understand the nature and facts about environment and implement scientific, technological, economic solutions to environmental problems.

CO2: Understand the integrated themes and biodiversity, natural resources, pollution control and waste management.

CO3: Analyze the importance of environment by assessing its impact on the human world.

CO4: Study the dynamic processes and understand the features of the earth's interior and surface and describe the role of an individual in Conservation of Natural Resources.

CO5: Understand the role of government in solving the environmental problems and also describe about Population Growth and variation among Nations

Text Books

1. De AK, Environmental Chemistry, Wiley Eastern Ltd.
2. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.
3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

Reference Books

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
2. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
3. Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs.
4. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws.Himalaya Publishing House, Delhi 284pgs.
5. Mckinney ML and Schoch RM, 1996. Environmental Science Systems and Solutions. Web enhanced edition, 639pgs.
6. Miller TG, Jr. Environmental Science, Wadsworth Publishing CO. (TB)

SEMESTER V

PCC -13 **DIAGNOSTIC INSTRUMENTATION** 3 0 0 3

COURSE OBJECTIVES

Students should be made to

- Understand the basics of instrumentation, biopotentials and bio amplifiers
- Illustrate the devices described for the diagnosis of cardiac and muscular abnormalities
- Learn about the neurological devices for analysis and diagnosis
- Describe the measurement techniques for non-electrical parameters.
- Illustrates the recent advancements in the field of diagnostic devices.

UNIT- I BASICS OF INSTRUMENTATION **9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, 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.Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference

UNIT II CARDIAC AND MUSCULAR EQUIPMENT **9**

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system.Patient Monitoring system.ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit. Generation, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, EMG Bio Feedback Instrumentation.

UNIT III NEUROLOGICAL EQUIPMENT **9**

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph).EEG Bio Feedback Instrumentation. Nerve conduction velocity measurement.

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure measurement, Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

UNIT V RECENT TRENDS **9**

Principles and application of thermography, Principles of cryogenic Technique and application, Endoscopy, Laparoscopy, ophthalmic equipments- slit Lamp, Tonometer , Retinal response Plotter, principles of Bio telemetry, principles of Lithotripsy.

TOTAL: 45 HOURS

COURSE OUTCOMES

At the end of the course Students will be able to

CO1: Understand the basics of instrumentation, biopotentials and design the bio amplifiers
CO2: Understand the basic principles, construction & working of various Medical Equipment's
CO3: Understand the various instruments used for various diagnostic purposes.
CO4: Apply the instrumentation techniques for the study of various vital parameters of the human body
CO5: Understand various Medical instruments used for transmission of medical data and design of circuits

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.

REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design"
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

PCC-14 **BIO SIGNAL PROCESSING** 3 0 0 3

COURSE OBJECTIVES

Students should be made to

- Illustrates a solid foundation in signal processing and systems including advancements in the field.
- Define the basic analysis and use of spectral estimation in signal processing
- Demonstrate processing, validation, optimization and analysis of different biomedical signals.
- Illustrate the bio signal classification and recognition for diagnosis of different diseases.

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, non-stationary process, fixed segmentation, adaptive segmentation. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation.

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminant function, neural network based classification. Application in Normal versus Ectopic ECG beats and other biomedical applications.

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, Wavelet packets, Multivariate component analysis-PCA, ICA.

TOTAL: 45 HOURS

COURSE OUTCOMES

Students will be able to

CO1: Analyse and understand the basic principles of biosignal processing

CO2: Understand various techniques in biosignal processing

CO3: Apply the techniques in biosignal processing for various applications

CO4: Analyze the biosignals with different illustrative techniques

CO5: Develop and analyse the knowledge in various biosignal processing techniques

REFERENCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach" Pearson education Ltd., 2002
3. P.Ramesh Babu, ―Digital Signal Processing‖, Sixth Edition, Scitech publications, Chennai, 2014.
4. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
5. Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach", Wiley, IEEE Press, 2015.
6. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

PCC-15 **TROUBLESHOOTING OF MEDICAL INSTRUMENTS** **3 0 2 4**

COURSE OBJECTIVE:

- To provide knowledge to students to enable them to troubleshoot the various equipments used in hospitals.
- To provide adequate technical information on operating principles of medical instruments
- To attain mastery in fault detection and corrective measures.
-

UNIT- 1 FUNDAMENTAL TROUBLESHOOTING PROCEDURES **9**

Making of an Electronic Equipment, causes of Equipment Failure, Troubleshooting Process & Fault finding Aids, Troubleshooting Techniques, Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and Correction Action to repair the Equipment.

UNIT- 2 TESTING OF PASSIVE COMPONENTS & SEMICONDUCTOR DEVICES **9**

Testing: resistors, capacitors & inductors, causes of failure for electronic components, testing procedure for semiconductor devices: special diodes, bipolar transistors, field effect transistor (FET), and thyristor.

UNIT- 3 FAULT DIAGNOSIS IN ANALOG& DIGITAL INTEGRATED CIRCUITS **9**

Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

UNIT- 4 BIOMEDICAL EQUIPMENT TROUBLESHOOTING –I **9**

Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anaesthesia machine, Autoclaves & sterilizers, Endoscope.

UNIT -5 BIOMEDICAL EQUIPMENT TROUBLESHOOTING –II **9**

Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators, Oxygen cylinders & flow meters, PulseOximeter, Sphygmomanometers, SuctionMachine, X-RayMachine .

TOTAL: 45 HOURS

PRACTICAL:

1. Study of Fault finding aids and tools of electrical and electronic equipment's
2. Troubleshooting semiconductor devices
3. Troubleshooting of Electrical and Electronic Equipment's
4. Study of safety procedures in handling medical equipment's
5. Study of grounding procedures in electrical and electronic equipment's
6. Study of Troubleshooting of Op Amp
7. Study of Troubleshooting of IC & Circuit board
8. Study of Troubleshooting ECG
9. Study of Troubleshooting of Nebulizer
10. Study of Troubleshooting of Electrosurgical Unit

COURSE OUTCOMES

At the end of the course, student will be able to

CO1: Explain the basic equipment failure and troubleshooting techniques.

CO2: Develop knowledge about the concept of resistor, capacitor, inductor, semi conductor troubleshooting.

CO3: Apply and illustrate the knowledge on Digital IC troubleshooting.

CO4: Apply the knowledge of Biomedical Equipment Troubleshooting Procedures.

CO5: Distinguish the reason for failure & evaluating the procedure for troubleshooting of biomedical instruments.

TEXTBOOKS:

1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair &Maintenance", Tata McGraw-Hill, Second Edition 2009.
2. Dan Tomal& Neal Widmer, "ElectronicTroubleshooting", McGraw Hill, 3rd Edition 2004.

REFERENCES:

1 Nicholas Cram & Selby Holder, "Basic Electronic Troubleshooting forBiomedical Technicians", TSTC Publishing, 2nd Edition 2010.
2 World Health Organisation, "Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment", Geneva,1994.
3 Ian R, McClelland , "X-ray Equipment maintenance & repairs workbook for Radiographers& Radiological Technologists", World Health Organisation, Geneva, 2004.
4 Ministry of Health & Family Welfare, "Medical Equipment Maintenance Manual- A first line maintenance guide for end users", New Delhi, October 2010.
5 Joseph.J, Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment", Charles C Thomas Publisher Ltd, 2nd Edition 2005.

HSC – 05 **PERSONALITY DEVELOPMENT III** **0 0 2 1**

COURSE OBJECTIVES:

- Verbal and written communication skills.
- Interpersonal and group skills.

UNIT I VERBAL APPTITUDE I 6

Phonetics/Neutral Accent/Pronunciation – Speech Mechanism/Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation – Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

UNIT II VERBAL APTITUDE II 6

Singular/plural-present tense/past tense—genders - Prepositions-conjunctions-Choice of words—simple sentences—compound sentences- summarising phrases—Synonyms—Antonyms—Analogies—Similar Words

UNIT III SOFT SKILLS IV

6

Attitude—Meaning- Features of attitude-Formation-Personality Factors-Types of attitude-change in attitude-Developing Positive attitude.

UNIT IV TIME MANAGEMENT

6

Definition –Meaning-Importance, Value of time as an important resource- comparison of Time and Money-Circle of influence and circle of control—Definition of URGENT and IMPORTANT—Time Wasters and how to reduce—Procrastination—meaning and impact- 4 Quadrants.

UNIT V TEAM BUILDING 6

Meaning—Aspects of team building—Process of team building—Types of Teams-Team ethics and Understanding-Team trust and commitment

TOTAL: 30 Hours

COURSE OUTCOME

At the end of this course the students will be able to

CO1: Acquire the personality development techniques and communication skills.

CO2: Possess and apply verbal knowledge & communication skills

CO3: Develop positive attitude in communication

CO4: Develop time management skill and personality development

CO5: Acquire the Team work skills to shape personality

REFERENCES:

1. Managing Soft Skills And Personality--B N GhoshMcgraw Hill Publications
2. Principles and Practices of Management Shejwalkar and Ghanekar McGraw Hill Latest
3. Time management for Busy people – Roberta roesch, TatamcGraw-Hill Edition
4. Personality Development --Dr V M Selvaraj, Bhavani Publications

PCC – 16 **0 0 3 2**

DIAGNOSTIC INSTRUMENTATION LABORATORY

COURSE OBJECTIVES

Students should be made to

- Understand the basics of pre-amplifiers and bio amplifiers
- Illustrate the circuits for ECG detection and driven amplifiers
- Demonstrate the measurements of non-electrical parameters.
- Illustrates the recording of bio signals and blood flow.
- Define the functioning of the diagnostic instrumentation

LIST OF EXPERIMENTS:

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC‘s
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier
4. Design of frontal EEG amplifier
5. Analysis of ECG, EEG & EMG signals
6. Measurement of pulse-rate using Photo transducer.
7. Recording of Audiogram
8. Measurement of pH and conductivity.
9. Measurement of blood pressure using sphygmomanometer.
10. Measurement and recording of peripheral blood flow
11. Measurement of Respiratory parameter using spirometry
12. Study of Ultrasound Scanners
13. Design a PCB layout for any bio amplifier using suitable software tool.

TOTAL: 60 HOURS

COURSE OUTCOMES

Students will be able to

CO1: Understand the basics of Instrumentation in diagnostic techniques

CO2: Illustrate the circuits and operations of the different diagnostic instruments

CO3: Demonstrate the measurements of biosignals and parameters used in diagnosis.

CO4: Illustrates the recording of bio signals and various physiological parameters

CO5: Illustrates the functioning of the diagnostic instrumentation

SEMESTER VI

PCC-17	THERAPEUTIC EQUIPMENTS	3 1 0 4

COURSE OBJECTIVES

Students should be made to

- Understand the use of cardiac care devices and safety issues
- Illustrate the devices in the field of physiotherapy and applications of diathermy
- Learn about ventilators and applications of anaesthetic system.
- Describe the extra corporeal devices and safety measures applied for patients.

UNIT I CARDIAC CARE UNITS **9**

Pacemakers – Need for pacemaker, different types and their comparison, batteries for pacemakers. Defibrillator- Need, AC defibrillators and demerits, DC Defibrillator, asynchronous and synchronous DC defibrillators, Hazards and safety issues.

UNIT II PHYSIOTHERAPY AND DIATHERMY EQUIPMENT

9

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Electrical safety- Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser.

UNIT III VENTILATORS & ANAESTHETIC SYSTEM **9**

Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, different ventilatory adjuncts, neonatal ventilators, p based ventilator, ventilator testing. Anaesthesia: Need of anaesthesia, gas used and their sources, gas blending and vaporizers, anaesthesia delivery system, breathing circuits, EEG controlled Anesthetic monitor.

UNIT IV EXTRA CORPOREAL DEVICES AND ELECTRICAL STIMULATORS **9**

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameters. Hemo Dialyser unit. Electrical Stimulators- Strength-duration curve, types of stimulators, an electrodiagnostic / therapeuticstimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain andrelief.Transcutaneous nerve stimulator

UNIT V PATIENT SAFETY **9**

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient‘s electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

TOTAL: 45 HOURS

COURSE OUTCOMES

Students will be able to

CO1: Explain the basics principles of the instrumentation of therapeutic devices

CO2: Understand the analysis of bio signals and basic therapeutic equipments

CO3: Analyze the working and functioning of different therapeutic equipments

CO4: Understand the working principles of different therapeutic devices

CO5: Describe about the use of therapeutic devices

TEXT BOOK:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. John Webster. Medical Instrumentation.- Application and Design. John Wiley and Sons. Inc., New York. Thirdedition 2003.

2. Cromwell Leslie, Fred Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000

3. Wolbasrsht . M. L, Laser Application in Medicine and Biology plenum press NewYork 1989.
4. Bronzino, Joseph; Handbook of Biomedical Engineering. 2nd edition, CRC Press, 2000.
5. Welkowitz, Walter & Others Bio-Medical Instruments Theory & Design., 2nd Edition, Academic Press, 1994

PCC – 18 **0 0 2 1**

THERAPEUTIC EQUIPMENTS LABORATORY

COURSE OBJECTIVES

Students should be made to

- Understand the basics measurements of bio signals
- Illustrate the therapeutic and telemetric devices
- Learn about the medical stimulators and surgical units
- Describe the recording of audiogram and electrical safety measures
- Study the functioning of different therapeutic devices.

LIST OF EXPERIMENTS:

1. Measurement of visually evoked potential
2. Galvanic skin resistance (GSR) measurement
3. Study of shortwave diathermy
4.Study of ultrasonic diathermy
5. Electrical safety measurements
6. Study of medical stimulator
7. Analyze the working of ESU – cutting and coagulation modes
8. Study the working of Defibrillator
9.Study the working of pacemakers

COURSE OUTCOMES

Students will be able to

CO1: Explain the basics principles of the instrumentation of therapeutic devices

CO2: Understand the analysis of bio signals and basic therapeutic equipments

CO3: Analyze the working and functioning of different therapeutic equipments

CO4: Understand the working principles of different therapeutic devices

CO5:Describe about the use of therapeutic devices

HOSPITAL VISIT

Hospital visit is necessary for the students to visualize high tech and advanced equipment’s used in the hospitals for the diagnostic and treatment of the patients. Real time functioning of the equipment’s can be analysed.

PCC-19	MEDICAL IMAGE PROCESSING	3 0 0 3

COURSE OBJECTIVES

Students should be made to

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- Learn to restore and reconstruct the medical images

UNIT I FUNDAMENTALS OF DIGITAL IMAGE AND TRANSFORMS 9

Anatomy of Human Eye- Elements of Visual perception, Image sampling and quantization, Neighborhood pixel Relationships – Basic Image operations – Arithmetic, Geometric and Morphological. Image transform: 2D DFT-Discrete cosine-, Sine-, Haar-, and Hadamard- transform.

UNIT II IMAGE ENHANCEMENT 9

Basic gray level transformation, Histogram processing ,Smoothening by spatial filters - Sharpening by spatial filters ,Smoothening- frequency domain filters, Sharpening- frequency domain filters ,Color image Processing-color models- Pseudo color image processing– Color Image Transformation – Smoothening - Sharpening.

UNIT III IMAGE SEGMENTATION AND OBJECT RECOGNITION 9

Edge detection- Marr Hidreth edge detector - Canny edge detector, Thresholding foundation- Basic global thresholding - Basic Adaptive thresholding, Region Based segmentation, Watershed segmentation algorithm, Patterns and pattern classes, Recognition based on decision theoretic methods-matching, Optimum statistical classifiers.

UNIT IV IMAGE COMPRESSION 9

Image compression- Fundamentals - Image compression standards- Coding: Run length-, Huffman- Arithmetic-, Bit plane-, Transform- and Lossy- and lossless predictive coding.

UNIT V IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGES 9

Image degradation models, Algebraic approach to restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms - Filter back projection algorithm – Fourier reconstruction of MRI Images, Image Registration

TOTAL: 45 HOURS

COURSE OUTCOMES

Students will be able to

CO1: Explain the basics of digitization and transforms.
CO2: Analyse various image processing transforms.
CO3: Analyse the image segmentation and various image processing techniques
CO4: Distinguish and understand the techniques of image compression
CO5: Understand the principles of image preprocessing and processing techniques

TEXTBOOKS:

1. Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing*"*,Pearson Education Asia, Third Edition, 2007.
2. Anil K Jain, "Fundamentals of Digital Image Processing*"*, Prentice Hall of India, 2nd edition 1997.

REFERENCES:

1. William K Pratt, "Digital Image Processing*"*, John Wiley NJ, 4th Edition, 2007.
2. Albert Macouski, "Medical Imaging Systems*"*, Prentice Hall, New Jersey 2nd edition 1997.

PCC – 20	MEDICAL IMAGE PROCESSING LABORATORY	0 0 3 2

COURSE OBJECTIVES

Students should be made to

- Learn about the basics and fundamentals of image processing
- Illustrate applications of different transforms
- Demonstrate the different enhancement techniques
- Describe the applications of image segmentation process
- Illustrates the advancements and formatting in image processing

1. Medical Image sampling and quantization
2. Analysis of spatial and intensity resolution of medical images.
3. Intensity transformation of medical images.
4. DFT analysis of medical images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Medical Image Enhancement-Spatial filtering
8. Medical Image Enhancement- Filtering in frequency domain
9. Medical Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Region based Segmentation in medical images
12. Segmentation using watershed transformation
13. Analysis of medical images with different color models.
14. Study of DICOM standards
15. Medical Image compression techniques
16. Medical Image restoration

COURSE OUTCOMES

Students will be able to

CO1: Explain the basics of digitization of images
CO2: Determine the various techniques in image processing
CO3: Analyse the concepts and illustrations in image analysis
CO4: Distinguish and understand the techniques of image processing
CO5: Explain and develop the skills in analysing and processing the digital images

HS – 06	PERSONALITY DEVELOPMENT IV	0 0 2 1

COURSE OBJECTIVES:

- To develop awareness of different job search techniques, including how to employ practical networking techniques
- To begin to recognize the skills developed during research and analyse how to present these effectively in written applications
- To critique the strengths and weaknesses of their own and colleagues' current CVs
- To understand interview processes and practice being interviewed in a supportive environment.

UNIT I SOFT SKILLS V **6**

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication – Merits –forms of assertion – Causes of misunderstanding

UNIT II COMMUNICATION SKILLS **6**

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

UNIT III PRESENTATION SKILLS I **6**

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience – Types of presentations – How to make effective presentation.

UNIT IV PRESENTATION SKILLS II **6**

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences – Steps to eliminate Stage fear.

UNIT V CHANGE MANAGEMENT **6**

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

TOTAL: 30 h

COURSE OUTCOME

At the end of this course the students will be able to,
CO1: Understand the characteristics of assertiveness and be assertive in communication.
CO2: Analyse the causes of communication misunderstanding.
CO3: Differentiate the principles of formal and informal communication.
CO4: Determine and Overcome barriers in the communication process.
CO5: Illustrate an effective communications and presentation skills.

REFERENCE BOOKS:

1. Helping employees embrace change – LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.
2. Who Moved My Cheese by Spencer Johnson published by vermilion first edition
3. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.
4. Business Communication Today: Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. Tenth Edition. New Jersey: Prentice Hall, 2010.

PCC – 21	SUMMER INTERNSHIP	0 0 4 2

COURSE OBJECTIVES

- To get real time experience in the field of Biomedical Engineering
- To develop the problem-solving skills
- To train students in preparing real time projects

Syllabus

The Industrial / Practical Training shall carry 100 marks. At the end of the Industrial / Practical training / internship / Summer Project, the student shall submit a certificate from the organization where the student has undergone training and a brief report about the training. The evaluation will be made based on this report, presentation and a Viva-Voce Examination conducted internally by a three -member Departmental Committee consisting of one co-ordinator and two members constituted by the Head of the Department.

COURSE OUTCOME

CO1: Express the technical ideas, strategies, solutions and methodologies.
CO2: Observe real time problem and implement problem solving ideas.
CO3: Knowledge on Engineering tools, solutions to problems, skill development
CO4: Solve real time Engineering problems
CO5: Understand real time Engineering problems and solutions

SEMESTER VII

PCC-21	MEDICAL IMAGING TECHNIQUES	3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Study the different techniques in advanced medical imaging
- Learn the analysis of the advanced medical imaging.

UNIT I MEDICAL X-RAY EQUIPMENT 9 hours

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT II COMPUTED TOMOGRAPHY 9 hours

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems-spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.

UNIT III MAGNETIC RESONANCE IMAGING 9 hours

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radiofrequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR MEDICINE SYSTEM 9 hours

Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT-V OTHER IMAGING TECHNIQUES 9 hours

Fluoroscopy, OCT, fundus camera, thermography, video laryngoscopy, Ultrasound,

TOTAL:45 HOURS

COURSE OUTCOME:

At the end of the course, the student should be able to

CO1: Explain all techniques involved in medical imaging
CO2: Illustrate the concepts of the imaging techniques for medical images
CO3: Determine the analysis tools for various medical imaging techniques
CO4: Understand the processing procedures in advanced medical imaging
CO5: Apply the techniques of advanced medical images in various applications

TEXTBOOKS:

T1. Khandpur R S, *"*Hand-book of Biomedical Instrumentation*",* Tata McGraw Hill, 2nd Edition, 2003.
T2. William Hendee R, Russell Ritenour E, ―Medical imaging physics‖, Fourth Edition, 2002.

REFERENCES:

R1. Stephan Ulmer, Olav Jansen, ―FMRI: Basics and Clinical Applications*"*, Springer, first Edition,2010.
R2. Matteo Pastorin , ―Microwave imaging*"*, John Wiley and Sons ,first edition , 2010.
R3. R C Gonzalez, R E Woods, S L Eddins, Digital Image Processing using Matlab &quotes, Gates mark Publishing,2009

PCC -22	ADVANCED MEDICAL IMAGING LABORATORY	0 0 2 1

Course Objective: To impart adequate knowledge on programming in Virtual Instrumentation for acquisition and analysis of signals in medical system and to impart knowledge on various analysis tools

LIST OF EXPERIMENTS

1. Introduction to Medical imaging techniques
2. Analyze and visualize the 3D images
3. Study of feature extraction from medical images
4. Analyze the Basic MRI images and illustrate the report
5. Study the statistical parameters of basic angiography images
6. Analyze the CT brain images
7. Measurement in the 3D images
8. Analyze the fMRI images and state the difference
9. Analyze medical images using neural network algorithms
10. Design an algorithm for analysis of 3D images

TOTAL: 45 HOURS

Course outcome:

CO1: Explain all techniques involved in medical imaging

CO2: Illustrate the concepts of the imaging techniques for medical images

CO3: Determine the analysis tools for various medical imaging techniques

CO4: Understand the processing procedures in advanced medical imaging

CO5: Apply the techniques of advanced medical images in various applications

PCC -23	BIOSIMULATION LABORATORY	0 0 3 2

Course Objective: To impart adequate knowledge in the simulation of basic operations and functions and to impart knowledge on various analysis tools for biosimulation

LIST OF EXPERIMENTS

1. Basic arithmetic operations using Simulink
2. Design of simple model using Simulink
3. Design of signal analysis system
4. Convolution of two signals
5. Design of image analysis system
6. Thermal conduction analysis
7. Design of Defibrillator (using Simulink)
8. Simulate and analyse the statistical features
9. Design Artificial neural network
10. Design of Simple GUI for analysis
11. Introduction to HDL coder in MATLAB
12. Design of an application using MATLAB

TOTAL: 45 HOURS

Course outcome:

CO1: Understand and analyse the basic functions in biosimulation process

CO2: Apply and develop knowledge about the different bio simulation techniques

CO3: Distinguishing the simulation techniques and processes.

CO4: Compare and evaluate the simulation process for various applications

CO5: Develop the functional skill and knowledge of biosimulation techniques

PCC -24	PROJECT PHASE I	0 0 10 5

COURSE OBJECTIVES

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To develop skills to analyse and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

Syllabus

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOME

CO1: Analyze a real-world problem, identify the requirement and develop the design solutions.
CO2: Evaluate the technical ideas, strategies and methodologies.
CO3: Design the new tools, algorithms, techniques that contribute to obtain the solution of the project.
CO4: Estimate and validate through conformance of the developed prototype and analysis the cost Effectiveness.
CO5: Evaluate and present the oral demonstrations

SEMESTER VIII

PCC-25	PROJECT PHASE II	0 0 20 10

COURSE OBJECTIVES

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To develop skills to analyse and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

Syllabus

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOME

CO1: Describe the problem of the work
CO2: Determine and Identify the literature survey
CO3: Experiment the methodologies and Implementation process
CO4: Proposing the model and its explanation
CO5: Validate the resultant outcomes

PROFESSIONAL ELECTIVE COURSES

PE – 01 **MEDICAL PHYSICS** **3 0 0 3**

COURSE OBJECTIVES

The student should be made to:

- To study principles and effects of ionizing and non-ionizing radiation in human body
- To discuss the physics of the senses
- To explore the effects of radiation in matter and how isotopes are produced
- To understand various detectors for detecting the presence of ionizing radiation

UNIT I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS 9

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

UNIT II PHYSICS OF THE SENSES 7

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

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES

10

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

UNIT IV RADIOACTIVE DECAY AND INTERACTION OF RADIATION WITH MATTER

11

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

UNIT V SCINTILLATION, SEMICONDUCTOR AND GAS FILLED DETECTORS 8

Scintillation Detectors - Solid Scintillation Counters - Gamma-Ray Spectrometry-Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Thyroid Probe-Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Müller Counters

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Interpret different structures and systems related to medical physics

CO2: Illustrate the principles and use of various devices used in hospitals

CO3: Explain the principles and techniques of various equipment's

CO4: Compare interaction of various radiations

CO5: Evaluate various radiation quantities and study the activities of radio nucleotides

TEXT BOOKS:

1. Gopal B. Saha, ―Physics and Radiobiology of Nuclear Medicine‖, 4th Edition, Springer, 2013.

2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, ―Medical Physics and Biomedical Engineering‖, 2nd Edition, IOP Publishers.2001.

REFERENCES:

1. S.Webb ― The Physics of Medical Imaging‖, Taylor and Francis, 1988

2. J.P.Woodcock, ―Ultrasonic,Medical Physics Handbook series 1‖, Adam Hilger, Bristol, 2002

3. HyltonB.Meire and Pat Farrant ―Basic Ultrasound‖ John Wiley & Sons.

PE-02 ANALOG AND DIGITAL IC's 3 0 0 3

Course Objective: To teach the students the basic of the Digital systems, application of analog ICs in the designing circuit, study the applications of these Digital ICs,

UNIT - I NUMBER SYSTEMS AND LOGIC GATES 12

Decimal, Binary, Octal and Hexadecimal Numbers.-Conversion between these number systems.- Complements r's and (r-1)'s complements.- subtraction using complements – Encoding numbers and characters using Binary digits. –Binary coded Decimal –Gray code - Binary to Gray code conversion –ASCII Code. Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems – Solving Boolean expressions, Truth Tables and Logic circuits – The Karnaugh Map – half adder, full adder, Multiplexers and Demultiplexers - Decoders and encoders. Coding of Combination Circuits in verilog.

UNIT- II REGISTERS AND COUNTERS 12

Flip Flops – RS, D, T, JK Flip Flops – Characteristic equations, exciting tables – JK Master– Slave flip-flop – Universal shift register. Design of modulo-N counters – counter design using state diagram. sequential circuit design with verilog.

UNIT- III OPERATIONAL AMPLIFIERS 12

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth - equivalent circuit of an op-Amp – virtual ground concept – Linear applications of op-amp – inverting and noninverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter – Differential amplifiers – differentiator and integrator. Nonlinear applications – comparator – Schmitt Triggers – Precision Diode Half wave and full wave rectifiers – Average detectors – peak Detector.

UNIT - IV ACTIVE FILTERS AND SIGNAL GENERATOR 12

Active filters (first and second order) – Low pass, high pass, band pass filters, band reject filters (notch filters). Oscillators - RC Phase shift and Wein-bridge. Waveform generators - Square, triangular and saw tooth.

UNIT- V TIMER, PLL, A/D AND D/A CONVERTERS 12

555 Timer (internal diagram) and its applications – monostable multivibrator, astable multivibrator. Phase locked Loop (565 - block diagram approach) and its applications - Frequency multiplication, Frequency translation, voltage to frequency and frequency to voltage converters. DAC – Binary weighted DAC and R-2R DAC. ADC – single slope and dual slope ADCs, successive approximation ADC

TOTAL: 45 HOURS

COURSE OUTCOME:

CO1: Acquire knowledge about solving problems.
CO2: Ability to apply knowledge of Analog and digital IC's
CO3: Ability to design various circuits.
CO4: Capability to design analog circuits & digital circuits.
CO5: Understand the terminal characteristics of fundamental circuits

TEXT BOOKS:

1. M. Morris Mano , "Digital Logic and Computer design " Prentice Hall 1994.
2. Ramakant A. Gayakwad , "Op-AMP and Linear Ics", Prince Hall, 1994

REFERENCES:

1. Robert B.Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.
2. Sergio Franco, "Design with Operational Amplifiers and analog Integrated circuits", McGraw- Hills, 2003.
3. Millman J and Halkias .C., "Integrated Electronics", TMH, 2007.

MEDICAL OPTICS

PE – 03 **3 0 0 3**

COURSE OBJECTIVES

Students should be made to

- Understand the optical properties and interaction of the light with tissue
- Illustrate the photonics devices and detectors used for optical analysis
- Learn about the applications of laser in surgery
- Describe the applications of laser in non-thermal diagnosis
- Illustrates the photodynamic and other therapeutic applications of laser.

UNIT I OPTICAL PROPERTIES OF THE TISSUES **9**

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, LaserCharacteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal- Electromechanical – Photoabalative processes.

UNIT II INSTRUMENTATION IN PHOTONICS **9**

Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors – Time resolved and phase resolved detectors.

UNIT III SURGICAL APPLICATIONS OF LASERS **9**

Lasers in ophthalmology- Dermatology –Dentistry-Urology-Otolaryngology - Tissue welding.

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 application of lasers in biology and medicine.

UNIT V THERAPEUTIC APPLICATIONS

9

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological andnononcological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

TOTAL: 45 HOURS

COURSE OUTCOMES

Students will be able to

CO1: Distinguish the basic properties of light in tissue.
CO2: Illustration about the Instruments used in optics
CO3: Explain the applications of LASER
CO4: Apply the knowledge about Lasers for therapeutic and diagnostic applications
CO5: Explain the application of lasers in therapy

TEXT BOOKS:

1. Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007.
2. Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and Sons, Inc. Publications, 2003.

REFERENCES:

1. Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Pres LC, 2003.
2. Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.
3. R. Splinter and B.A. Hoper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007

PE – 04 **BIOLOGY FOR ENGINEERS** **3 0 0 3**

COURSE OBJECTIVE

- To understand the essentials of basic biological principles
- To understand the importance of Biomolecules
- To study in detail about human physiology

UNIT 1 INTRODUCTION TO CELLS **9**

Cell: Functional unit of living organisms - Cell theory - Prokaryotic and eukaryotic cell – bacterial, plant, animal cells - cell components - functions- cell organization – tissues - basic types -cell division: Mitosis, meiosis, cell cycle regulation

UNIT 2 SOCIAL IMPORTANCE **9**

Application of biological sciences and biotechnology to the society - human health care and medicines - pharmaceuticals and nutraceuticals -food and agriculture- pollution management and environment - Biofuels

UNIT 3INTRODUCTION TO BIOMOLECULES **9**

Biomolecules - classification, salient features - biological significance - carbohydrates, proteins and amino acids - lipids and fats - nucleic acids - vitamins-Enzymes

UNIT 4 HUMAN PHYSIOLOGY **9**

Human Physiology - Different systems associated with humans- Tissues, organ and physiology of the various systems: Digestive, respiratory, circulatory, skeletal, nervous, excretory and reproductive system - Artificial memory and neural network

UNIT 5 MEDICAL IMPORTANCE **9**

Infectious and non-infectious diseases- causative agents, epidemiology, pathogenicity, control and prevention, treatment of AIDS, tuberculosis, Pathology of non-infectious and genetic diseases and disorders - cancer, diabetes mellitus, cardiac diseases- neurological disorders-Parkinson's disease Max.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the students would

CO1: Understand the basics of cells
CO2: Describe the medical importance of different diseases
CO3: Understand the biomolecules
CO4: Describe the Different systems associated with humans
CO5: Illustrate about infectious and non-infectious diseases

TEXT / REFERENCE BOOKS

1. Satyanarayana, U. Biotechnology, 4th Edition, Books and Allied Pvt. Ltd. Kolkata, 2007.
2. Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry. CBS Publications 1993

PE – 05 **3 0 0 3**

WEARABLE MEDICAL SYSTEMS

COURSE OBJECTIVE

- To Learn about challenges and research issues related to wearable sensors
- To design wireless sensor networks
- To learn about Humanistic intelligence
- To have an understanding about IoT
-

UNIT 1 – FUNDAMENTALS OF SENSOR NETWORKS **9**

Introduction to computer and wireless sensor networks and Overview of the syllabus , Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints - node architecture-sensing subsystem, processor subsystem communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

UNIT 2- COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS **9**

Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time SynchronizationClock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols - Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization

UNIT 3 - CYBERNETICS AND HUMANISTIC INTELLIGENCE **9**

Wearables - Augmented Reality – Mixed Reality. Case studies, Oculus Rift , AR versus VR - IoT and Wearables: Smart Cites and Wearable Computing as a form of urban design - Advanced I/O – open Frameworks:Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, sqLite, XML, PHP/Web) - Arduino:Wired/Wireless Networking (hardware vs. USB proxy) - Software serial (RS-232) talking to other devices - Advanced sensor/device communication SPI - Advance IC interfacing / Bitbanging (bitwise operators) - Linux – GPIO

UNIT 4 - THE WORLD OF THE FUTURE – INTERNET OF EVERYTHING **9**

Humanistic Intelligence,. Wearable Computing and IoT (Internet of Things) The scalespace theory; sur/sousveillance; integrity; VeillanceContract; Humanistic Intelligence; MedialityAxis , Overview of Mobile and Wearable Computing, Augmented Reality, and Internet of Things. The fundamental axes of the Wearables + IoT + AR space - Freeroaming AR: Wearable Computing, Wireless, Sensing, and Metasensing with light bulbs Phenomenal Augmented Reality: Real world physical phenomena as the fundamental basis of mobile and wearable AR.

UNIT 5 - FUTURE AND PERSPECTIVES **9**

Internet of Everything – The Future and perspectives – Challenges, Case studies

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, student will be able to

CO1:	Develop knowledge about the sensor networks in advanced and emerging technologies
CO2:	Explain the mechanisms and characteristics of communication systems
CO3:	Categorise the equipment's that can be integrated with wearable systems
CO4:	Differentiate the wearable technology and illustrates knowledge about internet of things
CO5:	Apply and illustrate the future challenges

REFERENCES

1. "Practical Electronics for Inventors, Third Edition," by Paul ScherzandSimon Monk. 2016

2. Intel Galileo and Intel Galileo Gen 2API Features and Arduino Projects for Linux Programmers, Ramon, Manoel 2014 (Open Access)

3. Fundamentals of Wearable Computers and Augmented Reality, Second Edition by Woodrow Barfield 2015
4. Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design By OmeshTickoo, Ravi Iyer 2016
5. Programming Interactivity, Second Edition By Josha Noble, 2012
6. Programming the Raspberry Pi: Getting Started with Python 2E, 2016

PE-06 **REHABILITATION ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES
Students should be made to

- Understand the basics of rehabilitation engineering
- Illustrate the devices described for mobility functions
- Learn about the orthotic and prosthetic devices
- Describe the technology assistance for vision and hearing impairments
- Illustrates the advancements in the field of rehabilitation

UNIT- I INTRODUCTION TO REHABILITATION ENGINEERING 9
Introduction to Rehabilitation Engineering - PHAATE model - Clinical practice of rehabilitation Engineering - Low technology tools - Service delivery – Universal design - Design based on human ability - Standards for assistive technology - Test for best design.

UNIT- II MOBILITY AIDS 9
Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Polarized Ultrasonic Travel aids.Seating Assessment - Interventions in seating system - Biological aspects of tissue health - Support surface classification - Manual wheelchairs – Electric power wheelchairs - Power assisted wheelchairs - Wheel chair standards & tests - Wheel chair transportation.

UNIT - III ORTHOTIC & PROSTHETIC DEVICES 9
Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription - Components of upper limb prosthesis - Fabrication of prosthesis - Components of lower limb prosthesis – Orthoses: It"s need and types - Lower extremity- and upper extremity- orthoses - Slints – materials used .

UNIT- IV ASSISTIVE TECHNOLOGY FOR VISION & HEARING 9
Anatomy of eye, Categories of visual impairment - Cortical & retinal implants - Auditory Information Display - Blind mobility aids – reading writing & graphics access, Orientation & navigation Aids - Anatomy of ear – hearing functional assessment - Surgical and non surgical hearing aids - Assistive technologysolutions for hearing Tactile - Information Display.

UNIT -V ADVANCED APPLICATIONS 9
Functional Electrical stimulation - Robots in rehabilitation - Rehabilitation in sports -Daily living aids - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering - Role of biomedical engineering in rehabilitation.

TOTAL: 45 HOURS

COURSE OUTCOMES
Students will be able to

CO1: Explain the introduction and importance of rehabilitation engineering
CO2: Illustrate the principle and working of assistive aids
CO3: Examine the basic fundamentals and working of orthotic and prosthetic devices
CO4: Explain the assistive device for various parts of human body
CO5: Explain advanced applications of Rehabilitation engineering

TEXTBOOKS:

1. Rory A, Cooper, Hisaichi Ohnabe, Douglas A, Hodson, "An Introduction to Rehabilitation Engineering", CRC Press, First edition, 2006.

REFERENCES:

1. Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visuallyimpaired and blind people", Springer Publications, First edition, 2008.
2. Suzanne Robitaille, "The illustrated guide to Assistive technology and devices–Tools and gadgets for living independently", Demos Health Newyork, First edition, 2010

PE – 07 **EFFECTS OF RADIATION AND RADIATION SAFETY** **3 0 0 3**

COURSE OBJECTIVE

- To provide a broad knowledge on the interaction of Non-Ionizing radiation
- To learn about affects of ultrasound in tissues and their use in medicine.
- To have a better understanding about radiation monitoring instruments

UNIT I REVIEW OF NONIONISING RADIATIONPHYSICS IN MEDICINE **9**

Different sources of Non Ionising radiation-their physical; properties-first law of photochemistry-Law of reciprocity- - Electrical Impedance and Biological Impedance - Principle and theory of thermography - applications

UNIT 2 TISSUE OPTICS **9**

Various types of optical radiations - UV, visible and IR sources - Lasers: Theory and mechanism- Laser Surgical Systems-Measurement of fluence from optical sources - Optical properties of tissues – theory and experimental techniques-interaction of laser radiation with tissues – photothermal -photochemical – photoablation – electromechanical effect

UNIT 3 PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS **9**

Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors – Ion chamber dosimetry systems - free air ion chamber – parallel plate chamber - ionization chamber – proportional chamber - GM counter – condenser type chambers and thimble chambers working and different applications – film dosimeteryLuminescence dosimetry – semiconductor dosimetry – Gel dosimetry - – radiographic and radiochromic films – scintillation detections.

UNIT 4 RADIATION MONITORING INSTRUMENTS **9**

Introduction – operational quantities for Radiation monitoring – Area survey meters – Ionization chambers – proportional counters – neutron area survey meters – GM survey meters – scintillation detectors – Personal monitoring – film badge – TLD – Properties of personal monitors - Radiophtoluminesce glass dosimetry system – OSLD

UNIT 5 RADIATION TREATMENT PLANNING PARAMETERS **9**

Build-up, central axis depth doses for different energies and their determination - Tissue Air Ratio, Tissue Maximum Ratio and Tissue Phantom Ratio - their relationship - back scatter factor –phantom scatter factor – collimator scatter factor - source to surface distance –dependence of SSD

TOTAL: 45 HOURS

COURSE OUTCOME:

At the end the Students will be able

CO1: Explain the understanding of radiation physics in medicine

CO2: Explain the applications of optics

CO3: Describe the radiation detection system and its applications

CO4: Analyse the radiation monitoring system and the treatment planning

CO5: Analyse the applications of radiation in therapeutic systems

PE – 08 **TELEHEALTH TECHNOLOGY** **3 0 0 3**

TEXT BOOKS:

1. F M Khan-Physics of Radiation Therapy, 3rd Edition,Liippincott Williams & Wilkins,USA, 2003.
2. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
3. Radiation oncology physics : A Handbook for teachers and students. IAEA publications 2005.
4. F.M.Khan,The Physics of Radiation Therapy,Third Edition,Lippincott Williams and Wilkins,U.S.A.,2003.
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COURSE OBJECTIVES:

The students should be made to

- Learn the key principles for telemedicine and health
- Understand telemedical technology.
- Understand ethical and legal aspects of Telemedicine.
- Know telemedical standards, mobile telemedicine and it applications.

UNIT I FUNDAMENTALS OF TELEMEDICINE **9**

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE **9**

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE **9**

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM **9**

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE **9**

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine.

TOTAL : 45 HOURS

COURSE OUTCOMES:

At the end of this course, the student should be able to

CO1: Illustrate the fundamentals of Telemedicine
CO2: Explain about the communication system and its work flow
CO3: Explain the various aspects based on which communication is done
CO4: Describe the communication system
CO5: Describe the applications of telehealth technology

TEXTBOOKS:

1. Norris A C, ―Essentials of Telemedicine and Telecare‖, John Wiley, New York, 2002.
2. H K Huang, ―PACS and Imaging Informatics: Basic Principles and Applications‖ Wiley, New Jersey, 2010.

REFERENCES:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, ―Handbook of Telemedicine‖, IOS Press, Netherland, 2002. 2. Khandpur R S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, ―Pacs: A Guide to the Digital Revolution‖, Springer, New York, 2002.

4. Khandpur R S, ―TELEMEDICINE – Technology and Applications‖, PHI Learning Pvt Ltd., New Delhi, 2017.

PE – 09 **BIOPHOTONICS** **3 0 0 3**

COURSE OBJECTIVES:

The students should be made to

- Impart adequate knowledge on various optical systems used in sensing and imaging of biological elements.
- Educate about the various interaction mechanisms of light with matter
- Understand the working principles of optical imaging systems
- Gain knowledge biosensors
- Understand the photodynamic therapy

UNIT- I LIGHT - MATTER INTERACTION & PRINCIPLE OF OPTICS 9

Light matter interaction: Interaction of light with bulk matter- Types of spectroscopy: Electronic absorption-, Electronic luminescence-, Vibration-, and Fluorescence spectroscopy.

UNIT- II BIO-IMAGING: PRINCIPLES AND TECHNIQUES 9

Introduction of optical imaging, Types of microscopy: Transmission-,Fluorescence-,Scanning- and Multi-photon- microscopy- Advantages and disadvantages of optical imaging-Applications of optical imaging.

.UNIT – III OPTICAL BIOSENSORS 9

Principles of Optical biosensing, Immobilization of bio-recognition elements, Types of optical biosensor: Fiber optic-, Planar waveguide-, Evanescent-,Interferometric-, and Surface plasmon resonance- biosensor- Advantages and disadvantages- Applications.

UNIT- IV FLOW CYTOMETRY 9

Flow cytometry: Basis, Components, and Flourochromes- Data manipulation and Presentation.

UNIT- V PHOTODYNAMIC THERAPY 9

Photodynamic therapy: Mechanism, and light irradiation- Photo-hemotheraphy- PUVA Technique-Applications.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Explain about light matter interaction.
CO2: Articulate the knowledge regarding interaction mechanisms.
CO3: Analyze the use of optical biosensors.
CO4: Explain about equipments used in biophotonis.
CO5: Explain about the principles and techniques of various therapies done with light

TEXTBOOKS:

1. Jurgen Popp, Valery V, Techin, Arthur Chiou, Stefen Heinemann, "Handbook of Biophotonics Vol 2: Photonics for Health Care*"*, John Wiley & Sons, First Edition, 2012.
2. Paras N, Prasad*, "*Introduction to Biophotonics*"*, John Wiley & Sons, First Edition, 2003.

REFERENCES:

1. Harold Sackman, Brian Wilson, Valeri Viktorovich Tuchin, S. Tanev, Harold Sackman *"*Advances in Biophotonics*"*, IOS Press, 2005.
2. Paras N Prasad, "Nanophotonics", John Wiley & Sons, First Edition, 2004.

PE – 10 **CLINICAL ENGINEERING** **3 0 0 3**

COURSE OBJECTIVE

- To understand the essentials of basic biological principles
- To learn about Hospital Organization and the Role of Clinical Engineering
- To learn about Clinical Engineering Programs
- To clear view of The Health Care Delivery System, Strategic Technology Planning, Technology Assessment,
- To learn about Quality Improvement, Standard Database, Measurement Indicators

UNIT 1 CLINICAL ENGINEER **9**

Definition, Evolution of Clinical Engineering – interactions of a clinical engineer , Hospital Organization and the Role of Clinical Engineering, Clinical Engineering Programs

UNIT -2 MANAGEMENT AND ASSESSMENT OF MEDICAL TECHNOLOGY AND RISK FACTORS **9**

The Health Care Delivery System, Strategic Technology Planning, Technology Assessment, Equipment Assets Management. Risk Management – Strategies, Risk Management: Application

UNIT -3 QUALITY OF IMPROVEMENT AND TEAM BUILDING **9**

Deming's 14 Points, Zero Defects, TQM (Total Quality Management) and Tools Used for Quality Improvement, Standard Database, Measurement Indicators.

UNIT -4 CLINICAL STANDARDS **9**

Standards Regulatory and Assessment Agencies, Standards for clinical Engineers, Regulatory Agnecies, Technology Assessment Agencies

UNIT -5 APPLICATIONS OFVIRTUAL INSTRUMENTS IN HEALTH CARE **9**

Application with Examples , Trending, Relationships, and Interactive Alarms, Data Modeling,0 Medical Equipment Risk Criteria, Peer Performance Reviews

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the students would

CO1: Explain about role of clinical engineering

CO2: Illustrate on the health care system and hospital organization

CO3: Interpret tools in clinical engineering

CO4: Categorize various health care delivery system based on asesssment

CO5: Apply the recent trends of clinical Engineering in health care

REFERENCES

1. Handbook of Biomedical Engineering-Joseph Bronzino, 2000
2. Principles of Biomedical Engineering-Joseph Bronzino

PE – 11 **3 0 2 4**

BASICS OF PYTHON AND MATLAB SOFTWARES

COURSE OBJECTIVES:

- To know the basics of algorithmic problem solving in python and MATLAB
- To read and write simple Python programs.

UNIT I BASICS OF PYTHON **9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs

UNIT II CONTROL FLOW, FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT III LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT IV MATLAB – BASICS **9**

Introduction to MATLAB, Variables and Assignment Statements - Initializing, Incrementing, and Decrementing, Expressions, Characters and Encoding, Vectors and Matrices – creating rows, coloumns, matrix,

UNIT V MATLAB PROGRAMMING **9**

MATLAB Scripts, Input and output, Scripts to Produce and Customize Simple Plots, Introduction to File Input/Output (Load and Save), User-Defined Functions, Selection Statements – if, else if, switch, menu. Looping – for, while, Vectorsing, Illustrative programs.

PRACTICAL:

1. Introduction to Python Programming
2. Basic arithmetic and logical functions using python
3. Compute the GCD of two numbers.
4. Conditional statements
5. Find the square root of a number (Newton's method)
6. Exponentiation (power of a number)
7. Find the maximum of a list of numbers
8. Linear search and Binary search
9. Selection sort, Insertion sort & merge sort
10. First n prime numbers
11. Multiply matrices
12. Basic MATLAB programming

COURSE OUTCOMES: Upon completion of the course, students will be able to

CO1: Develop knowledge about basics of python
CO2: Determine knowledge about programs execute simple Python programs.
CO3: Analyse the various additional features in python
CO4: Develop knowledge about basics of MATLAB software
CO5: Determine and execute knowledge about MATLAB programming

TEXT BOOKS.

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

2. Stromy Attaaway, "Matlab: A Practical Introduction to Programmingf and Problem Solving", Elsevier,
2009.

COURSE OBJECTIVES

The student should be made to

- Understand the basics of Robotics, Kinematics.
- Understand the basics of Inverse Kinematics.
- Explore various kinematic motion planning solutions for various Robotic configurations.
- Explore various applications of Robots in Medicine.

UNIT – I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT – II MOTORS AND SYSTEMS 9

Hydraulic, pneumatic and electric drives determination of HP of motor and gearing ratio variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT – III MANIPULATORS, ACTUATORS AND GRIPPERS

9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – various types of grippers – design considerations.

UNIT- IV POWER SOURCES AND SENSORS

9

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, variable speed arrangements, Path determination - Machinery vision, Ranging Laser- Acoustic, Magnetic fiber optic and Tactile sensor.

UNIT - V ROBOTICS IN MEDICINE

9

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

TOTAL: 45 HOURS

PRACTICALS

1. Basics of robotic systems.
2. Analyse the power sources in robotics system
3. Analyse the functions of actuators
4. Analyse the Internal and external sensors.
5. Basics of manipulators
6. Analyse the Grippers
7. Analyse and illustrate the tactile sensors
8. Robot programming and simulation for pick and place
9. Robot programming and simulation for Colour identification
10. Robot programming and simulation for Shape identification

COURSE OUTCOMES:

At the end of the course student should be able to

CO1:Acquire basic knowledge on robotics

CO2:Understand the basic concept of robots and its types

CO3:Acquire information about robots and its kinematics

CO4:Understand the various types of equipments that can be integrated with robotics

CO5:applications of robots along with the advantages and disadvantages

TEXT BOOK

1. Niku Saeed B, Introduction to Robotics: Analysis, System, Applications, PHI Publishers.
2. Tony Hyland, Scientific and Medical Robotics, Smart Apple Media Publishers, 2007.
3. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

REFERENCES:

1. Staugaard, Andrew C,―Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning, Prentice Hall Of India, 1987
2. Grover, Wiess, Nagel, Oderey, ―Industrial Robotics: Technology, Programming and Applications‖, McGraw Hill, 1986.
3. Wolfram Stadler, ―Analytical Robotics and Mechatronics‖, McGraw Hill, 1995.
4. Saeed B. Niku, ―Introduction to Robotics: Analysis, Systems, Applications‖, Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, ―Robotics‖, McGraw Hill, 2008.

PE – 13 **3 0 2 4**

PATTERN RECOGNITION AND NEURAL NETWORKS

COURSE OBJECTIVES:

The student should be made to:

- The course will introduce the student to the fundamentals of pattern recognition and its application.
- The course will discuss several supervised and unsupervised algorithms suitable for pattern classification
- Particular emphasis will be given to computational methods such as linear discriminant functions and nearest neighbor rule.
- The course also covers basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision.
- The major focus of this course will be on the use of Pattern and Neural Classifiers for classification applications.

UNIT I INTRODUCTION AND SUPERVISED LEARNING 9

Overview of Pattern recognition, Types of Pattern recognition, Parametric and Nonparametric approach, Bayesian classifier, Discriminant function, non parametric density estimation, histograms, kernels, window estimators, k- nearest neighbor classifier, estimation of error rates.

UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS 9

Unsupervised learning- Hierarchial clustering- Single-linkage Algorithm, Complete – linkage Algorithm, Average-linkage algorithm and Ward's method. Partitional clustering- Forgy's Algorithm, k-means algorithm and Isodata Algorithm

UNIT III INTRODUCTION AND SIMPLE NEURAL NET 9

Elementary neurophysiology and biological neural network- Artificial neural network-Architecture, biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

UNIT IV BACK PROPAGATION AND ASSOCIATIVE MEMORY 9

Back propagation network, generalized delta rule, Bidirectional Associative memory Hopfield Network

UNIT V NEURAL NETWORKS BASED ON COMPETITION 9

Kohonen Self organizing map, Learning Vector Quantisation, Counter Propagation network

TOTAL: 45 HOURS

PRACTICALS

1. To Design and train a perceptron for AND Gate.
2. To design and train a perceptron training for OR gate.
3. To design and train a perceptron training for EX-OR gate.
4. To design and train a perceptron for NOT gate.
5. To design KNN classifier for classification of data
6. To design BPN network for classification
7. To design SOM networks for analysing the data
8. To design and train a perceptron for identifying ODD and EVEN number.
9. To create a Bi-directional Associative Memory (BAM) for ID and telephone number.
10. To design and train the Hopfield net to map the input vector with the stored vector and correct them

COURSE OUTCOME

CO1: Apply the basic concepts in pattern recognition.

CO2: Utilize Unsupervised learning algorithms to solve problems.

CO3: Apply the concepts and techniques of neural networks

CO4: Construct and develop neural network systems.

CO5: Solve neural network and patterns based on competition.

TEXT BOOKS:

1. Duda R.O. Hart P.G, “Pattern Classification and scene analysis”, Wiley Edition 2000 .
2. Hagan, Demuth and Beale, “Neural network design”, Vikas Publishing House Pvt Ltd., New Delhi, 2002.

REFERENCES:

1.Freeman J.A., and Skapura B.M, “Neural Networks, Algorithms, Applications and Programming Techniques”, Addison - Wesley, 2003.
2.Earl Gose, Richard Johnsonbaugh Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt Ltd., New Delhi, 1999.
3.Robert Schalkoff, “Pattern recognition, Statistical, Structural and neural approaches” John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.
4.Laurene Fausett, “Fundamentals of neural networks- Architectures, algorithms and applications”,Prentice Hall, 1994

PE – 14 **3 0 2 4**

PATHOLOGY AND MICROBIOLOGY

COURSE OBJECTIVES:

The student should be made to:

- Gain a knowledge on the structural and functional aspects of living organisms.
- Gain a knowledge on fluids and disorders.
- Know the etiology and remedy in treating the pathological diseases.
- Empower the importance of public health.

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

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

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS **9**

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

UNIT III MICROBIOLOGY **9**

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

UNIT IV MICROSCOPES **9**

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

UNIT V IMMUNOPATHOLOGY

9

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

TOTAL : 45 HOURS

PRACTICALS

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope
3. Histopathological slides of benign and malignant tumours.
4. Manual paraffin tissue processing and section cutting (demonstration)
5. Bleeding time and clotting time.
6. Basic staining – Hematoxylin and eosin staining.
7. Special stains – Cresyl Fast Blue (CFV)- Trichrome – oil red O – PAS
8. Simple stain.
9. Gram stain.
10. AFB stain.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Explain the importance of study of pathology and microbiology
CO2: Illustrate the importance and cycle of a cell in human body
CO3: Examine the structure and functions pathogens
CO4: Explain the various type of equipments used in microbiology
CO5: Analyze about tests to assess the different staining procedures

TEXT BOOKS:

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, 2017 10th edition. (Units III,IV and V).

REFERENCES:

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Dubey RC and Maheswari DK. ―A Text Book of Microbiology‖ Chand & Company Ltd, 2007
3. Prescott, Harley and Klein, ―Microbiology‖, 10th edition, McGraw Hill, 2017

PE – 15 **ANALOG AND DIGITAL COMMUNICATION** **3 0 0 3**

COURSE OBJECTIVES:

The student should be made to:

- Understand analog communication techniques.
- Learn data and pulse communication techniques.
- Learn basics digital communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

UNIT I ANALOG COMMUNICATION **9**

Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II PULSE AND DATA COMMUNICATION **9**

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM). **Data Communication:** History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.

UNIT III DIGITAL COMMUNICATION **9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV SOURCE AND ERROR CONTROL CODING **9**

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes - ARQ Techniques.

UNIT V MULTI-USER RADIO COMMUNICATION **9**

Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TOTAL: 45 HOURS

PRACTICALS

1. Active filter – first order LPF and HPF
2. Wein bridge oscillator
3. Multivibrator using IC555 Timer
4. Generation of AM signals
5. Introduction to Phased Locked Loop
6. MATLAB Basics for Communication System Design
7. Study of logic gates, Half adder and Full adder
8. Multiplexer and demultiplexer using digital ICs
9. Universal shift register using flipflops
10. Design of mod-N counter

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Apply the various communication techniques.
CO2: Apply the advanced digital communication techniques.
CO3: Illustrate the basics of digital communication techniques.
CO4: Analyze Source and Error control coding.
CO5: Determine knowledge about radio and digital communication.

TEXT BOOK:

1. Wayne Tomasi, ―Advanced Electronic Communication Systems‖, 6th Edition, Pearson Education, 2009.

REFERENCES:

1. Simon Haykin, ―Communication Systems‖, 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha, ―Principles of Communication‖, 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, ―Modern Analog and Digital Communication Systems‖, 3rd Edition, Oxford University Press, 2007.

PE-16 HOSPITAL MANAGEMENT 3 0 0 3

Course Objectives

The students should be made to

- Understand the fundamentals of hospital administration and management.
- Know the market related research process
- Explore various information management systems and relative supportive services.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9 hours

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9 hours

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

UNIT III MARKETING RESEARCH PROCESS 9 hours

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 hours

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 hours

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

TOTAL : 45 hours

Text Books:

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.
2. G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

Reference Books:

1. Cesar A.Caceres and Albert Zara, ―The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, ―Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman ―Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.
4. William A. Reinke ―Health Planning For Effective Management‖ - Oxford University Press.1988

Web Links:

COURSE OUTCOMES

CO1: Understand the functions of management and administration of hospitals.
CO2: Apply various principles of planning and management in implementing health projects and programmes.
CO3: Analyze the various components of health care delivery system in India.
CO4: Integrate healthcare ethics with business and industry knowledge.
CO5: Evaluate the knowledge and understanding of concepts, theories, laws, tools, and practices in Budgeting, financial reporting and control, Management and organization

PE – 17 **NEUROSCIENCE FOR BIOMEDICAL APPLICATIONS** **3 0 0 3**

Course Objectives

The students should be made to

- This course encompasses a scientific study of human nervous system.
- It Includes different approaches to study the molecular, cellular, developmental, structural, functional, evolutionary, and medical aspects of nervous system
- It addresses the mechanisms of how neurons process signals physiologically and electrochemically.

UNIT I INTRODUCTION TO NEUROSCIENCE. 9 hours

An overview of neuroscience, Applications of neuroscience, Neurons and Neuroglia, Neurotransmitters

UNIT II NERVOUS SYSTEM 9 hours

Nervous system: central nervous system, peripheral nervous system, autonomic nervous system; anatomical organization of the nervous system, functional organization of the nervous system, neurons-the nerve cell, CSF

UNIT III ELECTRICAL PROPERTIES OF NERVOUS SYSTEM 9 hours

Electrolytes within our neurons; Ion channels, Local signaling, Signal propagation - Action potential, Synapse, Synaptic integration, Modulation of synaptic transmission, Nerve-Muscle interaction

UNIT IV NEURAL NETWORKS 9 hours

Current flow in neurons, Introduction to electro diagnostic signals and their measurement, nerve conduction study, evoked potentials and EEG

UNIT V CHALLENGES 9 hours

Neuroscience methods and techniques to understand the functions of nervous system – Pathology of Nervous system – Molecular and cellular mechanisms of Parkinson's, Huntington's, Stroke and Alzheimer's diseases.

TOTAL : 45 hours

Text Books:

1. Richard S Snell, Clinical Neuro Anatomy, Lippincott Williams & Wikkins,2006
2. W.F Ganang Review of Medical Physiology, Mc Graw Hill Professional, 21st Edition, 2003

Reference Books:

1. A Krishnamurti Notes on Nervous System, Janagam Offset Printers, 1999
2. Eric R Sandel, Principles of Neural Science, Elsevier, 4th Edition,2000
3. U.K.Misra, Clinical neurophysiology, Elsevier Health Science, 2006 6. James D Fix, Neuroanatomy, William and Wilkins, 2nd Edition, 1995

COURSE OUTCOMES

CO1: Understanding the basics of neuroscience
CO2: Illustrate about the nervous system
CO3: Appreciation of how physiological signals can help us to understand motor and sensory systems
CO4: Knowledge of the current level of development of the field of Neuroscience
CO5: Analyse the challenges and mechanisms of different neurological disorders

PE –18 BIO MEMS AND NANOTECHNOLOGY 3 0 0 3

Course Objectives

The students should be made to

- Acquire knowledge about the principles of BioMEMS & Biomedical Nanotechnology.
- Understand the working principle of MEMS & Microsystems.
- Understand the application of BioMEMS

UNIT I MEMS & MICROSYSTEM 9 hours

MEMS and Microsystems- Introduction - Typical MEMS and Microsystem Products - Application of Micro-system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation - MEMS with Microactuation – Micro-accelerators & Micro-fluidics - Materials for MEMS & Microsystems

UNIT II MICRO-OPTO ELECTROMECHANICAL SYSTEMS & MICROFLUIDICS 9 hours

Fundamental principle of MOEMS Technology - Light Modulators, Beam splitter – Microlens, Micro-mirrors - Digital Micro-mirror Device, Light detectors - Important Consideration on Micro-scale fluid, Properties of fluid - Fluid Actuation Methods – Micro-pumps – Typical Micro-fluidic Channel, Micro-fluid Dispenser.

UNIT III BIOMEMS 9 hours

BIOMEMS-Introduction, the driving force behind the biomedical Application - Principle of Biosensor, Ampero-metric Biosensor - Multi-analyte measurement, Micro-dialysis - BioMEMS for Clinical Monitoring - Multi-parameter monitoring - Monitoring of Glucose & Lactate with a micro-dialysis probe – Ammonia Monitoring - Electronic Nose, DNA Sensors.

UNIT IV DNA BASED BIOMEMS 9 hours

Introduction, Unique features of Nucleic Acids,Lab on the Chip, Electrophoresis, Polymerase Chain Reaction (PCR), Biochemical reaction chains for integration: Biosensors & the "lab biochip", Typical Microarray experiment, Manufacturing of Microarrays, Synthesis on the chip, Spotting Techniques, PCR on the chip, Microchamber Chips, Micro-fluidics Chips, Emerging BioMEMS Technology

UNIT V BIOMEDICAL NANOTECHNOLOGY 9 hours

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.

TOTAL : 45 hours

Text Books:

1. Steven S, Saliterman, "Fundamentals of BioMEMS & Medical Microdevices*",*International Society for Optical Engineering, First Edition 2006.
2. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill, 2nd Reprint 2008.
3. Wanjun Wang & Steven A.Soper , "BioMEMS- Technologies and applications", CRC Press, First edition 2007.

Reference Books:

1. Tai-Ran Hsu, "MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering*"*, John Wiley & Sons, 2nd Edition 2008.
2. Gerald A Urban, "BioMEMS*",* Springer, First Edition 2006.
3. Abraham P. Lee and James L. Lee, "BioMEMS and Biomedical Nanotechnology",Volume I, Springer, First Edition 2006.
4. Paul C.H. Li, "Introduction to Microfluids and BioMEMS: A Design and Problem- SolvingTextbook", CRC Press, First Edition 2009.
5. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, First Edition 2002.
6. Guozhong Cao & Ying Wang, "Nanostructures and Nanomaterials-Synthesis, Propertiesand Applications*",* World Scientific, 2nd Edition 2011.

COURSE OUTCOMES

CO1: Understand the knowledge to design solutions to probe biomedical and biology systems
CO2: Apply the integration of mechanical and electrical elements nof biomems and nanotechnology
CO3: Examine the basic design and operation of BioMEMS sensors and transducers, and Biochips

CO4: Demonstrate a detailed understanding of the fundamental principles of nanotechnology and their application to biomedical engineering.

CO5: Evaluate and employ electrical measurements for MEMS mechanical structure characterization, understanding possible problems encountered in living systems

PE –19 **BIOLOGICAL EFFECTS OF RADIATION** **3 0 0 3**

Course Objectives

The students should be made to

- To learn about effects of radiation in the biological system.
- To learn about protocols of different human tissues
- To learn in detail about microwave ,UV, RF transmitters

UNIT I ACTION OF RADIATION IN LIVING CELLS 9 hours

Various theories related to radiation at cellular level. DNA and chromosomal damages.

UNIT II SOMATIC APPLICATION OF RADIATION 9 hours

Radio sensitivity protocols of different tissues of human. LD50/30 effective radiation on skin. Bone marrow, eye,
endocrine glands, and basis of radio therapy.

UNIT III GENETIC EFFECTS OF RADIATION 9 hours

Threshold and linear dose, gene control hereditary diseases effect of dose

UNIT IV EFFECT OF MICROWAVE AND RF WITH MATTERS 9 hours

Effects of various human organs and systems, Wavelength in tissue, non thermal interaction.Standards of protection, national, and international standards and precautions.

UNIT V UV RADIATION 9 hours

Classification of sources, measurement, photo medicine, UV radiation, safety visible and infrared Radiation.

TOTAL : 45 hours

Reference Books:

1. Paul Fryer, Duncan Ward, Radiatiom, White Cube Publishers (2008).
2. Steve Forshier, Essential of Radiation Biology and Protection, Delmar Publishers (2008).

COURSE OUTCOMES

CO1: Understanding the basics of ionizing radiation biological effects and risks from cellular to human.
CO2: Planning and implementing radiation protection education/information for patients, general public or professionals.
CO3: Applying Radiation Protection Act and the relevant radiation protection regulations.
CO4: Explain the principles of radiation protection for both ionizing and non-ionizing radiation.
CO5: Analyse the effects of UV Radiation

PE –20 BIOMETRIC SYSTEMS 3 0 0 3

Course Objectives

The students should be made to

- To understand the technologies of fingerprint, iris, face and speech recognition
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To recognize personal privacy and security implications of biometrics based identification technology.
- To identify issues in the realistic evaluation of biometrics based systems.

UNIT I INTRODUCTION TO BIOMETRICS 9 hours

Introduction and back ground – biometric technologies – passive biometrics – active biometrics -Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications –biometric characteristics- Authentication technologies –Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics

UNIT II FINGERPRINT TECHNOLOGY 9 hours

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement– Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY 9 hours

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers -Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm –Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION 9 hours

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy –training and adaptability – examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION 9 hours

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation- Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location –local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication

TOTAL : 45 hours

Text Books:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”, Springer, 2005 (Units I, II, III & IV)
2. S.Y. Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach” Prentice Hall, 2005(Unit V)

Reference Books:

1. Paul Reid, “Biometrics for Network Security”, Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, “Automatic fingerprint Recognition System”, Springer, 2003
3. L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and Face Recognition” CRC Press, 1999.
4. John Chirillo, Scott Blaul, “Implementing Biometric Security”, John Wiley, 2003.
5. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain, “Handbook of Multibiometrics”, Springer, 2006.

COURSE OUTCOMES

CO1: Understand the technological uplifts with biometrics compared to traditional securing mechanisms.
CO2: Gain knowledge in building blocks of research fields in biometric systems
CO3: Describe the recognition systems involved in biometrics
CO4: Evaluate the performance of biometric systems.
CO5: Analyze design basic biometric system authentication

PE-21 ARTIFICIAL INTELLIGENCE AND DEEP LEARNING 3 0 2 4

COURSE OBJECTIVES:

The student should be made to:

- Study the basic concepts and implementation of AI and Deep learning
- Understand the techniques and applications of AI and Deep learning

UNIT -I BASICS OF AI 9

General AI Goal, Engineering based AI Goal, Science-based AI Goal. Techniques that make system to behave as Intelligent, Describe and match, Goal reduction, Constraint satisfaction, Tree Searching, Generate and test, Rule based systems, Biology-inspired AI techniques, Neural Networks, Genetic Algorithms, Reinforcement learning.

UNIT -II BRANCHES OF AI 9

Logical AI, Search in AI, Pattern Recognition, Knowledge Representation, Inference, Commonsense knowledge and reasoning, Learning, Planning, Epistemology, Ontology, Heuristics, Genetic programming.

UNIT-III APPLICATIONS OF AI 9

Game playing, Speech Recognition, Understanding Natural Language, Computer Vision, Expert Systems.

UNIT IV DEEP NETWORKS BASICS 9

Linear Algebra: Scalars -- Vectors -- Matrices and tensors; Probability Distributions – Gradient based Optimization – Machine Learning Basics: Capacity -- Overfitting and underfitting -- Hyperparameters and validation sets -- Estimators -- Bias and variance -- Stochastic gradient descent -- Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization -- Optimization.

UNIT V CONVOLUTIONAL NEURAL NETWORKS 9

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers -- Gradient Computation.

TOTAL:45 HOURS

PRACTICAL:

1. Study of Artificial Intelligence
2. Implementation of Hidden Markov Models
3. Solving XOR problem using Multilayer perceptron
4. Implement character and Digit Recognition using ANN
5. Implement CNN for basic data
6. Speech recognition using AI
7. Implement Support vector machines for Analysis
8. Solve and analyse statistical parameters using ANN
9. Solve and analyse a biomedical data using deep learning

TOTAL:45 HOURS

COURSE OUTCOME:

At the end of the course, the student should be able to

CO1: Illustrate the basic concepts of AI and deep learning.
CO2: Understand the functioning of different forms of AI and deep learning
CO3: Analyse the approaches and techniques in AI and deep learning
CO4: Examine the implementation and analysis of AI and deep learning
CO5: Explain the applications and networks for AI and deep learning

TEXT BOOKS

T1. S. Russell, P. Norvig , Artificial Intelligence,Prentice Hall

T2. E.Rich, K. Knight, Artificial Intelligence, McGraw Hill
T3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016
T4. Stone, James. (2019). Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep
Learning, Sebtel Press, United States, 2019

PE-22 VIRTUAL INSTRUMENTATION IN MEDICINE 3 0 2 4

COURSE OBJECTIVES:

The student should be made to:

- Impart adequate knowledge on Virtual Instrumentation for acquisition and analysis of signals in medical system.
- Educate about the Basic concepts of VI,programming concepts of VI
- Enable to implement VI in medical systems

UNIT I - INTRODUCTION TO VIRTUAL INSTRUMENTATION 8

Virtual instrumentation (VI): Evolution, Definition, Architecture- Conventional-, and, Comparison of VI with traditional Instruments, Need of VI, advantages, block diagram, data flow techniques, graphical programming, Comparison between graphical programming and conventional programming.

UNIT II - PROGRAMMING MODES IN VI 10

front panel, Block diagram, LABVIEW Environment: Startup-, Shortcut-, and Pull down menu, Palletes, Control structures: FOR loop, WHILE loop, Shift Registers, feedback nodes, Selection Structures: Case and sequence structures, Formulae nodes, Arrays, Clusters, Waveform Chart and graph, XY Graph, Strings, Tables, File I/O functions.

UNIT III - HARDWARE ASPECTS OF VI SYSTEM 9

Digital I/O Techniques: pull-up and pull down resistors, TTL to solid state Relays, Voltage dividers, data acquisition in LABVIEW, hardware installation and configuration, Data acquisition (DAQ): Components, Accessories, Hardware, and Software.

UNIT IV - COMMON INSTRUMENT INTERFACE 10

Current loop:4-20mA,60mA, RS232, RS422, RS485, General purpose interface bus(GIPB) ,Virtual Instrument Software Architecture (VISA), Universal serial port bus(USB), Peripheral computer interface (PCI), VME extensions for instrumentation (VXI), PCI extensions for Instrumentation (PXI), Personal Computer Memory Card International Association (PCMCIA), Signal conditioning extension for instrumentation (SCXI).

UNIT V - ANALYSIS TOOLS AND APPLICATIONS OF VI 8

Fourier transform, Power spectrum, Correlation, Windowing, filtering, Oscilloscope, Waveform generator, Multi-channel data acquisition using LABVIEW, Biomedical applications.

COURSE OUTCOMES: **TOTAL: 45 HOURS**

At the end of the course, the student should be able to:

CO1: Explain about the basic concepts involved in Virtual instrumentation
CO2: Articulate the different modes in VI
CO3: Examine about the concepts of Virtual Instrumentation
CO4: Explain about the interface and programming of VI
CO5: Experiment the principles and applications of VI

TEXT BOOKS

T1. Gary Jonson, “Labview Graphical Programming”, Second Edition, McGraw Hill, New York, Fourth edition 2006.
T2. Lisa K. wells & Jeffrey Travis, “Labview for everyone”, Prentice Hall Inc., New Jersey;First edition 1997.

REFERENCES

R1. Gupta S, Gupta J P, “PC interfacing for Data Acquisition & Process Control”, Instrument Society of America, Second Edition, 1994
R2. Technical Manuals for DAS Modules of Advantech and National Instruments

PE-23 HUMAN ASSIST DEVICES 3 0 2 4

COURSE OBJECTIVES:

The student should be made to:

- Study various mechanical techniques in functioning of the human system
- Learn the functioning of the assistive technological devices.
- Understand the tests to assess and development of electronic devices to compensate for the loss.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions

UNIT II CARDIAC ASSIST DEVICES 9

Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra-Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNIT III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV PROSTHETIC AND ORTHOTIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices.

UNIT V RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, Construction and Functional Characteristics

TOTAL:45 HOURS

PRACTICAL:

1. Recording of Audiogram
2. Study of Hemodialysis model
3. Study of oxygenators
4. Study of Ventilators
5. Analysis of the muscle stimulator
6. Measurement of Respiration rate
7. Study of heart-lung machine
8. Analysis of Breathing sequence
9. Design of basic 3D prosthetic devices
10. Study of Cardio valves

TOTAL:45 HOURS

COURSE OUTCOME:

At the end of the course, the student should be able to

CO1: Explain all types of assist devices and its operations.
CO2: Understand biocompatibility and the properties of different types of assistive materials
CO3: Determine the functioning and working of all assistive devices and technologies
CO4: Understand the designing of assistive devices to overcome loss in human system
CO5: Analyze about tests to assess the development of assistive devices

TEXTBOOKS

T1. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.
T2. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.

REFERENCES:

R1. Andreas.F.Von racum, Hand book of bio material evalution, Mc-Millan publishers, 1980.

R2. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc.,New Jersey,1982

R3. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.

PE-24 PRINCIPLES OF 3D PRINTING TECHNOLOGY 3 0 2 4

COURSE OBJECTIVES:

The student should be made to:

- Understand the basic principles and concepts in 3D printing
- Learn the design and implementation skills of 3D printing.

UNIT I 3D PRINTING – INTRODUCTION 9

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT II PRINCIPLE AND APPLICATION OF 3D PRINTING 9

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials – Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection – Processes, applications, limitations; Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Opensource; Future trends

UNIT - III BIOMODELLING 9

Introduction, Surgical Applications of Real Virtuality - Cranio-maxillofacial biomodelling, Use of real virtuality in customized cranio-maxillofacial prosthetics, Biomodel-guided stereotaxy, Vascular biomodelling, Skull-base tumor surgery, Spinal surgery, Orthopaedic biomodelling.

UNIT–IV BIOBUILD SOFTWARE FOR MEDICAL DATA TRANSFER 9

Introduction, Medical Imaging: from Medical Scanner to 3D Model, Computer Approach in Dental Implantology. BioBuild Paradigm - Importing a dataset, Volume reduction, Anatomical orientation confirmation, Volume editing, Image processing, Build orientation optimization, 3D visualization, RP file generation, Future Enhancements

UNIT–V MEDICAL APPLICATIONS FOR 3D PRINTING 9

Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications.

TOTAL:45 HOURS

PRACTICAL:

1. Introduction to 3D printing
2. Study the file formats and data importing
3. Analyse the anatomical 3D orientation
4. Study the volume analysis
5. Study of 3D visualisation
6. Analyse 3D slicing
7. Study of polymer materials
8. Study of 3D modelling of physiological organs
9. Study and design a Mesh for 3D
10. Design of basic components in 3D printing

TOTAL:15 HOURS

COURSE OUTCOME:

At the end of the course, the student should be able to

CO1: Explain all types of assist devices and its operations.

CO2: Understand biocompatibility and the properties and classification of different types of assistive materials

CO3: Determine the functioning and working of all assistive devices and technologies

CO4: Understand the designing of assistive devices to overcome loss in human system

CO5: Analyze about tests to assess the development of assistive devices

TEXT BOOK

T1. Ian Gibson, Advanced Manufacturing Technology for Medical Applications, John Wiley, 2005.

REFERENCES

R1. Paulo Bartolo and Bopaya Bidanda, Bio-materials and Prototyping Applications in Medicine, Springer, 2008.

R2. Joseph D. Bronzino, The Biomedical Engineering Hand Book, 3rd Edition, CRC Press, 2006

R3. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

PE-25 REAL TIME SIGNAL ACQUISITION AND ANALYSIS 3 0 2 4

UNIT -I INTRODUCTION TO REAL-TIME COMPUTATION 9

Data converters (A/D, D/A), machine architecture, software considerations. Sampling theorem, aliasing, quantization, sampled data systems, cardinal (Whitaker) reconstruction, zero-, first-, second-order hold reconstructors, interpolators, non-resetting reconstructors, matched filtering. Interpolation and decimation.

UNIT -II DISCRETE SPECTRAL ANALYSIS 9

The DFT and its relationship to the continuous FT, the FFT and implementations (decimation in time and frequency), radix-2 implementation, leakage, windowing. Uses of the DFT: convolution — (overlap and add, select savings), correlation. Random processes, power spectral density (PSD) estimation — methods of smoothing the periodogram

UNIT -III REAL-TIME SIMULATION METHODS USING DIFFERENCE EQUATIONS 9

Impulse-, step-, ramp-invariant simulations. Tustin's method, matched poles/zeros, bilinear transform methods. Error analysis.

UNIT- IV FILTER DESIGN — CONTINUOUS AND DISCRETE 9

Butterworth, elliptic, Chebyshev low-pass filters. Low-pass design methods based on continuous prototypes. Realizations. Conversion to high-pass, band-pass, band-stop filters. Discrete-time filters: IIR and FIR. Linear phase filters. Frequency sampling filters.

UNIT-V STATISTICAL SIGNAL PROCESSING 9

Linear prediction, adaptive filters (LMS), recursive least-squares.

TOTAL:45 HOURS

PRACTICAL:

1. Basics of signal acquisition and analysis
2. Sampling and Quantisation of biosignals
3. Apply FIR filters for biosignals
4. Apply IIR filters for biosignals
5. Real time Acquisition and analysis of ECG using BIOPAC
6. Real time Acquisition and Analysis of EMG
7. Real time Acquisition and Analysis of EOG
8. Real time Acquisition and Analysis of EEG
9. Computation of FFT to biosignals
10. Compute and analyse the statistical parameters of biosignals

TOTAL:45

HOURS

COURSE OUTCOME:

At the end of the course, the student should be able to

CO1: Understand the concepts in real time signal acquisition and analysis

CO2: Illustrate the computation of real time signals

CO3: Determine the techniques for analysis of real time signals

CO4: Understand the simulation and acquisition process of real time signals

CO5: Analyze the real time signals using various mathematical descriptions.

TEXTBOOKS

T1: Proakis, John G., and Dmitris K. Manolakis. Digital Signal Processing. 4th ed. Upper Saddle River, NJ: Prentice Hall, 2006. ISBN: 9780131873742.

T2: Oppenheim, Alan V., Ronald W. Schafer, and John R. Buck. Discrete-Time Signal Processing. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1999. ISBN: 9780137549207.

PE –26 **PHYSIOLOGICAL MODELING AND SIMULATION** **3 0 0 3**

Course Objectives

The students should be made to

- To explain the application of Physiological models and vital organs.
- To Formulate the methods and techniques for analysis and synthesis of dynamic models
- To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.
- To describe nonlinear models of physiological systems
- To compute the Simulation of physiological systems

UNIT I INTRODUCTION TO PHYSIOLOGICAL MODELING 9 hours

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.

UNIT II MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM 9 hours

Dynamic systems and their control, modeling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.

UNIT III NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS 9 hours

Nonparametric Modeling-Volterra Models.Wiener Models. Efficient Volterra Kernel Estimation.Parametric Modeling- Basic Parametric Model Forms and Estimation ProceduresVolterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.

UNIT IV COMPARTMENTENTAL PHYSIOLOGICAL MODEL 9 hours

Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.Mathematical modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

UNIT V SIMULATION OF PHYSIOLOGICALSYSTEMS 9 hours

Simulation of physiologicalsystemsusing Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.

TOTAL : 45 hours

Text Books:

1. Michel C Khoo, ―Physiological Control Systems -Analysis, simulation and estimation‖, Prentice Hall of India, 2001.

2. Marmarelis, ―Nonlinear Dynamic Modeling of Physiological Systems‖, Wiley-IEEE Press,200**4.**

Reference Books:

1. Benjamin C Kuo, ―Automatic control systems‖, Tenth Edition, McGraw-Hill Education, 2017.

2. DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, WileyIEEE Press, 2003.

3. V.Z. Marmarelis, ―Advanced methods of physiological modeling‖ , Springer, 1989

4. L.Stark,‖ Neurological Control System, Plenum Press‖,1968. 5. John H Milsum , ―Biological control systems‖, McGraw Hill 1966

6. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,―Advanced Computational Methods in Life System Modeling and Simulation‖, Springer,2017 BM

COURSE OUTCOMES.

CO1: Explain the application of Physiological models
CO2: Describe the methods and techniques for analysis and synthesis of Linear and dynamic system
CO3: Examine the methods and techniques for analysis and synthesis of Non linear models
CO4: Deduce differential equations to describe the compartmental physiological model
CO5: Develop simulation model using heuristic methods

PE –27 **CRYPTOGRAPHY AND NETWORK SECURITY** **3 0 0 3**

Course Objectives
The students should be made to

- To learn the fundamental principles of computer and network security by studying attacks on computer systems, network, and the Web.
- To learn how those attacks work and how to prevent and detect them.
- To have a good understanding about Smartphone technology

UNIT I INTRODUCTION AND BASICS **9 hours**

Class Introduction (syllabus, policies, and projects),An Overview of Computer Security,Course projects (labs),Unix Security Basics

UNIT II DATA SECURITY AND STANDARDS **9 hours**

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,
.

UNIT III SOFTWARE SECURITY **9 hours**

Vulnerabilities, Attacks, and Countermeasures, Privileged programs (Set-UID programs) and vulnerabilities ,Buffer Overflow vulnerability and attack,, Return-to-libc attack ,Race Condition vulnerability and attack ,Format String vulnerability and attack ,Input validation,Shellshock attack

UNIT IV WEB SECURITY: VULNERABILITIES, ATTACKS, AND COUNTERMEASURES **9 hours**

Same Origin Policy, Cross-Site Scripting Attack, Cross-Site Request Forgerty Attack ,SQL-Injection Attack ,Click-Jacking Attack ,Web Tracking,Web Proxy and Firewall

UNIT V SMARTPHONE SECURITY **9 hours**

Access control in Android operating system ,Rooting Android devices,Repackaging attacks ,Attacks on apps ,Whole-disk encryption,Hardware protection: TrustZone

TOTAL : 45 hours

COURSE OUTCOMES

CO1: Understand basics of Cryptography and Network Security.
CO2: Explain the standards and security of data
CO3:Analyse the security of the software and its attack systems
CO4: Examine the functional actions of the web security
CO5: Analyse the smartphone security and fucntions

PE-28 REGULATORY ASPECTS IN BIOSCIENCES 3 0 0 3

Course Objective: To provide the ability to gain knowledge of different regulatory aspects in biosciences. To make them understand the regulations of Food and Drug Administration and impart the knowledge about Legal issues and Health policies related to Biosciences.

UNIT- I

INDIVIDUAL AND INSTITUTIONAL RESPONSIBILITY & REGULATION BY FDA & CE 9

Researching a bioethical question, Individual and institutional responsibility, Institutional review boards, Role of independent institutional review boards, The regulation of drugs and biological products by the food and drug administration, CE.

UNIT- II LEGAL ISSUES AND HEALTH POLICY 9

Data and safety monitoring, Legal issues, rules to prevent conflict of interest on human subjects, National institutes of health policy on the Inclusion of women and minorities as subjects, Role and importance of trial registries and results databases.

UNIT- III ETHICAL AND REGULATORY GUIDANCE 9

Immobilization, The Nurenberg code, Declaration of Helsinki: Ethical principles of medical research involving human subjects, The Belmont report: Ethical principles and guidelines for the protection of human subjects, The common rule, Code of federal regulations.

UNIT- IV DISTINCTION BETWEEN RESEARCH AND TREATMENT & THE ETHICS OF RANDOMIZED CLINICAL TRIALS 9

Research and Practice, Demarcating Research and Treatment: A Systematic Approach, The ethics of randomized clinical trials: Problems of the randomized clinical trial, Equipoise and the ethics of clinical research, Randomized controlled trials: Lessons from ECMO.

UNIT- V ROLE OF PLACEBOS IN CLINICAL RESEARCH & CHANGING LANDSCAPE OF HUMAN EXPERIMENTATION 9

The continuing unethical use of placebo controls, Placebo-controlled trials and the logic of clinical purpose, Active control trials in the evaluation of new treatments, The changing landscape of human experimentation.

TOTAL: 45 HOURS

TEXTBOOKS:

1. John I, Gallin, Frederick P, Ognibene "Principles and Practice of Clinical Research", Academic Press, Third Edition, 2012.

2. Ezekiel J, Emanuel, Robert A Crouch, John D Arras, Jonathan D Moreno, Christine Grady, "Ethical and Regulatory Aspects of Clinical Research", Johns Hopkins University Press, First Edition, 2003.

REFERENCES:

1. Michael A, Santoro, Thomas M. Gorrie, "Ethics and the Pharmaceutical Industry", Cambridge University Press, First Edition, 2005.

2. Susan E, Lederer, "Subjected To Science: Human Experimentation in America before the Second World War", Johns Hopkins University Press, First Edition, 1995.

PE –29 **ADVANCED BIOANALYTICAL AND THERAPEUTIC TECHNIQUES** **3 0 0 3**

Course Objectives

The students should be made to

- Gain knowledge about the Light spectrum, Absoprtion, Fluorescence,
- Gain knowledge about the NMR, Mass spectroscopy
- Gain knowledge on the different chromotographic methods for separation of biological products..

UNIT I INTRODUCTION TO SPECTROMETRY 9 hours

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9 hours

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law– Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation– Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications –Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9 hours

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers –applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

UNIT IV SEPARATION METHODS 9 hours

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatographyprinciples of GC and applications – HPLC-Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9 hours

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry –Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL : 45 hours

Text Books:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". Cengage Learning , 2007.

COURSE OUTCOMES

CO1: Explain the introduction and importance of spectrometry
CO2: Illustrate the principle and working of molecular spectroscopy
CO3: Examine the basic fundamentals and working of magnetic resonance spectroscopy and mass spectroscopy
CO4: Explain the separation methods of chromatography
CO5: Develop the skills to understand the theory and practice of bio analytical techniques.

PE –30 **BODY AREA NETWORKS** **3 0 0 3**

Course Objectives

The students should be made to

- Learn about body area networks' and different hardwares related to it
- Learn about wireless communication
- Provide knowledge in the applications of Body Area Networks.

UNIT I INTRODUCTION **9 hours**

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 hours**

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 **9 hours**

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 hours**

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 hours**

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

TOTAL : 45 hours

Text Books:

1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.(Unit I, II, III & V).
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013. (Unit IV).

Reference Books:

1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems",Springer, 2013.
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006.

COURSE OUTCOMES

CO1: Comprehend technical information and challenges in body area networks (BAN)
CO2: Describe the hardware requirements of BAN
CO3: Review the network topologies, protocols and standards used for BAN
CO4: Describe and analyse the Hardware for BAN
CO5: Discuss various applications of BAN.

OPEN ELECTIVE COURSES

(TECHNICAL & MANAGEMENT)

OE-T1 **FIBER OPTICS AND LASERS IN MEDICINE** **3 0 0 3**

Course Objectives

The students should be made to

- To enable the student to understand the basics of tissue properties, instrumentation principles in medical optics and the the therapeutic applications.
- Explain the principles of light emission in LED and LASER
- Learn the surgical applications of LASER
- Basics of holography and its applications

UNIT I TYPES OF LASERS AND DISPLAY DEVICES 9 hours

Lasers-Definition-Types-Working-Helium Neon Laser-Argon Laser-Ruby Laser-Nd:Yag Laser-Semiconductor Laser Diode-LCD display: --liquid crystals, construction and types.

UNIT II OPTICAL PROPERTIES OF THE TISSUES 9 hours

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

UNIT III SURGICAL APPLICATIONS OF LASERS 9 hours

Lasers in ophthalmology- Dermatology – Types of lasers used in dermatology – Dentistry- Types of Dental lasers - Urology – Surgical Laser therapy in urology - Otolaryngology - Tissue welding – Specifications Laser in tissue welding,lasers in ophthalmology.

UNIT IV OPTICAL HOLOGRAPHY &NON THERMAL DIAGNOSTIC APPLICATIONS 9 hours

Wave fronts, interference patterns, principle of hologram, optical hologram, applications,Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and speckle application of lasers in biology and medicine.

UNIT V THERAPEUTIC APP LICATIONS 9 hours

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non oncological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

TOTAL : 45 hours

Text Books:

1. Leon Goldman, M.D., &R.James Rockwell, Jr., “Lasers in Medicine”, Gordon and Breach, Science Publishers Inc., 1975.
2. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic Press Edition,1998.

Reference Books:

1. Tuan Vo Dirh, “Biomedical Photonics – Handbook”, CRC Press, Bocaraton,2003 (Unit I – III, V)
2. Glasser, O., “Medical Physics -- Vol 1, 2, 3 “Adam HilgarBrustolInc, 1987.
3. G.David Baxter “Therapeutic Lasers – Theory and practice”, Churchill Livingstone Publications Edition-2001.

COURSE OUTCOMES

CO1: Describe the laser radiation characteristics and interaction of lasers with tissues
CO2: Explain the types, construction and operation of different laser systems
CO3: Associate the role of different types of laser systems used for biomedical applications
CO4: Understand the applications of laser in ophthalmology, dermatology, urology, gynecology and neurology
CO5: Attain the knowledge on applications of laser in orthopedic surgery, dentistry and precautionary method in laser safety.

OE-T2 **BIOMEDICAL INFORMATICS** **3 0 0 3**

Course Objectives

The students should be made to

- Learn ICT applications in medicine
- Learn health informatics.
- Understand the theories and practices adopted in Hospital Information Systems in the light of medical standards,
- Understand medical data formats and recent trends in Hospital Information Systems.

UNIT I MEDICAL INFORMATICS 9 hours

Introduction – Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and Off – line services - Dialogue with the computer

UNIT II MEDICAL STANDARDS 9 hours

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA –Electronics Patient Records – Healthcare Standard Organizations – JCAHO (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT III MEDICAL DATA STORAGE AND AUTOMATION 9 hours

Representation of Data, Data modeling Techniques, Relational Hierarchical and network Approach, Normalization techniques for Data handling - Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface – Medical Data formats – Signal, Image and Video Formats –Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System –PACS.

UNIT IV HEALTH INFORMATICS 9 hours

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9 hours

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.

TOTAL : 45 hours

Text Books:

1. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata McGraw Hill Publishing Ltd, 2005 (Units I, III & IV).
2. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003 (Units II, IV & V).

Reference Books:

1. Orpita Bosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2007.
2. Yi Ping Phoebe Chen, “Bioinformatics Technologies”, Springer International Edition, New Delhi, 2007.

COURSE OUTCOMES

CO1: Identify opportunities for healthcare informatics interventions.
CO2: Analyse the different medical standards and organisations
CO3: Apply and determine the knowledge about the automated medical data storage
CO4: Explain the categories of health informatics and its applications
CO5: Classify and determine the recent trends and applications in medical informatics

OE-T3 **ELECTRONICS IN HEALTH CARE INDUSTRY** **3 0 0 3**

Course Objectives

The students should be made to

- Illustrate diverse applications of electronics in cardiology
- Explain about the electronic equipments used in diagnosis and treatment
- Infer the role of electronics in various health care industry
- Identify technologies in medical instruments in health care Industry.

UNIT I ELECTRONICS IN CARDIOLOGY 9 hours

Physiology of Heart and its abnormalities, Cardiac Monitoring and Recording Devices- ECG, Pacemaker, Defibrillators, Counter pulsation technique, Intra aortic balloon pumping and prosthetic heart valves and Imaging for cardiovascular system.

UNIT II ELECTRONICS IN NEUROLOGY 9 hours

Neurons and its abnormalities, EEG, Evoked response – Auditory and Visual sensory, Polysomnography, nerve stimulator and Imaging for brain disorders.

UNIT III ELECTRONICS IN NEPHROLOGY 9 hours

Nephrons and its abnormalities, Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Artificial kidney, Lithotripsy.

UNIT IV ELECTRONICS IN CIRCULATORY SYSTEM 9 hours

Interrelationships among Pressure, Flow, and Resistance, Blood and blood components, blood cell counters, Methods for blood flow meter, EM and ultrasonic blood flow meters, Blood Pressure, Plethysmography technique, Heart Lung machine, Respiration rate, Respiratory volume measurement, spirometer, Ventilators.

UNIT V ELECTRONICS IN VISUAL AND AUDITORY SYSTEM 9 hours

Anatomy of eye and its abnormalities, Laser in ophthalmology, Ear and it abnormalities Types of Deafness, Audiometer, Hearing Aids and cochlear implants.

TOTAL : 45 hours

Text Books:

1. Guyton, Arthur C & John E. Hall, Text book of Medical Physiology – WB Jaunder company Philadelphia – 11th edition 2006.
2. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 4th edition 2010.
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 3rd edition 2014.

Reference Books:

1. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology-

COURSE OUTCOMES

CO1: Understand the usage of Electronic Health Care in a medical office.
CO2: Explain the application of electronics in the field of diagnosis and treatment
CO3: Analyze the role of technology in cardiology, neurology, nephrology
CO4: Establish the knowledge about instruments involved for health care management.
CO5: Incorporate knowledge Electronics in Health Care into their personal health care decisions.

OE-T4 BASICS OF BIOMEDICAL ENGINEERS 3 0 0 3

Course Objectives

The students should be made to

- Teach the principles of ultrasonic's and its interaction with tissue.
- Know about the scanning techniques and real time scanners
- Understand the principles and application of these principles in health care setting

UNIT I PRINCIPLES OF ULTRASONICS 9 hours

Introduction, Piezo Electric Devices, The Fields of 'simple', CW excited sources, The PulsedAcoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays,Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation,Radiation Pressure

UNIT II TISSUE-ULTRASOUND INTERACTION 9 hours

Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theoryof mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuationand Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissueorganization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shearacoustic properties of tissues. Relevance to tissue characterization, Ultrasound quantitation andtissue characterization

UNIT III SCANNING TECHNIQUES 9 hours

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulseecho imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beamforming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converterAnalog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques-Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing.Basic Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts.

UNIT IV REAL TIME ULTRASONIC SCANNERS 9 hours

Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

UNIT V ULTRASONIC APPLICATIONS 9 hours

Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations of 3-Dimensional Ultrasound.

TOTAL : 45 hours

Text Books:

1. Shirley Blackwell Cusick, Farman and Vicary, A User's Guide to Diagnostic Ultrasound; Pitman Medical Publishing Co Ltd; Kent, England. (1978).

2. C.R.Hill, Jeff C.Bamber, Gail Haa, Physical Principles of medical Ultrasonics; John Wiley & Sons Ltd; 2nd Edition, 200

Reference Books:

1. W.N.McDicken, Churchill Livingstone, Diagnostic Ultrasonics – Principles and use instruments New York, 3rd Edition, 1991.

2. Timothy J.Hall, AAPM/RSNA, "Physics Tutorial For Residents: Elasticity Imaging With Ultrasound", Radio Graphics, Vol.23, No.6, Nov-Dec 2003. (RSNA 2003)

3. T.Rago, F.Santini, M.Scutari, A. Pinchera and P.Vitti, "Elastography: New developments in Ultrasound for Predicting Malignancy in Thyroid Nodules", Journal of Clinical Endocrinology and Metabolism, August 2007, 92(8) : 2917 – 2922.

COURSE OUTCOMES

CO1: Develop knowledge about the principles of Ultrasound and the imaging systems.

CO2: Analyse the interaction of tissues with ultrasound and the effects

CO3: Determine knowledge about the scanning techniques in Ultrasound imaging

CO4: Classify and understand the real time scanners in ultrasound

CO5: Interpret diagnostic ultrasound images based on understanding of the interaction between ultrasound and tissue.

OE-M1 HEALTH POLICY AND EQUIPMENT MANAGEMENT 3 0 0 3

Course Objectives

The students should be made to

- Expose the students for planning and operation of hospitals in a detailed manner which will include all facts of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.
- Introduce the equipment maintenance management skills and how to protect equipment from electromagnetic interferences.

UNIT I HEALTH SYSTEM 9 hours

Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system.

UNIT II NATIONAL HEALTH POLICY 9 hours

Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

UNIT III EQUIPMENT MAINTENANCE MANAGEMENT 9 hours

Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of equipment and operating instructions. Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT IV LOGISTIC SUPPORT & RELIABILITY 9 hours

Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials.Reliability fundamentals

UNIT V EMI TO HOSPITAL EQUIPMENTS 9 hours

Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference

TOTAL : 45 hours

Text Books:

1. Antony Kelly, `Maintenance Planning & control' Butterworth, London 1984.
2. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

Reference Books:

1. Hans Pleiff veradammann (ed) `Hospital Engineering in developing countries, GTZ report Eschborn, 1986.

COURSE OUTCOMES

CO1: Develop understanding of the various health organisations and policies
CO2: Explain the Planning activities at health care centres.
CO3: Describe the healthcare Equipment installation, service & calibration needs
CO4: Analyse the logistics of equipments and tools for maintenance.
CO5: Evaluate the principles, computation and methods of EMI.

Annexure II

Category	Course Code	Name of the Course	Activities/Content with direct on Interdisciplinary	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
SEMESTER I				
HSC	22CGMA11	English	Interdisciplinary	Skill development
BSC	22CBBM11	Physics (Oscillations, waves and optics)	Interdisciplinary	Employability
BSC	22CBBM12	Mathematics I (Calculus and Linear Algebra)	Interdisciplinary	Skill development
ESC	22CBBM14	Basic Electrical and Electronics Engineering	Interdisciplinary	Employability
ESC	22CBBM15	Engineering Graphics and Design	Interdisciplinary	Employability
HSC	22PBBM11	English Laboratory	Interdisciplinary	Skill development
BSC	22PBBM12	Physics Laboratory	Interdisciplinary	Employability
ESC	22PBBM13	Basic Electrical and Electronics Engineering Laboratory	Interdisciplinary	Employability
MC	22CBBM16	Constitution of India	Interdisciplinary	Skill development
MC	-	Student Induction Program	Interdisciplinary	Skill development
SEMESTER II				
BSC	22GCCH21	Chemistry	Interdisciplinary	Skill development
BSC	22GCMA21	Mathematics II (Probability and Statistics)	Interdisciplinary	Skill development
ESC	22CBCE22	Programming for Problem Solving	Interdisciplinary	Employability
ESC	22CBME22	Basics of Civil and Mechanical Engineering	Interdisciplinary	Employability
ESC	22PBME21	Workshop and Manufacturing Practices	Interdisciplinary	Employability
BSC	22GPCH21	Chemistry Laboratory	Interdisciplinary	Employability
ESC	22PBCE21	Programming for Problem Solving Laboratory	Interdisciplinary	Employability
MC	22GCHV21	Universal Human Values : Understanding Harmony	Interdisciplinary	Skill development
SEMESTER III				
BSC	22GCMA32	Mathematics III (Numerical Methods)	Interdisciplinary	

ESC	22CBBM31	Electronic Devices and Circuits	Interdisciplinary	Employability
PCC	22CBBM32	Human Anatomy and Physiology	Interdisciplinary	Employability
PCC	22CBBM33	Bioinstrumentation and measurements	-	Employability
PCC	22CBBM34	Biochemistry	Interdisciplinary	Employability
PCC	22PBBM32	Human Anatomy and Physiology Laboratory	Interdisciplinary	Employability
PCC	22PBBM31	Electronic Devices and Circuits Laboratory	Interdisciplinary	Employability
HSC	22SUPD31	Personality Development I	Interdisciplinary	Skill Development
MC	22BESY31	Basic Life Skills	Interdisciplinary	Skill Development
SEMESTER IV				
PCC	22CBBM41	Biocontrol systems	-	
PCC	22CBBM42	Microprocessor and Microcontroller	Interdisciplinary	Employability
PCC	22CBBM43	Biosensors and Transducers	Interdisciplinary	Employability
PCC	22CBBM44	Biomaterials and biomechanics	-	Employability
PCC	22CBBM45	Internet of Medical Things	Interdisciplinary	Employability
PCC	22PBBM41	Biosensors and Transducers Laboratory	Interdisciplinary	Employability
PCC	22PBBM42	Microprocessor and Microcontroller Laboratory	Interdisciplinary	Employability
HSC	22SUPD41	Personality Development II	Interdisciplinary	Skill Development
BSC	22CBBM46	Environmental Science and Engineering	-	Skill Development
MC	22GISS41	Gender Institution and Society	Interdisciplinary	Skill Development
SEMESTER V				
PCC	22CBBM51	Diagnostic Instrumentation	Interdisciplinary	Employability
PCC	22CBBM52	Biosignal Processing	Interdisciplinary	Employability
PCC	22CBBM53	Troubleshooting of Medical Equipments	-	Employability
PCC	22PBBM51	Diagnostic Instrumentation Laboratory	Interdisciplinary	Employability
PCC	22PBBM52	Bio signal Processing Laboratory	Interdisciplinary	Employability
HSC	22SUPD51	Personality Development III	Interdisciplinary	Skill development
PCC	22PBBM53	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/ Mathworks) - Minimum 4 weeks	Interdisciplinary	Skill development

SEMESTER VI				
PCC	22CBBM61	Therapeutic Equipment	-	Employability
PCC	22CBBM62	Medical Image Processing	Interdisciplinary	Employability
PCC	22PBBM61	Therapeutic Equipments Laboratory	-	Employability
PCC	22PBBM62	Medical Image Processing Laboratory	Interdisciplinary	Employability
HSC	22SUPD61	Personality Development – IV	Interdisciplinary	Skill development
PCC	22PBBM63	Summer Internship (4 weeks)	Interdisciplinary	Skill development
SEMESTER VII				
PCC	22CBBM71	Medical Imaging techniques	Interdisciplinary	Employability
PCC	22PBBM71	Advanced Medical imaging laboratory	-	Employability
PCC	22PBBM72	Biosimulation Laboratory	-	Skill development
Project	22RBBM71	Project Phase I	Interdisciplinary	Skill development
SEMESTER VIII				
Project	22RBBM81	Project Phase II	Interdisciplinary	Skill development
PEC/OEC				
PEC	22EBBM81	Regulatory aspects in bioscience	Interdisciplinary	Skill Development
OEC	22EBBM01	Basics of Biomedical Engineers	-	Skill Development
OEC	22EBBM02	Electronics in Healthcare industry	-	Skill Development
PEC	22EBBM82	Artificial Intelligence and Deep learning	Interdisciplinary	Skill Development
PEC	22EBBM83	Real-time signal Acquisition and Analysis	-	Skill Development
PEC	22EBBM84	Principles of 3D printing technology	Interdisciplinary	Skill Development
PEC	22EBBM61	Robotics in medicine (blended)	-	Skill Development
PEC	22EBBM62	Pattern recognition and neural networks (Blended)	Interdisciplinary	Skill Development
PEC	22EBBM63	Analog and Digital communication (blended)	Interdisciplinary	Skill Development
PEC	22EBBM64	Analog and Digital Integrated circuits	Interdisciplinary	Skill Development
OEC	22EBBM03	Fibre optics and lasers in medicine	-	Employability

ANNEXURE III

COURSES INTEGRATES CROSS CUTTING ISSUES

Sl. No	Name of the Programme	Course Code	Name of the Course	Gender	Environment and Sustainability	Human Values	Health Detrminants	Right to Health	Emerging Demographic Changes	Professional Ethics
1	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CGMA11	English						√	√
2	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM11	Physics (Oscillations, waves and optics)						√	√
3	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM12	Mathematics I (Calculus and Linear Algebra)						√	√
4	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM14	Basic Electrical and Electronics Engineering		√				√	
5	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM15	Engineering Graphics and Design						√	√
6	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM11	English Laboratory						√	√
7	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM12	Physics Laboratory						√	√
8	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM13	Basic Electrical and Electronics Engineering Laboratory						√	√
9	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM16	Constitution of India						√	√

10	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	-	Student Induction Program						√	√
11	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22GCCH21	Chemistry						√	√
12	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22GCMA21	Mathematics II (Probability and Statistics)						√	√
13	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBCE22	Programming for Problem Solving						√	
14	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBME22	Basics of Civil and Mechanical Engineering						√	
15	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBME21	Workshop and Manufacturing Practices						√	
16	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22GPCH21	Chemistry Laboratory		√				√	
17	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBCE21	Programming for Problem Solving Laboratory						√	
18	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22GCHV21	Universal Human Values : Understanding Harmony			√				
19	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22GCMA32	Mathematics III (Numerical Methods)						√	
20	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM31	Electronic Devices and Circuits						√	
21	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM32	Human Anatomy and Physiology	√			√	√	√	

22	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM33	Bioinstrumentation and measurements				√	√		
23	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM34	Biochemistry		√		√	√		
24	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM32	Human Anatomy and Physiology Laboratory					√	√	
25	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM31	Electronic Devices and Circuits Laboratory					√	√	
26	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22SUPD31	Personality Development I			√				√
27	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22BESY31	Basic Life Skills			√				√
29	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM41	Biocontrol systems						√	
30	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM42	Microprocessor and Microcontroller						√	
31	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM43	Biosensors and Transducers					√		
32	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM44	Biomaterials and biomechanics					√		
33	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM45	Internet of Medical Things						√	√

34	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM41	Biosensors and Transducers Laboratory				√			
35	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM42	Microprocessor and Microcontroller Laboratory			√				√
36	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22SUPD41	Personality Development II		√					√
37	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM46	Environmental Science and Engineering			√				√
38	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22GISS41	Gender Institution and Society	√		√				√
39	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM51	Diagnostic Instrumentation					√		
40	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM52	Biosignal Processing						√	
41	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM53	Troubleshooting of Medical Equipments						√	
42	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM51	Diagnostic Instrumentation Laboratory					√		
43	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM52	Bio signal Processing Laboratory						√	
44	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22SUPD51	Personality Development III			√				√

45	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM53	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/ Mathworks) - Minimum 4 weeks			√				√
46	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM61	Therapeutic Equipment					√		
47	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM62	Medical Image Processing					√		
48	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM61	Therapeutic Equipments Laboratory					√	√	
49	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM62	Medical Image Processing Laboratory					√		
50	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22SUPD61	Personality Development – IV			√				√
51	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM63	Summer Internship (4 weeks)		√	√				√
52	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22CBBM71	Medical Imaging techniques					√		
53	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM71	Advanced Medical imaging laboratory					√		
54	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22PBBM72	Biosimulation Laboratory					√		
55	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22RBBM71	Project Phase I		√			√	√	√

56	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM81	Regulatory aspects in bioscience					√	√	√
57	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM01	Basics of Biomedical Engineers					√	√	√
58	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM02	Electronics in Healthcare industry					√	√	
59	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM82	Artificial Intelligence and Deep learning					√	√	
60	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM83	Real-time signal Acquisition and Analysis					√	√	
61	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM84	Principles of 3D printing technology					√		√
62	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM61	Robotics in medicine (blended)		√			√	√	
63	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM62	Pattern recognition and neural networks (Blended)					√	√	
64	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM63	Analog and Digital communication (blended)					√	√	
65	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM64	Analog and Digital Integrated circuits					√		
66	B.E. BIOMEDICAL ENGINEERING DEGREE COURSE	22EBBM03	Fibre optics and lasers in medicine			√			√	√