

# **SETHU INSTITUTE OF TECHNOLOGY**

**PULLOOR, KARIAPATTI – 626115**

**(An Autonomous Institution**

**Affiliated to Anna University Chennai)**



## **B.E. BIOMEDICAL ENGINEERING**

### **CURRICULUM & SYLLABUS**

### **REGULATION 2019**

#### **CHOICE BASED CREDIT SYSTEM**

**(Applicable to candidates admitted in the Academic Year 2019 – 2020 onwards)**

**SETHU INSTITUTE OF TECHNOLOGY**  
PULLOOR, KARIAPATTI – 626115  
(An Autonomous Institution Affiliated to Anna University Chennai)



**B.E. BIOMEDICAL ENGINEERING**

**CURRICULUM & SYLLABUS**

**REGULATIONS 2019**

**CHOICE BASED CREDIT SYSTEM**

(Applicable to candidates admitted in the Academic Year 2019 - 2020)

**Chairman**  
**Board of Studies**  
**Chairperson**  
Board of Studies  
Bio Medical Engineering  
Sethu Institute of Technology  
Kariapatti - 626 115.

**Chairman**  
**Academic Council**  
**CHAIRMAN**  
**ACADEMIC COUNCIL**  
Sethu Institute of Technology  
Pulloor, Kariapatti - 625 115

# SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti - 626 115

(An Autonomous Institution)

B.E. Degree Program

CHOICE BASED CREDIT SYSTEM

CURRICULUM

Regulation 2019

Bachelor of Engineering in Biomedical Engineering

## OVERALL COURSE STRUCTURE

S.No.	Course Category	Total No. of Courses	Credits	Percentage
1	Humanities and Social Sciences (HS)	7	13.5	7.63 %
2	Basic Science courses (BS)	9	27.5	15.54 %
3	Engineering Science courses (ES)	8	21	11.86 %
4	Professional Core courses (PC)	28	70	39.55 %
5	Professional Elective (PE)	6	18	10.17 %
6	Open Elective (OE)	4	12	6.78 %
7	Project work (PW)	5	15	8.47 %
8	Mandatory Courses (MC)	5	--	--
TOTAL		72	177	100

## COURSE CREDITS - SEMESTER WISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
BME	23	20.5	22	25.5	25.5	25	21.5	14	177

## **PROGRAM: B.E. BIOMEDICAL ENGINEERING**

### **VISION**

To provide high quality technical education and to become a Centre of Excellence in education and research in Biomedical Engineering ensuring quality healthcare services.

### **MISSION**

- Providing quality technical education to enable the students to meet the industrial needs.
- Adapting innovative teaching methodologies to produce competent technocrats.
- Facilitating the students towards employability and entrepreneurship.
- Promoting Industry Institute Interaction to enable new technologies.
- Enriching the student's technical competence in research and development.
- Serving the society by conducting research to improve health care services.

### **PROGRAM EDUCATIONAL OBJECTIVES:**

Our graduates will

- PEO-1:** Develop innovative solutions for challenges in the healthcare systems and patient care. **(Core competency)**
- PEO-2:** Providing societal challenges in biomedical engineering, making ethical decisions to promote responsible advancements in healthcare and technology. **(Professionalism)**
- PEO-3:** Enhance their professional expertise through active involvement in research and continuous learning. **(Lifelong Learning)**

### **PROGRAM OUTCOMES:**

**The graduates of Biomedical Engineering Program will have ability to:**

- PO-1:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems. **(Engineering knowledge)**
- PO-2:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. **(Problem analysis)**
- PO-3:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations. **(Design/Development of Solutions)**
- PO-4:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. **(Conduct investigations of complex problems)**
- PO-5:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. **(Modern tool usage).**
- PO-6:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice. **(The engineer and society).**

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

**PROGRAM SPECIFIC OUTCOMES:**

- PSO-1:** Analyze, design and develop suitable systems to supplement and / or address healthcare challenges.
- PSO-2:** Leverage information and communication technologies to provide innovative solutions towards improving healthcare.

## SEMESTER I

[illegible]

## SEMESTER II

[illegible]

## SEMESTER III

[illegible]

## SEMESTER IV

[illegible]

## SEMESTER V

[illegible]

## SEMESTER VI

S.No.	Course Code	Course Title	Course Category	L	T	P	C
<b>THEORY</b>							
1.	19UBM601	Medical Imaging Equipments	PC	3	0	0	3
2.	19UBM602	Biomechanics	PC	3	0	0	3
3.	19UIT623	Object Oriented Programming and Data Structures	ES	2	0	3	3.5
4.	PE - II	Professional Elective – II	PE	3	0	0	3
5.	PE - III	Professional Elective – III	PE	3	0	0	3
6.	OE - II	Open Elective – II	OE	3	0	0	3
<b>PRACTICAL</b>							
7.	19UBM607	Product Development Project	PW	0	0	8	4
8.	19UGS631	Logical Reasoning and Aptitude	HS	1	0	0	1
9.	19UGS532	Soft skills Laboratory	HS	0	0	3	1.5
<b>MANDATORY</b>							
10.	19UGM631	Indian Constitution	MC	1	0	0	P/F
Total				19	0	14	25
<b>Total Credits : 25</b>							



## SEMESTER VII

[illegible]

## SEMESTER VIII

S.No.	Course Code	Course Title	Course Category	L	T	P	C
<b>THEORY</b>							
1.	PE - VI	Professional Elective – VI	PE	3	0	0	3
2.	OE - IV	Open Elective – IV	OE	3	0	0	3
<b>PRACTICAL</b>							
3.	19UBM801	Project work	PW	0	0	16	8
Total				6	0	16	14
<b>Total Credits : 14</b>							

## LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UBM901	Bio-MEMS and Nano Electronics	3	0	0	3
2.	19UBM902	Clinical Engineering	3	0	0	3
3.	19UBM903	Principles of Tissue Engineering	3	0	0	3
4.	19UBM904	Biomaterials and Artificial Organs	3	0	0	3
5.	19UBM905	Pattern Recognition and Neural Networks	3	0	0	3
6.	19UBM906	Forensic Science	3	0	0	3
7.	19UBM907	Drug Delivery Systems	3	0	0	3
8.	19UBM908	Nuclear Medicine	3	0	0	3
9.	19UBM909	Medical Radiation Safety Engineering	3	0	0	3
10.	19UBM910	Medical Technology	3	0	0	3
11.	19UBM911	Medical Optics	3	0	0	3
12.	19UBM912	Genetic Engineering	3	0	0	3
13.	19UBM913	Communication Engineering	2	0	2	3
14.	19UBM914	Biometric Systems	3	0	0	3
15.	19UBM915	Medical Informatics	3	0	0	3
16.	19UBM916	Telemedicine	3	0	0	3
17.	19UBM917	Rehabilitation Engineering and Robotics	3	0	0	3
18.	19UBM918	Virtual Bio-Instrumentation	2	0	2	3
19.	19UBM919	Medical Embedded Systems	3	0	0	3
20.	19UBM920	Brain Computer Interface and virtual reality	3	0	0	3
21.	19UBM921	Neuroscience	3	0	0	3
22.	19UBM922	Cancer Biology	3	0	0	3
23.	19UBM923	Human Assist Devices	3	0	0	3
24.	19UBM924	Body Area Networks and Mobile Healthcare	3	0	0	3
25.	19UBM925	Regenerative Medicine and Ergonomics	3	0	0	3
26.	19UBM926	Physiological Modeling	2	0	2	3
27.	19UBM927	Big Data and IOT in Medical Applications	3	0	0	3
28.	19UBM928	VLSI System Design	3	0	0	3
29.	19UBM929	Medical Waste management	3	0	0	3
30.	19UBM930	Digital System Design	3	0	0	3
31.	19UBM931	Bio-Signal Processing	3	0	0	3
32.	19UBM932	Principles of Machine Learning	3	0	0	3
33.	19UBM933	Bio Statistics	3	0	0	3
34.	19UBM934	Electro Magnetic Interference and Compatibility	3	0	0	3
35.	19UBM935	Smart Healthcare Engineering and Artificial Intelligence	3	0	0	3

### LIST OF OPEN ELECTIVES (For other Branch Students)

S.No.	Course Code	Course Title	L	T	P	C
1.	19UBM971	Biomedical Instrumentation Systems	3	0	0	3
2.	19UBM972	Computer Applications in Medicine	3	0	0	3
3.	19UBM973	Forensic Science in Health Care	3	0	0	3
4.	19UBM974	Radiotherapy and Nuclear Medicine	3	0	0	3
5.	19UBM975	Occupational Safety and Health in Public Health Emergencies	3	0	0	3

### LIST OF INTER-DISCIPLINARY COURSES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UGM951	Electrical Hazards and Safety In Hospitals	3	0	0	3
2.	19UGM952	Bio-Fluid Mechanics	3	0	0	3

### LIST OF ONE CREDIT COURSES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UBM861	Fundamentals of MATLAB Programming	0	0	2	1
2.	19UBM862	Python Programming	0	0	2	1
3.	19UBM863	Virtual Learning of Anatomy and Physiology	0	0	2	1
4.	19UBM864	DICOM Introduction and Interpretation	0	0	2	1
5.	19UBM865	Multi Medical Equipments Operating Skills Laboratory	0	0	2	1
6.	19UBM866	Medical Science	0	0	2	1
7.	19UBM867	3D Printing applicable to Medical Field	0	0	2	1
8.	19UBM868	Occupational Emergency Care	0	0	2	1
9.	19UBM869	Intellectual Property Rights	1	0	0	1
10.	19UBM870	Entrepreneurship in Biomedical Engineering	1	0	0	1
11.	19UBM871	Troubleshooting and Quality Control in Medical Equipments	0	0	2	1
12.	19UBM872	Regulation Perspective of Medical Research	1	0	0	1
13.	19UBM873	Introduction to Fuzzy Logic and Genetic Algorithms	1	0	0	1
14.	19UBM874	Numerical methods for Biomedical Engineers	1	0	0	1
15.	19UBM875	Introduction to International Medical Data Banks	1	0	0	1
16.	19UBM876	Role of Biomedical Engineers in Disaster Management	1	0	0	1
17.	19UBM877	Medical Coding and Transcription	0	0	2	1
18.	19UBM878	Calibration and Testing of Medical Equipments	0	0	2	1

## SEMESTER I

[illegible]

Course Code	Course Title	L	T	P	C
19UEN101	ENGLISH FOR TECHNICAL COMMUNICATION (Common to ALL Branches)	2	0	0	2
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To enhance the vocabulary of students.</li><li>To strengthen the application of functional grammar and basic skills.</li><li>To improve the language proficiency of students.</li></ul>					
<b>UNIT – I</b>	<b>RESENTING ESSENTIALS OF CORRESPONDENCE</b>	<b>8</b>			
Listening: Formal and informal conversations and comprehension – Speaking: introducing oneself – exchanging personal and social information – Reading: Skimming and Scanning – Writing: Sentence Formation, Formal Letters (Permission/Requisition) – Grammar: Parts of Speech – Tense Vocabulary Development: Technical Word Formation- Prefix – suffix – Synonyms and Antonyms Phrases and Clauses.					
<b>UNIT – II</b>	<b>COMMUNICATION SKILLS</b>	<b>8</b>			
Listening: Telephonic Conversations – Speaking: Pronunciation rules with Stress pattern –Reading: comprehension-pre-reading, post-reading – comprehension questions – Writing: Punctuation rules, paragraph writing – topic sentence – main ideas – free writing, short narrative descriptions, Precise writing, Developing Hints – Report Writing (Industrial, Accident) – Grammar: Voice – Vocabulary – Development: Words from other languages in English.					
<b>UNIT – III</b>	<b>CORRESPONDENT AND VOCATION DEVELOPMENTS</b>	<b>7</b>			
Listening: Motivational speech by Great Speakers – Speaking: Narrating daily events – retelling short stories – Reading: Newspaper reading – Writing: Job application letter – Transformation of Information (Transcoding) – Grammar: Subject-Verb Agreement (Concord) – Vocabulary – Development: Same word in different parts of speech.					
<b>UNIT – IV</b>	<b>PORTRAYAL AND SAMMASIONS</b>	<b>7</b>			
Listening: Understating the instruction – Speaking: Intonation and preparing dialogue on various formal and informal situation — Reading: Note Making from given text — Writing: Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) – Grammar: Spot the Errors in English – Vocabulary Development: One word substitution.					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply grammar effectively in writing meaningful sentences and paragraphs.	Apply			
<b>CO2</b>	Exhibit reading skills and comprehension to express the ideas in the given text.	Understand			
<b>CO3</b>	Develop writing skills to present the ideas in various formal situations.	Create			
<b>CO4</b>	Develop oral fluency to express the ideas in various formal situations.	Create			
<b>CO5</b>	Exhibit writing skills to prepare reports for various purposes.	Create			
<b>TEXT BOOKS:</b> 1. KN Shoba, Lourdes Joavani Rayen, Communicative English, New Delhi, Cambridge University Press, 2017					

**REFERENCES:**

1. Raman, Meenakshi, Sangeetha Sharma, Business Communication, New Delhi, Oxford University Press, 2014.
2. Lakshminarayanan. K.R, English for Technical Communication, Chennai, ScitechPublications (India) Pvt. Ltd, 2004.
3. Rizvi. Asraf M, Effective Technical Communication, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2007.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1										3		3		
CO2										3		3		
CO3										3		3		
CO4									2	3		3		
CO5										3		3		
CAM									2	3		3		

Course Code	Course Title	L	T	P	C
19UMA102	ENGINEERING MATHEMATICS – I (Common to ALL Branches - Except CSBS)	3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"><li>To make the students capable of identifying linear equations based problems (Eigen Value) from practical areas and obtain the Eigen value oriented solutions in certain cases.</li><li>To widen the students' knowledge base on linear algebra, growth rate computation and application of integrals.</li><li>Able to integrating various types of functions using various integration methods.</li><li>To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions</li><li>To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field.</li></ul>					
UNIT – I	MATRICES				8 + 3
Eigen value and eigenvector of a real matrix — Characteristic equation — Properties — Cayley-Hamilton theorem (excluding Proof) – Orthogonal reduction – (transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.					
UNIT – II	DIFFERENTIAL CALCULUS				9 + 3
Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation ( $n^{\text{th}}$ derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling – Heat flow problems, Rate of decay of radioactive materials - Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems).					
UNIT – III	FUNCTIONS OF SEVERAL VARIABLES				9 + 3
Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylor's expansion – Maxima and Minima – Method of Lagrangian Multipliers.					
UNIT – IV	INTEGRAL CALCULUS				8 + 3
Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions.					
UNIT – V	MULTIPLE INTEGRALS				8 + 3
Double integration – Cartesian and Polar coordinates – Change of order of integration – Area as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integration in Cartesian coordinates — Volume as triple integral.					
SUPPLEMENT TOPIC (for internal evaluation only)					3
Evocation /Application of Mathematics, Quick Mathematics — Speed Multiplication and Division Applications of Matrices.					
TOTAL : 45 (L) + 15 (T) = 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the knowledge of Matrices to solve Engineering problems.				Apply
CO2	Analyze Engineering problems using limits, continuity and derivatives.				Analyze
CO3	Apply the knowledge of differentiation techniques to predict the extreme values of the Engineering problems with constraints.				Apply
CO4	Apply the knowledge of Beta and Gamma function and their relation to evaluate the Engineering problems involving definite integrals.				Apply
CO5	Apply the concept of Multiple integrals to compute the graphical representation in Engineering problems.				Apply
CO6	Explain the basic concepts of Matrix, Differentiation and Integration.				Understand

**TEXT BOOKS:**

1. Bali N. P and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications (p) Ltd, New Delhi, 8<sup>th</sup> Edition, 2011.
2. Veerarajan. T "Engineering Mathematics" Tata Mcgraw Hill Publishing Company, New Delhi, 2008.
3. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 42<sup>nd</sup> Edition, 2012.

**REFERENCES:**

1. Ramana B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 11<sup>th</sup> Reprint, 2010.
2. Glyn James, “Advanced Engineering Mathematics”, Pearson Education, New Delhi, 7<sup>th</sup> Edition, 2007.
3. Jain R.K and Iyengar S.R.K,” Advanced Engineering Mathematics”, Narosa Publishing House, New Delhi, 3<sup>rd</sup> Edition, 2007.
4. Bharati Krishna Tirthaji, “Vedic Mathematics - Mental Calculation”, Motilal Banarsi Dass Publications, New Delhi, 1<sup>st</sup> Edition, 1965.
5. Kreyszig. E, “Advanced Engineering Mathematics”, John Wiley & Sons, New York, 10<sup>th</sup> Edition, 2011.
6. P.Sivaramakrishna Das, E.Rukmangadachari “Engineering Mathematics”, Volume 1, Pearson Edison New Delhi, 2nd Edition, 2013.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3											1	2	
CO2	3	3		1								1	2	
CO3	3											1	2	
CO4	3											1	2	
CO5	3											1	2	
CO6	2											1	2	
CAM	2.83	3		1								1	2	



Course Code	Course Title	L	T	P	C
19UPH103	ENGINEERING PHYSICS (Common to ALL Branches)	3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"><li>To develop the research interest in crystal physics.</li><li>To use the principles of Lasers and its types.</li><li>To apply principles of Quantum physics in engineering field.</li><li>To develop knowledge on properties of materials.</li></ul>					
UNIT – I	CRYSTAL STRUCTURE	12			
Introduction – Classification of solids – Space lattice – Basis-Lattice parameter – Unit cell – Crystal system – Miller indices – d-spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfection – Point defects – Line defects – Surface defects – Volume defects Burger vector.					
UNIT – II	PHOTONICS	10			
Introduction – Principles of Laser – Characteristics of laser – Spontaneous and stimulated emission – Population inversion – Einstein’s A and B coefficients – Pumping methods – Basic components of Laser – Types of lasers – Nd-YAG laser – CO2 laser – Holography – Construction and Reconstruction of hologram – Industrial and Medical Applications.					
UNIT – III	QUANTUM MECHANICS	13			
Introduction – Black body radiation – Planck’s law of radiation – Wien’s displacement law – Rayleigh Jeans law – Compton Effect – Theory and experimental verification – Matter waves – Schrodinger’s wave equation – Time dependent – Time independent equation – Particle in 1-D dimensional box					
UNIT – IV	PROPERTIES OF SOLIDS	10			
Introduction – Elasticity – Stress and Strain – Hooke’s law – Three moduli of elasticity – stress-strain curve – Poisson’s ratio – Factors affecting elasticity – Bending moment – Depression of a cantilever – Young’s modulus by uniform bending – I-shaped girders.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamentals of crystals and laser physics.				Understand
CO2	Explain the dual nature of radiation and matter, modulus of elasticity and bending of beams.				Understand
CO3	Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.				Apply
CO4	Apply principles of crystals, light, lasers, matter waves and elastic modulus to evaluate the parameters of different engineering materials.				Apply
CO5	Apply principles of quantum mechanics to calculate observables on known wave functions.				Apply
CO6	Analyze the effects of defects, light interference, stimulated emission, Compton scattering and linear strain in prototype engineering and medical applications.				Analyze
TEXT BOOKS:					
<ol style="list-style-type: none"><li>Dr. Mani.P, “Engineering Physics”, Dhanam Publications, Edition, 2018, Chennai.</li><li>Rajendran.V, “Engineering Physics”, Tata Mc-Graw Hill Publishing Company limited, New Delhi, Revised Edition 2018.</li><li>Palanisami P.K., “Physics For Engineers”, Scitech Publications (India), Pvt Ltd., Chennai, 2018.</li></ol>					

**REFERENCES:**

1. Raghuvenshi G.S., "Engineering Physics", PHI Learning Private Limited, New Delhi, Revised Edition 2018.
2. Arul doss .G. "Engineering Physics", PHI Learning Limited, New Delhi, Revised Edition 2018.
3. Marikani. A., "Engineering Physics", PHI Learning Private Limited, New Delhi, Revised Edition 2017.
4. Sankar B.N., and Pillai .S.O., "A Text book of Engineering Physics", New Age International Publishers Private Limited, New Delhi, Revised Edition 2017.
5. Avadhanulu M.N. and Kshirsagar P.G., "A Textbook: of Engineering Physics", S.Chand & Company Ltd., New Delhi, 2018.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2		
CO2	3	2										2		
CO3	3	2										2		
CO4	2	3										2		
CO5	2	3										2		
CO6	2	3							2			2		
CAM	2.33	2.6							2			2		

Course Code	Course Title	L	T	P	C
19UCY105	APPLIED CHEMISTRY (Common to ECE, EEE, CSE, IT, BME & BT)	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To gain the knowledge on Chemical bonding and types.</li><li>To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.</li><li>To know the importance of smart material and green chemistry.</li><li>To acquire knowledge on energy storage devices.</li></ul>					
<b>UNIT – I</b>	<b>CHEMICAL BONDING</b>	<b>11</b>			
Chemical Bonding: Electronic Configuration – Ionic Bond – Covalent Bond – Metallic bond – Aufbau principle, Pauli Exclusion principle, Valence bond theory application and its limitations, Various types of hybridization (sp, sp <sup>2</sup> , sp <sup>3</sup> ) (C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , CH <sub>4</sub> ) – bond strength and bond energy – Hydrogen bonding, Vander Waals forces.					
<b>UNIT – II</b>	<b>WATER AND ITS TREATMENT TECHNOLOGIES</b>	<b>11</b>			
Hardness of water – types – expression of hardness (Problems) – units – estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment Ion exchange process – Zeolite process – desalination of brackish water – Reverse Osmosis.					
<b>UNIT – III</b>	<b>SMART MATERIALS AND GREEN CHEMISTRY</b>	<b>11</b>			
Introduction to smart materials and their structure – Organic Light Emitting Diodes – Principles and applications, Liquid crystals – definition and applications. Green chemistry – Concept, importance, principles – e-waste disposal.					
<b>UNIT – IV</b>	<b>ENERGY STORAGE DEVICES</b>	<b>12</b>			
Batteries, fuel cells and super capacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H <sub>2</sub> -O <sub>2</sub> fuel cell and application.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
CO1	Describe the basic concept of chemistry involved in chemical bonding, water treatment methods, smart materials, e-waste management and energy storage devices.				Understand
CO2	Apply the knowledge of chemical bonding to identify the types of bonds in molecules.				Apply
CO3	Analyze the impurities of water to find its hardness and remove the hardness causing substances.				Analyze
CO4	Explain the principles and application of organic light emitting diodes, liquid crystals and green chemistry.				Understand
CO5	Apply the knowledge of the basic electrochemical cell terminology to differentiate various types of energy storage devices.				Apply
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2002.</li><li>Dr.Sunita Rattan, “A Textbook of Engineering Chemistry” S.K. Kataria &amp; Sons, New Delhi, 2013.</li></ol>					

**REFERENCES:**

1. Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Chapman and Hall, New York, 1993.
2. Peter Grundler, "Chemical Sensors — An introduction for Scientists and Engineers", Springer, New York, 2007.

[illegible]

Course Code	Course Title	L	T	P	C
19UCS108	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to ALL Branches)	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To impart the concepts in problem solving for computing.</li><li>To familiarize the logical constructs of programming.</li><li>To illustrate programming in Python.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION</b>				<b>9</b>
Definition and basic organization of computers – classification of computers – Software – Types of software – types of programming paradigms – Translators: compiler and interpreter – Problem solving tools: Algorithms – Flowchart – Pseudo code.					
<b>UNIT – II</b>	<b>INTRODUCTION TO PYTHON</b>				<b>9</b>
Introduction to python – features of python – modes of working with python. Values and data types: numbers, Boolean, strings; variables, expressions, statements, tuple assignment, precedence of operators, comments – print function – conversion of algorithm in to program – Solving simple problems involving arithmetic computations and sequential logic to solve.					
<b>UNIT – III</b>	<b>CONTROL CONSTRUCTS</b>				<b>9</b>
Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass — Solving problems involving decision making and iterations.					
<b>UNIT – IV</b>	<b>FUNCTIONS AND PACKAGES</b>				<b>9</b>
Functions – function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition – Anonymous or Lambda Function, recursion – packages.					
<b>UNIT – V</b>	<b>LISTS, TUPLES, DICTIONARIES AND STRINGS</b>				<b>9</b>
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 – Strings: string slices; immutability, string functions and methods, string module.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Utilize problem solving tools in solving computing problems.				Apply
<b>CO2</b>	Solve mathematical expressions involving sequential logic in python.				Apply
<b>CO3</b>	Solve problems using python using decision structure and looping constructs.				Apply
<b>CO4</b>	Write modular programs using functions and packages.				Apply
<b>CO5</b>	Manipulate data using List, Tuples, Dictionaries and strings.				Apply
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Ashok Namdev Kamthane &amp; Amit Ashok Kamthane, “Problem solving and python programming”, McGraw Hill Education, 2018 (copyright)</li><li>Anurag Gupta &amp; G P Biswas, “Python Programming — Problem solving, packages and libraries”, McGraw Hill Education, 2020 (copyright).</li></ol>					

**REFERENCES:**

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python:An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring PythonII, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First ProgramsII, CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introductionto Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

[illegible]

Course Code	Course Title	L	T	P	C
19UME109	ENGINEERING GRAPHICS (Common to ALL Branches)	3	1	0	4
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.</li><li>To impart knowledge in development of surfaces and isometric projections.</li></ul>					
<b>CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)</b>					<b>4</b>
Importance of Graphics in Engineering Applications — Use of Drafting Instruments — BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets – Lettering and Dimensioning – Introduction to Plane Curves, Projection of Points, Lines and Plane Surfaces.					
<b>UNIT – I</b>	<b>PROJECTION OF SOLIDS</b>				<b>12</b>
Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.					
<b>UNIT – II</b>	<b>SECTION OF SOLIDS</b>				<b>10</b>
Section of solids – simple position with cutting plane parallel, perpendicular and inclined to one of the plane.					
<b>UNIT – III</b>	<b>DEVELOPMENT OF SURFACES</b>				<b>10</b>
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids and cylinders and cones – Development of lateral surfaces of sectioned solids.					
<b>UNIT – IV</b>	<b>ISOMETRIC PROJECTIONS</b>				<b>12</b>
Principles of isometric projection – isometric scale – isometric view – isometric projections of simple solids and cut solids.					
<b>UNIT – V</b>	<b>ORTHOGRAPHIC PROJECTION</b>				<b>12</b>
Representation of Three Dimensional objects – General principles of orthographic projection- Need for importance of multiple views and their placement – First angle projection – layout views – layout views – Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects.					
<b>TOTAL : 45 (L) + 15 (T) = 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Draw orthographic projections of basic geometrical entities in various positions and translate the Geometric information of engineering objects into engineering drawings.				Understand
<b>CO2</b>	Apply the principles of orthographic projections to draw projections of solids and sections of solids.				Apply
<b>CO3</b>	Develop lateral surfaces of regular and sectioned solids.				Apply
<b>CO4</b>	Prepare isometric drawings of simple solids from orthographic views.				Apply
<b>CO5</b>	Construct orthographic projection from the given pictorial view.				Apply
<b>CO6</b>	Analyze the projections of various solid models using different resting conditions.				Analyze
<b>TEXT BOOKS:</b>  1. Natarajan K.V., “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, (2006). 2. Bhatt N.D., “Engineering Drawing”, Charotar Publishing House, (2012).					

**REFERENCES:**

1. Venugopal K., and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, (2008).
2. Gopalakrishnan K.R., "Engineering Drawing" (Vol.I&II), Subhas Publications. (2014).
3. DhananjayA.Jolhe, "Engineering Drawing with an introduction to Auto CAD", Tata McGrawHill Publishing Company Limited, (2012).
4. Saravanan M, Benson Raj J and Ganesh Kumar S, "Engineering Graphics", JBR Trisea Publishers, Nagercoil, (2020).

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		2						2					
CO2	3		2						2					
CO3	3		2						2					
CO4	3		2						2					
CO5	3		2						2					
CO6	3		2						2					
CAM	3		2						2					



Course Code	Course Title	L	T	P	C
19UCS110	<b>PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY</b> (Common to ALL Branches )	0	0	3	1.5

#### OBJECTIVES:

- To familiarize with programming environment.
- To familiarize the implementation of programs in Python.

#### LIST OF EXPERIMENTS:

##### Problems involve Sequential logic and Decision making:

1. Develop a computing solution to process the mark processing system (Record has the following fields: Name, Reg\_no, Mark1, Mark2, Mark3, Mark4, Total, average). Generate student information with total and average marks.
2. Provide a software solution to compute the +2 Cutoff mark, given the Mathematics, physics and Chemistry marks. A college has decided to admit the students with a cut off marks of 180. Decide whether the student is eligible to get an admission in that college or not.
3. A pizza in a circular shape with 8 inches and which is placed in a square box whose side length is 10 inches. Find how much of the box is "empty"?
4. A person owns an air conditioned sleeper bus with 35 seating capacity that routes between Chennai to Bangalore. He wishes to calculate whether the bus is running in profit or loss state based on the following scenario:  
Amount he spent for a day for diesel filling is: Rs. 15,000  
Amount he spent for a day for Driver and cleaner beta is: Rs. 3,000  
Ticket amount for a Single person is Rs: 950  
If all the seats are filled, what would be the result? If only 15 seats are filled, what would be the result?
5. Consider the person 'X' has some amount in his hand and the person 'Y' has some amount in his hand. If they wish to exchange the amount among them, how they can exchange the amount by using the third party 'Z'.

##### Problems involve iterations:

6. A man is blessed with a duck that can lay golden eggs. First day it lays one egg, in second day it lays two eggs, in third day it lays three eggs, and it continues to lay eggs in an incremental manner day by day. Now calculate how many golden eggs that duck lays till 'n'th day.
7. Four People A,B,C,D are sitting in a Circular arrangement. In how many ways their seating can be arranged.
8. The Greek theater shown at the right has 30 seats in the first row of the center section. Each row behind the first row gains two additional seats. How many seats are in the 5th row in the center section?

##### Problem involve functions and recursive functions:

9. Develop a solution to identify the right angle triangle while giving the sides of a triangle. (Recall from the Pythagoras theorem that in a right triangle, the square of one side equals the sum of the squares of other two sides)
10. A game has to be made from marbles of five colors, yellow, blue, green, red and Violet where five marbles has to be kept one upon another. Write a python program using recursion, to find how many ways these marbles can be arranged.
11. Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:  
Here is a high-level outline of how to move a tower from the starting pole, to the goal pole, using an intermediate pole:
  1. Move a tower of height-1 to an intermediate pole, using the final pole.
  2. Move the remaining disk to the final pole.
  3. Move the tower of height-1 from the intermediate pole to the final pole using original pole.

##### Problems involve List and Nested List:

12. In a class of 50 numbers of students, 6 students are selected for state cricket academy. Sports faculty of this school has to report to the state cricket academy about the selected students' physical fitness. Here is one of the physical measures of the selected students'; Height in cm is given for those 6 selected students [153,162,148,167,175,151]. By implementing functions, do

the following operations.

- (i) State academy selector has to check whether the given height is present in the selected students list or not.
- (ii) State academy selector has to order the height of students in an incremental manner.
- (iii) State academy selector has to identify the maximum height from the list.

**Problems involve Dictionary and Tuples:**

**Dictionary:**

13. A university wishes to create and maintain the details of the students such as Rollno, Regno, Name, Dept, Batch, Contact\_no, Nativity (Indian/NRI) as key value pairs. Do the following operations:
  - (i) Display the complete student details on giving Rollno as input.
  - (ii) Display the complete student details whose nativity belongs to NRI.
  - (iii) Display the complete student details whose department is CSE.

**Tuples:**

14. A librarian wishes to maintain books details such as ISBN, Book Name, Author Name, Year published, Publisher Name. He wishes to retrieve the book details in the following scenario:
  - (i) Retrieve the complete details of the book on giving ISBN.
  - (ii) Retrieve the details of the book which published after the year 2015.
  - (iii) Retrieve the details of the book whose author name is 'Andrew'.
  - (iv) Retrieve the details of the book that name of the book is 'Python'

**Problems involve Strings:**

15. A musical album company has 'n' number of musical albums. The PRO of this company wishes to do following operations based on some scenarios:
  - (i) Name of the album starts with 's' or 'S'.
  - (ii) Name of the album which contains 'jay' as substring.
  - (iii) Check whether the album name presents in the repository or not.
  - (iv) Count number of vowels and consonants in the given album name.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course the student will be able to:**

<b>CO1</b>	Formulate algorithms for simple problems and translate the algorithms to a working program.	Apply
<b>CO2</b>	Formulate algorithms and programs for arithmetic computations and sequential logic.	Apply
<b>CO3</b>	Write iterative programs using control constructs.	Apply
<b>CO4</b>	Develop programs using functions, packages and use recursion to reduce redundancy.	Apply
<b>CO5</b>	Represent data using lists, tuples, dictionaries and manipulate them through a program.	Apply

**HARDWARE AND SOFTWARE REQUIREMENTS:**

Hardware Requirements:

LAN SYSTEM WITH 30 NODES (OR) STANDALONE PCS – 30 NOS

Software Requirements:

OS – UNIX CLONE (License free Linux)

EDITOR – IDLE

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3								2	2		2	2	2
<b>CO2</b>	3								2	2		2		
<b>CO3</b>	3								2	2		2		
<b>CO4</b>	3								2	2		2		
<b>CO5</b>	3								2	2		2		
<b>CAM</b>	<b>3</b>								<b>2</b>	<b>2</b>		<b>2</b>	<b>2</b>	<b>2</b>

Course Code	Course Title	L	T	P	C
19UCS112	<b>ENGINEERING FUNDAMENTALS LABORATORY</b> (Common to CSE, ECE,IT & BME Branches)	0	0	3	1.5

**OBJECTIVES:**

- To familiarize the Hardware components of Computer
- To practice the installation of operating systems and other software's

**LIST OF EXPERIMENTS:**

<b><u>GROUP A (COMPUTER)</u></b>		<b>24 Periods</b>
1.	Demonstrating basic components of a personal computer	
2.	Assembling hardware components of a computer	
3.	Installation of windows and linux operating systems	
4.	Installation of software's both in windows and linux operating system	
5.	Configuring the computer to connect with internet	
6.	PC trouble shooting and maintenance	
<b><u>GROUP B (ELECTRICAL &amp; ELECTRONICS)</u></b>		<b>21 Periods</b>
7.	Study of electronic components and equipment's:	
	(a) Resistor color coding	
	(b) Measurement of AC signal parameter (peak to peak, RMS, period, frequency) using CRO	
8.	Study of logic gates	
9.	Soldering practice – components devices and circuits - using general purpose PCB	
10.	Characteristics of LED	
11.	Interfacing of PIR sensor with microcontroller	
12.	Switch control with microcontroller	
13.	Temperature measurement with microcontroller	
<b>TOTAL : 45 PERIODS</b>		
<b>COURSE OUTCOMES:</b>		
<b>At the end of the course the student will be able to:</b>		
<b>CO1</b>	Identify the components of the computer and assemble the hardware components of a computer.	Apply
<b>CO2</b>	Install and uninstall the Operating systems and other software's both in windows and Linux environment.	Apply
<b>CO3</b>	Demonstrate the basic network settings and make trouble shoot and Maintain the compute.	Apply
<b>CO4</b>	Demonstrate the function of electronics components.	Apply
<b>CO5</b>	Develop code for interfacing sensors with microcontroller.	Apply

**HARDWARE AND SOFTWARE REQUIRMENTS:**

Sl. No.	Name of the equipment / Software	Quantity Required
1	LAN System with 30 Nodes (OR) Standalone PCs	30
2	OS – Unix Clone (License Free Linux)	-
3	Logic Trainer kit	2
4	CRO and AFO	2
5	Small Multipurpose PCBs	5
6	Soldering Guns	5

Sl. No.	Name of the equipment / Software	Quantity Required
7	Multimeters	5
8	DC Ammeter	10
9	DC Voltmeter	10
10	Variable DC Power Supply	5
11	Node MCU Development Board	10
12	PIR Sensor (HC-SR501)	5
13	Temperature Sensor (LM35 OR DHT11)	5
14	PC with Windows 7	3
15	Logic Trainer kit	2

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3								2	2		2	2	2
CO2	3								2	2		2	2	2
CO3	3								2	2		2	2	2
CO4	3								2	2		2	2	2
CO5	3								2	2			2	2
CAM	3								2	2		2	2	2

Course Code	Course Title	L	T	P	C
19UGS113	<b>BASIC SCIENCES LABORATORY (Common to ALL Branches)</b>	0	0	2	1
<b>PHYSICS LABORATORY</b>					
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To create scientific Temper among the students.</li> <li>To know how to execute experiments properly, presentation of observations and arrival of conclusions.</li> <li>To view and realize the theoretical knowledge acquired by the students through experiments.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
<b>A minimum of FIVE experiments shall be offered – 15 Periods</b> <ol style="list-style-type: none"> <li>Laser – Determination of particle size and wavelength of Laser source using Diode Laser.</li> <li>Ultrasonic Interferometer - Determination of velocity of sound in liquid and compressibility of liquid.</li> <li>Poiseuille's method - Determination of Coefficient of viscosity of liquid.</li> <li>Spectrometer – Determination of dispersive power of a prism.</li> <li>Air Wedge method - Determination of thickness of a thin wire.</li> <li>Uniform bending method — Determination of Young's modulus of the given rectangular beam</li> </ol>					
<b>CHEMISTRY LABORATORY</b>					
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To impart knowledge on basic concepts in applications of chemical analysis</li> <li>Train the students to handle various instruments.</li> <li>To acquire knowledge on the chemical analysis of various metal ions.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
<b>A minimum of FIVE experiments shall be offered – 15 Periods</b> <ol style="list-style-type: none"> <li>Preparation of molar and normal solutions of the following substances — Oxalic acid, Sodium Carbonate, Sodium Hydroxide and Hydrochloric acid.</li> <li>Conductometric Titration of strong acid with strong base</li> <li>Conductometric Titration of Mixture of Acids.</li> <li>Estimation of Iron by Potentiometry</li> <li>Determination of Strength of given acid using pH metry.</li> <li>Determination of molecular weight of polymer by Viscometry.</li> <li>Comparison of the electrical conductivity of two samples - Conductometric method.</li> <li>Estimation of copper in brass by EDTA method.</li> </ol>					
<b>Laboratory classes on alternate weeks for Physics and Chemistry: TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply the principles of Optics, Laser physics and Mechanics to determine the Engineering properties of materials.	Apply			
<b>CO2</b>	Analyze the given liquid sample to determine the viscosity and compressibility of the liquid.	Analyze			
<b>CO3</b>	Apply the principles of spectroscopy to determine the properties using prism.	Apply			
<b>CO4</b>	Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis.	Apply			
<b>CO5</b>	Analyze the concentration of a given analyte by analytical methods.	Analyze			
<b>CO6</b>	Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents.	Apply			

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3								3				2	2
CO2	3								3				2	2
CO3	3								3				2	2
CO4	3								3				2	2
CO5	3	3							3				2	2
CO6	3								3				2	2
CAM	3	3							3				2	2

Course Code	Course Title	L	T	P	C
19UGM131	INDUCTION PROGRAM (Common to ALL branches)	3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"><li>To rejuvenate the Body and Mind.</li><li>To strengthen Attitude and soft skills.</li><li>To practice Moral values of life.</li></ul>					
UNIT – I	PHYSICAL ACTIVITY				10
Zumba - Bokwa Fitness – Yoga – Mediation – Fine Arts.					
UNIT – II	CREATIVE ARTS				5
Painting – Class Painting – Wall Painting – Art from waste.					
UNIT – III	UNIVERSAL HUMAN VALUES & EMINENT SPEAKERS				5
Ethical values – Ambition and Family Expectation, Gratitude, Competition and Excellence – Belief – Morality of life – Guest Lecture by Eminent personality.					
UNIT – IV	LITERARY				-
Elocution – Essay writing Competition – Impromptu Session – Dance and singing competition.					
UNIT – V	PROFICIENCY MODULES				15
Toastmaster club meet					
UNIT – VI	INDUSTRIAL & LOCAL VISIT				8
Vaigai Dam Theni – VOC- Port-Tuticorin – Madurai Radio City-Madurai – Alvin Milk Madurai – NSS Activities.					
UNIT – VII	FAMILIARIZATION OF THE DEPT. AND INNOVATION				2
Department Introduction and Purpose of Course – Eminent speakers – Scope and Feature of the Course – Latest Innovation.					
TOTAL: 45 PERIODS (3 Weeks Model curriculum As per AICTE)					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Practice physical activities regularly.				Apply
CO2	Implement creativity in drawing and waste material.				Apply
CO3	Communicate their ideas effectively.				Apply
CO4	Identify inputs and outputs of different industry process.				Apply
CO5	Describe the scope and features of their program of study.				Apply
REFERENCE:					
1. Student Induction Programme: A Detailed Guide by AICTE, New Delhi.					

## SEMESTER II

S.No.	Course Code	Course Title	Course Category	L	T	P	C
<b>THEORY</b>							
1.	19UEN201	Communication Skills for Professionals (Common to ALL Branches)	HS	1	0	1	1.5
2.	19UMA207	Calculus, Complex Analysis and Transform Techniques (Common to AGRI, CHE, BME & BT)	BS	3	1	0	4
3.	19UPH204	Biomaterial Physics (Common to BME & BT)	BS	3	0	0	3
4.	19UCY204	Environmental Science (Common to ALL Branches)	HS	3	0	0	3
5.	19UBM205	Introduction to Biomedical Engineering	ES	3	0	0	3
6.	19UBM206	Electrical Circuits and Measurements	ES	3	0	0	3
<b>PRACTICAL</b>							
7.	19UGS210	Energy and Environmental Science Laboratory (Common to ALL Branches)	BS	0	0	3	1.5
8.	19UBM211	Electrical Circuits Laboratory	ES	0	0	3	1.5
Total				16	1	7	20.5
<b>Total Credits : 20.5</b>							



Course Code	Course Title	L	T	P	C
19UEN201	COMMUNICATION SKILLS FOR PROFESSIONALS	1	0	1	1.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>• Improve their oral expression and thought.</li><li>• Develop their confidence and ability to speak in public.</li><li>• Develop their capacity for leadership.</li></ul>					
<b>5 ORAL PROJECTS</b>					
<b>Project – 1</b>	<b>SELF INTRODUCTION &amp; DELIVER A SPEECH BEFORE AUDIENCE</b> <b>(Time: 5 to 7 minutes)</b>				
<ul style="list-style-type: none"><li>• To Speak in front of an audience with courage.</li><li>• Make your message clear, with supporting material.</li><li>• Create a strong opening and conclusion.</li></ul>					
<b>Project – 2</b>	<b>SPEAK ON THE CHOSEN CONTENT (Time: 5 to 7 minutes)</b>				
<ul style="list-style-type: none"><li>• Select a general topic and bring out specific purposes.</li><li>• Avoid using notes.</li><li>• Use symbolic ideas to develop your ideas.</li></ul>					
<b>Project – 3</b>	<b>USE EFFECTIVE BODY LANGUAGE &amp; INTONATION (Time: 5 to 7 minutes)</b>				
<ul style="list-style-type: none"><li>• Use appropriate posture, gestures, facial expressions and eye contact to express your ideas.</li><li>• Use proper intonation and adequate speech module.</li></ul>					
<b>Project – 4</b>	<b>PRESENT YOUR TOPIC WITH VISUAL AIDS (Time: 5 to 7 minutes)</b>				
<ul style="list-style-type: none"><li>• Persuade your points with suitable illustration, specific facts, examples</li><li>• Use suitable visual aids to present your topic with confidence.</li></ul>					
<b>Project – 5</b>	<b>GRASP THE ATTENTION OF THE AUDIENCE (Time: 5 to 7 minutes)</b>				
<ul style="list-style-type: none"><li>• Influence your listeners by adopting holistic viewpoint.</li><li>• Use emotions, stories, and positive quotes in your speech.</li></ul>					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply Language skills to write and speak effectively.				Create
<b>CO2</b>	Select the right words and sentence to communicate ideas clearly and accurately.				Create
<b>CO3</b>	Exhibit good postures and proper attire to present the ideas effectively.				Create
<b>CO4</b>	Present the ideas effectively using visual aids.				Create
<b>CO5</b>	Communicate with clarity and present the ideas effectively to the audience.				Create
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>1. Competent Communication – A Practical Guide to becoming a better speaker, Toastmasters International, USA.</li><li>2. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.</li></ol>					

### Internal and External Assessment plan

Internal Assessment plan			External Assessment plan <i>Prepared speech based on the Toastmasters Projects (5-7 minutes)</i>		
S.No	Criteria	Marks	S.No	Criteria	Marks
1.	Submission of 5 Project scripts	5x2= 10 marks	1.	Confident, Eye Contact, Body Language	5 marks
2.	Prepared speech based on the Projects	5x5= 25 marks	2.	Content and clarity	20 marks
3.	<u>Performance in other Roles</u> 1.TMOD 2. Speech Evaluator 3. Table Topic Speaker and Master 4. General Evaluator 5.JIG and TAG Team member	5x3= 15 marks	3.	Command over Language	15 marks
	4.		Error free language	10 marks	
	<b>Total</b>	<b>50 marks</b>		<b>Total</b>	<b>50 marks</b>
<b>Internal= 50 marks</b>			<b>External= 50 marks</b>		
			<b>Total=100 marks</b>		
<b>Minimum Pass Mark= 50 marks</b>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		3		
CO2									2	3		3		
CO3									2	3		3		
CO4									2	3		3		
CO5									2	3		3		
CAM									2	3		3		

Course Code	Course Title	L	T	P	C
19UMA207	CALCULUS, COMPLEX ANALYSIS AND TRANSFORM TECHNIQUES (Common to CHEMICAL, AGRI, BME & BT)	3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"><li>To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them.</li><li>To acquaint the student with the concepts of analytic functions and their interesting properties which could be exploited in a few engineering areas, and be introduced to the host of conformal mappings with a few standard examples that have direct application.</li><li>To make the student to acquire sound knowledge of Laplace transform techniques and its applications in getting the solution of certain linear differential equations.</li></ul>					
UNIT – I	SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS				8 + 3
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Applications of ODE (Bacterial growth, Population growth, Decayed problems).					
UNIT – II	VECTOR CALCULUS				8 + 3
Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopiped.					
UNIT – III	COMPLEX VARIABLES				8 + 3
Functions of a complex variable – Analytic function – Necessary and Sufficient Conditions (excluding Proofs) – Harmonic function – Properties of an analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping – Simple Transformations: $w = z+c$ , $cz$ , $1/z$ , and Bilinear transformation.					
UNIT – IV	COMPLEX INTEGRATION				9 + 3
Statement and applications of Cauchy’s integral theorem, Cauchy’s integral formula and Cauchy Residue Theorem – Taylor’s and Laurent’s expansions – Applications of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding Poles on the real axis).					
UNIT – V	LAPLACE TRANSFORM				9 + 3
Existence conditions – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function, impulse function and periodic function – Inverse Laplace transform – Convolution theorem (excluding Proof) – Solution of linear ODE of second order with constant coefficients.					
SUPPLEMENT TOPIC (for internal evaluation only)					3
Evocation / Application of Mathematics.					
TOTAL : 45 (L) + 15 (T) = 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the knowledge of higher order ordinary differential equations in real life engineering problems.				Apply
CO2	Apply the concept vector identities in problem solving and evaluate the line, surface and volume integrals.				Apply
CO3	Apply the knowledge of analytic function and conformal mapping in various Engineering fields.				Apply
CO4	Apply the knowledge of singularities, residues in complex integration.				Apply
CO5	Apply various techniques to solve linear, nonlinear equations and Eigen value problems of a Matrix by Numerically.				Apply

<b>CO6</b>	Understand the knowledge of ODE, directional derivatives, scalar potentials and poles.	Understand
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"> <li>1. Veerarajan, T. "Engineering Mathematics" Tata McGraw Hill Publishing Company, New Delhi, 2008.</li> <li>2. Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, 2008.</li> <li>3. Grewal, B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 43rd Edition, 2014.</li> </ol>		
<b>REFERENCES:</b> <ol style="list-style-type: none"> <li>1. Ramana, B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 11<sup>th</sup> Reprint, 2010.</li> <li>2. Brown, J.W. and Churchill R.V." Complex Variable and Applications" 7<sup>th</sup> Edition McGrawHill Publishing Company 2004.</li> <li>3. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House Pvt. Ltd., New Delhi, 3<sup>rd</sup> Edition, 2007.</li> <li>4. Ince E.L "Ordinary Differential Equations", Dover Publications 1958.</li> </ol>		

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3			1								2	2	2
<b>CO2</b>	3	3		1								2	2	2
<b>CO3</b>	3	3		1								2	2	2
<b>CO4</b>	3			1								2	2	2
<b>CO5</b>	3			1								2	2	2
<b>CO6</b>	3			1								2	2	2
<b>CAM</b>	<b>3</b>	<b>3</b>		<b>1</b>								<b>2</b>	<b>2</b>	<b>2</b>

Course Code	Course Title	L	T	P	C
19UPH204	BIOMATERIAL PHYSICS (Common to BME & BT)	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To identify the fleet of scientific channels exploring the generation of high-tech Bio materials.</li><li>To enable the students to understand the properties of Implant materials.</li><li>To provide a comprehensive overview of new engineering material's in terms of the synthesis, characterization, properties, and applications.</li></ul>					
<b>UNIT – I</b>	<b>BIO THERMODYNAMICS</b>	<b>13</b>			
Introduction – Thermodynamics of living systems – Conservation of energy in living systems – Entropy and Life – Gibbs and Standard free energy – Equilibrium constant – Coupled reactions – Diffusion – Laws of diffusion – Active transport – Facilitated diffusion – Osmosis – Osmoregulation – Viscosity and biological importance – Surface tension – Factors influencing surface tension – Biological importance.					
<b>UNIT – II</b>	<b>IMPLANT MATERIALS</b>	<b>10</b>			
Introduction – different classes of materials used in medicine – mechanical & thermal properties – Metallic implant materials – stainless steels – co-based alloys – Ti-based alloys – ceramic implant materials – aluminum oxides – glass ceramics – carbons – Applications.					
<b>UNIT – III</b>	<b>NEW ENGINEERING MATERIALS</b>	<b>12</b>			
Introduction – Metallic glasses – preparation – properties – medical applications – Shape memory alloys – preparation – properties – medical applications – Bio Materials -- Classification – properties Testing of biomaterials – Application – Nano materials – fabrication methods – Plasma arching – Chemical Vapour deposition – ball milling – sol gel method – Medical applications – Nano medicine Nano sensors – Drug delivery.					
<b>UNIT – IV</b>	<b>FIBRE OPTICS IN MEDICINE</b>	<b>10</b>			
Introduction – Principle and propagation of optical fibre – Types of optical fibre – Attenuation – Advantages of optical fibre – Remote spectrophotometry – Fibre optic sensors – Body temperature and Blood pressure sensor – Applications – Fibre optic endoscope.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply the law of thermodynamics in living system.	Apply			
<b>CO2</b>	Interpret the usage of new engineering materials in the area of medical implantation.	Analyze			
<b>CO3</b>	Explain the transport properties of biomolecules, mechanical and thermal properties of new engineering materials and the optical properties of fiber in the biotechnology field.	Understand			
<b>CO4</b>	Analyze the constructional parameters of optical fibers in endoscopy imaging and various molecular transport phenomenon of biomaterials	Analyze			
<b>CO5</b>	Apply the concept of nanotechnology in biomaterials towards the usage of human body implantation.	Apply			
<b>CO6</b>	Apply the principle of propagation of light in optical fiber to study the various prospects in biomedical field.	Apply			
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Jeffrey O.Hollinger, “An Introduction to biomaterials”, Second Edition, CRC Press. New Delhi, 2010.</li><li>Dr. Mani.P , “ Physics ”, Dhanam Publications, Chennai Revised Edition, 2018.</li><li>V. Rajendran, Materials Science, Tata McGraw-Hill, New Delhi, 2018.</li></ol>					

**REFERENCES:**

1. Raghavan.V, "Material Science and Engineering", Prentice Hall of India Private Limited, New Delhi, Revised Edition 2018.
2. Palanisamy P.K., "Engineering Physics', Scitech Publication, Chennai, Edition, 2018.

<b>CO</b>	<b>POs</b>												<b>PSOs</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>CO1</b>	3												2	2
<b>CO2</b>	2												2	2
<b>CO3</b>	3												2	2
<b>CO4</b>	3												2	2
<b>CO5</b>	3												2	2
<b>CO6</b>	2												2	2
<b>CAM</b>	<b>2.67</b>												<b>2</b>	<b>2</b>

Course Code	Course Title	L	T	P	C
19UCY204	ENVIRONMENTAL SCIENCE (Common to ALL Branches)	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand the concepts of Environment and ecosystem.</li><li>To acquire knowledge about the impact of environmental pollution.</li><li>To understand the importance of environmental issues in the society.</li><li>To gain knowledge about the impact of environment related to human health.</li><li>To gain knowledge in alternative energies.</li></ul>					
<b>UNIT – I</b>	<b>ENVIRONMENT AND ECOSYSTEMS</b>				<b>9</b>
Definition, scope and importance of environment – Need for public awareness – Concept of ecosystem – Structure and function of ecosystem – Producers, consumers and decomposers – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grass land ecosystem.					
<b>UNIT – II</b>	<b>ENVIRONMENTAL POLLUTION</b>				<b>9</b>
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 – pollution case studies – Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides.					
<b>UNIT – III</b>	<b>SOCIAL ISSUES AND THE ENVIRONMENT</b>				<b>9</b>
Water conservation, rain water harvesting, watershed management — Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).					
<b>UNIT – IV</b>	<b>HUMAN POPULATION AND THE ENVIRONMENT</b>				<b>9</b>
Population growth, variation among nations – Population explosion – Human rights – 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.					
<b>UNIT – V</b>	<b>FUTURE POLICY AND ALTERNATIVES</b>				<b>9</b>
Introduction to future policy and alternatives – fossil fuels – nuclear energy-solar energy – wind energy – hydroelectric energy – geothermal energy – tidal energy – sustainability – green power – nanotechnology.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Understand the basic concept of structure and function of ecosystem.				Understand
<b>CO2</b>	Apply the knowledge of various pollution types to prevent the ecosystem and Environment.				Apply
<b>CO3</b>	Analyze the environmental problem to report the social issues and the environment.				Analyze
<b>CO4</b>	Compare the suitable methods for conservation and sustainable development of natural resources.				Analyze
<b>CO5</b>	Apply the principles of value education with respect to human population to preserve environment.				Apply
<b>CO6</b>	Analyze the current energy crisis and suggest a suitable sustainable alternatives that promotes social health and environmental prospects.				Analyze
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Anubha Kaushik, kaushik C.P., “Environmental Science and Engineering”, Third Edition, New Age International, New Delhi, 2009.</li><li>Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.</li></ol>					

## REFERENCES:

1. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', Pearson Education, Upper saddle River, New Jersey, 2008.
2. Miller T.G. Jr., Environmental Science", Wadsworth Publishing Company, Belmont, California, 2005.
3. De A.K., "Environmental Chemistry", Wiley Eastern Ltd., New Delhi, 2001.
4. Trivedi R.K., Goel P.K., "Introduction to Air Pollution", Techno-Science Publication, Jaipur, 2005.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	1	1
CO2	3											2	1	1
CO3	3	3										2	2	1
CO4	3	3										2	1	1
CO5	3											2	1	1
CO6	3	3										2	1	1
CAM	2.83	3										2	1.17	1



Course Code	Course Title	L	T	P	C
19UBM205	INTRODUCTION TO BIOMEDICAL ENGINEERING	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the basics of biomedical engineering in healthcare.</li><li>To discuss the opportunities of Biomedical engineering.</li><li>To introduce the scopes and various domains of Biomedical Engineering.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION</b>				<b>9</b>
Evolution of modern health care system – Engineering in modern medicine – Definition of Biomedical Engineering – Roles played by Biomedical Engineers – Professional status of Biomedical Engineering – History of Biomedical Devices.					
<b>UNIT – II</b>	<b>BIOLOGY AND ENGINEERING</b>				<b>9</b>
Introduction to human anatomy and physiology related to biomedical devices — Engineering of immunity and pathology – Communication systems in the body and its connection to biomedical engineering – Medical Electronics – Basis of Bioelectric potential Bio potential electrodes.					
<b>UNIT – III</b>	<b>CLINICAL ENGINEERING</b>				<b>9</b>
Evolution of clinical engineering – Clinical engineer Vs Biomedical engineer – Role of clinical engineers – Good clinical practice – Major functions of a clinical engineering – Standards for clinical engineering.					
<b>UNIT – IV</b>	<b>DOMAINS IN BIOMEDICAL ENGINEERING</b>				<b>9</b>
Introduction to: Medical devices and Robotics – Bio fabrication and Bio manufacturing – Biomedical Imaging – Bio molecular Science and Engineering – Musculoskeletal Biomechanics and Mechanobiology – Systems Biology – Tissue Engineering – Rehabilitation Engineering – Biomaterials and Nanotechnology – Neural Engineering.					
<b>UNIT – V</b>	<b>RECENT ADVANCES IN BIOMEDICAL ENGINEERING</b>				<b>9</b>
Introduction to: Research Opportunities – Prosthetics: Orthopedic Prosthetics, Neural Prosthetics – Stem cell Research – Virtual Reality – Forensic Science – Regenerative Medicine – Ergonomics – Robotics in Biomedical – IoT in Biomedical – Genetic Engineering – Smart health care Engineering – Technical Societies – Higher Studies opportunities.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Discuss his/her role as a biomedical engineer.	Understand			
<b>CO2</b>	Interpret the application of biology in engineering.	Understand			
<b>CO3</b>	Examine his/her responsibility as a clinical engineer.	Understand			
<b>CO4</b>	Analyze the various domains and recent advances in biomedical engineering.	Analyze			
<b>CO5</b>	Apply the knowledge of FET characteristics to identify the different modes of operation.	Apply			
<b>TEXT BOOKS:</b> 1. John D Enderle and Joseph D Bronzino, “Introduction to Biomedical Engineering” Third Edition, Academic Press – An Imprint of Elsevier, 2018.					
<b>REFERENCES:</b> 1. C. Raja Rao, Sujoy K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press, 2001. 2. W. Mark Saltzman, Biomedical Engineering: Bridging Medicine and Technology, Cambridge University Press, 2015. 3. Sundararajan V. Madhally, Principles of Biomedical Engineering, Artech House Publishers, 2010. 4. Azzam F.G. Taktak, Paul Ganney, David Long, Clinical Engineering: A Handbook for Clinical and Biomedical Engineers, Elsevier, 2013.					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2	3					3	2	2
CO2	2					2	3					3	2	2
CO3	2					2	3					3	2	2
CO4	2					2	3					3	2	2
CO5	2					2	3					3	2	2
CAM	2					2	3					3	2	2

Course Code	Course Title	L	T	P	C
19UBM206	ELECTRICAL CIRCUITS AND MEASUREMENTS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the basic concepts of DC and AC circuits behavior.</li><li>To introduce different methods of circuit analysis using Network theorems.</li><li>To study the transient and steady state response of the circuits.</li><li>To discuss the construction and working of basic electrical instruments.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION AND ANALYSIS</b>				<b>9</b>
Voltage and current sources: independent, dependent, ideal and practical – VI characteristics of resistor, inductor, mutual inductance and capacitor – Ohm’s Law – Kirchoffs laws – Resistors in series and parallel circuits – Mesh current and node voltage methods of analysis for D.C circuits.					
<b>UNIT – II</b>	<b>NETWORK THEOREMS</b>				<b>9</b>
Network reduction: voltage and current division – source transformation – star delta conversion – Thevenin’s Theorem – Norton’s Theorem – Superposition Theorem – Maximum power transfer theorem — Reciprocity Theorem.					
<b>UNIT – III</b>	<b>RESONANCE AND COUPLED CIRCUITS</b>				<b>9</b>
Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling.					
<b>UNIT – IV</b>	<b>TRANSIENTS AND AC CIRCUITS</b>				<b>9</b>
Transient response of RL, RC and RLC Circuits with dc excitation – Peak, average and RMS values of ac quantities – apparent, active and reactive powers – phasor analysis – impedance and admittance.					
<b>UNIT – V</b>	<b>ELECTRICAL INSTRUMENTS</b>				<b>9</b>
Construction and working of Permanent Magnet Moving Coil instruments — Moving Iron instruments – Dynamometer – DC Potentiometer.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the basic electrical elements and electromechanical Indicating Instruments.				understand
<b>CO2</b>	Elucidate the various types of wiring terminologies and electrical safety in hospitals.				Understand
<b>CO3</b>	Apply the basic laws and theorems to compute voltage and current in AC and DC circuits.				Apply
<b>CO4</b>	Estimate the values of various lumped network elements of resonant and coupled circuits.				Apply
<b>CO5</b>	Analyze the different parameters of Electromechanical Instruments.				Analyze
<b>CO6</b>	Evaluate the performance of transient circuits in bio-medical equipment.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Sudhakar A and Shyam Mohan S.P., “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2007.</li><li>Sawhney A.K., “Electrical &amp; Electronic Measurement &amp; Instruments”, Dhanpat Rai &amp; Co. Publications, 2005.</li></ol>					

**REFERENCES:**

1. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Fifth Edition, Tata McGraw-Hill, New Delhi, 2010.
2. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
3. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2003.
4. Banerjee G. K., "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	2					2	3					2	2	
CO3	3											2	2	
CO4	3												2	
CO5	3	3											2	
CO6	3	3	2	2								2	3	
CAM	2.67	3	2	2		2	3					2	2.17	

Course Code	Course Title	L	T	P	C
19UGS210	<b>ENERGY AND ENVIRONMENTAL SCIENCE LABORATORY</b> (Common to ALL Branches)	0	0	3	1.5
<b>PHYSICS LABORATORY</b>					
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To analyze the Band gap, moment of inertia, thermal conductivity and rigidity modulus of the materials.</li> <li>To gain knowledge in Photonics.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
<b>A minimum of FIVE experiments shall be offered</b> <ol style="list-style-type: none"> <li>Determination of Energy band gap of a semiconductor.</li> <li>Torsion pendulum — Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire.</li> <li>Spectrometer - Determination of wavelength of mercury spectrum using grating.</li> <li>Laser – Determination of numerical aperture and acceptance angle of an optical fiber.</li> <li>Newton's rings – Determination of radius of curvature of a convex lens.</li> <li>Lee's Disc - Determination of thermal conductivity of a bad conductor.</li> <li>Determination of Solar cell Characteristics using optical transducers kit.</li> </ol>					
<b>CHEMISTRY LABORATORY</b>					
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To apply the theoretical concepts to perform lab experiments.</li> <li>To assess the water quality parameters.</li> <li>To acquire knowledge on water quality parameters for the analysis of industrial effluents</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
<b>A minimum of FIVE experiments shall be offered</b> <ol style="list-style-type: none"> <li>Estimation of hardness of water by EDTA method.</li> <li>Estimation of alkalinity of water sample.</li> <li>Estimation of Chloride in water sample (Argentometric method).</li> <li>Determination of DO in water.</li> <li>Estimation of chromium in tannery wastes.</li> <li>Estimation of available chlorine in bleaching powder.</li> <li>Estimation of iron by Spectrophotometry.</li> <li>Determination of acidity of industrial effluents.</li> </ol>					
<b>Laboratory classes on alternate weeks for Physics and Chemistry: TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply the principles of Light and Elasticity to determine the Engineering properties of materials.	Apply			
<b>CO2</b>	Analyze the thermal conductivities of different bad conductors.	Analyze			
<b>CO3</b>	Analyze the Characteristics of a semiconductor.	Analyze			
<b>CO4</b>	Apply the basic knowledge of water quality testing for environmental sustainability.	Apply			
<b>CO5</b>	Analyze the water quality parameters for industrial effluents to prevent water pollution.	Analyze			
<b>CO6</b>	Estimate the quality of water that suits for domestic and industrial applications.	Apply			

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3								3				2	2
CO2	3	3							3				2	2
CO3	3	3							3				2	2
CO4	3													
CO5	3	3												
CO6	3	3				3	3		3			2	2	2
CAM	3	3				3	3		3			2	2	2

Course Code	Course Title	L	T	P	C
19UBM211	ELECTRICAL CIRCUITS LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To familiarize the basic electrical laws and network theorems.</li> <li>To determine the resonance and transient responses of RLC circuits.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b> <ol style="list-style-type: none"> <li>Verification of Ohm's law.</li> <li>Verification of Kirchoff's laws.</li> <li>Verification of Mesh and Nodal Analysis</li> <li>Verification of Thevenin's theorem.</li> <li>Verification of Norton's theorem.</li> <li>Verification of Reciprocity theorem.</li> <li>Verifications of Super Position Theorem</li> <li>Verifications of maximum power transfer</li> <li>Determination of Resonance Frequency of Series &amp; Parallel RLC Circuits.</li> <li>Transient analysis of RL and RC circuits.</li> </ol>					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Validate the basic electrical laws for the given circuits.				Apply
<b>CO2</b>	Analyze and validate electrical circuits using network theorems.				Analyze
<b>CO3</b>	Design and test RLC series and parallel circuits to compute the resonant frequency and bandwidth.				Apply

#### HARDWARE REQUIREMENTS

Sl. No.	Name of the equipment	Quantity required
1.	Voltmeter	15
2.	Ammeter	15
3.	CRO (30MHz)	4
4.	Function Generators (3MHz)	4
5.	Regulated Power Supplies ( 0 – 30V)	10
6.	Multimeter	5
7.	DRB	4
8.	DCB	2
9.	Resistor	Required Nos.
10.	Capacitor	Required Nos.
11.	Inductance	Required Nos.
12.	Bread board	10

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3								3	3		2	2	
<b>CO2</b>	3								3	3		2	2	
<b>CO3</b>	3	2							3	3		2	2	
<b>CAM</b>	3	2							3	3		2	2	

## SEMESTER III

[illegible]



Course Code	Course Title	L	T	P	C
19UMA326	<b>TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS</b> <b>(Common to AGRI, CHEMICAL, BME &amp; BT)</b>	3	1	0	4
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To make the student knowledgeable in formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.</li><li>To familiarize the students to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them numerically and interpret the results.</li><li>To acquaint the student with the basics of Z - transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z - transform technique bringing out the elegance of the procedure involved.</li></ul>					
<b>UNIT – I</b>	<b>FOURIER SERIES</b>	<b>9 + 3</b>			
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic analysis – Application of Fourier series – Gibb's Phenomenon.					
<b>UNIT – II</b>	<b>FOURIER TRANSFORM</b>	<b>9 + 3</b>			
Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Application of Fourier Transform.					
<b>UNIT – III</b>	<b>Z-TRANSFORM AND DIFFERENCE EQUATIONS</b>	<b>9 + 3</b>			
Organization of nervous system – Neuron – Classification and Properties of nerve fibers – Synapse – Neurotransmitters – Reflex activity – Central Nervous System (CNS): Structure and functions of Brain and Spinal cord – Peripheral Nervous System (PNS): Structure and functions of Sympathetic and Parasympathetic nervous system.					
<b>UNIT – IV</b>	<b>PARTIAL DIFFERENTIAL EQUATIONS</b>	<b>9 + 3</b>			
Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.					
<b>UNIT – V</b>	<b>APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS</b>	<b>9 + 3</b>			
Introduction of Partial differential equations – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.					
<b>TOTAL : 45 (L) + 15 (T) = 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply the knowledge of Fourier series for the given function or Discrete data and compute the Periodic function arising in the study of Engineering problems.	Apply			
<b>CO2</b>	Apply the knowledge of Fourier transform and its properties which are used to transform signals between time and frequency domain.	Apply			
<b>CO3</b>	Apply the acquired knowledge of Z transform and its properties inverse Z transform and difference equations.	Apply			
<b>CO4</b>	Apply the knowledge of partial differential equation in solving linear and higher order partial differential equation.	Apply			
<b>CO5</b>	Apply the knowledge of PDE in solving linear, higher order and one dimensional Wave, Heat flow equation.	Apply			
<b>CO6</b>	Understand the basic concept of periodic, non-periodic function and nature of partial differential equation.	Understand			

**TEXT BOOKS:**

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 42nd Edition, (2012).
2. Bali N.P., Manish Goyal and Watains, "Advanced Engineering Mathematics", Firewall Media (An imprint of Laxmi Publication Private limited) New Delhi, 7th Edition, 2009.
3. Veerajan.T, "Higher Engineering Mathematics", Yes Dee Publishing Pvt. Limited, 2015.

## REFERENCES:

1. Kandasamy.P, Thilagavathy.K and Gunavathy.K, “Engineering Mathematics III”, S.Chand & Company Ltd., New Delhi, 3rd Edition, 1996.
2. Ramana.B.V, “Higher Engineering Mathematics” Tata McGraw Hill, New Delhi, 11th Reprint 2010.
3. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 3rd Edition, 2007.
4. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India, 10th Edition, 2011.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			1								1	2	2
CO2	3			1								1	2	2
CO3	3			1								1	2	2
CO4	3			1								1	2	2
CO5	3			1								1	2	2
CO6	3			1								1	2	2
CAM	3			1								1	2	2

Course Code	Course Title	L	T	P	C
19UBM302	HUMAN ANATOMY AND PHYSIOLOGY	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explore the structural and functional elements of human body.</li><li>To explain structure and functions of various types of organ systems of human body.</li><li>To familiarize the fundamental relation between human anatomy and physiology.</li></ul>					
<b>UNIT – I</b>	<b>CELL: STRUCTURE AND FUNCTIONS</b>	<b>9</b>			
Functional Organization of the Human Body and Control of the Internal Environment. Cell: Different types of cells — Structure and organelles — Functions of each component in the cell — Cell membrane: transport across membrane – Origin of cell membrane potential (Nernst and Goldman and Katz equations) – Action potential and propagation. Cell division: Mitosis & Meiosis, Cell cycle and its Regulation.					
<b>UNIT – II</b>	<b>CARDIOVASCULAR AND RESPIRATORY SYSTEM</b>	<b>9</b>			
Cardiovascular System – Heart: Structure of the heart – Functions – Actions of the heart – Properties of cardiac muscle – Conducting system of heart – Cardiac cycle – Relationship of the Heart soundsto Heart pumping – classification of circulatory system – Volume and pressure changes and regulation of heart rate. Respiratory system – Lungs: Structure and functions – Types and phasesof respiration – Breathing mechanism – Respiratory tract – Pulmonary ventilation and Pulmonary circulation – Regulation of respiration.					
<b>UNIT – III</b>	<b>NERVOUS SYSTEM</b>	<b>9</b>			
Organization of nervous system – Neuron – Classification and Properties of nerve fibers – Synapse – Neurotransmitters – Reflex activity – Central Nervous System (CNS): Structure and functions of Brain and Spinal cord – Peripheral Nervous System (PNS): Structure and functions of Sympathetic and Parasympathetic nervous system.					
<b>UNIT – IV</b>	<b>DIGESTIVE AND EXCRETORY SYSTEM</b>	<b>9</b>			
Digestive system: Gastro Intestinal functions – Motility, Nervous Control and Blood Circulation – Digestion and absorption – Movement of GI tract – Secretion of digestive fluids. Urinary system: Structure and functions of Kidney and Nephron – Mechanism of Urine formation – Regulation of extracellular fluid Osmolarity, Sodium Concentration and other ions – Regulation of Acid – Base balance.					
<b>UNIT – V</b>	<b>SKELETAL AND SENSORY SYSTEM</b>	<b>9</b>			
Skeletal System: Bone types and functions – Organization of skeletal muscle – physiology of muscle contraction – neuromuscular junction. Joint – Types of Joints – Cartilage and functions. Sensory organs: Auditory (Ear), Olfactory (Nose), Ophthal (Eye), Gustatory (Taste) and Tactile (Touch).					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Illustrate the structure and functional mechanism of various organs in human body.	Understand			
<b>CO2</b>	Discuss and infer the diseases, disorders and conditions commonly found in human beings.	Understand			
<b>CO3</b>	Apply the knowledge of human anatomy to the clinical scenarios.	Apply			
<b>CO4</b>	Analyze various cell structures at tissue and organ levels to maintain the homeostasis condition.	Analyze			
<b>CO5</b>	Comparatively analyze the human heart and nervous system for the healthy people and people suffering from an illness.	Analyze			
<b>CO6</b>	Investigate the factors responsible for various vital functions of human body and correlate it with the diseased condition.	Evaluate			

**TEXT BOOKS:**

1. Arthur C, Guyton, John Hall. E "Textbook of Medical Physiology", W.B. Saunders Company, Eleventh edition, 2006
2. K Sembulingam, PremaSembulingam "Essentials of Medical Physiology" Jaypee Brothers Medical Publishers (P) Ltd, Sixth edition, 2012.

**REFERENCES:**

1. Prabhjot Kaur, "Text Book of Anatomy and Physiology", Lotus Publsihers, 2014.
2. Elaine.N. Marieb, Essential of Human Anatomy and Physiology, Eight Edition, Pearson Education, New Delhi, 2007.
3. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers, 2014.
4. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2013.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	
CO2	2					3		2				2	3	
CO3	3											2	3	
CO4	3	3		2					2				3	
CO5	3	3											3	2
CO6	3	3	2	2		3	2					2	3	2
CAM	2.67	3	2	2		3	2	2	2			2	3	2

Course Code	Course Title	L	T	P	C
19UBM303	BIOCHEMISTRY	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>• To learn about fundamentals of chemical foundations of biology.</li><li>• To explore the principle of general techniques and study its biomedical applications.</li><li>• To study structural &amp; functional properties of carbohydrates, proteins, lipids and nucleic acids.</li><li>• To emphasize the overview of metabolic pathways of bio-molecules and their biomedical significance.</li></ul>					
<b>UNIT – I</b>	<b>BIOCHEMISTRY : CHEMICAL BASIS OF LIFE</b>	<b>9</b>			
Introduction to Biochemistry – Bio-organic Chemistry – Biophysical Chemistry – Tools of Biochemistry – Biomolecules – Study of Metabolic processes – Stabilizing forces in molecules: Covalent and Ionic bonds – Principles of Thermodynamics.					
<b>UNIT – II</b>	<b>METABOLISM OF CARBOHYDRATES</b>	<b>9</b>			
Nomenclature – Biological Functions – Classification: Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides, Mucopolysaccharides, Glycoproteins and Mucoproteins – Structure – physical and chemical properties of carbohydrates – Metabolic Pathways of Glucose: Glycogen, Glycogenolysis, Glycogenesis and its hormonal regulation – Metabolic disorders.					
<b>UNIT – III</b>	<b>PROTEINS, AMINO AND NUCLEIC ACIDS</b>	<b>9</b>			
Proteins: Structure – Primary, Secondary, Tertiary, Quaternary – Properties – Denaturation – Classification – Plasma Proteins – Amino Acids: Structure – Classification – Properties – Metabolism – Peptide bond formation – Nucleic Acids: Structure of purines and pyrimidines, Nucleoside, Nucleotide, DNA act as a genetic material, Chargoffs rule– Watson and crick model of DNA– Structure of RNA and its type – Metabolic disorders.					
<b>UNIT – IV</b>	<b>ENZYME AND LIPID METABOLISM</b>	<b>9</b>			
Enzymes: Nomenclature and Classification – Chemical Nature and Properties of Enzymes – Factors affecting Enzyme activity – Mechanism of Enzyme Action – Application and Diagnostic importance of Enzymes. Lipids: Classification of lipids – Fatty acids – Saturated fatty acids – Unsaturated fatty acids – Trans fatty acids – Neutral fats – Phospholipids – Physical and chemical properties of lipid – Metabolic pathways – Synthesis and degradation of fatty acid – Hormonal metabolism of fatty acid metabolism – Metabolic disorders.					
<b>UNIT – V</b>	<b>ENVIRONMENTAL BIOCHEMISTRY AND GENERAL TECHNIQUES</b>	<b>9</b>			
Environmental Biochemistry: Atmospheric Changes – Pollution – Carcinogens – Metabolism of Nitrogen containing compounds: Nitrogen fixation, Amino acids and Nucleotides Photosynthesis: Calvin cycle. General Techniques: Electrophoresis – Chromatography – Radioimmunoassay – ELISA test – Colorimeter – Auto-analyzer – Mass spectrometry.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the structural and functional components of bio-molecules and enzymes.	Understand			
<b>CO2</b>	Apply the characteristics of genetic materials to determine the genetic disorder.	Apply			
<b>CO3</b>	Apply the knowledge of body fluid composition and function to interpret the clinical laboratory reports.	Apply			
<b>CO4</b>	Analyze the physical and chemical properties of bio-molecules and enzymes.	Analyze			
<b>CO5</b>	Analyze biochemical processes involved in the metabolic pathways of bio-molecules and its metabolic activity in normal and abnormal conditions.	Analyze			
<b>CO6</b>	Investigate environmental changes due to biological molecules and provide suggestions to protect and preserve the environment.	Evaluate			

**TEXT BOOKS:**

1. Dr.U.Satyanarayana, "Biochemistry", 3rd Revised Edition, ArunabhaSen Books & Allied (P) Ltd. 2007.
2. D.M. Vasudevan, "Textbook of Biochemistry for Medical Students", Jaypee Brothers Medical Publishers (P) Ltd, Seventh Edition, 2013.

**REFERENCES:**

1. RAFI MD, "Text book of biochemistry for Medical Student", Second Edition, University Press, 2014.
2. Keith Wilson & John Walker, "Practical Biochemistry – Principles & Techniques", Oxford University Press, 2009.
3. Pamela. C. Champe & Richard. A. Harvey, "Lippincott Biochemistry Lippincott's Illustrated Reviews", Raven publishers, 1994.
4. David. W. Martin, Peter. A. Mayes, Victor. W. Rodwell, "Harper's Review of Biochemistry", LANGE Medical Publications, 1981.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	2	
CO2	3	3							2	2			2	
CO3	3	3				2	2	2					2	
CO4	3	3		2									2	
CO5	3	3							2	2		2	2	
CO6	2	3		2			3					3	2	
CAM	2.67	3		2		2	2.5	2	2	2		2.33	2	

Course Code	Course Title	L	T	P	C
19UBM304	BIOMEDICAL INSTRUMENTATION	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the basic theory of bio potential electrodes and measurement.</li><li>To design Bio potential amplifiers for acquisition of bio signals.</li><li>To familiarize the various non-electrical physiological parameter measurement and biochemical measurements.</li></ul>					
<b>UNIT – I</b>	<b>BIO POTENTIAL ELECTRODES</b>				<b>9</b>
Origin of bio potential and its propagation – Electrode-electrolyte interface – electrode-skin interface – half-cell potential –contact impedance – polarization effects of electrode – non-polarizable electrodes – Types of electrodes: surface, needle and micro electrodes and their equivalent circuits – Recording problems – measurement with two electrodes.					
<b>UNIT – II</b>	<b>BIOPOTENTIAL MEASUREMENT</b>				<b>9</b>
Bio signals characteristics – frequency and amplitude ranges – ECG – Einthoven’s triangle, standard 12 lead system – Principles of vector cardiography – Measurements of heart sounds – PCG – EEG – 10-20 electrode system, unipolar, bipolar and average mode – EMG – unipolar and bipolar mode – Recording of ERG, EOG and EGG.					
<b>UNIT – III</b>	<b>SIGNAL CONDITIONING CIRCUITS</b>				<b>9</b>
Need for bio-amplifier – single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier – Impedance matching circuit – Isolation amplifiers – transformer and optical isolation – Isolated DC amplifier and AC carrier amplifier – Power line interference – Band pass filtering – Artifacts and removal.					
<b>UNIT – IV</b>	<b>MEASUREMENT OF NON-ELECTRICAL PARAMETERS</b>				<b>9</b>
Temperature, respiration rate and pulse rate measurements–Measurement of blood pressure – direct and indirect methods – Pressure amplifiers – Systolic, diastolic, mean detector circuit – Blood flow measurement: Electromagnetic and ultrasound methods – Cardiac output measurement: Indicator dilution, dye dilution and thermodilution methods.					
<b>UNIT – V</b>	<b>BIOCHEMICAL MEASUREMENT AND BIOSENSORS</b>				<b>9</b>
Biochemical sensors – pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors – Blood gas analyzers – colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – amperometric and voltmetric techniques.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the fundamentals of bio signal recording and measurement.				Understand
<b>CO2</b>	Apply bio-potential recording concepts to diagnostic applications.				Apply
<b>CO3</b>	Apply the principles of biochemical measuring instruments in clinical settings.				Apply
<b>CO4</b>	Select an appropriate acquisition method for analyzing various vital bio-signal parameters.				Analyze
<b>CO5</b>	Design and implement amplifiers for various bio electrical signal measurements.				Create
<b>CO6</b>	Design a PCB layout for bio-amplifiers using software tools.				Apply
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and Sons,New York, 4th Edition, 2009.</li><li>Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 3rd Edition, 2014.</li></ol>					

**REFERENCES:**

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice Hall of India, New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and sons, 3rd Edition, Reprint 2008.
4. Myer Kutz, ' Standard Handbook of Biomedical Engineering & Design', McGraw-Hill Publisher, 2003.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2											3	
CO3	3	2				2						2	3	
CO4	3	3	2		2					2			3	
CO5	3	2	3	2	3			2	2			2	3	2
CO6	3	2			3								3	2
CAM	2.83	2.2	2.5	2	2.67	2		2	2	2		2	2.83	2



Course Code	Course Title	L	T	P	C
19UBM305	SEMICONDUCTOR DEVICES AND CIRCUITS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the working of various semiconductor devices.</li><li>To explain the concept of amplifiers, regulators and oscillators using transistors.</li><li>To learn the required functionality of positive and negative feedback systems.</li></ul>					
<b>UNIT – I</b>	<b>SEMICONDUCTOR DIODES &amp;TRANSISTOR</b>	<b>9</b>			
PN Junction — Structure and Operation — Current components in a PN diode — Junction capacitance – Junction diode switching time– Structure and Operation of Zener diode – Varactor diode – Tunnel diode – Schottky diode-Transistor Structure – Basic Transistor operation – Transistor characteristics and parameters – Transistor bias circuits: Voltage divider bias circuits, base bias circuits, emitter bias circuits.					
<b>UNIT – II</b>	<b>FET, UJT and SCR</b>	<b>9</b>			
JFET – Characteristics and parameters – JFET biasing, self-bias, voltage divider bias – Q point – MOSFET – Characteristics and parameters – Characteristics of UJT and SCR.					
<b>UNIT – III</b>	<b>AMPLIFIERS</b>	<b>9</b>			
CE,CB and CC amplifiers – Small signal low frequency transistor amplifier circuits – h parameter representation of a transistor – Analysis of single stage transistor amplifier using parameters voltage gain, current gain, input impedance, output Admittance and frequency response – Power amplifiers: Class A,B and AB (Qualitative analysis).					
<b>UNIT – IV</b>	<b>FEEDBACK AMPLIFIERS AND OSCILLATORS</b>	<b>9</b>			
Advantages of negative feedback – Voltage/current, series/shunt feedback – Positive feedback – Condition for oscillators – Phase shift – Wein Bridge – Hartley-Colpitts and Crystal oscillators.					
<b>UNIT – V</b>	<b>PULSE CIRCUITS AND REGULATORS</b>	<b>9</b>			
RC wave shaping circuits — Diode clampers and clippers — Multivibrators — Astable and Monostable multivibrators — Schmitt triggers — UJT — Saw tooth oscillators — Single phase rectifiers and analysis of filter circuits – Design of zener and transistor series voltage regulators.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the structure and working of basic electronic devices.				Understand
<b>CO2</b>	Identify the various transistor biasing and compensation circuit parameters.				Apply
<b>CO3</b>	Design a power supply, regulator and filter for the given requirements.				Apply
<b>CO4</b>	Analyze the different characteristics of diodes, transistors and amplifiers.				Analyze
<b>CO5</b>	Estimate the exact analysis and approximate analysis for amplifiers.				Analyze
<b>CO6</b>	Design the Oscillators and wave shaping circuits for given specifications.				Create
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>1. Millman and Halkias, "Electronic Devices and Circuits", Tata McGraw–Hill, 2007.</li><li>2. Floyd, T.L, "Electronic Device" 7th Edition, Pearson Education, 2008.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>1. Millman, J., PrakashRao., M.S. and Taub, H., "Pulse Digital and Switching Wave Forms", McGraw-Hill, 2nd Edition, 2007.</li><li>2. Streetman,B. and Sanjay,B., "Solid State Electronic Devices", Prentice-Hall of India, 5th Edition, 2005.</li><li>3. Mottershead, A., "Electronic Devices and Circuits an Introduction", Prentice Hall of India, 2003.</li><li>4. Boylsted and Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall of India, 6th Edition, 1999.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3													
CO3	3											2	2	
CO4	3	3			2				2				2	
CO5	3	3											2	
CO6	3	3	2						2			2	2	
CAM	2.83	3	2		2				2			2	2	

Course Code	Course Title	L	T	P	C
19UBM306	SENSORS AND MEASURING TECHNIQUES	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To explain the purpose of measurement, the methods of measurements and errors associated with measurements.</li><li>To explore the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.</li><li>To familiarize the different bridges, signal analyzers, display and recording devices.</li></ul>					
<b>UNIT – I</b>	<b>MEASUREMENT SYSTEM AND BASICS OF TRANSDUCERS</b>	<b>9</b>			
Measurements: Significance and methods – Instrumentation system – Classification of Instruments – Static and dynamic characteristics – Classification and selection of transducers – Errors in measurements and their statistical analysis – Calibration – Primary and secondary standards.					
<b>UNIT – II</b>	<b>DISPLACEMENT, PRESSURE AND TEMPERATURE SENSORS</b>	<b>8</b>			
Displacement & Pressure Measurement: Strain Gauge – Principle, Gauge factor – Types of Strain gauges – Strain gauge as displacement & pressure transducers – Capacitive transducer – Inductive transducer – LVDT – Temperature Measurement: RTD – Thermistor– Thermocouple – Materials, Range and Characteristics.					
<b>UNIT – III</b>	<b>PHOTOELECTRIC, PIEZOELECTRIC AND OTHER SENSORS</b>	<b>9</b>			
Phototube – Scintillation counter – Photo Multiplier Tube (PMT) – Photovoltaic, Photo conductive cells – Photo diodes – Phototransistor – Comparison of photoelectric transducers – Spectrophotometric applications of photo electric transducers – Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer – Digital Transducers – Introduction to MEMS and Nano sensors.					
<b>UNIT – IV</b>	<b>BRIDGE CIRCUITS AND SIGNAL ANALYZERS</b>	<b>9</b>			
AC and DC Bridges – Wheat stone bridge, Kelvin, Maxwell, Hay, Wien, Schering bridges – Function generator – Wave analyzer – Spectrum analyzer.					
<b>UNIT – V</b>	<b>DISPLAY AND RECORDING DEVICES</b>	<b>10</b>			
Digital voltmeter – Multi meter – CRO – block diagram – CRT – vertical & horizontal deflection system – Special purpose oscilloscopes – Dual beam, Dual trace, DSO – LCD and LED displays – Graphic recorders – Magnetic tape recorders – Digital recorders – Photographic, Inkjet, Thermal and Electrostatic recorders.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the concepts of instrumentation and measurement system.				Understand
<b>CO2</b>	Apply the fundamentals of physics to the various sensors and measuring devices.				Apply
<b>CO3</b>	Select appropriate sensors and signal conditioning circuits for given requirements.				Apply
<b>CO4</b>	Analyze the performance of the various sensors and display/recording devices for specific biomedical application.				Analyze
<b>CO5</b>	Analyze the impact of environmental factors on the performance of bridge circuits and photo/piezoelectric transducers-based medical devices.				Analyze
<b>CO6</b>	Evaluate new sensor technologies or measurement methodologies to address the emerging challenges in healthcare.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Doebelin E.O. and Manik D.N., “Measurement Systems – Applications and Design”, Tata McGraw-Hill Education Pvt. Ltd., 6th Edition, 2011.</li><li>Albert D.Helfrick and William D.Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.</li></ol>					

**REFERENCES:**

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation", 10th edition, DhanpatRai& Co, New Delhi, 19th Revised edition 2011, Reprint 2014.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and sons, 3rd Edition, Reprint 2008.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
4. Kalsi H.S, "Electronic Instrumentation" Tata McGraw-Hill Education, 3rd edition, 2012.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2											3	
CO3	3	2				2			2	2			3	
CO4	3	3	2					2				2	3	
CO5	3	3					2					2	3	
CO6	3	3	2	2				2	2			2	3	2
CAM	2.83	2.6	2	2		2	2	2	2	2		2	2.83	2

Course Code	Course Title	L	T	P	C
19UBM307	SEMICONDUCTOR DEVICES AND CIRCUITS LABORATORY	0	0	3	1.5

#### OBJECTIVES:

##### To impart knowledge on:

- The characteristics of semiconductor and special purpose electron devices.
- Design of amplifiers, oscillators and regulators.
- Simulation software to implement electronic circuits.

#### LIST OF EXPERIMENTS:

1. Characteristics of PN Junction Diode.
2. Characteristics of Zener diode.
3. Characteristics of Transistor using CE and CB configurations.
4. Characteristics of JFET
5. Differential amplifier using FET.
6. Characteristics of Thyristor and UJT.
7. Design and Analysis of Feedback Amplifiers.
8. Design of RC Oscillators and LC Oscillators using BJT.
9. Characteristics of Passive filters.
10. Common PCB design and practice for simple circuits.
11. Simulate and study resistance impact under series and parallel connection using Circuit Simulation software.
12. Simulate and study of Common Emitter amplifier using Circuit Simulation software.

**TOTAL : 45 PERIODS**

#### COURSE OUTCOMES:

##### At the end of the course the student will be able to:

CO1	Identify and construct the circuit for amplifiers, filters and oscillators.	Apply
CO2	Analyze the frequency response and stability of the given transistor circuit configuration.	Analyze
CO3	Analyze the characteristics response of various semiconductor devices.	Analyze
CO4	Apply appropriate software tools to make measurements of physical quantities	Apply
CO5	Demonstrate proficiency in using discipline-specific tools	Apply
CO6	Function effectively as an individual for efficiently executing the given task	Organize

#### HARDWARE REQUIREMENT:

S.No	Name of the experiment	Range/Specification	Quantity Required
1.	Regulated Power Supply	0-30V.2A	10
2.	Dual Tree CRO (20 MHz)	30MHZ	3
3.	Function Generator	3MHZ	3
4.	3 1/2 Digit digital multimeter	500mA/250V	8
5.	Bread Boards	-----	20
6.	Transistor	BC107	25
7.	JFET	BFW 10	10
8.	Diode	IN 4007	10
9.	Zener Diode	Z10	5
10.	UJT	ZN 2646	5
11.	Photo Diode	LED55C	5
12.	Photo Transistor	BPX38	5
13.	Milli Ammeter (0-100mA)	0-100mA, 0-50mA, 0-30mA	15
14.	Micro Ammeter (0-50μA)	(0-100mA), (0-50mA)	10
15.	Low range voltmeter (0-30V)	(0-10V), (0-1 V)	10
16.	Resistor	Various ranges	50
17.	Capacitors	Various ranges	50
18.	SCR	TYN616	5

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	
CO3	3	2											2	
CO4	3	3	3		2	2			3	2		2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	2.8	2.25	3		2	2			3	2		2	2	

Course Code	Course Title	L	T	P	C
19UBM308	BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <b>To impart knowledge on:</b> <ul style="list-style-type: none"> <li>• Estimation and quantification of biomolecules.</li> <li>• Separation of macromolecules.</li> <li>• Interpretation of metabolic changes in pathological conditions.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
<p><b><u>Biochemistry:</u></b></p> <ol style="list-style-type: none"> <li>1. General tests for carbohydrates, proteins and lipids.</li> <li>2. Preparation of solutions: Percentage solutions, Molar solutions, and Normal solutions</li> <li>3. Standardization of pH meter, preparation of buffers, emulsions.</li> <li>4. Separation of amino acids by thin layer chromatography.</li> <li>5. Preparation of serum and plasma from blood and estimation of Haemoglobin</li> <li>6. Estimation of blood glucose &amp; cholesterol.</li> <li>7. Estimation of creatinine.</li> <li>8. Estimation of urea and Uric acid</li> <li>9. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)</li> <li>10. Separation of DNA by agarose gel electrophoresis. (demo)</li> <li>11. Separation of proteins by SDS electrophoresis. (demo)</li> </ol> <p><b><u>Human Physiology:</u></b></p> <ol style="list-style-type: none"> <li>12. Identification of Blood groups</li> <li>13. Differential count of Blood cells</li> <li>14. Total RBC and WBC count.</li> <li>15. ESR, PCV, MCH, MCV and MCHC estimation.</li> <li>16. Assay of SGOT/SGPT.</li> </ol>					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Demonstrate various biochemical reactions using human body fluids or in given samples and quantify the bio-molecules.	Apply			
<b>CO2</b>	Examine normal and abnormal biochemical reactions in human body and quantitative analysis of blood glucose, creatinine, urea and cholesterol.	Analyze			
<b>CO3</b>	Evaluate the composition of blood and urine samples.	Evaluate			
<b>CO4</b>	Apply appropriate software tools to make measurements of physical quantities	Apply			
<b>CO5</b>	Demonstrate proficiency in using discipline-specific tools	Apply			
<b>CO6</b>	Function effectively as an individual for efficiently executing the given task	Organize			

**HARDWARE REQUIREMENT:**

Sl. No.	Name of the equipment	Quantity required
1.	Spectrophotometer	1
2.	Colorimeter	2
3.	pH meter	1
4.	Refrigerator	1
5.	Vortex Shaker	2
6.	SDS gel electrophoresis	1
7.	TLC plates	1
8.	Wintrobe tube	2
9.	Centrifuge Normal	1
10.	Microslides	2 packets
11.	Lancet : 5 boxes	5 boxes
12.	Microscope	1
13.	Neubaur's Chamber	1
14.	Heparinized Syringe	1 box
15.	Haemoglobinometer	1
16.	Capillary tubes	1
17.	Blood grouping kit	1
18.	Wax dispenser	1
19.	Slide warming	1
20.	Slides	1 box
21.	Cover slip	1 box
22.	Water bath normal	1
23.	Oven	1
24.	PCV tube	2

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3					2						2	
CO2	3	3						2		2			2	
CO3	3	3							2	2		2	2	
CO4	3	3	2										2	
CO5	3				3							2	2	
CO6									3			2	2	
CAM	3	3	2		3		2	2	2.5	2		2	2	



Course Code	Course Title	L	T	P	C
19UGM331	BIOLOGY FOR ENGINEERS (For BME & BT)	2	0	0	P/F
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the essentials of basic biological principles.</li><li>To familiarize the different clinical and industrial applications of biology for solving societal problems with engineering tools.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO LIFE</b>	<b>5</b>			
Characteristics of living organisms — Basic classification — Cell theory—Structure of prokaryotic and eukaryotic cell – Introduction to Bio-molecules: Definition – General classification and important functions of Carbohydrates – Lipids – Proteins – Nucleic acids, Vitamins and Enzymes – Genes and Chromosome.					
<b>UNIT – II</b>	<b>BIODIVERSITY</b>	<b>5</b>			
Plant System: Basic concepts of Plant growth – Nutrition – Photosynthesis and Nitrogen fixation – Animal System: Elementary study of Digestive, Respiratory, Circulatory, Excretory systems and their functions – Microbial System: History – types of Microbes – Economic importance and control of microbes.					
<b>UNIT – III</b>	<b>BASICS OF CELL AND MOLECULAR BIOLOGY</b>	<b>6</b>			
Discovery of cell and Cell Theory – Comparison between plant and animal cells – Cell wall – Plasma membrane – Modification of plasma membrane and intracellular junctions – Central Dogma of Molecular biology – Stem cells and Tissue engineering.					
<b>UNIT – IV</b>	<b>HUMAN DISEASES</b>	<b>7</b>			
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.					
<b>UNIT – V</b>	<b>BIOLOGY AND ITS INDUSTRIAL AND CLINICAL APPLICATION</b>	<b>7</b>			
Transgenic plants and animals – Bioreactors – Bio-pharming – Recombinant vaccines– Cloning– Drug discovery – Artificial memory and neural networks – Bioremediation – Biofertilizer – Biocontrol – Biofilters – Biosensors – Biopolymers – Bioenergy – Biochips – Basic Biomedical Instrumentation – Biostatistics.					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Explain the fundamentals of living things, their classification, cell structure and biochemical constituents.	Understand			
<b>CO2</b>	Apply the concept of plant, animal and microbial systems and growth in real life situations.	Apply			
<b>CO3</b>	Analyze biological engineering principles, procedures needed to solve societal issues.	Analyze			
<b>TEXT BOOKS</b> <ol style="list-style-type: none"><li>Satyanarayana, U. “Biotechnology”, 4th Edition, Books and Allied Pvt. Ltd. Kolkata, 2007.</li><li>Carol D. Tampo and Marcia A. “Diseases of the Human Body”, Lewis, F.A. Davis Company, 2011.</li><li>R. Khandpur, “Biomedical instrumentation - Technology and applications”, McGraw Hill Professional, 2004.</li></ol>					
<b>REFERENCES</b> <ol style="list-style-type: none"><li>Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry”, CBS Publications 2017.</li><li>Arthur T. Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2nd Edition, 2019.</li><li>Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, “Cell Biology and Genetics (Biology: The unity and diversity of life Volume I)”, Cengage Learning, 12th Edition, 2008.</li><li>B.D. Singh, “Biotechnology: Expanding horizon”, Kalyani Publishers, 2015.</li></ol>					

## SEMESTER IV

[illegible]

Course Code	Course Title	L	T	P	C
19UMA424	PROBABILITY AND INFERENTIAL STATISTICS	3	1	0	4
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To provide necessary basic probability concepts and standard distributions that can describe real life phenomena.</li><li>To make the student acquire skills in handling situations involving more than one random variable and functions of random variables.</li><li>To make the student understand and characterize phenomena which evolve with respect to time in probabilistic manner.</li><li>To familiarize the student to analyze the response of random inputs to linear time invariant systems.</li></ul>					
<b>UNIT – I</b>	<b>PROBABILITY &amp; STATISTICAL DISTRIBUTIONS</b>	<b>9 + 3</b>			
Axioms of probability – Conditional probability – Total probability – Baye’s theorem – Discrete and continuous random variables – Moments – Moment generating functions and their properties. Binomial, Poisson, Normal, Geometric, Uniform, Exponential and Gamma distributions.					
<b>UNIT – II</b>	<b>TWO DIMENSIONAL RANDOM VARIABLES</b>	<b>9 + 3</b>			
Joint probability distributions – Marginal and Conditional distributions – Covariance – Correlation and Regression – Transformation of random variables – Central limit theorem.					
<b>UNIT – III</b>	<b>CORRELATION AND SPECTRAL DENSITIES</b>	<b>9 + 3</b>			
Random Process – Introduction – Auto Correlation Functions – Cross Correlation Functions – Properties – Power Spectral density – Cross spectral density – Applications of correlations and Spectral Densities.					
<b>UNIT – IV</b>	<b>LINEAR SYSTEMS WITH RANDOM INPUTS</b>	<b>9 + 3</b>			
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output – White noise.					
<b>UNIT – V</b>	<b>TESTING OF HYPOTHESIS</b>	<b>9 + 3</b>			
Sampling distributions – Normal, t, Chi-square and F distributions – Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.					
<b>TOTAL : 45 (L) + 15 (T) = 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply the knowledge of concepts of probability to acquired knowledge of standard Distributions.	Apply			
<b>CO2</b>	Apply the concept of testing of hypothesis for small and large samples in Real life Problems	Analyze			
<b>CO3</b>	Analyze a process, to find its significance using design of experiments	Analyze			
<b>CO4</b>	Apply the knowledge on random process to analyze the linear system with random inputs in the areas of communication and signal processing	Apply			
<b>CO5</b>	Apply basic probability techniques and models in linear systems.	Apply			
<b>CO6</b>	Understand the basic concept of probability, Random Variable and statistics	Understand			
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Veerarajan, "Probability and Random Processes", 4<sup>th</sup> edition, 2015.</li><li>Gupta S.C, Kapoor V.K. "Fundamental of Mathematical Statistics" 10<sup>th</sup> Edition, Sultan Chand and Sons, New Delhi, 2002.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India, Bangalore, 2<sup>nd</sup> Edition, 2012.</li></ol>					

2. Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Asia, 3<sup>rd</sup> Edition, 2002.
3. Walpole. R.E., Myers .R.H., Myers S.L., and YE. K, "Probability and Statistics for Engineers and Scientists", Pearson Education, New Delhi, 8<sup>th</sup> edition, 2007.
4. Veerarajn.T., "Probability and Statistics", Tata McGraw Hill Publishing company Limited 2008.
5. Oliver C. IBE, "Fundamentals of Applied probability and Random processes", Elsevier, Lowell, Massachusetts, 1<sup>st</sup> Indian Reprint, 2007.
6. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, New Delhi, 4<sup>th</sup> Edition, 2002.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			1								1	2	2
CO2	3	3		1								1	2	2
CO3	3			1								1	2	2
CO4	3			1								1	2	2
CO5	3			1								1	2	2
CO6	2			1								1	2	2
CAM	2.83	3		1								1	2	2

Course Code	Course Title	L	T	P	C
19UBM402	ANALOG AND DIGITAL INTEGRATED CIRCUITS	4	0	0	4
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To outline the design procedure of applications using operational amplifiers, analog multipliers and PLL.</li><li>To employ op-amp for a variety of engineering applications.</li><li>To familiarize with the design of various combinational digital circuits using logic gates.</li><li>To explain the various semiconductor memories and related technology.</li></ul>					
<b>UNIT – I</b>	<b>OPERATIONAL AMPLIFIER FUNDAMENTALS &amp; BASIC APPLICATIONS</b>	<b>12</b>			
Introduction — Ideal Op-amp circuit — DC characteristics, AC characteristics — Basic Op-amp applications, Instrumentation amplifier, V to I and I to V converters, Precision rectifier, Peak detector, Clipper, Clamper, Sample and hold, Log & antilog amplifiers, Differentiator, Integrator.					
<b>UNIT – II</b>	<b>ADVANCED APPLICATIONS OF OP-AMP</b>	<b>12</b>			
Comparator – Multivibrators and Schmitt trigger – Sine wave and Triangular wave generator – First and Second order Low pass and High pass filters – A/D converters: Flash, Dual slope, Successive approximation – D/A converter: weighted resistor type, R-2R ladder – Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time).					
<b>UNIT – III</b>	<b>SPECIAL ICs</b>	<b>12</b>			
IC555 Timer – Functional block description – Monostable & Astable multivibrator operations – PLL – Basics, Phase detector/comparator, Voltage controlled oscillator – IC Voltage regulators –Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator – Monolithic switching regulator, Low Drop-Out (LDO) Regulators – F to V and V to F converters –Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC – Analog multiplier ICs.					
<b>UNIT – IV</b>	<b>BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS</b>	<b>12</b>			
Number Systems – Code conversions – Logic gates – IC families: TTL and CMOS – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR – implementation of combinational logic functions: Boolean Algebra – Demorgans Theorem, SOP, POS, Karnaugh map, Quine-Mcclusky method, Half/Full adder, Half/full subtractor, Encoder, Decoder, Multiplexer, Demultiplexer.					
<b>UNIT – V</b>	<b>SEQUENTIAL CIRCUITS AND MEMORY DEVICES</b>	<b>12</b>			
Sequential Circuits: Flip flops – SR, JK, T, D and Master slave – Characteristic, excitation tables, Level and Edge Triggering – Counters – asynchronous & synchronous – Shift registers – Memory Devices: Classification of memories, RAM organization, ROM organization, Flash memory, Combinational PLD's, PLA, PAL.					
<b>TOTAL : 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the concepts of the circuit configuration for the design of linear integrated circuits.				Understand
<b>CO2</b>	Design the linear and nonlinear applications of an Op-Amp along with special function ICs.				Apply
<b>CO3</b>	Analyze the various types of waveform generators, timers and data converters.				Analyze
<b>CO4</b>	Apply the fundamental concepts of digital electronics to design digital Logic circuits.				Apply
<b>CO5</b>	Design various combinational and sequential circuits to meet the given functional requirements.				Apply
<b>CO6</b>	Analyze the digital circuits to verify their functionalities for various input conditions.				Analyze
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 5th Edition, 2018.</li><li>M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.</li></ol>					

**REFERENCES:**

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw-Hill, 2016
2. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
3. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
4. S.Salivahanan and S.Arivazhagan, "Digital Electronics", 1st Edition, Vikas Publishing House pvt Ltd, 2012.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												2	
CO3	3	3											2	
CO4	3	2											2	
CO5	3	3	2		3								2	
CO6	3	3	2	2	3							2	2	
CAM	2.83	2.75	2	2	3							2	2	

Course Code	Course Title	L	T	P	C
19UBM403	MEDICAL PHYSICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>Summarize the principles and effects of ionizing and non-ionizing radiation in human body.</li><li>Explore the effects of radiation in matter and how isotopes are produced</li><li>Understand various detectors for detecting the presence of ionizing radiation.</li></ul>					
<b>UNIT – I</b>	<b>NON IONIZING RADIATION AND ITS MEDICAL APPLICATION</b>	<b>9</b>			
Overview of non-ionizing radiation effects – Tissue as a leaky dielectric – Low Frequency Effects – Higher frequency effects – Measurement of Tissue Anisotropy – Measurement of Ultraviolet Radiation – Physics of light and sound – Thermography – Application – Ultrasound Transducer – Interaction of Ultrasound with matter, Transmission-Scanning systems – Doppler-Double Doppler shift Clinical Applications.					
<b>UNIT – II</b>	<b>PRINCIPLES OF RADIOACTIVE NUCLIDES</b>	<b>9</b>			
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, radionuclide Generator-Milking process (Technetium generator).					
<b>UNIT – III</b>	<b>INTERACTION OF RADIATION WITH MATTER</b>	<b>9</b>			
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.					
<b>UNIT – IV</b>	<b>PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS</b>	<b>9</b>			
Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge, TLD, OSLD. Electrical Impedance Tomography — biomedical laser beam delivery systems					
<b>UNIT – V</b>	<b>BASIC RADIATION QUANTITIES</b>	<b>9</b>			
Introduction – exposure – Inverse square law – KERMA and absorbed dose – stopping power – relationship between the dosimetric quantities – Bremsstrahlung radiation, Bragg's curve-concept of LD 50 – Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert – Radiation protection.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Explain the effect of non-ionizing radiation in human body and applications in the field of medicine.				Understand
<b>CO2</b>	Explain the instrumental setup for measuring the intensity of light.				Understand
<b>CO3</b>	Apply the suitable methods for detecting and recording the ionizing radiation and its interaction with matter.				Apply
<b>CO4</b>	Measure and record the radiation exposure to health care workers in hospitals and diagnostic centers.				Apply
<b>CO5</b>	Apply the principles of radioactive nuclides in medicine.				Apply
<b>CO6</b>	Analyze the interaction of ionizing and non-ionizing radiation with the human body and it's clinical significance.				Analyze
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Gopal B. Saha, “Physics and Radiobiology of Nuclear Medicine”, 4th Edition, Springer, 2013.</li><li>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.</li></ol>					

**REFERENCES:**

1. W.J. Meredith & J.B. Massey, Fundamental Physics of radiology, Varghese Publishing House, Bombay, 1992.
2. J.P.Woodcock, "Ultrasonic, Medical Physics Handbook series 1", Adam Hilger, Bristol, 2002.
3. Hylton B.Meire and Pat Farrant, "Basic Ultrasound" John Wiley & Sons, 1995
4. P.Umadevi, A. Nagarathnam, B S Satish Rao, "Introduction to radiation biology" B.I Churchill Livingstone pvt Ltd, 2000.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2							2						
CO2	2													
CO3	3	2						2				2	2	
CO4	3	2				2		2				2	2	
CO5	3													
CO6	3	3						2	2	2		2	2	
CAM	2.67	2.33				2		2	2	2		2	2	



Course Code	Course Title	L	T	P	C
19UBM404	PRINCIPLES OF SIGNALS AND SYSTEMS	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To explain classifications and properties of signal &amp; systems</li><li>To introduce Laplace Transform, Fourier transform, Z transform and their properties.</li><li>To characterize LTI systems in the Time domain and various Transform domains.</li></ul>					
<b>UNIT – I</b>	<b>CLASSIFICATION OF SIGNALS AND SYSTEMS</b>	<b>9</b>			
Standard signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential – Classification of signals – Continuous Time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals – Classification of Systems – CT systems and DT systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.					
<b>UNIT – II</b>	<b>ANALYSIS OF CONTINUOUS TIME SIGNALS</b>	<b>8</b>			
Fourier series analysis – Spectrum of Continuous Time (CT) signals – Fourier and Laplace Transforms in CT Signal Analysis – Properties.					
<b>UNIT – III</b>	<b>LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS</b>	<b>8</b>			
Differential Equation – Block diagram representation – impulse response, convolution integrals – Fourier and Laplace transforms in Analysis of CT systems.					
<b>UNIT – IV</b>	<b>ANALYSIS OF DISCRETE TIME SIGNALS</b>	<b>10</b>			
Baseband signal Sampling — DTFT — Properties of DTFT — Z Transform — Properties of Z Transform.					
<b>UNIT – V</b>	<b>LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS</b>	<b>10</b>			
Difference Equations – Block diagram representation – Impulse response – Convolution sum – Discrete Fourier and Z Transform Analysis of Recursive & Non-recursive systems.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the fundamental concepts of continuous time and discrete time signals and systems.				Understand
<b>CO2</b>	Classify the signals and systems by applying their properties.				Apply
<b>CO3</b>	Apply various transform techniques to solve the problems related to signals and systems.				Apply
<b>CO4</b>	Analyze the LTI systems to different input signals considering factors such as system stability, transient response and frequency response.				Analyze
<b>CO5</b>	Evaluate the characteristics of continuous time and discrete time systems using properties of convolution.				Evaluate
<b>CO6</b>	Assess the effectiveness of various transforming techniques in solving real world engineering problems.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Allan V. Oppenheim, S. Willsky and S. H. Nawab, "Signals and Systems", Pearson, Indian Reprint, 2nd Edition, 2015.</li><li>S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2nd Edition, 2007.</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.</li><li>R. E. Zeimer, W. H. Tranter and R. D. Fannin, "Signals &amp; Systems - Continuous and Discrete", Pearson, 2007.</li><li>John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.</li><li>M. J. Roberts, "Signals &amp; Systems - Analysis using Transform Methods &amp; MATLAB", Tata McGraw Hill, 2012.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	2
CO2	3	2											2	2
CO3	3	2										2	2	2
CO4	3	3	2										2	2
CO5	3	3	2		2								2	2
CO6	3	3	3						2	2		2	2	2
CAM	2.83	2.6	2.33		2				2	2		2	2	2

Course Code	Course Title	L	T	P	C
19UBM405	PATHOLOGY AND MICROBIOLOGY	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To explain the purpose of structural and functional aspects of living organisms</li><li>To explore the etiology and remedy in treating the pathological diseases</li><li>To familiarize the different types of microscopes and microbial cultures for diagnosing disease.</li><li>To explain various immunological techniques in diagnosing the pathological diseases</li></ul>					
<b>UNIT – I</b>	<b>CELL DEGENERATION, REPAIR AND NEOPLASIA</b>				<b>8</b>
Cell injury and Necrosis, Apoptosis – Intracellular accumulations – Pathological calcification – 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 – Demonstration of techniques used in tissue processing.					
<b>UNIT – II</b>	<b>FLUID AND HEMODYNAMIC DERANGEMENTS</b>				<b>8</b>
Fluid and hemodynamic derangements: Edema, Normal Hypostasis, Thrombosis, Disseminated Intravascular Coagulation, Embolism, Infarction – Hematological disorders – Bleeding disorders, Leukemia, Lymphomas – Demonstration of bleeding and clotting time for analysis of the fluid in the body.					
<b>UNIT – III</b>	<b>MICROBIAL CULTURES AND MICROSCOPES</b>				<b>10</b>
Morphological and structural organization of Bacteria, Virus, Archea and Eukaryotic microbes such as Yeasts, molds and protozoa – Growth pattern – Culture media and its types– Pure culture techniques – Enrichment culture techniques for isolation – observation of microorganisms – Biochemical identification techniques for identification of microorganisms – Theory and practice of Sterilization – 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.					
<b>UNIT – IV</b>	<b>MICROBIAL GENETICS</b>				<b>10</b>
Types of Mutation: UV and chemical mutagens — Selection of mutants — Ames test for mutagenesis – Bacterial genetic system: Transformation, Conjugation, Transduction, Recombination, Plasmids, Transposons – DNA repair – Regulation of gene expression: Operon model — Bacterial genome with special reference to <i>E.coli</i> — RNA phages — RNA viruses — Retroviruses – Basic concept of microbial genomics.					
<b>UNIT – V</b>	<b>IMMUNOLOGY</b>				<b>9</b>
Natural and artificial immunity — Opsonization — Phagocytosis — Inflammation — Immune deficiency syndrome – Antibodies and its types – Antigen and antibody reactions. Immunological techniques: Immune diffusion, Immuno electrophoresis – Monoclonal antibodies and their production – Disease caused by Bacteria, Fungi, Protozoal, Virus and Helminthes.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the structure and function of living organisms and their association with various diseases.				Understand
<b>CO2</b>	Apply staining and immunological techniques for diagnosing various disease-causing microbes.				Apply
<b>CO3</b>	Apply diverse diagnostic methods to identify hematological, histopathological and immunological disorder.				Apply
<b>CO4</b>	Analyze the different techniques employed for tissue processing to determine tissue morphology using microscopes.				Analyze
<b>CO5</b>	Analyze the effectiveness of modern treatment method with the ancient treatment method for infectious diseases.				Analyze
<b>CO6</b>	Evaluate the results of culture and sensitivity tests to diagnose bacterial infections in patients.				Evaluate

**TEXT BOOKS:**

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7th edition, WB Saunders Co. 2005
2. Prescott, Harley and Klein, "Microbiology", 5th edition, McGraw Hill, 2002

**REFERENCES:**

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2005.
3. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2										2	2	
CO3	3	2		2		2							2	
CO4	3	3		2						2			2	
CO5	3	3						2				2	2	
CO6	3	3		3			2		2	2			2	
CAM	2.83	2.6		2.33		2	2	2	2	2		2	2	

Course Code	Course Title	L	T	P	C
19UBM406	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS – 1	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>• To explore the medical equipment used in the measurement of parameters related to cardiology, neurology and musculo-skeletal system.</li><li>• To familiarize the patient monitoring and biotelemetry system.</li><li>• To understand the function of extra corporeal devices and principle of various diagnostic techniques.</li></ul>					
<b>UNIT – I</b>	<b>CARDIAC EQUIPMENT</b>	<b>9</b>			
Electrocardiograph – Normal and Abnormal Waves – Heart rate monitor – Holter Monitor, Phonocardiography – Plethysmography – ECG Machine maintenance and troubleshooting – Cardiac Pacemaker – Internal and External Pacemaker – Batteries, AC and DC Defibrillator – Cardiotocography.					
<b>UNIT – II</b>	<b>NEUROLOGICAL EQUIPMENT</b>	<b>9</b>			
Clinical significance of EEG – Multi-channel EEG recording system – Evoked Potential – Visual, Auditory and Somatosensory – MEG (Magneto Encephalo Graph) – Polysomnography – EEG Bio Feedback Instrumentation.					
<b>UNIT – III</b>	<b>SKELETAL MUSCULAR EQUIPMENT AND SURGICALINSTRUMENTS</b>	<b>9</b>			
Generation of EMG – recording and analysis of EMG waveforms – fatigue characteristics – Muscle stimulators – nerve stimulators – Nerve conduction velocity measurement – EMG Bio Feedback Instrumentation –Instruments for surgery – Ultrasonic therapy unit.					
<b>UNIT – IV</b>	<b>PATIENT MONITORING AND BIOTELEMETRY</b>	<b>9</b>			
Patient monitoring systems – ICU/CCU Monitoring Equipment's – Electronic monitoring of functional parameter – bed side monitors – cardiac monitor – Central consoling controls – Oximetry – Foetal Monitor – Radio Telemetry (single, multi) – parameters and modes – Portable and Landline Telemetry unit – Applications in ECG and EEG Transmission.					
<b>UNIT – V</b>	<b>EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES</b>	<b>9</b>			
Need for heart lung machine – functioning of oxygenators and its types – bubble, disc type and membrane type, finger pump, roller pump –. Hemodialysis unit – Lithotripsy– Principles of Cryogenic technique and application – Endoscopy – Laparoscopy – Thermography – Recording and clinical application – Ophthalmic Instruments – Tonometer.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Elucidate the fundamentals of diagnostics and therapeutic equipment.	Understand			
<b>CO2</b>	Apply physics and engineering principles to the design and operation of ECG machines, cardiac devices and monitoring equipment.	Apply			
<b>CO3</b>	Develop innovative solutions to address technical and clinical challenges in diagnostic and therapeutic equipment.	Apply			
<b>CO4</b>	Analyze the principles and clinical significance of equipment in diagnostic and therapeutic systems.	Analyze			
<b>CO5</b>	Analyze the performance and troubleshooting requirements of diagnostic and therapeutic equipment.	Analyze			
<b>CO6</b>	Evaluate the principles and techniques involved in the design and implementation of biofeedback instrumentation.	Evaluate			
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.</li><li>2. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson Education, New Delhi, 2007.</li></ol>					

**REFERENCES:**

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3Edition, 2008
2. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2004.
4. John G.Webster, "Medical Instrumentation Application and Design", third edition, John Wiley and Sons, New York, 2006.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	2	
CO2	3											2	2	
CO3	3					2						2	2	
CO4	3	3				2		2	2			2	2	
CO5	3	3										3	2	
CO6	3	3	2	2					2	2		2	2	
CAM	2.83	3	2	2		2		2	2	2		2.17	2	

Course Code	Course Title	L	T	P	C
19UBM407	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <b>To impart knowledge on:</b> <ul style="list-style-type: none"> <li>The characteristics of operational amplifier and its linear and nonlinear applications.</li> <li>The basics of special function ICs.</li> <li>Boolean operations, code converters, counters and registers.</li> <li>SPICE software for circuit design.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b> <u><b>Analog Circuits Experiments:</b></u> <ol style="list-style-type: none"> <li>Design and testing of Inverting, Non inverting and differential amplifiers.</li> <li>Design and testing of Integrator and Differentiator.</li> <li>Design and testing of Instrumentation amplifier.</li> <li>Design and testing of Active low-pass and High-pass filters.</li> <li>Design and testing of Astable &amp; Monostable multivibrators and Schmitt Trigger using op-amp.</li> <li>Design and testing of Astable and monostable multivibrators using NE555 Timer.</li> <li>Study of VCO and PLL ICs.               <ol style="list-style-type: none"> <li>Voltage to frequency characteristics of NE/ SE 566 IC.</li> <li>Frequency multiplication using NE/SE 565 PLL IC.</li> </ol> </li> </ol> <u><b>Digital Circuits Experiments:</b></u> <ol style="list-style-type: none"> <li>Implementation of Adder/ Subtractor circuits.</li> <li>Design and implementation of code converters using logic gates (i) BCD to excess-3code and vice versa (ii) Binary to gray and vice-versa.</li> <li>Design and implementation of Multiplexer and De-multiplexer using logic gates.</li> <li>Design and implementation of encoder and decoder using logic gates.</li> <li>Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters.</li> <li>Design and implementation of 3-bit synchronous up/down counter.</li> <li>Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.</li> <li>SPICE Simulation studies.</li> </ol>					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the construction, operation and applications of linear integrated circuits.	Understand			
<b>CO2</b>	Develop linear and non-linear applications using operational amplifiers and special function ICs to meet specific requirements.	APPLY			
<b>CO3</b>	Design filters and data converters using op-amp for a given specification.	Apply			
<b>CO4</b>	Apply appropriate software tools to make measurements of physical quantities	Apply			
<b>CO5</b>	Demonstrate proficiency in using discipline-specific tools	Apply			
<b>CO6</b>	Function effectively as an individual for efficiently executing the given task	Organize			

**HARDWARE REQUIREMENT:**

Sl. No.	Name of the equipment	Quantity required
1	CRO	6
2	Function generator	6
3	Dual Regulated Power Supply (0 – 30) V	6
4	Digital Multimeter	5
5	Digital IC trainer Kit	10
6	Analog IC trainer kit	4
7	Bread boards	10
8	Chip IC – 7400	20
9	Chip IC – 7402	20
10	Chip IC – 7408	20
11	Chip IC – 7432	20
12	Chip IC – 7486	15
13	Chip IC – 7411	5
14	Chip IC – 7410	10
15	Chip IC – 555	10
16	Chip IC – 741	25
17	Chip IC – 74153	10
18	Chip IC – 7474	10
19	Chip IC – 7490	10
20	Chip IC – 7447	10
21	Chip IC – 7476	10
22	Chip IC – 7420	10
23	Chip IC – 7404	20
24	Desktop PC with SPICE software	5

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	3											2	
CO3	3	3											2	
CO4	3	3	3		2	2			3	2		2	2	
CO5	3	2			2	2			3	2		2	2	
CO6						2			3	2		2	2	
CAM	2.8	2.75	3		2	2			3	2		2	2	



Course Code	Course Title	L	T	P	C
19UBM408	SENSORS AND BIOMEDICAL INSTRUMENTATION LABORATORY	0	0	3	1.5

#### OBJECTIVES:

##### To impart knowledge on:

- Characteristics of various sensors.
- Different bridge circuits for the measurement of resistance, capacitance and inductance.
- Recording and analyzing bio signals.
- Comprehension of suitable preamplifiers used for amplifying the bio signals.
- Monitoring and Measurements of physiological parameters.

#### LIST OF EXPERIMENTS:

##### Sensors and Measurements:

1. Characteristics of various temperature sensors ( RTD and Thermocouple)
2. Characteristics of various light sensors (LDR, Photodiode and Phototransistor)
3. Displacement measurement using LVDT.
4. Measurement of Resistance, Inductance and Capacitance using bridge circuits.

##### Biomedical Instrumentation:

5. Design of preamplifiers to acquire bio-signals along with impedance matching circuit using suitable IC's
6. Design of ECG amplifier and Measurement of heart rate.
7. Measurement of pulse-rate using Photo transducer.
8. Design of EEG and EMG amplifiers.
9. Measurement of pH and Conductivity.
10. Measurement of respiration rate.
11. Measurement of blood pressure using sphygmomanometer.
12. Design and study the characteristics of optical Isolation amplifier.

**TOTAL : 45 PERIODS**

#### COURSE OUTCOMES:

##### At the end of the course the student will be able to:

<b>CO1</b>	Apply appropriate measurement techniques.	Apply
<b>CO2</b>	Analyze the performance characteristics of various sensors & biomedical equipments and infer their safety aspects.	Analyze
<b>CO3</b>	Evaluate the performance of medical instruments.	Evaluate
<b>CO4</b>	Apply appropriate software tools to make measurements of physical quantities	Apply
<b>CO5</b>	Demonstrate proficiency in using discipline-specific tools	Apply
<b>CO6</b>	Function effectively as an individual for efficiently executing the given task	Organize

#### HARDWARE REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Electric heater & Thermometer	each 1 No.
2	RTD & Thermocouple	each 1 No.
3	Light source and LDR	each 1 No.
4	Photodiode and Phototransistor	each 1 Nos.
5	LVDT 20mm core length movability type	1 No.
6	R L C Bridge kit	3 Nos.
7	pH meter and conductivity meter	1 No.
8	Photo transducer for pulse measurement	1 No.
9	Function Generator	6 Nos.
11	Regulated Power Supply	6 Nos.
12	Sphygmomanometer and Stethoscope	1 No.
13	Pulse Oximeter – Finger tip	1 No.

Sl. No.	Name of the equipment	Quantity required
14	Multiparameter (ECG, EMG, EEG) Simulator	1 No.
15	CRO	5 Nos.
16	DSO	1 No.
17	Bread boards	10 Nos.
18	IC 555 Timer	10 Nos.
19	ICs LM324 AD620	10 Nos.
20	ICs INA series 126 128 etc	10 Nos.
21	Opto Isolator IC: MCT2E	1 No.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2	2										3	
CO3	3	2	2										3	
CO4	3	3	3		2	2			3	2		2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	2.8	2.25	2.33		2	2			3	2		2	2.67	

Course Code	Course Title	L	T	P	C
19UBM409	PATHOLOGY AND MICROBIOLOGY LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b>					
<b>To impart knowledge on:</b> <ul style="list-style-type: none"> <li>• Use of Compound microscope.</li> <li>• Practice on chemical examinations, Cryoprocessing, Histopathological examinations etc.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
1. Study of parts of compound microscope. 2. Media preparation and sterilization techniques 3. Isolation of microorganisms by plating techniques. 4. Simple stain, Gram stain, AFB stain, Capsule stain. 5. Biochemical techniques for identification of microorganisms. 6. Basic staining – Hematoxylin and eosin staining. 7. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS 8. Bleeding time and clotting time 9. Haematology slides of anemia and leukemia 10. Antigen-Antibody reaction : Immuno diffusion and Immuno electrophoresis 11. Histopathological slides of benign and malignant tumours. 12. Manual paraffin tissue processing and section cutting (demonstration) 13. Cryo processing of tissue and cryosectioning (demonstration)					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
CO1	Demonstrate the defined skill set of microscopy, sample preparation and staining procedures.	Apply			
CO2	Differentiate the various cells in the blood smear and analyze physical and chemical composition of urine.	Analyze			
CO3	Evaluate physical and chemical examination of urine by conducting suitable experiments.	Evaluate			
CO4	Apply appropriate software tools to make measurements of physical quantities	Apply			
CO5	Demonstrate proficiency in using discipline-specific tools	Apply			
CO6	Function effectively as an individual for efficiently executing the given task	Organize			

**HARDWARE REQUIREMENT:**

Sl. No.	Name of the equipment	Quantity required
1	Wax dispenser	1
2	Slide warming	1
3	Microtome	1
4	Slides	1 box
5	Cover slip	1 box
6	Distillation Unit	1
7	Water bath normal	1
8	Incubator	1
9	Autoclave	1
10	Oven	1
11	Bone marrow charts	1
12	Microscope	4

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2	3	2										2	2	
CO3	3	2	2			2		2				2	2	
CO4	3	3	3		2	2			3	2		2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	3	2.25	2.5		2	2		2	3	2		2	2	

Course Code	Course Title	L	T	P	C
19UBM410	TECHNICAL SEMINAR	0	0	2	1
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To encourage the students to study recent innovative advances in biomedical engineering developments in healthcare industry.</li> <li>To prepare and present technical reports.</li> <li>To encourage the students to use various teaching aids such as overhead projectors (OHP), power point presentation and demonstrative models.</li> </ul>					
<b>METHOD OF EVALUATION:</b> <ul style="list-style-type: none"> <li>During the seminar session each student is expected to prepare and present a topic on recent innovative advances in biomedical engineering developments in healthcare industry, for a duration of about 8 to 10 minutes.</li> <li>Each student is expected to present atleast twice during the semester and the student is evaluated based on that presentation. At the end of the semester, the student can submit a report on the selected topic of seminar and marks are given based on the report.</li> <li>Faculty will guide and monitor the progress of the student and maintain attendance also.</li> </ul>					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
CO1	Identify promising new directions of various cutting edge technologies	Apply			
CO2	Communicate the technical information effectively by making an oral presentation before an evaluation committee	Lifelong learning / Communication			

Course Code	Course Title	L	T	P	C
19UGM431	GENDER EQUALITY	2	0	0	P/F
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce basic concepts relating to gender and to provide logical understanding of gender roles.</li></ul>					
<b>UNIT – I</b>	<b>GENDER SENSITIZATION</b>	<b>10</b>			
Definition of gender, Perspectives – Gender sensitive approach – Gender and sex – Social construction of gender and gender roles – Socialization – institutions of socialization – changing content and context of gender – need for re-socialization. Gender Stereotyping and Gender Discrimination.					
<b>UNIT – II</b>	<b>GENDER EQUALITY AND CONSTITUTION</b>	<b>10</b>			
Indian constitution related to equality – Fundamental rights – Directive principles of state policy – right to equality – rights against exploitation – cultural and educational rights – the right to constitutional remedy – Universal Declaration of Human Rights – Enforcement of Human Rights for Women and Children – Role of Cells and Counseling Centers – Internal Complaints Committee – Legal AID cells, Help line, State and National level Commission.					
<b>UNIT – III</b>	<b>GENDER ROLES &amp; EQUALITY</b>	<b>10</b>			
Gender & Morality – Structural and functionalist views of Gender – Gender in the Classroom – Beyond access for girls and boys – Gender equality in schools – Gender equality and adult basic education – Developing capacity to achieve gender equality in education – Individuality and removal of gender stereotypes – Respect for each other’s – Promote equal opportunity.					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Describe the social construction of gender and sexuality and their influence in social context.				Understand
<b>CO2</b>	Analyze how the concepts of gender equality are created, maintained, and/or challenged				Analyze
<b>CO3</b>	Apply concepts of gender roles and equality in classroom, school, disciplinary or interdisciplinary creative, scholarly, and/or activist project				Apply
<b>REFERENCE BOOKS:</b> <ol style="list-style-type: none"><li>Sheila Aikman and Elaine Unterhalter, “Practising Gender Equality in Education”, OxfamGB, 2007.</li><li>Pasadena and Hackensack, “Gender roles and Equality”, Salem Press, 2011.</li></ol>					

## SEMESTER V

S.No.	Course Code	Course Title	Course Category	L	T	P	C
<b>THEORY</b>							
1.	19UBM501	Microprocessors and Microcontrollers	PC	3	0	0	3
2.	19UBM502	Diagnostic and Therapeutic Equipments - II	PC	3	0	0	3
3.	19UBM503	Bio Control System	PC	3	1	0	4
4.	13UBM504	Principles of Digital Signal Processing	PC	3	0	0	3
5.	PE - I	Professional Elective – I	PE	3	0	0	3
6.	OE - I	Open Elective – I	OE	3	0	0	3
<b>PRACTICAL</b>							
7.	19UBM507	Creative Thinking and Innovation Project	P	0	0	2	1
8.	19UBM508	Microprocessors and microcontrollers Laboratory	PC	0	0	3	1.5
9.	19UBM509	Diagnostic and Therapeutic Equipments Laboratory	PC	0	0	3	1.5
10.	19UBM510	Signal Processing Laboratory	PC	0	0	2	1
11.	19UGS533	Interpersonal Skills Laboratory	HS	0	0	3	1.5
Total				18	1	13	25.5
<b>Total Credits : 25.5</b>							

Course Code	Course Title	L	T	P	C
19UBM501	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To impart knowledge in the architectural features and hardware of 8085 and 8086 microprocessors.</li><li>To impart knowledge in the concepts of PIC and ARM processor.</li></ul>					
<b>UNIT – I</b>	<b>ARCHITECTURE OF 8085/8086</b>				<b>9</b>
8085 – Functional Block Diagram – Description – Addressing Modes, Timing diagrams. Introduction to 8086 – Architecture, Instruction set, Addressing Modes.					
<b>UNIT – II</b>	<b>MICROCONTROLLER</b>				<b>9</b>
8051 – Architecture, Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming					
<b>UNIT – III</b>	<b>INTERFACING 8051: MEMORY, I/O, INTERRUPTS</b>				<b>9</b>
Programming 8051 Timers – Serial Port Programming – Interrupts Programming LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing, External Memory Interface – RTC Interfacing using I2C Standard – Motor Control – Relay, PWM, DC & Stepper Motor.					
<b>UNIT – IV</b>	<b>PIC MICROCONTROLLER</b>				<b>9</b>
Introduction to PIC microcontrollers - PIC 16FXX architecture-memory organization-comparison of PIC with other CISC and RISC based systems - Register File Structure - Addressing modes - instruction set - Simple Operations.					
<b>UNIT – V</b>	<b>ARMPROCESSOR</b>				<b>9</b>
The ARM architecture - ARM processor family - Co-processors -The ARM instruction set - LCD and Keyboard interfacing					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental concepts, addressing modes and instruction sets of 8085/8086 microprocessor, 8051 microcontroller, PIC Microcontroller and ARM processor.				Understand
<b>CO2:</b>	Execute an ALP program using various instruction sets of 8085 microprocessor and 8051 Microcontroller				Apply
<b>CO3:</b>	Analyze the features of interfacing devices such as LCD, Keyboard, ADC, DAC and sensors with the microcontroller and ARM processor.				Apply
<b>CO4:</b>	Apply the modern tools for various microprocessors and microcontroller - based application development				Apply
<b>CO5:</b>	Illustrate the functional blocks, addressing modes and development tools of PIC microcontroller and ARM processor.				Analyze
<b>CO6:</b>	Design 8051 microcontroller-based control systems for biomedical applications.				Create
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.</li><li>Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 4 th Edition, Penram International Publishing, New Delhi, 2000</li></ol>					



**REFERENCES:**

1. Douglas V. Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012
2. Furber, S., "ARM System on Chip Architecture", Addison Wesley trade Computer Publication, 2014
3. Peatman, J.B., "Design with PIC Microcontrollers Pearson Education", 3rd Edition, 2004.
4. Kenneth J. Ayala, 8051 Microcontroller, Thomson, 2005.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3				3									2
CO3	3													2
CO4	3				3				2			2	2	2
CO5	3	3	3	2	3							2	2	3
CO6	3	3	3	2	3				2	2		2	2	3
CAM	2.83	3	3	2	3				2	2		2	2	2

Course Code	Course Title	L	T	P	C
19UBM502	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS – II	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the basics of diagnostics techniques</li><li>To discuss the working and application of diagnostic equipments related to respiratory and sensory system.</li><li>To familiarize the patient safety system.</li></ul>					
<b>UNIT – I</b>	<b>ULTRASONIC TECHNIQUE</b>	<b>9</b>			
Diagnosis: Basic principles of Echo technique, display techniques A, B and M mode, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.					
<b>UNIT – II</b>	<b>RESPIRATORY MEASUREMENT STSTEM</b>	<b>9</b>			
Instrumentation for measuring the mechanics of breathing – Spirometer-Lung Volume and vital capacity, measurements of residual volume, pneumotachometer – Airway resistance measurement, Whole body plethysmography, Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor. Types of Ventilators – Pressure, Volume, Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.					
<b>UNIT – III</b>	<b>SENSORY MEASUREMENT</b>	<b>9</b>			
Psycho Physiological Measurements-for testing and sensory Responses, Electro-oculograph, Electro-retinograph, Audiometer-Pure tone, Speech. EGG (Electrogastrograph), Galvanic Skin Resistance (GSR).					
<b>UNIT – IV</b>	<b>LASER BASED EQUIPMENTS AND DIATHERMY</b>	<b>9</b>			
Lasers in Medicine – Types, Tissue reactions. Lasers in ophthalmology, Flow Cytometry, Laser Microirradiation, Laser Doppler Velocimetry, Neurosurgical Laser Techniques.IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.					
<b>UNIT – V</b>	<b>PATIENT SAFETY</b>	<b>9</b>			
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 – Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the concepts of ultrasound equipment and diagnostic techniques.				Understand
<b>CO2:</b>	Explain about measurements of parameters related to respiratory system.				Understand
<b>CO3:</b>	Choose the appropriate method for sensory measurement techniques.				Apply
<b>CO4:</b>	Analyze different types of diathermy units and appreciate the use of advanced laser technology in diagnosis.				Analyze
<b>CO5:</b>	Identify the electrical hazards and implement methods of patient safety.				Analyze
<b>CO6:</b>	Design of the protection circuit in isolation and protection equipment.				Create
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 3<sup>rd</sup> Edition 2014.</li><li>Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson Education, New Delhi, 2<sup>nd</sup> Edition 2015.</li><li>Leon Goldman, “The Biomedical Laser: Technology and Clinical applications”, Springer – Verlag Newyork Inc., 2013.</li></ol>					

**REFERENCES:**

1. L.A Geddes and L.E. Baker, "Principles of Applied Biomedical Instrumentation", 3<sup>rd</sup> Edition, 2008
2. Antony Y.K. Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2<sup>nd</sup> Edition 2016.
3. Laurence J. Street, "Introduction to Biomedical Equipment Technology", CRC Press 3<sup>rd</sup> Edition 2017.
4. John G. Webster, "Medical Instrumentation Application and Design", third edition, John Wiley and Sons, New York, 4<sup>th</sup> Edition 2015

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	2
CO2	2												2	2
CO3	3					2			2				3	2
CO4	3	3										3	3	2
CO5	3	3						2				3	3	3
CO6	3	3	3	2				2	2	2		3	3	3
CAM	2.67	3	3	2		2		2	2	2		3	2.67	2.33

Course Code	Course Title	L	T	P	C
19UBM503	BIO CONTROL SYSTEMS	3	1	0	4
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To discuss system concept and different mathematical techniques to model engineering systems</li><li>To learn to do the analysis of given system in time domain and frequency domain.</li><li>To practice the techniques of plotting the responses in both domain analysis.</li><li>To apply modeling concepts to biological systems.</li></ul>					
<b>UNIT – I</b>	<b>MODELING OF SYSTEMS</b>	<b>7 + 2</b>			
System concepts – Open and Closed loop systems – Differential Equations – Transfer Functions – Modeling of Electrical and Mechanical systems – Electrical analogy of Mechanical systems – Block diagram and Signal flow graph representation of systems – Conversion of Block diagram to Signal flow graph – Reduction of Signal flow graphs – Mason's Gain Formula.					
<b>UNIT – II</b>	<b>TIME RESPONSE ANALYSIS</b>	<b>11 + 4</b>			
Standard test inputs – Type and Order of systems – Step and Impulse response of First order and Second order systems – Time domain specifications – Steady state error and error constants – Effects of adding poles and zeros – Concept of Stability – Routh-Hurwitz criteria of stability – Relative Stability – Root Locus technique.					
<b>UNIT – III</b>	<b>FREQUENCY RESPONSE ANALYSIS</b>	<b>9 + 3</b>			
Performance specifications in frequency domain – Bode plot, Polar plot and Nyquist plot: Construction, Interpretation and stability analysis – Correlation between time and frequency domain specifications.					
<b>UNIT – IV</b>	<b>STATE VARIABLE ANALYSIS</b>	<b>9 + 3</b>			
State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solution of the state equations – Concepts of Controllability and Observability.					
<b>UNIT – V</b>	<b>PHYSIOLOGICAL CONTROL SYSTEM</b>	<b>9 + 3</b>			
Examples of physiological control system – Difference between Engineering and Physiological control systems – Mathematical Modeling – Generalized system properties – Models with combination of system elements – Linear models of physiological systems: respiratory mechanics, muscle mechanics – Introduction to simulation – Illustration with real time applications.					
<b>TOTAL : 45(L)+15(T) = 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental concepts of control systems.				Understand
<b>CO2:</b>	Develop mathematical models of feedback control systems.				Apply
<b>CO3:</b>	Determine the system parameters and assess system stability using time-domain approach.				Apply
<b>CO4:</b>	Analyze the performance and stability of system through frequency domain approach.				Analyze
<b>CO5:</b>	Explore the concept of modeling basic physiological systems.				Analyze
<b>CO6:</b>	Simulate and analyze the system response and stability of the system using software tools.				Analyze
<b>TEXT BOOKS:</b> <ul style="list-style-type: none"><li>M. Gopal "Control Systems Principles and Design", Tata McGraw Hill, 2002</li><li>Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001</li></ul>					
<b>REFERENCES:</b> <ul style="list-style-type: none"><li>Benjamin. C.Kuo, ' Automatic Control Systems', Prentice Hall of India, 1995.</li><li>Manfrecllyner and John H.Milsum, Bio Medical engineering system, McGraw-Hill and Co., NewYork, 1970.</li><li>John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.</li><li>Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 2004.</li></ul>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3								2				2	
CO3	3	2											2	
CO4	3	3	2										2	
CO5	3	3	2						2			2	3	
CO6	3	3			3								2	
CAM	2.83	2.75	2		3				2			2	2.17	

Course Code	Course Title	L	T	P	C
19UBM504	PRINCIPLES OF DIGITAL SIGNAL PROCESSING	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To learn discrete Fourier transform and its properties</li><li>To introduce the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals</li><li>To discuss Finite word length effects</li><li>To introduce the concept of Multirate and adaptive filters</li></ul>					
<b>UNIT – I</b>	<b>DISCRETE FOURIER TRANSFORM</b>				<b>9</b>
Review of discrete time signals & systems – DFT and its properties, Properties of DFT – Circular Convolution – FFT Algorithms – Decimation in time Algorithms, Decimation in frequency Algorithms – Radix 2 method.					
<b>UNIT – II</b>	<b>IIR FILTER DESIGN</b>				<b>9</b>
Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF) filter design using frequency translation					
<b>UNIT – III</b>	<b>FIR FILTER DESIGN</b>				<b>9</b>
Structures of FIR – Linear phase FIR filter – Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques					
<b>UNIT – IV</b>	<b>FINITE WORD LENGTH EFFECTS</b>				<b>9</b>
Representation of numbers – ADC Quantization noise – Coefficient Quantization error – Product Quantization error – truncation & rounding errors – Limit cycle due to product round-off error –Round-off noise power – limit cycle oscillation due to overflow in digital filters – Principle of scaling.					
<b>UNIT – V</b>	<b>INTRODUCTION TO DIGITAL SIGNAL PROCESSORS</b>				<b>9</b>
DSP functionalities – circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the functions and fundamental concepts of various DSP algorithms and processors.				Understand
<b>CO2:</b>	Apply transformation techniques to design and implement digital filters for specific signal processing requirements.				Apply
<b>CO3:</b>	Apply the digital signal processing algorithms to process the real time signals.				Apply
<b>CO4:</b>	Analyze the impact of design parameters and DSP architecture for different application based on requirements.				Analyze
<b>CO5:</b>	Evaluate various signal transformation techniques and the impact of finite word length effects.				Evaluate
<b>CO6:</b>	Simulate various DSP algorithms for real-time applications using open source software.				Apply
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>John G. Proakis &amp; Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms &amp; Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.</li><li>A.V.Oppenheim, R.W. Schafer and J.R. Buck, “Discrete-Time Signal Processing”, 8<sup>th</sup>Indian Reprint, Pearson, 2004.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Emmanuel C.Ifeachor, &amp; Barrie.W.Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.</li><li>Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007.</li><li>Andreas Antoniou, “Digital Signal Processing”, Tata Mc Graw Hill, 2006</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												2	
CO3	3	2	2		3			2				2	2	
CO4	3	3	2	2					2			2	2	
CO5	3	3											2	
CO6	3	3			3							2	2	
CAM	2.83	2.75	2	2	3			2	2			2	2	

Course Code	Course Title	L	T	P	C
19UBM507	CREATIVE THINKING AND INNOVATION PROJECT	0	0	2	1

**PREAMBLE:**

Creativity is vital in nearly every industry and occupation. Creativity and innovation are key to generation of new ideas and methods of improving goods and services for customer satisfaction. This course enhances the creative thinking and innovation skills of the students. Being creative helps one to be a better problem solver in all areas of life and work.

**COURSE OBJECTIVES:**

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses
- To use a range of creative thinking tools to develop Out of the Box Ideas

**COURSE CONTENT:**

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

**LIST OF ACTIVITIES:**

Duration	What does the Faculty do?	What do the students do?
Week 1	Explains creativity and innovation	Team Formation (Team Size: 3)
Week 2	Explains the Creative Techniques (Through Video / Presentation )	Discovering Consumer Need through Need Analysis (Customer Segment)
Week 3	Facilitates the brain storming	Problem Identification through brain storming
Week 4	Facilitates problem solving	Identify the solution for the chosen problem through creative techniques
Week 5	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 6	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 7	Explains about the Market Research / Competitor Analysis, Revenue Model and Business Model	Market Analysis after the explanation
Week 8	Facilitates the students work	Preparation of Innovation Development Plan, Business Development Plan and Financial Plan
Week 9	Facilitates the students work	Preparing product promotional material
Week 10	Facilitates the students work	Improvement through Feedback

**TOTAL : 30 PERIODS**

**ASSESSMENT PATTERN:**

1. Internal Assessment: Presentation on the Innovative Idea
2. End Semester Assessment:
  - Submission of Business Plan
  - Presentation on My Startup Idea (Evaluator : From Industry)

**COURSE OUTCOMES:**

**At the end of the course the student will be able to:**

<b>CO1:</b>	Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice.	Valuing – Affective Domain
<b>CO2:</b>	Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development.	Organization – Affective Domain
<b>CO3:</b>	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task.	Organization – Affective Domain



CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2									2	3	
CO2	3	3	2									2	3	
CO3	3	3	2									2	3	
CAM	3	3	2									2	3	

Course Code	Course Title	L	T	P	C
19UBM508	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To Introduce ALP concepts, features and Coding methods for 8085 microprocessor and 8051 microcontroller.</li> </ul>					
<b>LIST OF EXPERIMENTS:</b> <ol style="list-style-type: none"> <li>Addition / subtraction using 8085 microprocessors.</li> <li>multiplication / division using 8085 microprocessors</li> <li>Finding Maximum / minimum of numbers using 8085 microprocessors</li> <li>Ascending / Descending order.</li> <li>Hex / ASCII code conversions</li> <li>BCD code conversions</li> <li>8-Bit Microcontroller: Simple arithmetic operations: Addition / subtraction</li> <li>8-Bit Microcontroller: Simple arithmetic operations / multiplication / division.</li> <li>Parallel port programming with 8051 using port 1 facility: Traffic light controller, Stepper Motor</li> <li>RAM direct addressing, Bit Addressing</li> </ol>					
<b>TOTAL: 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Apply the programming knowledge of microprocessor and microcontroller to perform various functions	Apply			
<b>CO2</b>	Interface peripheral devices with microprocessor and microcontroller to develop applications	Apply			
<b>CO3</b>	Modern tool usage to develop applications using modern tools like MASM, EMU 8086	Create			
<b>CO4</b>	Apply appropriate software tools to make measurements of physical quantities	Apply			
<b>CO5</b>	Demonstrate proficiency in using discipline-specific tools	Apply			
<b>CO6</b>	Function effectively as an individual for efficiently executing the given task	Organize			

#### HARDWARE REQUIREMENTS

Sl. No.	Name of the equipment	Quantity required
1.	8085 Microprocessor Trainer with Power supply	8
2.	8051 Micro controller Trainer Kit with power supply	8
3.	8085 Microprocessor Trainer with Interface facility	6
4.	8255 Interface board	2
5.	8259 Interface board	4
6.	ADC card	4
7.	DAC card	3
8.	Stepper motor Interface kit for Processor	2
9.	Stepper motor Interface kit for Controller	2
10.	Traffic Light Controller kit	2
11.	8-bit LED board	2
12.	8051 Microcontroller trainer kit with flash memory	4

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			3				3	3	2	2		2
CO2	3	2	2		3				3	3	2	2		2
CO3	3	3	3		3				3	3	2	2		2
CO4	3	3	3		2	2			3	2		2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	3	2.4	2.67		2.6	2			3	2.5	2	2		2

Course Code	Course Title	L	T	P	C
19UBM509	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To provide practice on recording and analysis of different Bio potentials</li> <li>To demonstrate the function of different Therapeutic equipment</li> </ul>					
<b>LIST OF EXPERIMENTS:</b> <ol style="list-style-type: none"> <li>Simulation of ECG – detection of QRS complex and heart rate</li> <li>Simulation of EEG – detection of alpha waves</li> <li>Study of shortwave and ultrasonic diathermy</li> <li>Study of biotelemetry</li> <li>Measurement of Respiratory parameters using spirometer</li> <li>Study of medical stimulator</li> <li>Study of ESU – cutting and coagulation modes</li> <li>Recording of Audiogram using audiometer.</li> <li>Recording Heart sounds using Phonocardiograph</li> <li>Calculation of parameters like Drip rate, Total volume infused using drug infusion pump</li> <li>Recording of Electromyogram</li> <li>Study of Electrical safety measurements</li> <li>Study of Continuous Positive Airway Pressure (CPAP) Ventilator and Humidifier</li> </ol>					
<b>TOTAL: 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
CO1	Record and analyze bio-potentials and heart sounds using appropriate medical equipment for diagnostic purposes.	Apply			
CO2	Measure and interpret respiratory parameters and telemetry system.	Apply			
CO3	Conduct electrical safety measurements to verify the proper functioning and safety of medical devices.	Analyze			
CO4	Operate and evaluate therapeutic devices to understand their clinical applications.	Apply			
CO5	Demonstrate proficiency in using discipline-specific tools.	Precision - Psychomotor domain			
CO6	Function effectively as an individual for efficiently executing the given task.	Organize - Affective domain			

#### HARDWARE REQUIREMENTS

Sl.No.	Name of the equipment	Quantity required
1.	Multi output power supply (+15v, -15v, +30V variable, +5V , 2A)	2 Nos
2.	Short wave Diathermy	1 No
3.	Ultrasound Diathermy	1 No
4.	Single parameter biotelemetry system	1 No
5.	Electrical Safety Analyzer	1 No
6.	Spirometer with associated analysis system	1 No
7.	ECG Simulator	1 No
8.	Surgical diathermy with analyzer	1 No
9.	Audiometer	1 No
10.	Phonocardiograph	1 No
11.	CPAP device	1 No
12.	Medical stimulator	1 No
13.	PC with simulation software	1 No

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2				3							3	3	3
CO2	3				2								3	3
CO3	3					2		3	3				3	
CO4	3	2			2	2				2			3	3
CO5	3								3				3	
CO6									3	3				
CAM	2.8	2			2.33	2		3	3	2.5		3	3	3

Course Code	Course Title	L	T	P	C
19UBM510	SIGNAL PROCESSING LABORATORY	0	0	2	1
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To implement generation of sequences</li> <li>To realize Linear and Circular Convolution</li> <li>To design and realize FIR and IIR filters</li> <li>To implement signal processing algorithms using digital signal processor</li> </ul>					
<b>LIST OF EXPERIMENTS:</b>					
<b>Simulation using MATLAB/ Equivalent software:</b> <ol style="list-style-type: none"> <li>Generation of elementary Discrete-Time sequences</li> <li>Verification of Sampling theorem and effect of aliasing</li> <li>Analysis of Quantization effects in a first order system</li> <li>Linear and Circular convolutions of given two sequences</li> <li>Auto correlation and Cross Correlation of given sequences</li> <li>Frequency Analysis using DFT</li> <li>Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation</li> <li>Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.</li> <li>Implementation of Decimation and Interpolation process</li> <li>ECG Signal generation and Peak detection</li> </ol>					
<b>DSP Processor based Implementation:</b> <ol style="list-style-type: none"> <li>Study of architecture of Digital Signal Processor</li> <li>Perform MAC operation using various addressing modes</li> <li>Linear and Circular convolution</li> </ol>					
<b>TOTAL: 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Generate & Perform different operations on discrete time signals. [Apply]	Apply			
<b>CO2</b>	Verify the effect of Sampling, quantization and multi-rate signal processing. [Apply]	Analyze			
<b>CO3</b>	Perform convolution and correlation of given sequences to evaluate the response of a system. [Apply]	Apply			
<b>CO4</b>	Apply appropriate software tools to make measurements of physical quantities	Apply			
<b>CO5</b>	Demonstrate proficiency in using discipline-specific tools	Apply			
<b>CO6</b>	Function effectively as an individual for efficiently executing the given task	Organize			

#### HARDWARE/ SOFTWARE REQUIREMENTS

Sl.No.	Name of the equipment	Quantity required
1.	PCs with related accessories	15 Nos
2.	MATLAB / Equivalent software with Image processing tool box	15 Nos

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											2	
CO2	3	2											2	2
CO3	3	2										2	2	2
CO4	3	3	3		2	2			3	2		2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	3	2.2	3		2	2			3	2		2	2	2

Course Code	Course Title	L	T	P	C
19UGS533	INTERPERSONAL SKILLS LABORATORY	0	0	3	1.5
<p style="text-align: center;"><b><u>List of Exercises</u></b></p> <p><b>Part - A : Communication and Leadership Projects</b></p> <p><b>I) Speech Projects</b></p> <p>1.The Open up Speech (Prepared Speech) 2.Speech Organizing to the Point (Prepared Speech) 3.Table Topics Speech</p> <p><b>II) Evaluation Projects</b></p> <p>4.Speech Evaluation 5.TAG (Timer, Ah Counter and Grammarian) Evaluation</p> <p><b>III) Leadership Roles</b></p> <p>6.Speech Master of the Day 7.General Evaluator 8.Table Topics Master</p> <p><b>Part - B : Problem-Solving and Decision- Making Project</b></p> <p><b>IV) Quality Circle Project</b></p>					
<b>TOTAL: 45 PERIODS</b>					
<p><b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b></p>					
<b>CO1</b>	Communicate orally with fluency and clarity in a given contextual situation.	Responding - Affective Domain			
<b>CO2</b>	Evaluate a speech and offer constructive evaluation of the speech.	Evaluating - Cognitive Domain			
<b>CO3</b>	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task.	Organization – Affective Domain			
<b>CO4</b>	Analyze a problem and find appropriate solution.	Analyze – Cognitive Domain			
<b>CO5</b>	Take decision by organizing relevant information and defining alternatives.	Create – Cognitive Domain			

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		3		
CO2									2	3		3		
CO3									2	3		3		
CO4									2	3		3		
CO5									2	3		3		
CAM									2	3		3		



## SEMESTER VI

[illegible]

Course Code	Course Title	L	T	P	C
19UBM601	MEDICAL IMAGING EQUIPMENTS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand the generation of X-ray and its uses in imaging</li><li>To describe the principle of Computed Tomography.</li><li>To know the techniques used for visualizing various sections of the body.</li><li>To learn the principles of different radio diagnostic equipment in Imaging.</li><li>To discuss the radiation therapy techniques and radiation safety.</li></ul>					
<b>UNIT – I</b>	<b>X – RAYS</b>	<b>9</b>			
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.					
<b>UNIT – II</b>	<b>COMPUTED TOMOGRAPHY</b>	<b>9</b>			
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.					
<b>UNIT – III</b>	<b>MAGNETIC RESONANCE IMAGING</b>	<b>9</b>			
Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency 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.					
<b>UNIT – IV</b>	<b>NUCLEAR IMAGING AND OTHER IMAGING TECHNIQUES</b>	<b>9</b>			
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. Microwave imaging – Photo acoustic imaging – Optical coherence tomography – Microscopy imaging techniques.					
<b>UNIT – V</b>	<b>RADIATION THERAPY AND RADIATION SAFETY</b>	<b>9</b>			
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the principles and working mechanisms of various medical imaging equipment.				Understand
<b>CO2:</b>	Apply the knowledge of imaging technologies to operate medical imaging equipment effectively in clinical settings.				Apply
<b>CO3:</b>	Apply appropriate imaging methodologies for different diagnostic and therapeutic applications.				Apply
<b>CO4:</b>	Analyze the components and functioning of advanced imaging systems to identify their roles in medical imaging workflows.				Analyze
<b>CO5:</b>	Analyze safety considerations and radiation effects to recommend best practices for medical imaging and therapy.				Analyze
<b>CO6:</b>	Evaluate imaging techniques based on diagnostic accuracy, safety and efficiency to recommend suitable modalities for clinical applications.				Evaluate

**TEXT BOOKS:**

1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press, 2000
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000

**REFERENCES:**

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ",Springer-Verlag New York, 2011
3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015
4. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelphia, 1988.
5. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	3	
CO2	3							2				3	3	
CO3	3											3	3	
CO4	3	3		2					2			2	3	3
CO5	3	3				2	2	2				2	3	3
CO6	3	3	2	2		3	3	2	2			3	3	3
CAM	2.83	3	2	2		2.5	2.5	2	2			2.5	3	3

Course Code	Course Title	L	T	P	C
19UBM602	BIOMECHANICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the fundamental terms and concepts of human factors.</li><li>To discuss anthropometrics, physiological and biomechanical principles.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION OF MECHANICS</b>	<b>9</b>			
Use of statics, kinetics – rigid and non-rigid bodies – Forces and motion – Newtons laws –Moment of force – Free body Diagram- Static equilibrium – Centre of gravity –Stability of equilibrium – Steps in analyzing a biomechanical problem – Graphical methods – Contact forces – resolution of forces.					
<b>UNIT – II</b>	<b>MECHANICAL PROPERTIES OF BONES</b>	<b>9</b>			
Bone structure & composition mechanical properties of bone, cortical and cancellous bones, Fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Pseudo elasticity, nonlinear stress – strain relationship, viscoelasticity, Maxwell &Voight models, Mechanical properties of skin, ligaments and tendons, Hodgkin-Huxley Model.					
Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.					
<b>UNIT – III</b>	<b>MECHANICS OF THE JOINTS</b>	<b>9</b>			
Skeletal joints, skeletal muscles, basic considerations, assumption and limitations, forces and stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot.					
Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis					
<b>UNIT – IV</b>	<b>ALVEOLI MECHANICS</b>	<b>9</b>			
Alveoli mechanics, interaction of blood and lung, P-V curve of lung, breathing mechanism, airway resistance, physics of lung diseases.					
<b>UNIT – V</b>	<b>MECHANICAL PROPERTIES OF BLOOD VESSELS</b>	<b>9</b>			
Mechanical properties of blood vessels – arteries, arterioles, capillaries, veins, physics of cardio vascular diseases, prosthetic heart valves and replacement. Fluids – density – pressure – blood pressure and gravity – laminar and turbulent flow.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Illustrate the fundamental principles of mechanics and their application in biofluids and musculoskeletal systems.				Understand
<b>CO2:</b>	Apply principles of statics, dynamics and kinematics to analyze mechanical forces and motion in biological systems.				Apply
<b>CO3:</b>	Apply viscoelastic models to analyze the biomechanics of tissues, bone fractures, and implants. [Apply]				Apply
<b>CO4:</b>	Analyze the mechanics of fluid dynamics in cardiovascular systems to assess their functional roles and design implications.				Analyze
<b>CO5:</b>	Analyze finite element models and ergonomic designs to evaluate their role in preventing musculoskeletal disorders and enhancing workplace environments.				Analyze
<b>CO6:</b>	Evaluate biomechanical models and workplace designs using mechanical, physiological and ergonomic principles to ensure safety and efficiency.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Frank Bell, “Principles of Mechanics and Biomechanics”, Stanley Thorne (Publishers) Ltd., 1998.</li><li>Donald R. Peterson and Joseph D. Bronzino, “Biomechanics Principles and applications”, CRC press, Taylor &amp; Francis Group, LLC, 2008.</li><li>Duane Knudson, “Fundamentals of Biomechanics”, Second Edition, Springer publication, 2000.</li></ol>					

**REFERENCES:**

1. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science Business Media, 2004.
2. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2							2					3	
CO2	3	2					2						3	
CO3	3	2							2	2			3	
CO4	3	3		2								2	3	3
CO5	3	3		2					2	2		3	3	3
CO6	3	3	2	2		3	3	2					3	3
CAM	2.83	2.6	2	2		3	2.5	2	2	2		2.5	3	3

Course Code	Course Title	L	T	P	C
19UIT623	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	2	0	3	3.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand the principles of object oriented programming</li><li>To explain the systematic way of solving problems using various linear and non-linear data structures</li><li>To demonstrate implement the different linear and non-linear data structures</li></ul>					
<b>UNIT – I</b>	<b>PRINCIPLES OF OBJECT ORIENTED PROGRAMMING</b>				<b>10</b>
Introduction – Tokens – Expressions - Control Structures - Functions in C++, Classes and Objects, Constructors and Destructors, Operator Overloading, Inheritance - Extending classes, Virtual Functions and Polymorphism, Exception handling.					
<b>UNIT – II</b>	<b>LINEAR DATA STRUCTURES</b>				<b>10</b>
Abstract Data Type – Arrays: Accessing Elements – Operations – List ADT: Memory Allocation and De-allocation – Singly linked lists – Circular linked lists – Doubly linked lists – Applications of lists – Stack ADT: Array & Linked Representation – Applications of Stack, Queue ADT: Array & Linked Representation – Applications of Queue.					
<b>UNIT – III</b>	<b>NON-LINEAR DATA STRUCTURES</b>				<b>10</b>
Tree – Basic Terminology – Traversal – Operations: Binary trees – Binary Search tree – AVL tree – Graph Terminology – Representation of Graphs – Graph Traversal – Topological sort – Minimum Spanning Tree – Shortest path algorithm.					
<b>LIST OF EXPERIMENTS:</b>					<b>45</b>
1. Program to implement Operator Overloading. 2. Program to implement Classes with constructor, destructor and copy constructor. 3. Program to implement Classes with inheritance concepts. 4. Program to implement Arrays ADT. 5. Program to implement List ADT. 6. Program to implement stack ADT using array and linked list. 7. Program to implement queue ADT use array and linked list. 8. Program to implement binary search tree. 9. Program to implement insertion and deletion in AVL trees. 10. Program to implement Prim's / Kruskal's algorithm using priority queues to find MST of an undirected graph.					
<b>TOTAL : 30 (L) + 45 (P) = 75 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain the use of linear, non-linear data structures and object oriented approaches to solve the problems in real time applications.				Understand
<b>CO2:</b>	Apply the linear, non-linear data structures and object oriented approaches to solve variety of computational problems.				Apply
<b>CO3:</b>	Analyze the efficiency of various algorithmic approach through object oriented programming to solve real world applications with approach.				Analyze
<b>CO4:</b>	Design and develop efficient and effective algorithms to solve problems.				Create
<b>CO5:</b>	Evaluate the problems and find solutions using various linear and non-linear applications.				Evaluate
<b>CO6:</b>	Select and apply appropriate data structures to design algorithms using modern tool.				Apply
<b>TEXT BOOKS:</b> 1. E.Balagurusamy,“Object Oriented Programming with C++”, Tata McGraw Hill, 6 <sup>th</sup> Edition, 2013. 2. Weiss. M.A, “Data Structures and Algorithm Analysis in C++”, Pearson Education, 4 <sup>th</sup> Edition, 2014.					

## REFERENCES:

1. Bhusan Trivedi, "Programming with ANSI C++ - A Step by Step Approach", Oxford University Press, 2<sup>nd</sup> Edition, 2014.
2. Stroustrup B, "The C++ Programming Language", Pearson Education, 4<sup>th</sup> Edition, 2013.
3. Aho V, Hopcroft J E, Ullman.J.D, "Data Structures and Algorithms", Pearson Education, 1<sup>st</sup> Edition Reprint, 2006.
4. Gilberg R F, Forouzan.B.A, "Data Structures: A Pseudo code Approach with C++", Thomson India Education, 2<sup>nd</sup> Edition, 2005

- ## REFERENCES:
1. Bhusan Trivedi, "Programming with ANSI C++ - A Step by Step Approach", Oxford University Press, 2<sup>nd</sup> Edition, 2014.
  2. Stroustrup B, "The C++ Programming Language", Pearson Education, 4<sup>th</sup> Edition, 2013.
  3. Aho V, Hopcroft J E, Ullman.J.D, "Data Structures and Algorithms", Pearson Education, 1<sup>st</sup> Edition Reprint, 2006.
  4. Gilberg R F, Forouzan.B.A, "Data Structures: A Pseudo code Approach with C++", Thomson India Education, 2<sup>nd</sup> Edition, 2005

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

## **HARDWARE / SOFTWARE REQUIREMENTS:**

**Hardware Requirements:**

Computer Required: 30 No's

Minimum Requirement: Processor- Pentium IV, Ram: 1 GB, Hard Disk: 80 GB

**Software Requirements**

Operating System: Linux (Ubuntu / Fedora / Debian / Mint OS) / Windows

Turbo C Version 3 or GCC Version 4 / Built in Linux / DEV++

[illegible]

Course Code	Course Title	L	T	P	C
19UBM607	PRODUCT DEVELOPMENT PROJECT	0	0	8	4

#### OBJECTIVES:

- To develop skills to formulate a technical project.
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical/ Electronics/ Mechatronics/ Instrumentation system.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- For enabling the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.
- To provide guidelines to prepare technical report of the project.

#### About the Course:

This course is introduced to enable the students to take up investigative study in the broad field of Biomedical Engineering, involving both theoretical and practical work to solve the real world healthcare problems as a group under the guidance of the allotted faculty. The students shall work in groups (Maximum 3) and focus on research problem and discover solutions by applying the knowledge of subjects that he/she has learnt upto 5<sup>th</sup> semester. This is expected to provide a good initiation for the student(s) in R&D work. This includes:

- Survey and study of published literature in the selected domain.
- Review and finalization of the approach to the problem relating to the selected topic.
- Preparing an Action Plan for conducting the investigation, including team work.
- Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed.
- Final development of product/process, testing, results, conclusions and future directions.
- Preparing a Report in the standard format for being evaluated by the Department.
- Final Presentation before an Evaluation Committee.

**TOTAL: 120 PERIODS**

#### COURSE OUTCOMES:

**At the end of the course the student will be able to:**

CO1	Design and develop sustainable innovative solutions for societal issues with consideration for public health, safety and environment.	Create - Cognitive Domain
CO2	Analyze the market potential and evolve the product strategy	Analyze - Cognitive Domain
CO3	Apply modern engineering and IT tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice	Apply - Cognitive Domain
CO4	Test and evaluate the performance of the developed innovative product using appropriate techniques and tools	Evaluate- Cognitive Domain
CO5	Organize effectively as a team for executing the project	Organize - Affective Domain
CO6	Write effective reports and make clear presentations	Respond - Affective Domain

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3					3			3				3	3
CO2		3	3										3	3
CO3				3	3								3	3
CO4									3		3		3	3
CO5										3			3	3
CO6		3		3						3			3	3
CAM	3	3	3	3	3	3			3	3	3		3	3



Course Code	Course Title	L	T	P	C
19UGS631	LOGICAL REASONING AND APTITUDE	1	0	0	1
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.</li><li>To familiarize the student with various principles involved in solving mathematical problems.</li><li>To develop an understanding of the basic concepts of reasoning skills.</li></ul>					
<b>UNIT – I</b>	<b>QUANTITATIVE APTITUDE</b>	<b>8</b>			
Ratio and Proportion - Averages – Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest – Time – Speed –Distance - Time and Work – Permutation and Combination - Alligation or Mixture – Probability – Clocks – Calendars.					
<b>UNIT – II</b>	<b>VERBAL AND NON VERBAL REASONING</b>	<b>7</b>			
Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams - Data Sufficiency – Data interpretation — Syllogism - Coding – Decoding.					
<b>TOTAL : 15 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Select an appropriate technique to solve the quantitative problems within the stipulated time.	Apply			
<b>CO2:</b>	Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning.	Apply			
<b>TEXT BOOKS:</b> <ul style="list-style-type: none"><li>1. Dr. R.S.Agarwal, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20<sup>th</sup> Edition, (2013).</li><li>2. Abijit Guha, “Quantitative Aptitude for Competitive Examinations”, Tata McGraw Hill Publication, New Delhi, 4th Edition, (2011).</li><li>3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2<sup>nd</sup> Edition, (2013).</li></ul>					
<b>REFERENCES:</b> <ul style="list-style-type: none"><li>1. Ashish Aggarwal, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition, (2014).</li><li>2. Dr.V.A.Sathgurunath’s “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition, (2011).</li></ul>					
<b>WEBSITES:</b> <a href="http://www.m4maths.com">www.m4maths.com</a> , <a href="http://www.fresherworld.com">www.fresherworld.com</a> , <a href="http://www.indianstudyhub.in">www.indianstudyhub.in</a> , <a href="http://www.indiabix.com">www.indiabix.com</a> , <a href="http://www.campusgate.co.in">www.campusgate.co.in</a> , <a href="http://www.tcyonline.com">www.tcyonline.com</a> .					

Course Code	Course Title	L	T	P	C
19UGS532	SOFT SKILLS LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To develop a requisite knowledge in Communication skills and Soft skills.</li><li>To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.</li></ul>					
<b>UNIT – I</b>	<b>SPEAKING SKILLS</b>				<b>9</b>
Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills					
<b>UNIT – II</b>	<b>WRITING SKILLS</b>				<b>9</b>
Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation					
<b>UNIT – III</b>	<b>READING AND LISTENING SKILLS</b>				<b>9</b>
Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking					
<b>UNIT – IV</b>	<b>SOFT SKILLS</b>				<b>9</b>
Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution					
<b>UNIT – V</b>	<b>INTERVIEW SKILLS</b>				<b>9</b>
Types of Interviews – Body Language – Professional Grooming – Basic Etiquette.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Answer the queries precisely after carefully listening to the conversation or speech.			Responding	
<b>CO2:</b>	Communicate orally with fluency and clarity in a given contextual situation			Responding	
<b>CO3:</b>	Debate with clarity of thought and expression to convey their ideas politely to others			Valuing	
<b>CO4:</b>	Apply correct usage of English grammar in writing, fluent speaking and comprehending.			Apply	
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Skills for Success, Listening and Speaking – Level 4 by Brooks and Margret – Oxford University Press, Oxford 2011 Edition.</li><li>Professional Communication by Raman, Meenakshi and Sangeetha Sharma – Oxford University Press, 2014 Edition.</li><li>Developing Soft Skills by Sherfield, Robert M, R J Montgomery and Patricia G Moody – Pearson Education Publishers.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								2	3	3			2	2
CO2								2	3	3			2	2
CO3								2	3	3			2	2
CO4								2	3	3			2	2
CAM								2	3	3			2	2

Course Code	Course Title	L	T	P	C
19UGM631	INDIAN CONSTITUTION	1	0	0	P/F
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>• The students will be exposed to fundamental rights &amp; duties in Indian Constitution.</li><li>• The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development.</li><li>• The student will have knowledge on powers and functions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB...</li><li>• The student will know about the functions of judiciary and electoral process followed in the country.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION ON INDIAN CONSTITUTION</b>	<b>4</b>			
Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articles of constitution- important Amendments of constitution.					
<b>UNIT – II</b>	<b>PARLIAMENTARY SYSTEM</b>	<b>4</b>			
Parliamentary System – parliamentary system of other countries - Indian parliamentary system-Federal System – LS and RS, Centre-State Relations-Election of member of parliaments - Union Executive - President, Prime Minister, Union Cabinet. State Legislature - State Executives – election of MLA - Governor, Chief Minister, State Cabinet.					
<b>UNIT – III</b>	<b>JUDICIARY AND ELECTION COMMISSION</b>	<b>4</b>			
Supreme Court of India: Structure, Power and Functions of Supreme Court – Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. – Lok adhalats. Elections - Electoral Process - Election Commission of India - Election Laws – Emergency Provisions - types of Emergencies and its consequences.					
<b>UNIT – IV</b>	<b>LOCAL ADMINISTRATION</b>	<b>3</b>			
Local Administration: Powers and functions of Municipalities and Panchayats System - Panchayat Raj – Co-operative Societies and Constitutional and Non-constitutional Bodies.					
<b>TOTAL : 15 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations.	Apply			
<b>CO2:</b>	Manage complex societal issues in society with the knowledge of judiciary and local administration.	Analyze			
<b>CO3:</b>	Interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills.	Evaluate			
<b>CO4:</b>	Elaborate the ethical responsibilities of municipalities, panchayats and co-operative societies.	Understand			
<b>CO5:</b>	Describe and distinguish the functioning of the parliamentary system followed in various countries.	Understand			
<b>TEXT BOOKS:</b> <ul style="list-style-type: none"><li>1. Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” by Cengage Learning India Private Limited, 2018.</li><li>2. Subhash C. Kashyap,”Our Constitution: An Introduction to India’s Constitution and constitutional Law”, NBT, 2018.</li><li>3. Brij Kishore Sharma,”Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., New Delhi, 2011.</li><li>4. M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.</li><li>5. Durga Das Basu, “Introduction to the Constitution on India”, Prentice Hall, 2001.</li></ul>					

## SEMESTER VII

[illegible]

Course Code	Course Title	L	T	P	C
19UME701	PROJECT MANAGEMENT AND FINANCE	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To impart knowledge to find solutions and approaches for various projects.</li><li>To familiarize the utilization of project within time, resource and financial constraint</li></ul>					
<b>UNIT – I</b>	<b>PROJECT MANAGEMENT CONCEPTS</b>	<b>9</b>			
Concept and characteristics of a project, importance of project management, types of project, project organizational structure, project life cycle, Statement of Work, Work Breakdown Structure.					
<b>UNIT – II</b>	<b>PROJECT PLANNING</b>	<b>9</b>			
Project Planning and Scheduling techniques - developing the project network using CPM/PERT, Limitations of CPM/PERT, Precedence Diagramming Method, constructing diagram and computations using precedence diagramming method, PERT/CPM simulation, reducing project duration.					
<b>UNIT – III</b>	<b>RESOURCE SCHEDULING &amp; CRITICAL CHAIN SCHEDULING</b>	<b>9</b>			
Resource Scheduling - Resource allocation method, splitting and multitasking, Multi project resources scheduling - Critical Chain Scheduling -Concept of critical chain scheduling - critical chain scheduling method, application of Critical chain scheduling and limitations.					
<b>UNIT – IV</b>	<b>PROJECT QUALITY MANAGEMENT</b>	<b>9</b>			
Concept of project quality, responsibility for quality in projects, quality management at different stages of project, tools and techniques, Quality Management Systems, TQM in projects - Project Performance Measurement and Control - Monitor and assess project performance, schedule, and cost. Earned Value Management, performance measurement methods to monitor, evaluate and control planned cost and schedule performance - Project Closure/ Termination - Meaning of closure/ termination, project audit process, termination steps, final closure.					
<b>UNIT – V</b>	<b>FINANCIAL ACCOUNTING</b>	<b>9</b>			
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis – Comparative financial statements. Investments- Average rate of return - Payback Period - Net Present Value - Internal rate of return.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the concept and characteristics of project management and application of resource scheduling and critical chain scheduling.				Understand
<b>CO2:</b>	Estimate the suitable resources required for given project work.				Apply
<b>CO3:</b>	Construct the balance sheet to identify the fund flow and cash flow statements.				Apply
<b>CO4:</b>	Apply the concept of CPM and PERT to develop the project network.				Apply
<b>CO5:</b>	Examine the various tools and techniques at different stages of Quality management.				Analyze
<b>CO6:</b>	Evaluate the decision related to fore casting, inventory, quality control problems etc. for the industries.				Evaluate
<b>TEXT BOOKS:</b> <ul style="list-style-type: none"><li>Prasanna Chandra, —' Fundamentals of Financial Management 'll , Tata Mc graw – Hill Publishing Ltd, 2005.</li><li>Jack Meredith, Samuel J. Mantel,—Project Management-A Managerial Approach ll, John Wiley and Sons.</li></ul>					
<b>REFERENCES:</b> <ul style="list-style-type: none"><li>Clifford F Gray, Erik W Larson, —Project Management-The Managerial Process ll, Tata Mcgraw-Hill Publishing Co. Ltd.</li><li>John M Nicholas, —Project Management for Business and Technology ll, Prentice Hall of India Pvt. Ltd.</li><li>Paresh Shah, —Basic Financial Accounting for Management ll, Oxford University Press, 2007.</li></ul>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2										2			
CO2	3										3			
CO3	3					2					3			
CO4	3				3	2					3			
CO5	3	3			3	2	3		3		3			
CO6	3	3			3	2			3		3			
CAM	2.8	3			3	2	3		3		2.8			

Course Code	Course Title	L	T	P	C
19UBM702	HOSPITAL MANAGEMENT	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the basic planning and organization of Hospitals</li><li>To explain clinical, administrative and HR services</li><li>To discuss the medical ethics and medical regulations</li><li>To analyze the infection control and safety management in hospitals</li></ul>					
<b>UNIT – I</b>	<b>OVERVIEW OF HOSPITAL ADMINISTRATION AND ORGANIZATION OF THE HOSPITALS</b>	<b>9</b>			
Distinction between Hospital and Industry – Challenges in Hospital Administration – Hospital Planning – Equipment Planning – Functional Planning – Current Issues in Hospital Management. Roles of hospital in healthcare, Different Departments of Hospital - Effective hospital management.					
<b>UNIT – II</b>	<b>HUMAN RESOURCE MANAGEMENT IN THE HOSPITALS</b>	<b>8</b>			
Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.					
<b>UNIT – III</b>	<b>SUPPORTIVE SERVICES IN HOSPITAL AND HOSPITAL INFORMATION SYSTEMS</b>	<b>9</b>			
Organization of Ancillary Services: Lab Services – Department of Physiotherapy & Occupational Therapy, Blood Transfusion Services, Radio diagnosis – Medical Transcription – Medical Records Department – Pharmacy – Food Services – Central Sterilization and Supply Department - Laundry and linen service – Housekeeping – Volunteer department – Need for computerization of hospitals - Hospital Information System – Clinical Information Systems – Administrative Information Systems – Technical Information Systems.					
<b>UNIT – IV</b>	<b>MEDICAL ETHICS AND REGULATIONS</b>	<b>9</b>			
Definition of Medical ethics, Scope of ethics in medicine, International code of Ethics for occupational health professionals, Bioethics, Evolution of Medical Standards and Regulations - WHO – International Health Regulations (IHR), – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Healthcare Standard Organizations – JCAHO (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Regulatory Standards For Medical Devices.					
<b>UNIT – V</b>	<b>MEDICAL WASTE MANAGEMENT AND QUALITY MEASUREMENT IN HOSPITAL</b>	<b>10</b>			
Types of Waste – Importance of infection control – Hand hygiene – Aseptic techniques – Isolation precautions –Disinfection and sterilization – Clinical laboratory standards to infection control –Disposal of biological waste: Incinerator – Hazardous waste, radioactive waste, liquid waste destruction – landfill – Risk management in hospitals - Quality system – Elements, implementation of quality system, Documentation, Quality auditing.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the principles, practices and applications of hospital management and discuss the significance of supportive services.				Understand
<b>CO2:</b>	Describe the process of HRM and manpower planning in hospitals.				Understand
<b>CO3:</b>	Incorporate computerization in various departments of Hospital.				Apply
<b>CO4:</b>	Assess the quality measures and systems in health care services.				Apply
<b>CO5:</b>	Analyze the importance of sterilization and waste management in health care services.				Analyze
<b>CO6:</b>	Evaluate the ethics in healthcare laboratories and the standards and rules for hospital operations and planning.				Analyze
<b>TEXT BOOKS:</b> 1. Kunders G D, “Hospitals, facilities planning and management”, Tata McGraw Hill, 2008.					

2. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Sixth Edition, 2013
3. Sakharkar B M, "Principles of hospital administration and planning", Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.

**REFERENCES:**

1. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6 th Edition, 2011
2. Communicating in Hospital Emergency Departments - Page iii Diana Slade, Marie Manidis, Jeannette McGregor · 2015
3. Hospital Information Systems : a Concise Study Kelkar S. A. · 2010
4. Healthcare Human Resource Management By Walter J. Flynn, Robert L. Mathis, John H. Jackson, Sean R. Valentine · 2015

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	
CO2	2								2	2		3	3	
CO3	3	2					2						3	3
CO4	3	2						2					3	2
CO5	3	3				2		2				3	3	2
CO6	3	3	2	2		3	2	3	2	2	3	3	3	3
CAM	2.67	2.5	2	2		2.5	2	2.33	2	2	3	3	3	2.5



Course Code	Course Title	L	T	P	C
19UBM703	IMAGE PROCESSING TECHNIQUES	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To analyze the mathematical transforms necessary for image processing and different image enhancement techniques.</li><li>To analyze image restoration procedures and image segmentation techniques.</li><li>To analyze the image compression procedures.</li></ul>					
<b>UNIT – I</b>	<b>DIGITAL IMAGE FUNDAMENTALS</b>	<b>9</b>			
Elements of digital image processing systems – Elements of visual perception, brightness, contrast, hue, saturation, mach band effect – Color image fundamentals, RGB, HSI models - Image sampling - Quantization – Basic relationship between pixels - 2-D Image transforms: DFT, DCT, KLT and SVD.					
<b>UNIT – II</b>	<b>IMAGE ENHANCEMENT</b>	<b>9</b>			
Basic Intensity Transformations – Histogram equalization and specification techniques - Spatial Smoothing Filters, Spatial sharpening Filters – Frequency domain Smoothing and Sharpening Filters – Selective Filtering, Homomorphic filtering.					
<b>UNIT – III</b>	<b>IMAGE RESTORATION</b>	<b>9</b>			
Model of the Image Degradation/Restoration Process – Noise Models, Estimation of noise parameters – Restoration in the presence of Noise only situation, Mean Filters, Order Statistic Filters (OSF), Adaptive Mean and Median Filters – Periodic Noise Reduction by Frequency Domain Filtering – Linear, Position-Invariant Degradations – Estimating the Degradation Function – Inverse Filtering – Minimum Mean Square Error (Wiener) Filtering –Constrained Least Squares Filtering – Geometric Transformations.					
<b>UNIT – IV</b>	<b>IMAGE SEGMENTATION, REPRESENTATION AND DESCRIPTION</b>	<b>9</b>			
Point, Line and Edge detection – Edge linking via Hough transform – Thresholding – Region based segmentation, Region growing, Region splitting and Merging – Image representation schemes – Boundary descriptors – Regional descriptors – Relational descriptors.					
<b>UNIT – V</b>	<b>IMAGE RECOGNITION AND COMPRESSION</b>	<b>9</b>			
Image Recognition: Patterns and Pattern classes –Decision Theoretic Methods, Minimum distance classifier, Matching by correlation, Optimum statistical classifier. Image Compression: Compression fundamentals – Optimal variable length Coding, Huffman, Arithmetic coding - Near optimal variable length coding– Bit plane coding, Constant area coding, Run Length encoding – Predictive coding – Scalar and Vector Quantization - Transform coding.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the core principles of image processing techniques used for analyzing medical images.				Understand
<b>CO2:</b>	Apply image enhancement techniques to improve the quality and clarity of medical images.				Apply
<b>CO3:</b>	Apply image restoration, segmentation, and visualization techniques to process and analyze medical images for clinical applications.				Analyze
<b>CO4:</b>	Analyze the mathematical transforms, pixel relationships and noise models to understand their impact on medical image quality and processing.				Analyze
<b>CO5:</b>	Analyze segmentation, feature extraction, and compression techniques to assess their effectiveness in medical imaging.				Evaluate
<b>CO6:</b>	Design and develop a computer-aided diagnostic system for real-world medical imaging challenges.				Apply
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing', 3rd Edition, Pearson Education, 2011.</li><li>Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2003.</li></ol>					

**REFERENCES:**

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
3. D. E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, "Digital Image Processing", 4th Edition, John Wiley", New York, 2007.
5. Milan Sonkaetal, "Image Processing, Analysis and Machine Vision", 3rd Edition, Vikas Publishing House, 2007.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2							2					3	2
CO2	3				3								3	3
CO3	3				3					2		2	3	3
CO4	3	3										3	3	2
CO5	3	3											3	3
CO6	3	3	3	3	3	2		2		3		3	3	3
CAM	2.83	3	3	3	3	2		2		2.5		2.67	3	2.67

Course Code	Course Title	L	T	P	C
19UBM707	SUMMER INERNSHIP	0	0	2	1
<b>OBJECTIVES:</b> <b>The student should be made to:</b> <ul style="list-style-type: none"> <li>Gain a better understanding of the hospital workplace</li> <li>Develop and demonstrate knowledge necessary for plant operations, clinical engineering, biomedical engineering, safety technology and hospital information system.</li> <li>Solve the rising challenges and specific necessities of modern day hospitals.</li> </ul>					
<b>COURSE REQUIREMENTS:</b> <p>Students shall work in groups (Maximum 3) and has to identify and discuss about various activities of departments like out/in patient and nursing critical care departments of hospital like ICCU, ICU and activities of central sterile supply department and also challenges in designing the biomedical equipment. There shall be three reviews for the summer internship during the semester by the internship co-ordinator. The incharge faculty will review the report submitted by the student. The students should make a presentation on the progress made by him/her before the committee. The student should submit the report at the end of the semester. At the end of the internship period, the marks shall be awarded by the same co-ordinator for the report and viva-voce.</p>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1</b>	Comprehend professional ethics and legal issues related to hospital engineering and healthcare System	Understand			
<b>CO2</b>	Recognize the basics of working model of biomedical equipment and discover the suitable improvements and solutions to specific biomedical technology issues.	Apply			
<b>CO3</b>	Interact and network with other healthcare technology managers to point out the best practices and solutions for common issues	Analysis			
<b>CO4</b>	Compare and justify better management of information regarding identification of biomedical and hospital technology planning, procurement and operation requirements.	Evaluate			

Course Code	Course Name	L	T	P	C
19UBM708	HOSPITAL TRAINING	0	0	2	1

#### OBJECTIVES:

The student should be made to:

- Observe medical professional at work and the roles of allied health professionals
- Provide access to healthcare professionals to get a better understanding of their work environment.
- Demonstrate patient care in a hospital setting

#### COURSE REQUIREMENTS:

Students need to complete training in any leading Multi-specialty hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session. Out of the following departments, it is mandatory to complete training in any 5 departments. The students can give presentation of the remaining departments during laboratory hours.

S.No	Departments
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopedic and physiotherapy
5	ICU/CCU
6	Operation theatre
7	Neurology
8	Nephrology
9	Radiology
10	Urology

#### COURSE OUTCOMES:

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

CO1	Recognize their skills in solving problems in patient centered approach in health care.	Apply
CO2	Reproduce the importance of inter-professional collaboration in healthcare and illustrate the techniques and skills to assess health improvement plan ethically based upon the patient's perceived needs.	Apply
CO3	Use the knowledge of their own role and those of other professions and thereby justifying healthcare needs of populations and patients served.	Analyze
CO4	Communicate with other health professionals in a respectful and responsible manner.	Apply
CO5	Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs.	Analyze
CO6	Predict the faults in the biomedical equipment and demonstrate the working condition of the equipment.	Evaluate

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2	3									3			2	
CO3	3	3								3			2	
CO4									3	3			2	
CO5	2	2	2						3	3			2	
CO6	2	2	3	3					3	3			2	
CAM	2.6	2.33	2.5	3					3	3			2	

Course Code	Course Title	L	T	P	C
19UBM709	IMAGE PROCESSING LABORATORY	0	0	3	1.5
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To practice the basic image processing techniques.</li><li>To compute magnitude and phasor representation of images.</li><li>To understand the concepts of image restoration and segmentation.</li><li>To explore the applications of image processing.</li></ul>					
<b>LIST OF EXPERIMENTS:</b> <ol style="list-style-type: none"><li>Image sampling and quantization levels on image quality.</li><li>Implement and demonstrate 2-D DFT &amp; DCT Transforms.</li><li>Implement and demonstrate Histogram Processing.</li><li>Implement and demonstrate various Point processing techniques.</li><li>Implement and demonstrate Inverse Filtering and Wiener Filtering.</li><li>Implement and demonstrate various Mean and Order Statistic Filters.</li><li>Implement and demonstrate various Line and Edge Detection Techniques and Edge linking.</li><li>Implement and demonstrate to extract Boundary, Regional and Texture features.</li><li>Implement and demonstrate various distance measures for classification.</li><li>Medical Image Enhancement - Spatial filtering.</li><li>Medical Image Enhancement - Filtering in frequency domain.</li><li>Implement and demonstrate various thresholding techniques.</li></ol>					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Demonstrate knowledge of a broad range of fundamental image processing, image analysis techniques and concepts.	Apply			
<b>CO2:</b>	Apply image processing technique to solve real health care problems.	Apply			
<b>CO3:</b>	Identify, Demonstrate and apply their knowledge by analyzing image processing problems and recognizing and proposing effective solutions.	Analyze			
<b>CO4:</b>	Apply appropriate software tools to make measurements of physical quantities	Apply			
<b>CO5:</b>	Demonstrate proficiency in using discipline-specific tools	Apply			
<b>CO6</b>	Function effectively as an individual for efficiently executing the given task	Organize			
<b>EQUIPMENTS FOR A BATCH OF 30 STUDENTS (2 students per experiment):</b> PCs with related accessories – 15 MATLAB/Equivalent software with Image processing tool box					
<b>REFERENCE:</b> <ol style="list-style-type: none"><li>Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												3	3
CO2	3	2											3	3
CO3	3	3	2										3	3
CO4	3	3	3		2	2			3	2		2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	3	2.5	2.5		2	2			3	2		2	3	3

Course Code	Course Title	L	T	P	C
19UGM731	PROFESSIONAL ETHICS AND HUMAN VALUES	2	0	0	P/F
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.</li></ul>					
<b>UNIT – I</b>	<b>HUMAN VALUES</b>				<b>7</b>
Morals- Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time - Co-operation –Commitment – Empathy- self-Confidence –Character.					
<b>UNIT – II</b>	<b>ENGINEERING ETHICS</b>				<b>7</b>
Senses of „Engineering Ethics” – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.					
<b>UNIT – III</b>	<b>UNIVERSAL HARMONY</b>				<b>4</b>
Engineering Harmony in the family – Harmony in the society – Trust and Respect – Universal harmonious order.					
<b>UNIT – IV</b>	<b>SAFETY, RESPONSIBILITIES AND RIGHTS</b>				<b>6</b>
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.					
<b>UNIT – V</b>	<b>GLOBAL ISSUES</b>				<b>6</b>
Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development– Engineers as Managers – Consulting Engineers – Honesty – Moral Leadership – Sample Code of Conduct.					
<b>TOTAL : 30 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.				Apply
<b>CO2:</b>	Illustrate the basic perception of profession, professional ethics and various issues.				Understand
<b>CO3:</b>	Describe the code of ethics and role of professional ethics in engineering field				Understand
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.</li><li>Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.</li><li>Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.</li><li>Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.</li><li>John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003</li><li>Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd. New Delhi, 2013.</li><li>World Community Service Centre, „Value Education”, Vethathiri publications, Erode, 2011.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3					2			3	2		2	2	2
CO2	2					2			3	2		2	2	2
CO3	3					2			3	2		2	2	2
CAM	2.67					2			3	2		2	2	2

## SEMESTER VIII

S.No.	Course Code	Course Title	Course Category	L	T	P	C
<b>THEORY</b>							
1.	PE - VI	Professional Elective – VI	PE	3	0	0	3
2.	OE - IV	Open Elective – IV	OE	3	0	0	3
<b>PRACTICAL</b>							
3.	19UBM801	Project work	P	0	0	16	8
Total				6	0	16	14
<b>Total Credits : 14</b>							





## LIST OF PROFESSIONAL ELECTIVES

S. No.	Course Code	Course Title	L	T	P	C
1.	19UBM901	Bio-MEMS and Nano Electronics	3	0	0	3
2.	19UBM902	Clinical Engineering	3	0	0	3
3.	19UBM903	Principles of Tissue Engineering	3	0	0	3
4.	19UBM904	Biomaterials and Artificial Organs	3	0	0	3
5.	19UBM905	Pattern Recognition and Neural Networks	3	0	0	3
6.	19UBM906	Forensic Science	3	0	0	3
7.	19UBM907	Drug Delivery Systems	3	0	0	3
8.	19UBM908	Nuclear Medicine	3	0	0	3
9.	19UBM909	Medical Radiation Safety Engineering	3	0	0	3
10.	19UBM910	Medical Technology	3	0	0	3
11.	19UBM911	Medical Optics	3	0	0	3
12.	19UBM912	Genetic Engineering	3	0	0	3
13.	19UBM913	Communication Engineering	2	0	2	3
14.	19UBM914	Biometric Systems	3	0	0	3
15.	19UBM915	Medical Informatics	3	0	0	3
16.	19UBM916	Telemedicine	3	0	0	3
17.	19UBM917	Rehabilitation Engineering and Robotics	3	0	0	3
18.	19UBM918	Virtual Bio-Instrumentation	2	0	2	3
19.	19UBM919	Medical Embedded Systems	3	0	0	3
20.	19UBM920	Brain Computer Interface and virtual reality	3	0	0	3
21.	19UBM921	Neuroscience	3	0	0	3
22.	19UBM922	Cancer Biology	3	0	0	3
23.	19UBM923	Human Assist Devices	3	0	0	3
24.	19UBM924	Body Area Networks and Mobile Healthcare	3	0	0	3
25.	19UBM925	Regenerative Medicine and Ergonomics	3	0	0	3
26.	19UBM926	Physiological Modeling	2	0	2	3
27.	19UBM927	Big Data and IOT in Medical Applications	3	0	0	3
28.	19UBM928	VLSI System Design	3	0	0	3
29.	19UBM929	Medical Waste management	3	0	0	3
30.	19UBM930	Digital System Design	3	0	0	3
31.	19UBM931	Bio-Signal Processing	3	0	0	3
32.	19UBM932	Principles of Machine Learning	3	0	0	3
33.	19UBM933	Bio Statistics	3	0	0	3
34.	19UBM934	Electro Magnetic Interference and Compatibility	3	0	0	3
35.	19UBM935	Smart Healthcare Engineering and Artificial Intelligence	3	0	0	3

Course Code	Course Title	L	T	P	C
19UBM901	BIOMEMS AND NANO ELECTRONICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce various MEMS fabrication techniques.</li><li>To impart knowledge on different types of sensors and actuators and their principles of operation at the micro scale level.</li><li>To discuss the applications of MEMS in different fields of medicine</li></ul>					
<b>UNIT – I</b>	<b>MEMS MATERIALS AND FABRICATION</b>				<b>9</b>
Typical MEMs and Microsystems, materials for MEMS - active substrate materials-Silicon and its compounds, Silicon piezo-resistors, Gallium Arsenide, quartz, polymers. Micromachining- photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.					
<b>UNIT – II</b>	<b>SENSORS AND ACTUATORS</b>				<b>9</b>
Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – micro-plates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor. Properties of piezoelectric materials, Piezo-electric sensor and actuator – inchworm motor, inertia sensor, flow sensor.					
<b>UNIT – III</b>	<b>THE PROSPECT OF NANOMEDICINE</b>				<b>9</b>
Current Medical Practice, The Evolution of Scientific Medicine – Volitional Normative Model of Disease – Treatment Methodology – Evolution of Bedside Practice – The Nano medical Perspective, Nano-medicine and Molecular Nanotechnology – Pathways to Molecular Manufacturing- Molecular Transport and Sortation.					
<b>UNIT – IV</b>	<b>NANOSENSORS &amp; NANOSCALE SCANNING</b>				<b>9</b>
Nano-sensor Technology – Chemical and Molecular Nano-sensor – Displacement and Motion Sensors – Force Nano-sensor – Thermal Nano-sensor – Electric and Magnetic Sensing – Cellular Bio scanning – Macro-sensing – integrated nano-sensor technologies, genomics & proteomics – real time & in vivo medical monitoring.					
<b>UNIT – V</b>	<b>NANODEVICES FOR MEDICINE &amp; SURGERY</b>				<b>9</b>
Nano-devices for Clinical Nano-diagnostics, Nano-endoscopy, Nano-biotechnology and Drug Delivery Devices- Tools for Nano-surgery, Nano-scale Laser Surgery, Nano-robotics for Surgery – Nanotechnology for Detection of Cancer, QDs, Dendrimers for Sensing Cancer Cell Apoptosis, Gold Nanoparticles for Cancer Diagnosis, Nanotubes for Detection of Cancer Proteins, Nanoparticles for the Optical Imaging of Tumors.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Summarize the different fabrication techniques used in the manufacture of BioMEMS and Nano electronics devices.				Understand
<b>CO2:</b>	Analyze the working principles of different BioMEMS and Nano electronics devices.				Apply
<b>CO3:</b>	Develop solutions to the problems associated with BioMEMS and Nano electronics devices.				Apply
<b>CO4:</b>	Evaluate the performance of BioMEMS and Nano electronics devices based on different criteria.				Analyze
<b>CO5:</b>	Assess the ethical and social implications of BioMEMS and Nano electronics devices.				Analyze
<b>CO6:</b>	Design novel BioMEMS and Nano electronics devices with improved functionality in medical applications.				Create

**TEXT BOOKS:**

1. Chang Liu," Foundations of MEMS", Pearson Education International, New Jersey, USA, 2nd Edition, 2011.
2. Robert .A. Freitas.Jr, " Nanomedicine " Landes Bioscience Press 2010

**REFERENCES:**

1. Wanjun Wang, Stephen A.Soper,||BioMEMs: Technologies and applications||, CRC Press, New York, 2007
2. Marc J. Madou , "Fundamentals of microfabrication: the science of miniaturization", CRC Press, 2002
3. Robert A. Freitas, "Nanomedicine, Volume IIA: Biocompatibility", Landes Bioscience, 2011.
4. Jain.K.K, "Handbook of Nanomedicine" Springer, 2012.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												3	
CO3	3												3	
CO4	3	3								2			3	
CO5	3	3											3	
CO6	3	3	2	2						2			3	
CAM	2.83	3	2	2						2			3	

Course Code	Course Title	L	T	P	C
19UBM902	CLINICAL ENGINEERING	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>• This course will provide a basic understanding of the clinical engineering profession, qualifications, roles, activities, and expectations.</li><li>• This course will enhance students to practice medical equipment and analyze challenges with their healthcare technology.</li><li>• This course will engage the students to work as a team to address problems and errors in medical devices.</li><li>• This course will help students to design better medical devices with computerized approaches.</li><li>• This course will expose students to explore the Health Technology Management systems with medical devices and supportive services with advanced application.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION</b>				<b>9</b>
Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.					
<b>UNIT – II</b>	<b>MEDICAL TECHNOLOGY MANAGEMENT PRACTICES</b>				<b>9</b>
Strategic Medical Technology Planning, Scope , Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequisite for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA					
<b>UNIT – III</b>	<b>ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP)</b>				<b>9</b>
Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis					
<b>UNIT – IV</b>	<b>CLINICAL ENGINEERING PROGRAM INDICATOR</b>				<b>9</b>
Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.					
<b>UNIT – V</b>	<b>ADVANCED TECHNOLOGY FOR PATIENT SAFETY</b>				<b>9</b>
Factors Contributing to Medical Errors: Heath Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the role of clinical engineers, medical technology concepts, program indicators and equipment management.				Understand
<b>CO2:</b>	Identify and mitigate errors in medical equipment and patient safety using program databases and frameworks.				Apply
<b>CO3:</b>	Develop patient safety solutions using the Essential Health Care Technology Package.				Apply
<b>CO4:</b>	Implement computerized medical equipment management using CPOE.				Apply
<b>CO5:</b>	Appraise management practices and examine issues using program indicators for medical technology assessment.				Analyze
<b>CO6:</b>	Assess medical device complexities and justify effective safety practices.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>1. Ernesto Iadanza, Joseph Dyro, “Clinical Engineering Handbook”, Elsevier Academic Press, 2014</li><li>2. Robert Miniati, “Clinical Engineering from Devices to Systems”, Academic Press, 23-Dec-2015 - Technology &amp; Engineering</li></ol>					

**REFERENCES:**

1. Ernesto Iadanza, Clinical Engineering Handbook, 2nd Edition, Elsevier, Academic Press, November 2019, ISBN 9780128134672,
2. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
3. Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.
4. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3													2
CO4	3	3		2				2				2	2	
CO5	3	3							2			2	3	2
CO6	3	2	2	2								2	3	
CAM	2.83	2.67	2	2				2	2			2	2.5	2

Course Code	Course Title	L	T	P	C
19UBM903	PRINCIPLES OF TISSUE ENGINEERING	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a basic understanding of tissue engineering concepts, qualifications, roles, activities, and expectations.</li><li>To enhance students to practice cell or tissue culture technique and analyze challenges with unique approaches.</li><li>To engage the students to work as a team to address problems and errors in tissue engineering.</li><li>To help students to solve medical problems of synthetic materials and design prosthetic devices with biomaterials.</li><li>To expose students to explore key principles or design paradigms of tissue engineering scaffolds for various tissue or organ systems.</li></ul>					
<b>UNIT – I</b>	<b>FUNDAMENTALS OF TISSUE ENGINEERING</b>	<b>9</b>			
Tissue Engineering: Introduction – Objectives of tissue engineering – the basis of growth and differentiation. Tissue development and Tissue exchange – Cell cycle and differentiation – cell adhesion – cell adhesion molecules – cell migration – cell aggregation and tissue equivalent.					
<b>UNIT – II</b>	<b>DEVELOPMENT OF TISSUES</b>	<b>9</b>			
In vitro control of tissue development: Engineering functional tissues - Principles of Tissue Culture and Bioreactor Design - Regulation of Cell Behavior by Extracellular Proteins - Growth Factors. In Vivo Synthesis of Tissues and Organs: Models as Precursors for Prosthetic Devices - Quantitative Aspects - Cell Interactions with Polymers - Matrix Effects - Polymer Scaffold Fabrication - Biodegradable Polymers.					
<b>UNIT – III</b>	<b>STEM CELLS</b>	<b>9</b>			
Definition of stem cells – types of stem cells – differentiation, maturation, proliferation, pluripotency and immortalization. Sources of stem cells: haematopoetic – fetal -cord blood – placenta – bone marrow – primordial germ cells – cancer stem cells – induced pluripotent stem cells.					
<b>UNIT – IV</b>	<b>TISSUE ENGINEERING PRACTICE</b>	<b>9</b>			
Cell Delivery and Recirculation: Cell Movement within the Circulatory - Microchimerism - Cell Penetration into Three-Dimensional Tissues. Delivery of Molecular Agents in Tissue Engineering: Technology for Controlled Release of Agents in Time and Space - Future Applications of Controlled Delivery in Tissue Engineering.					
<b>UNIT – V</b>	<b>APPLICATION OF TISSUE ENGINEERING</b>	<b>9</b>			
Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver. Regenerative engineering: peripheral Nerve regeneration – cardiac tissue regeneration – muscle regeneration – Tissue Engineered Food. Regulation, Commercialization and Patenting.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals of tissue engineering, stem cells, cell differentiation and tissue regeneration.				Understand
<b>CO2:</b>	Utilize pluripotent techniques to develop and manipulate 3D tissue structures.				Apply
<b>CO3:</b>	Identify challenges in artificial tissue development using polymers and analyze issues through in vitro assays.				Apply
<b>CO4:</b>	Assess biomaterial interactions in organ development and artificial skin generation.				Analyze
<b>CO5:</b>	Analyze the biomaterial properties, design novel compositions and validate their effectiveness for tissue engineering.				Analyze
<b>CO6:</b>	Examine tissue development using biomaterials and assess biodegradable polymer interactions.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Robert Lanza, Robert Langer, Joseph Vacanti - Principles of Tissue Engineering, Academic Press - libgen.lc., 2007.</li><li>W. Mark Saltzman, “Tissue Engineering – Engineering principles for design of replacement organs and tissue”,Oxford University Press Inc New York, 2004.</li><li>Stewart Sell - Stem cells. Handbook, Humana Press - libgen. lc., 2010.</li></ol>					

**REFERENCES:**

1. Gary E. Wnek, Gary L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc, New York, 2008.
2. R. Lanza, Anthony Atala (Eds), "Essential of Stem Cell Biology", Academic Press, USA, 2013.
3. R. Lanza, Anthony Atala," Handbook of Stem Cells"", Academic Press, USA, 2012.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3						2	2					2	
CO4	3	2										2	2	
CO5	3	3							2	2		2	2	
CO6	3	3	2	2				2	2	2		2	2	
CAM	2.83	2.67	2	2			2	2	2	2		2	2	



Course Code	Course Title	L	T	P	C
19UBM904	BIOMATERIALS AND ARTIFICIAL ORGANS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the characteristics and classification of biomaterials</li><li>To discuss the response of biomaterials in living system and their replacement</li><li>To impart knowledge on compatibility and functioning of artificial organs inside the living system.</li><li>To learn about the polymeric materials and composites in tissue replacements.</li></ul>					
<b>UNIT – I</b>	<b>STRUCTURE OF BIO-MATERIALS, TESTING AND BIO-COMPATIBILITY</b>	<b>9</b>			
Definition and classification of bio-materials, performance of biomaterials, mechanical properties, visco elasticity, wound- healing process, body response to implants, Testing of biomaterials: In-vitro, in-vivo preclinical tests, blood compatibility, HLA compatibility					
<b>UNIT – II</b>	<b>IMPLANT MATERIALS</b>	<b>9</b>			
Different classes of materials used in medicine - Mechanical & Thermal properties Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications - Dental metals: Dental Amalgam, Gold					
<b>UNIT – III</b>	<b>POLYMERIC IMPLANT MATERIALS</b>	<b>9</b>			
Polymerization, polyamides, Acrylic polymers, rubbers, high strength, thermoplastics, medical applications. Bio polymers: collagen and elastin. Medical Textiles: silica, chitosan, PLA, composites, Sutures, wound dressings. Materials for ophthalmology: contact lens, Intraocular lens. Membranes for plasma separation and blood oxygenation.					
<b>UNIT – IV</b>	<b>TISSUE REPLACEMENT IMPLANTS</b>	<b>9</b>			
Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft- tissue replacements, types of transplant by stem cell, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Pancreas replacement.					
<b>UNIT – V</b>	<b>ARTIFICIAL ORGANS</b>	<b>9</b>			
Introduction to artificial organs, immunological consideration, Artificial blood, Artificial skin, Artificial Heart, eye and ear implants, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyzer membrane), Dental Implants.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the characteristics, classification and biological response of biomaterials in living systems.				Understand
<b>CO2:</b>	Select appropriate metallic, ceramic and polymeric materials for medical implants based on their properties.				Apply
<b>CO3:</b>	Utilize polymeric materials, biopolymers and medical textiles in tissue replacement and wound healing applications.				Apply
<b>CO4:</b>	Assess mechanical properties and biocompatibility in implant design and their effects on tissue response.				Analyze
<b>CO5:</b>	Examine the structure, function and immunological considerations of artificial organs.				Analyze
<b>CO6:</b>	Evaluate the biocompatibility and toxicity of novel biomaterials using in vitro and in vivo models.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Joon park, R.S Lakes, “Biomaterials An Introduction ”Springer, 2007</li><li>Sujata V. Bhat “Biomaterials” springer 2007</li><li>Larry L. Hench and Julian R. Jones, Biomaterials, artificial organs and tissue engineering, CRC Press 2010</li></ol>					

**REFERENCES:**

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill, 2003
2. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.
3. AC Anand, JF Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Health Care", Woodhead Publishing Limited, 2006.
4. Biomaterials for Artificial Organs 1st Edition Michael Lysaght Thomas Webster. 2010
5. Biomedical Membranes and (Bio) Artificial Organs, Dimitrios Stamatialis, 2018

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	
CO2	3						2					3	3	
CO3	3						2						3	
CO4	3	3						2					3	
CO5	3	3						2					3	
CO6	3	3	3	3				2				3	3	
CAM	2.83	3	3	3			2	2				3	3	

Course Code	Course Title	L	T	P	C
19UBM905	PATTERN RECOGNITION AND NEURAL NETWORKS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce different neural models to solve regression, classification, feature selection and density estimation problems.</li><li>To explain the learning and adaptation of supervised and unsupervised modes in learning.</li></ul>					
<b>UNIT – I</b>	<b>SUPERVISED LEARNING</b>				<b>9</b>
Overview of pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum likelihood estimation – Bayesian parameter estimation – Perceptron algorithm – LMSE algorithm – Problems with Bayes approach – Pattern classification by distance functions – Minimum distance pattern classifier.					
<b>UNIT – II</b>	<b>UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS</b>				<b>9</b>
Clustering for unsupervised learning and classification – Clustering concept – C-means algorithm – Hierarchical clustering procedures – Graph theoretic approach to pattern clustering – Validity of clustering solutions.					
<b>UNIT – III</b>	<b>FEATURE EXTRACTION AND SELECTION</b>				<b>9</b>
Entropy minimization – Karhunen – Loeve transformation – Feature selection through functions approximation – Binary feature selection					
<b>UNIT – IV</b>	<b>NEURAL NETWORKS</b>				<b>9</b>
Fundamentals of Neural Networks – History – Architectures – Learning methods – XOR problem – Delta rule – derivation – Back propagation – parameters in BPN – Associative memory – Hetero associative – BAM – energy function – problems – Associative memories – ART1 – ART2 – Applications					
<b>UNIT – V</b>	<b>FUZZY LOGIC</b>				<b>9</b>
Fuzzy set theory – crisp sets – fuzzy sets – crisp relations – Fuzzy relations – Fuzzy systems – Crisp logic – predicate logic – fuzzy logic – fuzzy based systems – Defuzzification methods – applications					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals of pattern recognition, supervised learning and various classification techniques.				Understand
<b>CO2:</b>	Apply clustering and unsupervised learning techniques to analyze and classify data patterns.				Apply
<b>CO3:</b>	Utilize feature extraction and selection methods for dimensionality reduction and data optimization.				Apply
<b>CO4:</b>	Analyze different neural network architectures, learning rules, and their applications in classification and prediction.				Analyze
<b>CO5:</b>	Evaluate fuzzy logic systems, defuzzification methods, and their role in intelligent decision-making applications.				Evaluate
<b>CO6:</b>	Design and implement neural network models for real-world applications using back propagation and associative memory.				Create
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Hagan, Demuth and Beale, “Neural network design”, Vikas PublishingHouse Pvt. Ltd., New Delhi , 2002</li><li>Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 1999.</li><li>Timothy J.Ross, ”Fuzzy Logic with Engineering applications”, John Wiley and Sons, 2010.</li></ol>					

## REFERENCES:

1. Robert Schalkoff, “ Pattern recognition, Statistical, Structural and neural approaches” John Wiley and Sons(Asia) Pte. Ltd., Singapore, 2005
2. Laurene Fausett ,” Fundamentals of neural networks –Architectures, algorithms and applications”, Prentice Hall, 1994
3. Duda R.O, Hart P.G, “Pattern classification and scene analysis”, Wiley Edition,2000
4. Rajasekaran.S and VijayalakshmiPai.G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2011.

- ## REFERENCES:
1. Robert Schalkoff, “ Pattern recognition, Statistical, Structural and neural approaches” John Wiley and Sons(Asia) Pte. Ltd., Singapore, 2005
  2. Laurene Fausett ,” Fundamentals of neural networks –Architectures, algorithms and applications”, Prentice Hall, 1994
  3. Duda R.O, Hart P.G, “Pattern classification and scene analysis”, Wiley Edition,2000
  4. Rajasekaran.S and VijayalakshmiPai.G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2011.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	
CO3	3	2	2									2	2	2
CO4	3	3											3	2
CO5	3	2	2	2								2	3	2
CO6	3	2	3	2									3	2
CAM	2.83	2.2	2.33	2								2	2.6	2

Course Code	Course Title	L	T	P	C
19UBM906	FORENSIC SCIENCE	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To explain the basic principles of forensic science, crime and criminal justice system, police organization, the role of investigator and tools and techniques used in crime science</li><li>To emphasize the importance of scientific methods in crime identification and detection.</li><li>To deal with the modus operandi and role of modus operandi bureau in crime investigation</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO FORENSIC SCIENCE</b>	<b>9</b>			
Introduction – Definition – Principles – Laws of Forensic Science – Historical Background of Forensic Science in India - Need of Forensic Science in present scenario – Organizational set up of Forensic Science Laboratories at state and central level – their types and Divisions – Forensic Examination					
<b>UNIT – II</b>	<b>TOOLS AND TECHNIQUES IN FORENSIC SCIENCE</b>	<b>9</b>			
Branches of Forensic Science - Forensic science in international perspectives, including set up of INTERPOL and FBI - Duties of Forensic Scientists - Code of conduct for Forensic Scientists - Qualifications of Forensic Scientists - Data depiction - Report writing					
<b>UNIT – III</b>	<b>CRIME AND POLICE ORGANIZATION</b>	<b>9</b>			
Definition – types of crime – causes of crime, prevention of crime – Difference in blue and white collar crime – Introduction of Cybercrime – Criminal Justice System – Organizational set up of Police at central and state level, Functions of Police – Functions of Police in analyzing a crime scene – Different paramilitary forces in India					
<b>UNIT – IV</b>	<b>CRIME SCENE</b>	<b>9</b>			
Introduction, Significance-Role of Investigator-Evaluation of crime scene – protection of crime scene – Photography of Crime scene – Tools and techniques – Significance of Photography and Videography- Introduction of Sketching – Purpose of Sketching – Making of Sketches					
<b>UNIT – V</b>	<b>FORENSIC EVIDENCES, ANALYSIS AND MODUS OPERANDI</b>	<b>9</b>			
Hair analysis – Fiber analysis – Ballistics & Tool marks: Soil, Glass and Paint – Footprints and tire impressions – Bite Marks – Finger prints – Blood Spatter Analysis – DNA analysis – Forensic Anthropology and Entomology - Investigation & examination procedure of various types of cases - Murder – Burglary – Railway & Air Crashes – Road Accidents etc.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental principles, laws and historical background of forensic science in crime investigation.				Understand
<b>CO2:</b>	Apply forensic tools and techniques in crime scene investigation, evidence collection and criminal profiling.				Apply
<b>CO3:</b>	Demonstrate forensic photography, sketching and scientific reporting methods for crime scene documentation.				Apply
<b>CO4:</b>	Analyze different types of crimes, the criminal justice system and the role of police and paramilitary forces in crime prevention.				Analyze
<b>CO5:</b>	Evaluate various crime scene evidences for criminal identification.				Evaluate
<b>CO6:</b>	Assess various forensic evidence types and modus operandi to reconstruct crime scenarios and assist in legal proceedings.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher"s, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).</li><li>Saferstein, Richard. "<i>Criminalistics—An Introduction to Forensic Science</i>", 11<sup>th</sup> ed. Prentice Hall, Saddle River, NJ. 2011</li></ol>					

**REFERENCES:**

1. H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
2. V.J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton (2006).
3. T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	3	2										3	
CO3	3	2	3			2		2					3	2
CO4	2	2		3									3	2
CO5	3			2		3	2	3						2
CO6	2	2		3									2	2
CAM	2.5	2.25	2.5	2.67		2.5	2	2.5					2.6	2

Course Code	Course Title	L	T	P	C
19UBM907	DRUG DELIVERY SYSTEM	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the basic principles for development of novel drug delivery systems.</li><li>To emphasize the importance of various drug delivery systems and their usage in hospitals.</li><li>To deal with the formulation and evaluation of Novel drug delivery systems.</li></ul>					
<b>UNIT – I</b>	<b>CONTROLLED DRUG DELIVERY</b>	<b>9</b>			
Fundamentals of Controlled Release (CR) Drug Delivery – Rationale of sustained/controlled drug delivery – Physicochemical and biological factors influencing design and performance of CR products – therapeutic status of CDDS. Theory of mass transfer – Fick’s first and second laws and their applications in drug release and permeation. Pharmacokinetic and pharmacodynamic basis of controlled drug delivery – bioavailability assessment of CR systems.					
<b>UNIT – II</b>	<b>DESIGN AND FABRICATION OF TECHNOLOGY BASED CR SYSTEMS</b>	<b>9</b>			
Strategies and design of oral controlled release delivery systems – oral systems based on dissolution, diffusion and dissolution – Ion exchange resins, Ph – independent formulations – altered density formulations – Bucco/mucoadhesive systems. Osmotic controlled oral drug delivery - Feedback regulated Drug Delivery Systems					
<b>UNIT – III</b>	<b>PARENTERAL SYSTEM</b>	<b>9</b>			
Parenteral systems, biopharmaceutic considerations-design and development- polymeric microspheres – dispersed drug delivery – Implantable therapeutic systems - Biocompatibility of polymers and carriers – Intrauterine devices and intravaginal devices					
<b>UNIT – IV</b>	<b>TRANSDERMAL DRUG DELIVERY SYSTEM</b>	<b>9</b>			
Transdermal therapeutic systems (TTS): Drug absorption through skin-permeation enhancers, basic components of TTS – Approaches to development and kinetic evaluation – Testing of transdermal patches – pressure sensitive adhesives – Iontophoresis – Sonophoresis and electroporation. Formulation and evaluation of TTS					
<b>UNIT – V</b>	<b>TARGETED DRUG DELIVERY</b>	<b>9</b>			
History – concept, Types and key elements – ideal carrier system and approach with special reference to organ targeting (e.g. brain, tumor, lung, liver and lymphatics) – Basics of temperature – pH and magnetically induced targeting tactics. Vaccine delivery systems					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental principles and classifications of drug delivery systems.				Understand
<b>CO2:</b>	Apply drug delivery concepts to biopharmaceutical techniques and controlled-release formulations.				Apply
<b>CO3:</b>	Inspect various targeted drug delivery approaches and evaluate their key elements for specific organ targeting.				Apply
<b>CO4:</b>	Analyze the mechanisms of action of transdermal and targeted drug delivery systems to improve existing drug delivery methods.				Analyze
<b>CO5:</b>	Examine different drug delivery systems through literature surveys and propose innovative advancements based on case studies.				Evaluate
<b>CO6:</b>	Evaluate novel drug delivery technologies for efficiency, biocompatibility, and reduced side effects in human applications.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Tozer T N, Rowland M, “Introduction of Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy”, Williams &amp; Wilkins, 2006.</li><li>Howard C. Ansel, Nicholas G. Popovich, Lyold V. Allen , “Pharmaceutical dosage forms and Drug Delivery system”, 1<sup>st</sup> edition, 2014.</li><li>Jain N.K and Sharma S.N. “A text book of professional pharmacy”, 1<sup>st</sup> edition 1995.</li></ol>					

**REFERENCES:**

1. Samuel Harder and GlennV. Buskirk. "Pilot Plant Scale-Up Techniques. In The Theory and Practice of Industrial Pharmacy". 3<sup>rd</sup> edition., 1991
2. Remington, "The Science and Practice of pharmacy", 20 th Edn, vol.I, pg.no.903- 913.
3. Lachman et al "Theory and Practice of Industrial Pharmacy". 3<sup>rd</sup> edition Philadelphia, 1991,
4. S.D. Bruck, "Controlled Drug Delivery", Vol.1 (Basic Concepts) CRC Press. Florida, 1983

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3													
CO3	3	2						2						
CO4	3	3										2	2	
CO5	3	3	2						2				2	
CO6	3	3	2	2		2		2	2			2	2	
CAM	2.83	2.75	2	2		2		2	2			2	2	



Course Code	Course Title	L	T	P	C
19UBM908	NUCLEAR MEDICINE	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand the basic of various imaging modalities in nuclear medicine</li><li>Study the diagnostics and therapeutic applications of nuclear medicine and radiation safety procedures and regulations</li></ul>					
<b>UNIT – I</b>	<b>NUCLEAR MEDICINE PHYSICS</b>	<b>9</b>			
Basic Elementary introduction to structure of matter-elements-molecules and atoms- Radioactivity and interaction of radiation; Alpha, Beta and gamma emission, Laws of radioactive decay, Mechanisms of radioactive delay, Radiation intensity and exposure, Decay schemes and energy levels, Compton scattering, Pair productions, Particle interactions					
<b>UNIT – II</b>	<b>RADIOPHARMACEUTICALS</b>	<b>9</b>			
Radionuclide production, 99Mo/99mTc generator, Mechanism of localization, Types of radiopharmaceuticals, characteristics of radio pharmaceuticals, Radiopharmaceuticals for diagnosis and treatments in human, Dispensing of radio pharmaceuticals.					
<b>UNIT – III</b>	<b>PHYSICS OF NUCLEAR MEDICINE INSTRUMENTATION</b>	<b>9</b>			
Construction and principle operation of Gamma camera, Rectilinear scanner, Basic principles of pulse height analyser, Radiation detectors-Ionization chamber, Geiger Muller counter, Semiconductor detectors, Scintillation detectors, Electronic Instrumentation for radiation detection system					
<b>UNIT – IV</b>	<b>DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF RADIONUCLIDE</b>	<b>9</b>			
Invitro and Invivo Diagnostic techniques-PET-CT, Single photon emission computed tomography (SPECT), Radio iodine therapy for Thyrotoxicosis , Differentiated thyroid cancers, Palliative treatment for bone metastasis - 32P and 89 Strontium Dosage-Intravascular particulate radio nuclide Therapy, Receptor targeted therapy, 131I- MIBG Therapy, Targeted internal radiation in HCC: 90 Y, Radio-synovectomy using Yttrium					
<b>UNIT – V</b>	<b>RADIATION BIOLOGY AND SAFETY</b>	<b>9</b>			
Biological effects of radiation-Somatic and hereditary effects of radiation-Radiation protection indifferent nuclear isotope therapy procedures, Management of radiation accidents, Radiation effect on pregnancy and fertility, Diagnosis, evaluation and treatment of radiation overexposure, Instruments used in radiation survey & monitoring, Handling of radioactive patients, Role of national and international bodies in radiation safety, ICRP recommendations, BARC regulations regarding limits of radiation exposure.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental principles of nuclear medicine, including radioactivity, radiation interactions and decay mechanisms.				Understand
<b>CO2:</b>	Describe the production, characteristics and clinical applications of radiopharmaceuticals in diagnosis and treatment.				Understand
<b>CO3:</b>	Apply nuclear imaging and therapeutic techniques to diagnose and treat various diseases using radionuclides.				Apply
<b>CO4:</b>	Analyze the working principles of nuclear medicine instrumentation such as gamma cameras, PET-CT, SPECT and radiation detectors.				Analyze
<b>CO5:</b>	Analyze the biological effects of radiation exposure and implement safety protocols in nuclear medicine procedures.				Analyze
<b>CO6:</b>	Assess national and international radiation safety regulations and apply radiation protection measures in clinical settings.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Simon Cherry, James Sorenson, Michael Phelps. “Physics in Nuclear Medicine”, Elsevier Saunders, 4th Edition, 2012</li><li>Jerrold T Bushberg, J.Anthony Seibert, Edwin M Leidholdt,John M Boone, Lippincott, “The Essential Physics of Medical Imaging” Williams &amp; Wilkins, 3rd edition, 2011</li></ol>					

**REFERENCES:**

1. Fred A Mettler, Milton J Guiberteau, "Essentials of nuclear Medicine and molecular imaging" 7th Edition, Elseiver, 2018.
2. Gopal B.Saha, Physics and Radiation biology of Nuclear Medicine. 2006

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2				2							3	
CO3	3	2										2	3	2
CO4	3	3											3	2
CO5	3	2		2								2	3	2
CO6	3	2	2	2		2	2					2	3	2
CAM	2.83	2.2	2	2		2	2					2	3	2

Course Code	Course Title	L	T	P	C
19UBM909	MEDICAL RADIATION SAFETY ENGINEERING	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>Describe mechanisms of different types of biological effects following exposure to radiation</li><li>Explain radiation protection in diagnostic radiology</li></ul>					
<b>UNIT – I</b>	<b>RADIATION BASICS</b>	<b>9</b>			
Atomic structure, characteristics of radiations, types of ionizing & non-ionizing radiations - Radioactive decay constant – half-life period, units of radiation and radioactivity -Units of radiation risk, Relative Biological Effectiveness (RBE) -Motion of electron in a crossed electric and magnetic field, nuclear forces, nuclear model -Radiation shielding principles, use of pocket dosimeters					
<b>UNIT – II</b>	<b>BIOLOGICAL EFFECTS</b>	<b>9</b>			
Acute biological effects of ionizing radiations, long term biological effects of ionizing radiations. Typical radiation doses – background, medicine, and industry; dose limits for occupationally exposed individuals- Techniques for limiting radiation doses to personnel - Spontaneous mutation rate, effect of radiation on skin and blood forming organs, digestive tract – sterility and cataract formation - Effects of chronic exposure to radiation					
<b>UNIT – III</b>	<b>RADIATION PROTECTION IN NUCLEAR MEDICINE AND ONCOLOGY</b>	<b>9</b>			
Nuclear medicine, diagnostic & therapeutic nuclear medicine- Positron Emission Tomography (PET), special considerations for handling PET, intensity modulated radiation therapy - Facility design, radiation protection of nuclear medicine staff -Radiation oncology, external beam shielding, brachytherapy, low-dose-rate brachytherapy-Radiation hazards in brachytherapy departments and teletherapy departments and radioisotope laboratories – Particle accelerators					
<b>UNIT – IV</b>	<b>RADIATION PROTECTION IN DIAGNOSTIC RADIOLOGY</b>	<b>9</b>			
Definition of free radicals and G-value, kinetics of radiation chemical transformations , LET and dose-rate effects -Safety assessment, facility design and shielding-BIR shielding method-Teletherapy machines: reference conditions for measurement, Type of ion chambers, phantom, waterproof sleeve - Unintended and accidental medical exposures, pregnancy procedures, Magnetic Resonance Imaging safety issues - Derivation of an expression for machine timing error, procedure for evaluation of temperature and pressure correction					
<b>UNIT – V</b>	<b>RADIATION HAZARDS AND PROTECTIVE MEASURES</b>	<b>9</b>			
planning of medical radiation installations - general considerations, design of diagnostic, deep therapy, tele gamma and accelerator installations, -Evaluation of radiation hazards in medical diagnostic, therapeutic installations - Radiation monitoring procedures – protective measures to reduce radiation, exposure to staff and patients, protective equipment – Handling of patients- Radiation accidents in medicine, the role of recommendations and regulations - Waste disposal facilities, radiation safety during source transfer operations, special safety features in accelerators, reactor					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the characteristics of ionizing and non-ionizing radiations, their biological effects, and radiation hazards in medical applications.				Understand
<b>CO2:</b>	Apply radiation protection guidelines and interpret the use of radiation detectors in medical settings.				Apply
<b>CO3:</b>	Classify safety measures for different types of radiation exposure, including UV, laser, and nuclear medicine procedures.				Apply
<b>CO4:</b>	Analyze radiation assessment methods and monitoring procedures in diagnostic and therapeutic medical installations.				Analyze
<b>CO5:</b>	Analyze radiation protection techniques and safety measures for Magnetic Resonance Imaging				Analyze
<b>CO6:</b>	Evaluate radiation protection methods in medical settings and suggest improvements.				Evaluate

**TEXT BOOKS:**

1. Mary Alice Statkiewicz Sherer, Paula J. Visconti, E. Russell Ritenour, Kelli Haynes, "Radiation Protection in Medical Radiography", CRC Press, 7th edition, 2008.
2. Richard J. Vetter, Magdalena S. Stoeva, "Radiation protection in Medical imaging and Radiation oncology", CRC Press, Taylor and Francis group, 1st edition, 2016.
3. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine", Springer, 3<sup>rd</sup> edition, 2006.

**REFERENCES:**

1. Max H Lombardi, "Radiation Safety in Nuclear Medicine", CRC Press, 2<sup>nd</sup> edition, 2007.
2. Daniel Farb, Bruce Gordan, "Occupational Radiation Safety Guidebook", University of Health Care, 2005.
3. Robert J. Emery and Janelle Rios, "Operational Radiation Safety", Vol. 110, No. 2, February 2016.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	3	
CO2	3						2					2	3	
CO3	3											2	3	
CO4	3	3				2						2	3	
CO5	3	3										2	3	
CO6	3	3	3			2	2					2	3	
CAM	2.83	3	3			2	2					2	3	

Course Code	Course Title	L	T	P	C
19UBM910	MEDICAL TECHNOLOGY	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand the quality control</li><li>To study the recent digital and tele-health technologies</li><li>To understand the basic of medical instruments and advances</li></ul>					
<b>UNIT – I</b>	<b>MEDICAL TECHNOLOGY</b>	<b>9</b>			
Organization of medical technology – Components – Associated branches – Basis of diagnosis – Basics of Quality Control – General approaches – Biomedical Waste Disposal: Introduction – Categories of waste – Standard protocol of waste disposal – Methods of waste disposal – Ethics & Code of Conduct.					
<b>UNIT – II</b>	<b>MEDICAL DEVICES: INTRODUCTION</b>	<b>9</b>			
History of medical devices – Medical Device terminology – Design of medical devices – Cardiac care technology – Respiratory therapy – dialysis therapy – imaging science technology – clinical lab technology – operation theater – anesthesia technology.					
<b>UNIT – III</b>	<b>BIOMEDICAL DEVICES: HOME CARE</b>	<b>9</b>			
Medical devices at home and its implementation – Scope of market for home medical devices –Unique challenges to the design & implementation of high – tech home care devices – Infant monitors – Medical alert services – Activity monitors.					
<b>UNIT – IV</b>	<b>DIGITAL SUPPORT SYSTEM</b>	<b>9</b>			
Video communication to support care delivery to independently living seniors – Establishing an infrastructure for telecare – Implementation of mobile computing in home care programs -. Home medicare management by videophone – Continuous home care through wireless bio-signal monitoring system.					
<b>UNIT – V</b>	<b>ADVANCES IN MEDICAL TECHNOLOGIES</b>	<b>9</b>			
Dynamic configuration of medical services – Personalized ambient monitoring – Support for mental health at home – Multi model interaction and technologies for care at home – User centered design of technologies to support care at hospital – Applications of :VR-AR-Artificial Intelligence – Robotics – IoT.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the organization of medical technology, quality control and biomedical waste disposal methods.				Understand
<b>CO2:</b>	Apply knowledge of medical devices and their functions in various healthcare settings.				Apply
<b>CO3:</b>	Investigate the role and challenges of home-care medical devices.				Apply
<b>CO4:</b>	Analyze the implementation of digital support systems.				Analyze
<b>CO5:</b>	Assess the role of personalized monitoring and user-centered design in enhancing hospital and home-based healthcare technologies.				Analyze
<b>CO6:</b>	Evaluate the impact of advanced technologies on modern medical care and patient outcomes.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Dac-Nhuong Le, “Emerging technology of health and medicine”,Scrivener publishing,2018</li><li>A John Wiley, “Medical Devices-surgical and image guided technology”,wiley &amp; sons publication, 2013</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Lodewijk Bos, “Handbook of Digital Homecare: Successes and Failures”, Vol.3, Springer, 2011.</li><li>Mukherjee,K.L., Medical Laboratory Technology-A procedure manual for routine diagnostic tests- Volume 1,2,3, Tata McGraw Hill Publishing Company Ltd.</li><li>Robyn Rice, “Home care nursing practice: Concepts and Application”, Elsevier, 4th edition, 2006.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2	1	1					3	
CO2	3	3				2	2	2				2	3	
CO3	3	3				2	2	2					3	2
CO4	3	3	2									2	3	2
CO5	2	3	2									2	3	
CO6	3	3	2			2	2	2				2	3	2
CAM	2.83	3	2			2	1.75	1.75				2	3	2

Course Code	Course Title	L	T	P	C
19UBM911	MEDICAL OPTICS	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a possibility for the student to acquire knowledge about the impact and interaction of light with biological tissue.</li><li>To understand practical applications of optics related to medicine.</li></ul>					
<b>UNIT – I</b>	<b>INSTRUMENTATION IN PHOTONICS</b>	<b>9</b>			
Review of basic properties of light – Reflection, Refraction, Scattering, fluorescence and phosphorescence. 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, optical tweezers.					
<b>UNIT – II</b>	<b>OPTICAL PROPERTIES OF THE TISSUES</b>	<b>9</b>			
Light transport inside the tissue, optical properties of tissue. Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical, Thermal, Electro-mechanical. Photo ablative processes.					
<b>UNIT – III</b>	<b>SURGICAL APPLICATIONS OF LASERS</b>	<b>9</b>			
Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.					
<b>UNIT – IV</b>	<b>NON THERMAL DIAGNOSTIC APPLICATIONS</b>	<b>9</b>			
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.					
<b>UNIT – V</b>	<b>DIAGNOSTIC AND THERAPEUTIC APPLICATIONS</b>	<b>9</b>			
Near field imaging of biological structures, <i>In vitro</i> clinical diagnostics, Phototherapy, Photodynamic therapy (PDT) - Principles and mechanisms - Oncological and non-oncological applications of PDT - Biostimulation effect – applications - Laser Safety Procedures.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental principles of LASER physics, light interaction with biological tissues and various modes of operation.				Understand
<b>CO2:</b>	Apply fundamental concepts of optics, photonics and laser-tissue interaction in biomedical applications.				Apply
<b>CO3:</b>	Analyze the integration of biomedical sensors with optical fibers and their applications in imaging, diagnostics and therapy.				Analyze
<b>CO4:</b>	Assess biological systems and recommend suitable photonic techniques or instruments for diagnostic and therapeutic applications.				Analyze
<b>CO5:</b>	Critically evaluate the limitations of current optical imaging technologies and propose innovative solutions to enhance their performance.				Evaluate
<b>CO6:</b>	Evaluate the effectiveness, safety and clinical impact of optical imaging and laser-based therapeutic techniques in modern medicine.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007.</li><li>Paras N. Prasad, “Introduction to Bio photonics”, A. John Wiley and sons, Inc. Publications, 2003.</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Press LLC, 2003.</li><li>Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.</li><li>R. Splinter and B.A. Hooper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007.</li><li>Helena Jelinkova, “Lasers for Medical Applications: Diagnostics, Therapy and Surgery”, Woodhead Publishing, 1st Edition, 2013.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	2	2											3	2
CO3	3												3	3
CO4	3	3	2	2								2	3	
CO5	3	2	2	2								2	2	2
CO6	2	3	3	3		2						2	2	3
CAM	2.5	2.5	2.33	2.33		2						2	2.5	2.5



Course Code	Course Title	L	T	P	C
19UBM912	GENETIC ENGINEERING	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a basic understanding the concepts of gene cloning, genome analysis and genetic engineering.</li><li>To enhance students to practice recombinant DNA technologies and analyze challenges with novel approaches.</li><li>To engage the students to work as a team to troubleshoot in PCR and cloning techniques.</li><li>To help students to solve genetic engineering problems and design target gene expression with advanced genetic engineering techniques.</li><li>To expose students to explore with various genetic engineering techniques for cloning target gene or protein expression.</li></ul>					
<b>UNIT – I</b>	<b>BASICS OF GENETICS</b>				<b>9</b>
Biomolecules: Carbohydrates, Proteins, Lipid, Amino acid and Nucleic acids. Nucleic acids: Introduction, History, DNA and RNA - genetic material, types, mutation. Chromosome, Gene, Expression of genetic information, Regulation of mRNA stability.					
<b>UNIT – II</b>	<b>RECOMBINANT DNA TECHNOLOGY</b>				<b>9</b>
Gene cloning- concept and basic steps; Restriction modification enzymes used in recombinant DNA technology, endonucleases, ligases and other enzymes useful in gene cloning; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, artificial chromosomes, Ti plasmid, shuttle vectors, expression vectors; DNA delivery methods; Construction of genomic and cDNA libraries; Techniques for selection, screening and characterization of transformants.					
<b>UNIT – III</b>	<b>ROLE OF POLYMERASE CHAIN REACTION</b>				<b>9</b>
Concept of PCR; DNA polymerases; primer designing, linkers, adapters, setting up PCR reactions; Various types of PCR; Applications of PCR in disease diagnostics, forensic sciences and genetic engineering.					
<b>UNIT – IV</b>	<b>ADVANCED APPROACHES IN GENETIC ENGINEERING</b>				<b>9</b>
Gene expression in prokaryotes & eukaryotes, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters, promoter analysis (EMSA and DNA footprinting), gene expression profiling (real time PCR, SAGE, differential display, Microarray); DNA sequencing methods; Molecular markers: RAPD, RFLP, AFLP, SNP; Site directed mutagenesis, gene silencing techniques.					
<b>UNIT – V</b>	<b>APPLICATIONS OF GENETIC ENGINEERING</b>				<b>9</b>
Genetic engineering and Biotechnology; Creation of recombinant microorganisms, transgenic plants and animals; cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Gene therapy; DNA drugs and vaccines.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	State the fundamental concepts of PCR, recombinant DNA technologies, gene cloning, protein expression, and gene therapy.				Understand
<b>CO2:</b>	Apply recombinant DNA and PCR techniques to troubleshoot and interpret cloning methodologies.				Apply
<b>CO3:</b>	Apply recombinant DNA and stem cell technologies to develop genetically engineered model cell lines.				Apply
<b>CO4:</b>	Analyze gene expression profiles to identify potential issues and optimize gene expression in various biological systems.				Analyze
<b>CO5:</b>	Evaluate the ethical, technical and biological implications of human cloning and gene therapy by assessing solution strategies.				Evaluate
<b>CO6:</b>	Design genetic engineering approaches using stem cell technology to address errors and challenges in gene therapy.				Create

**TEXT BOOKS:**

1. Desmond S. T. Nicholl. An Introduction to Genetic Engineering Volume 2, Cambridge University Press- libgen.lc., 2008.
2. Brown, Terence Austen, Gene cloning and DNA analysis- an introduction, Wiley Blackwell - libgen.lc., 2016.

**REFERENCES:**

1. Sambrook, J., Fritsch, E.F., Mariatis. Molecular Cloning, A laboratory Manual. 3rd edition, 2001.
2. John M. Walker, Ralph Rapley - Molecular Biology and Biotechnology, Royal Society of Chemistry - libgen.lc., 2009.
3. S.B Primrose. Molecular biotechnology. Panima Publishing corporation, 2nd edition, 2001.
4. SmitaRastogi&DrNeelakPathak, Genetic Engineering, Oxford University Press, 2009.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	
CO3	3	2											3	
CO4	3	2	2										2	
CO5	3	2	2			2	2					2	2	
CO6	3	2	3	2		2						2	3	
CAM	2.83	2	2.33	2		2	2					2	2.4	

Course Code	Course Title	L	T	P	C
19UBM913	COMMUNICATION ENGINEERING	2	0	2	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the fundamentals of analog and digital communication</li><li>To provide the knowledge of various coding techniques for data transmission</li><li>To impart the knowledge of satellite and optical fiber communication</li></ul>					
<b>UNIT – I</b>	<b>ANALOG COMMUNICATION</b>				<b>10</b>
Introduction to analog signals, modulation techniques - AM – Frequency spectrum–vector representation–power relations – generation of AM – DSB, DSB/SC, SSB,VSB AM Transmitter & Receiver; FM and PM – frequency spectrum – power relations: NBFM &WBFM, Generation of FM and DM, Armstrong method & Reactance modulations :FM &PM frequency.					
<b>UNIT – II</b>	<b>DIGITAL COMMUNICATION</b>				<b>10</b>
Introduction to digital signals, Pulse modulations – concepts of sampling and sampling theorems, PAM, PWM, PPM, PTM, quantization and coding: DCM, DM, slope overload error. ADM, DPCM, OOK systems – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, applications of Data communication					
<b>UNIT – III</b>	<b>SOURCE CODES, LINE CODES &amp;ERROR CONTROL</b>				<b>10</b>
Primary communication – entropy, properties, BSC, BEC, source coding: Shannon – Fano, Huffman coding: noiseless coding theorem, BW–SNR tradeoff, codes: NRZ, RZ, AMI, HDBP, ABQ, MBnB codes: Efficiency of transmissions, error control codes and applications: convolutions & block codes					
<b>LIST OF EXPERIMENTS:</b>					<b>30</b>
<ol style="list-style-type: none"><li>Generation and Detection of Amplitude Modulation</li><li>Generation of Frequency Modulation and its Detection</li><li>Generation and Detection of PAM</li><li>Generation of BFSK and its Detection</li><li>Generation of standard inputs using simulation package</li><li>Simulation using MATLAB : AM / FM Modulator and Demodulator</li><li>Simulation using MATLAB: Pulse Code Modulation and Demodulation</li></ol>					
<b>TOTAL : 30(L) +30(P) = 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the various analog and digital communication techniques.				Understand
<b>CO2:</b>	Apply different modulation techniques and analyze their power and bandwidth requirements.				Apply
<b>CO3:</b>	Implement various error control coding techniques for reliable communication.				Apply
<b>CO4:</b>	Analyze the performance of different modulation and demodulation techniques.				Analyze
<b>CO5:</b>	Compare different coding techniques and their impact on communication systems.				Analyze
<b>CO6:</b>	Evaluate modulation techniques based on real-world applications and system requirements.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Taub and Schiling, “Principles of communication systems”, Tata McGrawhill, 2007.</li><li>J.Das, Mullick,S.K.,Chatterjee P.K., “Principles of digital communication”, New Age International,2012.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Kennedy and Davis,“Electronic communication systems”, Tata McGrawHill,4<sup>th</sup> Edition, 1993.</li><li>Sklar, “Digital communication fundamentals and applications”, Pearson Education, 2001.</li><li>Bary le,Memuschmidt, “Digital Communication”, Kluwer Publication, 2004.</li><li>Amitabha Bhattacharya, “Digital Communication”, Tata McGraw hill, 2006.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3											2	2	2
CO3	3	2											2	2
CO4	3	3		2									2	2
CO5	3	3	3	2					2	2			2	2
CO6	3	3	3	3		2			2	2		2	2	2
CAM	2.83	2.75		2.33		2			2	2		2	2	2

Course Code	Course Title	L	T	P	C
19UBM914	BIOMETRIC SYSTEMS	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a basic understanding the concepts of fingerprint, iris, face and speech recognition.</li><li>To enhance students to develop biometric systems and analyze challenges with novel approaches.</li><li>To engage the students to work as a team to troubleshoot of personal privacy and security implications of biometrics.</li><li>To help students to solve biometrics related problems and identify possible approaches.</li><li>To expose students to explore biometric system with genetic engineering techniques using DNA fingerprinting technologies.</li></ul>					
<b>UNIT – I</b>	<b>BIOMETRIC FUNDAMENTALS</b>				<b>9</b>
Key Biometric terms and Processes –Definitions-verification and identification – matching, Accuracy in Biometric Systems – False match rate -False nonmatch rate – Failure to enroll rate – Derived metrics - An Introduction to Biometric Authentication Systems – taxonomy of application environment, a system model, biometrics and privacy - Performance measures in biometric systems.					
<b>UNIT – II</b>	<b>FINGERPRINT IDENTIFICATION TECHNOLOGY</b>				<b>9</b>
Finger-scan – History, Components, working principles, competing technologies, Strengths and Weaknesses. Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing – Minutiae Determination - Application of Fingerprints: Criminal Applications, Civil Applications, Commercial Applications. Technology Evaluation of Fingerprint Verification Algorithms.					
<b>UNIT – III</b>	<b>IRIS RECOGNITION</b>				<b>9</b>
Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan -working principles, competing technologies, Strengths and Weaknesses, System Performance, Future Directions.					
<b>UNIT – IV</b>	<b>FACE RECOGNITION</b>				<b>9</b>
Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition –Representation and Classification, Kernel – based Methods and 3D Models, Learning the Face Spare, Facial Scan - working principles, competing technologies, Strengths and Weaknesses, Methods for assessing progress in Face Recognition.					
<b>UNIT – V</b>	<b>VOICE SCAN</b>				<b>9</b>
Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan - working principles, competing technologies, Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration. Multibiometric: Introduction – Information Fusion in Biometrics – Issues in Designing a Multibiometric System –Sensor level, Feature level, Rank level, Decision level fusion – Score level Fusion.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental concepts of biometric authentication systems.				Understand
<b>CO2:</b>	Apply biometric techniques to develop authentication systems and address privacy and security challenges.				Apply
<b>CO3:</b>	Design novel biometric approaches by combining facial scan technologies with 3D modeling.				Apply
<b>CO4:</b>	Implement and manipulate biometric models integrating DNA fingerprinting and iris recognition for enhanced identification accuracy.				Apply
<b>CO5:</b>	Analyze the limitations and challenges of biometric system integration and explore multi-biometric solutions.				Analyze
<b>CO6:</b>	Evaluate the performance of fingerprint, face, iris, and voice recognition systems based on efficiency and accuracy.				Evaluate

**TEXT BOOKS:**

1. James Wayman & Anil Jain, "Biometric Systems –Technology, Design and Performance Evaluation", Springer-verlag London Ltd, USA, 2005
2. SanirNanavati, Michael Thieme, "Biometrics Identity Verification in a Networked world", Wiley Computer Publishing Ltd, New Delhi, 2003.

**REFERENCES:**

1. Jain, Anil, Ross, Arun A., Nandakumar, Karthik. Introduction to Biometrics, Springer, 2011.
2. Anil K. Jain, Patrick Flynn, and Arun A. Ross, "Handbook of Biometrics", Springer, 2008.
3. John R. Vacca, 'Biometric Technologies and Verification Systems', Elsevier, 2007.
4. Ted Dunstone, Neil Yager, 'Biometric System and Data Analysis: Design, Evaluation, and Data Mining, Springer Science & Business Media, 2008.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3												2	2
CO4	3	3		2									2	2
CO5	3	2	2	2									3	2
CO6	3	2	2	2								2	3	3
CAM	2.83	2.33	2	2								2	2.4	2.25

Course Code	Course Title	L	T	P	C
19UBM915	MEDICAL INFORMATICS	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a basic understanding of Information communication technology and its applications in medicine.</li><li>To enhance students to practice adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Medical Information Systems.</li><li>To engage the students to work as a team to troubleshoot of medical image processing.</li><li>To help students to solve computer assisted medical related problems and identify possible approaches.</li><li>To expose students to explore the medical Informatics approaches and relative supportive services with advanced application.</li></ul>					
<b>UNIT – I</b>	<b>MEDICAL INFORMATICS</b>				<b>9</b>
Introduction – Health Informatics – Structure of Medical Informatics – Internet and Medicine – Security issues – Functional capabilities of a computerized Healthcare Information Systems – e-health services – Prospects of Medical Informaticians. Hospital Management And Information Science (HMIS): Introduction, need, Benefits, development, functional areas. HMIS and Internet, health information system, advantages of HMIS.					
<b>UNIT – II</b>	<b>COMPUTERISED PATIENT RECORD</b>				<b>9</b>
Introduction – History– Dialogue with the computer – Components and functionality of Computerized Patient Record – Development tools – Intranet – CPR in Radiology – Legal, Security and Privacy Issues – Application server provider.					
<b>UNIT – III</b>	<b>COMPUTER ASSISTED MEDICAL EDUCATION</b>				<b>9</b>
Computer Assisted Medical Education: Introduction, Educational software, Simulation, Virtual Reality, Tele-education, Tele-mentoring. Computer Assisted Patient Education: CAPE, patient counseling software. Computer assisted surgery (CAS), Limitations of conventional surgery, 3D navigation system, intra-operative imaging for 3D navigation system, merits and demerits of CAS.					
<b>UNIT – IV</b>	<b>COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING</b>				<b>9</b>
Automated clinical laboratories – Automated methods in hematology, cytology and histology – Intelligent Laboratory Information System – Computerized ECG, EEG and EMG – Computer assisted medical imaging – Nuclear medicine – Ultrasound imaging – Ultrasonography – Computed X-ray tomography – Radiation therapy and planning – Nuclear Magnetic Resonance.					
<b>UNIT – V</b>	<b>MEDICAL DATA, STANDARDS AND RECENT TRENDS IN MEDICAL INFORMATICS</b>				<b>9</b>
Medical data storage and retrieval techniques – Steganography – Medical Standards: Health Level 7 – DICOM – IEEE 1073 – IRMA – LOINC – ICD10 – Medical standard organizations. Virtual reality applications in medicine – Computer assisted surgery – Surgical simulation – Telemedicine – Tele surgery computer aids for the handicapped – Computer assisted instrumentation in Medical Informatics.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain the structure, functionality, and applications of Medical Informatics.				Understand
<b>CO2:</b>	Apply the concepts of Hospital Information Systems and automated clinical laboratory systems to real-life healthcare management.				Apply
<b>CO3:</b>	Implement decision support systems and computerized patient records in clinical settings.				Apply
<b>CO4:</b>	Analyze the role and effectiveness of neural networks and artificial intelligence in medical decision-making processes.				Analyze
<b>CO5:</b>	Examine the use of medical informatics technologies in modern healthcare.				Analyze
<b>CO6:</b>	Evaluate the integration of medical informatics in automated systems and surgery.				Evaluation

**TEXT BOOKS:**

1. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata McGraw Hill Publishing Ltd, 2005
2. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003

---

**REFERENCES:**

1. OrpitaBosu and SimminderKaurThukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2007.
2. Yi Ping Phoebe Chen, “Bioinformatics Technologies”, Springer International edition, New Delhi, 2007.
3. Medical Informatics: Computer Applications in Health Care and Biomedicine by E.H.Shortliffe, G. Wiederhold, L.E.Perreault and L.M.Fagan, 2ndEdition, Springer Verlag, 2000.
4. Handbook of Medical Informatics by J.H.VanBemmel, Stanford University Press/ Springer, 2000.

1. R.D.Lele, "Computers in medicine progress in medical informatics", Tata McGraw Hill Publishing Ltd, 2005
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Ltd, 2003

## REFERENCES:

1. OrpitaBosu and SimminderKaurThukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007.
2. Yi Ping Phoebe Chen, "Bioinformatics Technologies", Springer International edition, New Delhi, 2007.
3. Medical Informatics: Computer Applications in Health Care and Biomedicine by E.H.Shortliffe, G. Wiederhold, L.E.Perreault and L.M.Fagan, 2ndEdition, Springer Verlag, 2000.
4. Handbook of Medical Informatics by J.H.VanBemmel, Stanford University Press/ Springer, 2000.

1. OrpitaBosu and SimminderKaurThukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007.
2. Yi Ping Phoebe Chen, "Bioinformatics Technologies", Springer International edition, New Delhi, 2007.
3. Medical Informatics: Computer Applications in Health Care and Biomedicine by E.H.Shortliffe, G. Wiederhold, L.E.Perreault and L.M.Fagan, 2ndEdition, Springer Verlag, 2000.
4. Handbook of Medical Informatics by J.H.VanBemmel, Stanford University Press/ Springer, 2000.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3			2	3								2	2
CO4	3	2		2	3								2	3
CO5	3	2		2	2							2	2	3
CO6	3	2		2	2							2	2	3
CAM	2.83	2		2	2.5							2	2	2.75



Course Code	Course Title	L	T	P	C
19UBM916	TELEMEDICINE	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To impart knowledge on the key principles for telemedicine and healthcare application.</li><li>To introduce telemedical standards, mobile telemedicine and its applications</li><li>To Understand the telemedicine technology, and types of data transfer</li></ul>					
<b>UNIT – I</b>	<b>TELEMEDICINE AND HEALTH</b>	<b>8</b>			
History and Evolution of telemedicine, Definition of Telemedicine by WHO, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of Telemedicine, Global and Indian scenario, Advances in Telemedicine - Connecting rural India through telemedicine. Introduction to communication system – Input transducers – transmitter - communication channel - receiver – output transducer – communication technology.					
<b>UNIT – II</b>	<b>TELEMEDICAL TECHNOLOGY</b>	<b>10</b>			
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/wireless communications: GSM satellite, and Micro wave, Communication: LAN, WAN, Satellite communication, Mobile hand held devices and Mobile communication, Modulation techniques, Types of Antenna, telemedicine using world wide web (www), Video and audio conferencing. Telemedicine websites.					
<b>UNIT – III</b>	<b>TELEMEDICAL STANDARDS</b>	<b>9</b>			
Data Security and Standards: Encryption – DES, RSA, Mechanisms and Phases of Encryption – Cryptography – Protocols: TCP/IP, ISO-OSI, Standards: DICOM, HL7, H. 320 series (Video phone based ISBN) T.120, H.324 (Video phone based PSTN).					
<b>UNIT – IV</b>	<b>TELEMEDICAL APPLICATIONS</b>	<b>9</b>			
Introduction to Robotics surgery – Tele radiology – Basic parts of a Teleradiography System, Image acquisition and display system, Communication and Interpretation – Tele pathology, Telesurgery, Telecardiology, Teleoncology, Telemedicine in neurosciences, Telepsychiatry, Teledermatology, Telehome – Care Home based Applications.					
<b>UNIT – V</b>	<b>ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE</b>	<b>9</b>			
Confidentiality, Patient rights and consent, Ethical and legal aspects of internet – Administration of local and centralized medical data, Security, Confidentiality of medical records and access control, Cyber laws related to telemedicine – Telemedical malpractice – Consent treatment, Jurisdictional issues, Intellectual Property Rights – Constraints linked to economy, social acceptance.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals of telemedicine and its components.	Understand			
<b>CO2:</b>	Examining protocols behind encryption techniques for secure transmission of healthcare data.	Apply			
<b>CO3:</b>	Apply telemedicine technologies in PACS and various healthcare domains.	Apply			
<b>CO4:</b>	Analyze ethical, legal challenges and applications of telemedicine in healthcare specialties.	Analyze			
<b>CO5:</b>	Analyze emerging trends and future directions in telemedicine.	Analyze			
<b>CO6:</b>	Evaluate the various communication models and their applications in RTOS.	Evaluate			
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Olga Ferrer-Roca, Marcelo Sosa-Iudicissa, “Handbook of Telemedicine”, IOS press, 2003</li><li>A. C. Norris, “Essentials of Telemedicine and Telecare”, John Wiley &amp; Sons 2002.</li></ol>					

**REFERENCES:**

1. Brownsell, Simon, et al., A systematic review of lifestyle monitoring technologies, Journal of telemedicine and telecare 17.4 (2011): 185-189.
2. Ling Guan, "Multimedia image and video processing", CRC Press 2000.
3. Thorsten M Buzug, Heinz Handels, Dietrich Holz, "Telemedicine: Medicine and Communication", Springer Verlag 2001.
4. Douglas V.Goldstein, "E Healthcare: Harness the power of Internet, e-commerce and e-care", Jones and Barlett Publishers
5. Bommel, J.H. van, Musen, M.A. (Eds.) "Handbook of Medical Informatics", Heidelberg, Germany: Springer, 1997.
6. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill, 2004.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2											2	2	3
CO3	3	2				2	3					2	3	3
CO4	3	3		2		2		3				2	3	3
CO5	3	3		2		3						3	3	3
CO6	3	3		3								2	2	3
CAM	2.67	2.75		2.33		2.33	3	3				2.2	2.6	3

Course Code	Course Title	L	T	P	C
19UBM917	REHABILITATION ENGINEERING AND ROBOTICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand the sensory rehabilitation systems.</li><li>To learn the use of the orthopedic prosthetics and orthotics in rehabilitation.</li><li>To have an understanding of rehabilitation medicine and advocacy.</li><li>To explain the basic concepts of robots and types of robots</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO REHABILITATION</b>	<b>9</b>			
Engineering Concepts in Sensory Rehabilitation, Motor Rehabilitation - Rehabilitation Engineering Technologies: The Conceptual Frameworks - The Provision Process - Education and Quality Assurance – Specific Impairments and Relates Technologies - Future Developments - Design Considerations - Sensory augmentation and substitution- Visual system, Auditory system, Tactual system					
<b>UNIT – II</b>	<b>PROSTHETIC AND ORTHOTIC DEVICES</b>	<b>9</b>			
Engineering concepts in motor rehabilitation, Fundamentals – Amputation - Lower extremity prosthetics - Upper limb prosthetics (transradial), (transhumeral) - Ankle foot orthoses (AFO) - Knee Ankle Foot Orthoses (KAFO) - Truncal and Cervical orthoses – Assistive Devices – Adaptive Devices – Applications					
<b>UNIT – III</b>	<b>WHEELED MOBILITY AND THERAPEUTIC EXERCISE TECHNIQUE</b>	<b>9</b>			
Introduction - Categories of Wheelchairs - Wheelchair Prescriptions - Wheelchair Structure and Component Design - Ergonomics of Wheelchair Propulsion - Power Wheelchair Electrical Systems - Personal Transportation - Wheelchair Safety, Standards And Testing. Rehab-Therapy - Co-ordination exercises - Frenkels exercises - Gait Training - Relaxation exercises - Strengthening exercises - Mobilization exercises - Endurance exercises					
<b>UNIT – IV</b>	<b>INTRODUCTION OF ROBOTICS</b>	<b>9</b>			
Introduction to Robotics and its history, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Automation ,Mechanisms and movements, Dynamic stabilization-Applications of robotics in medicine					
<b>UNIT – V</b>	<b>REHABILITATION ROBOTICS</b>	<b>9</b>			
Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume - Precision of movement - End effectors - Sensors. human-robot interaction, Functions of rehabilitation robotics , rehabilitation robotics in recent areas – exoskeletons, Neuroplasticity, robotic therapy					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Elucidate the fundamental concepts of sensory and motor rehabilitation, including sensory augmentation and substitution systems.				Understand
<b>CO2:</b>	Apply engineering principles to the design and development of prosthetic and orthotic devices for motor rehabilitation.				Apply
<b>CO3:</b>	Apply the principles of rehabilitation engineering to design personalized assistive devices for individuals with motor impairments.				Apply
<b>CO4:</b>	Analyze different wheelchair technologies, therapeutic exercise techniques, and their impact on rehabilitation.				Analyze
<b>CO5:</b>	Analyze the effectiveness of different rehabilitation techniques and robotic therapies in improving the quality of life for patients with motor disabilities.				Analyze
<b>CO6:</b>	Evaluate the role of rehabilitation robotics in neuroplasticity, robotic therapy, and human-robot interaction.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Robinson C.J, “Rehabilitation Engineering”, CRC Press , 2006</li><li>Rory A Cooper, “Rehabilitation Engineering Applied To Mobility And Manipulation”, IOP Publishing Ltd 1995.</li><li>Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press,2000.</li><li>John Iovine, "Robots, Android and Animatronics", McGraw-Hill, 2nd Edition, 2012.</li></ol>					

**REFERENCES:**

1. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007.
2. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation
4. James Moore, George Zouridakis, "Biomedical Technology and Devices Handbook", CRC Press 2004.
5. Engineering", CRC; December 2000.Douglas V.Goldstein, "E Healthcare: Harness the power of Internet, e-commerce and e-care", Jones and Barlett Publishers
6. Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.
7. Bommel, J.H. van, Musen, M.A. (Eds.) "Handbook of Medical Informatics", Heidelberg, Germany: Springer, 1997
8. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill, 2004

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2													
CO3	3					2						2	3	2
CO4	3	2											3	2
CO5	3	3							2			2	3	2
CO6	3	3	3	3		2			2			2	3	2
CAM	2.67	2.67	3	3		2			2			2	3	2

Course Code	Course Title	L	T	P	C
19UBM918	VIRTUAL BIO-INSTRUMENTATION	2	0	2	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To introduce virtual instrumentation concepts and applications.</li><li>To train to program virtual instrumentation software for biomedical applications</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO VIRTUAL INSTRUMENTATION AND LABVIEW</b>	<b>10</b>			
Concept of virtual instrumentation– Block diagram and Architecture of Virtual Instruments – Virtual Instruments versus Traditional Instruments – LabVIEW software – LabVIEW basics – LabVIEW environment.					
<b>UNIT – II</b>	<b>PROGRAMMING TECHNIQUES</b>	<b>10</b>			
Creating, Editing and debugging a VI in LabVIEW – Creating a sub VI – Loops and charts – Case and sequence structures – File I/O – VI customization.					
<b>UNIT – III</b>	<b>DATA ACQUISITION AND CONTROL IN VI</b>	<b>10</b>			
Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems					
<b>LIST OF EXPERIMENTS:</b>					<b>30</b>
<ul style="list-style-type: none"><li>1. Creating Virtual Instrumentation for simple applications</li><li>2. Programming exercises for loops and charts</li><li>3. Programming exercises for clusters and graphs.</li><li>4. Programming exercises on case and sequence structures, file Input / Output.</li><li>5. Data acquisition through Virtual Instrumentation.</li><li>6. Bio-potential measurement using DAQ.</li></ul>					
<b>TOTAL : 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Demonstrate the basics of LabVIEW programming.				Understand
<b>CO2:</b>	Comprehend the components of virtual instrumentation and apply them for PC-based measurements.				Apply
<b>CO3:</b>	Design and develop virtual instruments using programming languages and software tools.				Apply
<b>CO4:</b>	Use virtual bio instrumentation tools to analyze and interpret biological signals and data.				Analyze
<b>CO5:</b>	Compare and contrast different programming approaches and techniques for VI development.				Analyze
<b>CO6:</b>	Create innovative virtual bio instrumentation solutions for emerging biomedical challenges.				Create
<b>TEXT BOOKS:</b>					
<ul style="list-style-type: none"><li>1. Jerome, Jovitha, “Virtual Instrumentation and LABVIEW”, PHI Learning, New Delhi, First Edition, 2010.</li><li>2. Sanjay Gupta and Joseph John, “ Virtual Instrumentation using LabVIEW”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.</li></ul>					
<b>REFERENCES:</b>					
<ul style="list-style-type: none"><li>1. Gupta, “Virtual Instrumentation Using Lab View”, Tata McGraw Hill, New Delhi, 1st Edition, 2008.</li><li>2. Leonard Sokoloff, “Applications in LabVIEW”, Prentice Hall, 0-13-833949-X, 2003.</li><li>3. Robert H. Bishop, ‘Learning with Lab-view’, Prentice Hall, 2003.</li><li>4. Gary W. Johnson, Richard Jennings, ‘Lab-view Graphical Programming’, McGraw Hill Professional Publishing, 2001.</li></ul>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3				3									2
CO3	3	2			3								2	2
CO4	3	3		2	3				2				2	3
CO5	3	3			3									2
CO6	3	3	3	2	3				3				2	3
CAM	2.83	2.75	3	2	3				2.5				2	2.40

Course Code	Course Title	L	T	P	C
19UBM919	MEDICAL EMBEDDED SYSTEM	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To impart knowledge in the basic Building Blocks of Embedded System and embedded networking.</li><li>To impart knowledge in the design of embedded system for various medical devices.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO EMBEDDED SYSTEMS</b>	<b>9</b>			
Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging					
<b>UNIT – II</b>	<b>EMBEDDED NETWORKING</b>	<b>9</b>			
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.					
<b>UNIT – III</b>	<b>EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT</b>	<b>9</b>			
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, 78 Sequential Program Model, concurrent Model, object-oriented Model.					
<b>UNIT – IV</b>	<b>DESIGN OF PATIENT MONITORING DEVICES</b>	<b>9</b>			
Design consideration of patient monitoring systems- Basic block diagram of pulse oximeter, design requirement of device -Circuit implementation of interfacing of oximeter sensors with microcontroller - Software coding and implementation					
<b>UNIT – V</b>	<b>DESIGNING OF PACEMAKER</b>	<b>9</b>			
System description of pacemaker - Design requirement and basic block diagram of pacemaker - Interfacing of pacemaker elements with processors - Software coding of pacemaker and implementation					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain the principles of embedded systems and their applications in medical devices.	Understand			
<b>CO2:</b>	Apply networking protocols and I/O communication in designing medical embedded systems.	Apply			
<b>CO3:</b>	Develop firmware for medical devices like pacemakers and monitoring systems.	Apply			
<b>CO4:</b>	Analyze design challenges in embedded systems for medical devices.	Analyze			
<b>CO5:</b>	Analyze subsystem integration in medical embedded systems.	Analyze			
<b>CO6:</b>	Evaluate the effectiveness and safety of medical embedded systems.	Evaluate			
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>James K. Peckol, “Embedded system Design”, John Wiley &amp; Sons, 1st edition, 2010.</li><li>Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2011</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003 (UNITS I, IV &amp; V)</li><li>Elicia White, “Making Embedded Systems”, O’Reilly Series, SPD, 1st edition, 2011.</li><li>G. Baura, "A Biosystems Approach to Industrial Patient Monitoring and Diagnostic Devices”, Morgan&amp; Claypool, IEEE, 2008.</li><li>David. E. Simon, “An Embedded Software Primer”, 1st Edition, Fifth Impression, Addison- Wesley Professional, 2007.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	2
CO2	3	2											2	2
CO3	3	2						2					2	2
CO4	3	3	2										2	2
CO5	3	3	2										2	2
CO6	3	3	3		2			2					2	3
CAM	2.83	2.6	2.33		2			2					2	2.17



Course Code	Course Title	L	T	P	C
19UBM920	BRAIN COMPUTER INTERFACE AND VIRTUAL REALITY	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To understand the basic concepts of brain computer interface</li><li>To study the various signal acquisition methods</li><li>To understand the various machine learning methods of BCI</li><li>To understand virtual reality and using them to build Biomedical engineering applications</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO BCI</b>				<b>9</b>
Fundamentals of BCI – Structure of BCI system – Classification of BCI- Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.					
<b>UNIT – II</b>	<b>BRAIN ACTIVATION</b>				<b>9</b>
Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.					
<b>UNIT – III</b>	<b>MACHINE LEARNING METHODS FOR BCI</b>				<b>9</b>
Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis					
<b>UNIT – IV</b>	<b>VR DEVELOPMENT PROCESS</b>				<b>9</b>
The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input and Output Devices- Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.					
<b>UNIT – V</b>	<b>VR ON THE MOBILE AND ITS APPLICATION</b>				<b>9</b>
VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics-Medical applications-military applications-robotics applications- Advanced Real time Trackingother applications- games, movies, simulations, therapy.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals and structure of Brain-Computer Interface systems and their classifications.				Understand
<b>CO2:</b>	Apply signal acquisition methods for Brain-Computer Interface development.				Apply
<b>CO3:</b>	Use machine learning techniques for classification and performance evaluation in BCI systems.				Apply
<b>CO4:</b>	Analyze brain activation patterns and their relation to cognitive tasks and movement-related potentials.				Analyze
<b>CO5:</b>	Analyze the VR development process and its components for designing biomedical engineering applications.				Analyze
<b>CO6:</b>	Evaluate the potential of VR applications in various fields such as medicine, military and therapy.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Rajesh.P.N.Rao, “Brain-Computer Interfacing: An Introduction”, Cambridge University Press, First edition, 2013.</li><li>Jonathan Wolpaw, Elizabeth Winter Wolpaw, “Brain Computer Interfaces: Principles and practice”, Oxford University Press, USA, Edition 1, January 2012.</li><li>Jason Jerald,The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan &amp; Claypool, New York, NY, USA,2015.</li></ol>					

**REFERENCES:**

1. Ella Hassianien, A & Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015
2. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
3. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1st edition, 2016.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												3	
CO3	3				2								3	2
CO4	3	3	2	2									2	2
CO5	3	2	2	2	2								3	2
CO6	3	2	3	2	2	2						2	3	
CAM	2.83	2.33	2.33	2	2	2						2	2.8	2

Course Code	Course Title	L	T	P	C
19UBM921	NEUROSCIENCE	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a basic understanding of nervous system and its disorder.</li><li>To enhance students to practice behavior science in animal model.</li><li>To engage the students to work as a team to troubleshoot of neurological disorder by <i>in vitro</i> assay.</li><li>To help students to investigate neural disorder and its behavior related science.</li><li>To expose students to explore the neurological science and enhance its efficiency in learning and memory of nervous system.</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO NERVOUS SYSTEM</b>	<b>9</b>			
Nervous system: Introduction - Central and peripheral nervous system – Signaling molecules: First growth factor, First Neuro transmitters in brain– functional organization, Synaptic potentials and Receptor potentials.					
<b>UNIT – II</b>	<b>NEURO ANATOMY</b>	<b>9</b>			
Structures and functions of neurons – Synapse – function, signals produced by neurons – Sensors function – Glial cells – molecular and cellular organization of neuronal differentiation – characterization of neuronal cells.					
<b>UNIT – III</b>	<b>NEUROPHYSIOLOGY AND NEUROPHARMACOLOGY</b>	<b>9</b>			
Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission. Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function.					
<b>UNIT – IV</b>	<b>NEUROLOGICAL DISORDERS</b>	<b>9</b>			
Pathogenesis – Genetic basis of neurological disorders – Psychiatric Disorders: Psychiatric epidemiology, Unipolar depression, Bipolar depression, Seasonal affective disorder, Panic disorder, Autism, Stroke, Huntington disease					
<b>UNIT – V</b>	<b>BEHAVIOUR SCIENCE</b>	<b>9</b>			
Neuronal mechanism of behavior – Animal behavior – Behaviour in various environments.Behavioural and cognitive neuroscience - Behavioural studies using animal model - Testing motor functions, Grip Strength Test, Testing Cognitive Functions – Learning and memory related test					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the basics of neuroscience and its role in behavior science.				Understand
<b>CO2:</b>	Solve neurological issues using neurotransmission methods.				Apply
<b>CO3:</b>	Design neuro-sensory devices to monitor autism and neurological disorders.				Apply
<b>CO4:</b>	Analyze approaches for addressing heart failure through nervous system and cellular functions.				Analyze
<b>CO5:</b>	Analyze the genetic basis of disorders and assess therapeutic strategies.				Analyze
<b>CO6:</b>	Develop solutions for enhancing cognitive and motor functions related to neural mechanisms.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Georg Goldenberg, Bruce L. Miller - Neuropsychology and Behavioral Neurology_ Handbook of Clinical Neurology, Elsevier - libgen.lc., 2008.</li><li>Michael J. Aminoff, “Handbook of Clinical Neurology”, Elsevier, London, 2012</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>Mason P., Medical Neurobiology, Oxford University Press, 2011.</li><li>Mathews G.G. Neurobiology, 2nd edition, Blackwell Science, UK, 2000.</li><li>Gordon M. Shepherd G.M, and Shepherd Neurobiology, 3rd Edition Oxford University Press, USA, 1994</li><li>Haynes, “Neuron in Tissue Culture”, 1998.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3													
CO3	3	2	2									2	2	
CO4	3	2		2										2
CO5	3	2		2								2	2	
CO6	3	2	2	2									2	2
CAM	2.83	2	2	2								2	2	2

Course Code	Course Title	L	T	P	C
19UBM922	CANCER BIOLOGY	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To impart knowledge on Cancer Biology fundamentals and principles of carcinogenesis.</li><li>To discuss about molecular cancer cell biology and metastasis</li><li>To introduce various therapeutic procedures for treating carcinoma</li><li>To emphasize knowledge of the historical background for the development of the tumor microenvironment</li></ul>					
<b>UNIT – I</b>	<b>FUNDAMENTALS OF CANCER BIOLOGY</b>	<b>9</b>			
Regulation of cell cycle, Mutations that cause changes in signal molecules, Cancer genes - Tumor suppressor genes, oncogenes and their mutations, Modulation of cell cycle in cancer, Different forms of cancers, Clinical examination, Radiological examination, Biopsy and its type, Prediction of aggressiveness of cancer , tumor markers, Molecular tools for early diagnosis					
<b>UNIT – II</b>	<b>PRINCIPLES OF CARCINOGENESIS</b>	<b>9</b>			
Theory of carcinogenesis – Chemical carcinogenesis – Metabolism of carcinogenesis, principles of physical carcinogenesis – x-ray radiation – mechanisms of radiation carcinogenesis – Diet and cancer					
<b>UNIT – III</b>	<b>PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER</b>	<b>9</b>			
Signal targets and cancer – Activation of kinases – Oncogenes – identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, Oncogenes/proto oncogene activity, Growth factors related to transformation, Telomerases.					
<b>UNIT – IV</b>	<b>PRINCIPLES OF CANCER METASTASIS</b>	<b>9</b>			
Clinical significances of invasion – Heterogeneity of metastatic phenotype – metastatic cascade, basement membrane disruption – Proteinases and tumour cell invasion.					
<b>UNIT – V</b>	<b>NEW MOLECULES FOR CANCER THERAPY</b>	<b>9</b>			
Different forms of therapy – Chemotherapy – Radiation therapy – Detection of cancers – Use of signal targets towards therapy of cancer – Gene therapy – Cancer resistance to chemotherapy - Advancement in cancer therapy, Nano systems for drug delivery. Enzyme inhibitors in relation to cancer therapy					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Illustrate the basic concepts of cell cycle, mutations in pathway that causes cancer and carcinogenesis.				Understand
<b>CO2:</b>	Apply the principles of molecular biology of cancer cells to diagnose cancer cells in human body.				Apply
<b>CO3:</b>	Apply the molecular principles of metastasis to treat currently available cancer.				Apply
<b>CO4:</b>	Analyze the molecular mechanisms behind carcinogenesis and their impact in human cells.				Analyze
<b>CO5:</b>	Investigate the various treatment procedures for cancer and analyze it with previous report and give your opinion to treat very rare cancers.				Evaluate
<b>CO6:</b>	Distinguish scientific explanations that show how the Multi-step tumorigenesis takes place and develop solution for the specific type of cancer.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Becker's World of the Cell 9th Edition By Jeff Hardin, Gregory Paul Bertoni, and Lewis J. Kleinsmith Pearson (Publisher), 2017.</li><li>Roger John Benjamin King,, "Cancer Biology", Pearson/Prentice Hall, 2006</li><li>Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988</li></ol>					

**REFERENCES:**

1. Raymond W Ruddon, "Cancer Biology", Oxford University Press, 4E, 2007.
2. Momna Hejmadi, "Introduction to Cancer Biology", Ventus publishing, 2010
3. Robert A. Weinberg, "Introduction to Cancer Biology", Garland Science, 2E, 2014

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												3	2
CO3	3	3											3	2
CO4	2	3	2	2									3	2
CO5	2	2	2	3		2							3	2
CO6	2	2	2	3		2							3	2
CAM	2.33	2.5	2	2.67		2							2.83	2

Course Code	Course Title	L	T	P	C
19UBM923	HUMAN ASSIST DEVICES	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce various mechanical techniques to rescue failing heart.</li><li>To describe various assist device in hospital practice and explain their usage</li><li>To learn about current trends in assisting devices.</li></ul>					
<b>UNIT – I</b>	<b>CARDIAC ASSIST DEVICES</b>	<b>9</b>			
Heart/Lung System – Different types of Oxygenators and Pumps – Pulsatile and Continuous Type – Monitoring Process – Shunting – Blood Handling System – Types and Functions of different types of Heart Intra-Aortic Balloon Pumping (IABP) - Venous Arterial Pumping – Prosthetic Cardio Valves					
<b>UNIT – II</b>	<b>ARTIFICIAL KIDNEY</b>	<b>9</b>			
Indication and Principles of Haemodialysis – Membrane – Dialysate – Types of Haemodialyzers – Monitoring Systems – Wearable Artificial Kidney – Implanting types					
<b>UNIT – III</b>	<b>RESPIRATORY AND HEARING AIDS</b>	<b>9</b>			
Intermittent Positive Pressure, Breathing Apparatus operating sequence – Electronic IPPB Unit with monitors for all respiratory parameters - CPAP machine –Types of Deafness – Hearing Aids, Construction and Functional Characteristics - Audiogram					
<b>UNIT – IV</b>	<b>COMMON TYPE OF ASSISTIVE DEVICES</b>	<b>9</b>			
Mobility devices – positioning devices – prosthetic, orthotic and orthopedic devices – daily living devices – vision, hearing devices – communication devices – cognitive devices					
<b>UNIT – V</b>	<b>ASSISTIVE TECHNOLOGY</b>				
Assistive technology – selection of assistive devices – Selection of appropriate technology –use of assistive devices in the barrier free environment – Issues in using assistive technology in the community.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the concepts, types and working principles of human assist devices.				Understand
<b>CO2:</b>	Demonstrate the principles and design of respiratory devices, hearing aids, and artificial kidneys.				Apply
<b>CO3:</b>	Apply appropriate techniques in designing and implementing cardiac assist devices.				Apply
<b>CO4:</b>	Analyze the working mechanisms of different assistive devices and their impact on patient health.				Analyze
<b>CO5:</b>	Identify challenges and limitations in the usage of assistive devices and modern rehabilitation technologies.				Analyze
<b>CO6:</b>	Assess various assistive technologies and select optimal solutions for real-time healthcare applications.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Levine S.N. (ed), “Advances in Bio-medical engineering and Medical physics”, Vol. I, II, IV, inter university publications, New York, 1968</li><li>Kolff W.J, “Artificial Organs”, John Wiley and sons, New York, 1976</li><li>Albert M.Cook and Webster J.G, “Therapeutic Medical Devices”, Prentice Hall Inc., New Jersey, 1982</li><li>Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 3<sup>rd</sup> Edition 2014.</li></ol>					

**REFERENCES:**

1. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010
2. James Moore, George Zouridakis, "Biomedical Technology and Devices Handbook", CRC Press 2004.
3. Community-Based Rehabilitation: CBR Guidelines. Khasnabis C, Heinicke Motsch K, Achu K, et al., editors. Geneva: World Health Organization; 2010
4. The Standard Rules for the Equalization of Opportunities of Persons with Disabilities. New York: United Nations; 1993.
5. WHO. Disability [cited 2018 09-28-2018]. Available from: <http://www.who.int/disabilities/technology/en/>.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2													
<b>CO2</b>	3												3	2
<b>CO3</b>	3	2	2									2	3	2
<b>CO4</b>	3	2		2									3	2
<b>CO5</b>	3	3		2								2	3	2
<b>CO6</b>	3	2	2	3	2				2	2		2	3	3
<b>CAM</b>	<b>2.83</b>	<b>2.25</b>	<b>2</b>	<b>2.33</b>	<b>2</b>				<b>2</b>	<b>2</b>		<b>2</b>	<b>3</b>	<b>2.2</b>



Course Code	Course Title	L	T	P	C
19UBM924	BODY AREA NETWORKS AND MOBILE HEALTHCARE	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide an overview of the technical background of Body Area Networks (BAN) and its application in health care using mobile technology</li><li>To know the hardware requirement of BAN</li><li>To understand the communication and security aspects in the BAN</li><li>To know the applications of BAN in the field of medicine</li></ul>					
<b>UNIT – I</b>	<b>BODY AREA NETWORKS</b>	<b>9</b>			
BAN and healthcare -Technical challenges- sensor design, Biocompatibility, energy supply, energy scavenging methods , optimal node placement, number of nodes, networks for BAN, System security and reliability, standards. BAN Architecture					
<b>UNIT – II</b>	<b>HARDWARE FOR BAN</b>	<b>9</b>			
Processor-Low Power MCUs, mobile computing MCUs ,Integrated processor with radio transceiver, memory types and ranges ,Antenna types , PCB antenna, wire antenna, ceramic antenna, external antenna, Sensor interface, power sources- batteries and fuel cells for sensor nodes.					
<b>UNIT – III</b>	<b>WEARABLE SENSORS AND STANDARDS FOR BAN</b>	<b>9</b>			
Wearable's fundamentals and role of wearable sensors, Attributes of wearable, flexible electronics, meta-wearable -Future of wearable, research road map -Wireless personal area network technologies-Zigbee, coexistence issues with BAN.					
<b>UNIT – IV</b>	<b>MOBILE DEVICES FOR HEALTHCARE</b>	<b>9</b>			
Wearable system for ECG monitoring-Evaluation of night time performance, smart phone based health care monitoring system - Phone based fall risk prediction - RFID based personal mobile medical assistance- Secure medical sensor network					
<b>UNIT – V</b>	<b>MOBILE HEALTH TECHNOLOGIES AND APPLICATIONS</b>	<b>9</b>			
Mobile nutrition tracking -case study - Accessing existing virtual electronic patient record, mobile personal health records - BME-Engg & Tech - Monitoring hospital patients, sensing vital signs and transmission using wireless networks - Context aware healthcare applications with case study					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Comprehend technical challenges in body area networks.				Understand
<b>CO2:</b>	Apply BAN knowledge to provide innovative mHealthcare solutions.				Apply
<b>CO3:</b>	Examine multiple sensors for wearable applications.				Apply
<b>CO4:</b>	Analyze effectiveness and limitations of existing Body Area Networks.				Analyze
<b>CO5:</b>	Compare different network architectures and protocols to meet specific medical requirements.				Analyze
<b>CO6:</b>	Evaluate BANs and healthcare systems for specific healthcare use cases.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.</li><li>Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013.</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>Canjun Yang , G.S.Virk, Huayong yang , “Wearable sensors and Robots”, Proceeding of international conference on wearable sensors and robots, 2017</li><li>Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems”, Springer, 2013.</li><li>Guang-ZhongYang(Ed.), “Body Sensor Networks”, Springer, 2006.</li><li>Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012</li></ol>					

<b>CO</b>	<b>POs</b>												<b>PSOs</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>CO1</b>	2													
<b>CO2</b>	3												3	2
<b>CO3</b>	3												2	2
<b>CO4</b>	3	3	2	2									3	2
<b>CO5</b>	3	3	2	2									3	2
<b>CO6</b>	3	3	3	3									3	3
<b>CAM</b>	<b>2.83</b>	<b>3</b>	<b>2.33</b>	<b>2.33</b>									<b>2.8</b>	<b>2.2</b>

Course Code	Course Title	L	T	P	C
19UBM925	REGENERATIVE MEDICINE AND ERGONOMICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To understand nature and significance of stem cells and its applications</li><li>To study the Molecular therapy for regeneration</li><li>To understand the basics of Biomechanical, physiological and anthropometric background.</li><li>To impart the knowledge about the user information, controls, relationship between information and operation.</li></ul>					
<b>UNIT – I</b>	<b>REGENERATIVE MEDICINE</b>	<b>9</b>			
Regenerative Therapy –Introduction-Large scale manufacturing of cells, tissues and organs -Artificial organs – Gene therapy applications-Engineered Tissues and Regenerative Medicine -Molecular therapy for regeneration- Personalized therapies in Regenerative Medicine- Applications of Regenerative Medicine					
<b>UNIT – II</b>	<b>STEM CELL BIOLOGY</b>	<b>9</b>			
Introduction, Types & sources of stem cell with characteristics: hematopoietic differentiation pathway, Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, cancer stem cells, induced pluripotent stem cells.					
<b>UNIT – III</b>	<b>BIOMATERIALS AND HUMAN- ENVIRONMENT INTERACTION</b>	<b>9</b>			
Biomaterials: Properties of Biomaterials, Surface, bulk, mechanical and biological properties- Biomechanical, Physiological, Anthropometric background - Posture - Sitting, Standing - Change of posture - Hand and arm postures - Movement – Lifting, carrying, pulling and pushing.					
<b>UNIT – IV</b>	<b>ANTHROPOMETRY</b>	<b>9</b>			
Anthropometric design principles –work space envelope- factors in design of work space surfaces- principles of seat design –principles of control panel -reducing accidents by altering behavior.					
<b>UNIT – V</b>	<b>HUMAN FACTORS AND ERGONOMICS</b>	<b>9</b>			
Standards – Applications in healthcare – Neuro-ergonomics in human-system interaction – Case Study Biomedical Application, Design optimization of Medical Equipments.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the principles and applications of regenerative medicine, stem cells and tissue engineering in modern therapies				Understand
<b>CO2:</b>	Apply stem cell biology and molecular therapies in regenerative medicine to solve biological and medical challenges.				Apply
<b>CO3:</b>	Utilize biomechanical, physiological and anthropometric principles to design human-environment interaction systems.				Apply
<b>CO4:</b>	Analyze the role of anthropometry in workspace design and human-system interaction to optimize ergonomics.				Analyze
<b>CO5:</b>	Analyze how ergonomic principles can enhance human performance particularly in healthcare and rehabilitation equipment.				Analyze
<b>CO6:</b>	Assess the effectiveness of personalized regenerative therapies in improving functional recovery.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>HosseinBaharvand (Editor), Nasser Aghdami (Editor). Regenerative Medicine and Cell Therapy (Stem Cell Biology and Regenerative Medicine). Humana Press; 2013 edition</li><li>Pascale Carayon, Handbook of Human Factors and Engineering, Second Edition, CRC Press, 2011</li></ol>					

**REFERENCES:**

1. Raphael G., Richard S., "Stem Cell-Based Tissue Repair.", Cambridge/RSC Publishing, 1st Edition, 2011
2. Lanza R., Gearhart J. et al. "Essential of Stem Cell Biology.", Elsevier/Academic, 1st Edition, 2006.
3. Gavriel Salvendy, 'Handbook of Human Factors and Ergonomics', John Wiley & Sons, Fourth Edition 2012.
4. Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, Third Edition, 2016

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2								
CO2	3	2	3										3	2
CO3	3	2	3										3	3
CO4	2		2	2									3	2
CO5	2		2	2			2						3	
CO6	3	2	2	2		2							2	3
CAM	2.5	2	2.4	2		2	2						2.8	2.5

Course Code	Course Title	L	T	P	C
19UBM926	PHYSIOLOGICAL MODELING	2	0	2	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To develop skills to model vital organs and to simulate their physiology</li><li>To discuss the steps to develop dynamic models and simulate their response</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION</b>				<b>10</b>
Introduction to Resistance mathematical modelling – Analogues models – Characterization of simple physiological systems - Utility of models and analogs in medical studies. System properties - Resistance - the resistive properties – linear resistance analysis – static and dynamic resistance - distributed and lumped systems – Resistance in other systems – thermal resistance					
<b>UNIT – II</b>	<b>SYSTEM PROPERTIES: STORAGE OF COMBINED PROPERTIES</b>				<b>10</b>
Introduction - Systems with volume storage -Electrical analog of compliance, Combined hollow elastic elements - Cylindrical elements – Storage in thermal systems – analog study of thermal system response – storage in mechanical system - Step response of resistance - compliant systems – step response data in dye dilution studies - pulse response of first order system (Dye dilution).					
<b>UNIT – III</b>	<b>TRANSFER FUNCTION</b>				<b>10</b>
Introduction – systems as operators – simple operations compared with the operation of a First – order system – The first order operator – operator function in terms of ‘s’ – Block diagram of coupled systems – signals to and from operator functions – transfer functions from Input – Output signal information.					
<b>LIST OF EXPERIMENTS:</b>					<b>30</b>
<ol style="list-style-type: none"><li>Simulation and analysis of static resistance property with physiological example.</li><li>Simulation and analysis using dynamic resistance with suitable biological example.</li><li>Simulation of thermal system in human body using single source and two source representation.</li><li>Linear Modeling and simulation of cardiovascular vessel physiology</li><li>Linear Modeling and simulation of Heart</li><li>Linear Modeling and simulation of airway mechanics</li></ol>					
<b>TOTAL : 60 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Illustrate the mathematical modeling of various physiological systems.				Understand
<b>CO2:</b>	Apply methods and techniques to analyze non-linear, dynamic and multi-compartmental systems.				Apply
<b>CO3:</b>	Apply software tools like MATLAB and OpenCV for simulating physiological systems.				Analyze
<b>CO4:</b>	Analyze mathematical modeling and provide suggestions for pupil control systems and thermoregulation.				Analyze
<b>CO5:</b>	Examine the simulation of physiological systems and analyze dynamic responses of physiological models.				Apply
<b>CO6:</b>	Evaluate concepts related to parametric systems in physiological modeling.				Analyze
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Willian B.Blessner ,A System Approach to Biomedicine , McGraw Hill Book Co., New York, 1969.</li><li>Manfreo Clynes and John H.Milsum, Biomedical Engineering System , McGraw Hill and Co.,New York , 1970.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Micheal C.K.Khoo ,”Physiological Control System Analysis ,Simulation and Estimation “.- Prentice Hall of India , New Delhi , 2001.</li><li>Richard Skalak and Shu Chien , Hand Book of Biomedical Engineering , McGraw Hill and Co.New York, 1987.</li><li>Douglas S.Rigg. Control Theory and Physiological Feedback Mechanism, The Wilkiam and Wilkins Co. Baltimore, 1970</li><li>Ewart Carson, Claudio Cobelli “Modelling Methodology for Physiology and Medicine” Elsevier, 31-Dec-2000</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2	3		3								3	3
CO3	3	2	3		3			2					3	3
CO4	3	2	3			2							3	2
CO5	3	2	2	2	2	2							3	2
CO6	3	2	3	2	2	2							3	2
CAM	2.83	2	2.8	2	2.5	2		2					3	2.33

Course Code	Course Title	L	T	P	C
19UBM927	BIG DATA AND IOT IN MEDICAL APPLICATIONS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the basics of Internet of things(IoT) and protocols</li><li>To explain the concepts of Web of Things and Cloud of Things</li><li>To discuss the healthcare operations and recent development</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO BIGDATA</b>				<b>9</b>
Introduction to Big Data Platform–Challenges of conventional systems-Web data–Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting- Modern data analytic tools, Statistical concepts: Sampling distributions, resampling, statistical inference, prediction error.					
<b>UNIT – II</b>	<b>DATA ANALYSIS</b>				<b>9</b>
Regression modeling, Multivariate analysis, Bayesian modeling, Inference and Bayesian networks, and Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics– Rule induction – Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, and Stochastic search methods.					
<b>UNIT – III</b>	<b>INTRODUCTION TO IoT</b>				<b>9</b>
Introduction to Elements of IoT - Basic Architecture of an IoT-Functional blocks of an IoT ecosystem - Applications Sensors & Actuators - Edge Networking (WSN) – Gateways - IoT Communication Model – WPAN & LPWA, Future Trends – Standards					
<b>UNIT – IV</b>	<b>IoT IN HEALTH CARE</b>				<b>9</b>
Role of IoT in Health care – Architecture of Health Care in IoT – Integrated framework for operations management – Evidence Based Medicine and Pay for Performance –Hospital business operations – Devices and Mobile apps for health care – Challenges for MIoT& Big Data in Health care.					
<b>UNIT – V</b>	<b>RECENT DEVELOPMENTS</b>				<b>9</b>
Techniques and tools – Map Reduce paradigm and the Hadoop system – IoT: Clustering, Synchronization and Software Agents. Applications, Social Media Analytics – IoT in Non Invasive Critical Brain activity monitor, Cardio Diagnostics – Fraud Detection – Big Data in Medicine and Healthcare – Digital companion					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals of Big Data, IoT architecture, and their role in healthcare.				Understand
<b>CO2:</b>	Apply data analysis techniques for medical data processing.				Apply
<b>CO3:</b>	Develop IoT-based healthcare solutions using sensors, actuators, and cloud platforms.				Apply
<b>CO4:</b>	Analyze IoT frameworks for healthcare operations, patient monitoring, and hospital management				Analyze
<b>CO5:</b>	Assess the impact of Big Data and IoT in real-time medical diagnostics and decision-making				Analyze
<b>CO6:</b>	Evaluate the challenges and advancements in integrating Big Data and IoT for improved healthcare outcomes.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Michael Berthold, David J.Hand, “Intelligent Data Analysis”, Springer, 2007.</li><li>AnandRajaraman and, Jeffrey David Ullman,”Mining of Massive Datasets”,Cambridge University Press, 2012.</li><li>Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley Publications, 2012.</li></ol>					

**REFERENCES:**

1. Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer Publishing, 2011.
3. Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
4. R.Langabeer "Healthcare Operations Management: A Quantitative Approach to Business and Logistics", Jones & Bartlett Publishers, First Edition, 2007.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3				3									2
CO3	3													2
CO4	3												2	2
CO5	3	3	3	2	3							2	2	3
CO6	3	3	3	2	3				2	2		2	2	3
CAM	2.83	3	3	2	3				2	2		2	2	2.33



Course Code	Course Title	L	T	P	C
19UBM928	VLSI SYSTEM DESIGN	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To learn the fundamentals of VLSI design</li><li>To understand the IC Manufacturing Process</li><li>To familiarize with VLSI combinational and Sequential logic circuits design</li></ul>					
<b>UNIT – I</b>	<b>MOS TRANSISTOR PRINCIPLES</b>				<b>9</b>
Introduction of MOSFET, Threshold voltage, MOSFET I-V characteristics, CMOS inverter, Characteristics of CMOS inverter, CMOS process flow, Stick diagram, Layout diagrams, Layout and design rules.					
<b>UNIT – II</b>	<b>COMBINATIONAL LOGIC CIRCUITS</b>				<b>9</b>
Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL					
<b>UNIT – III</b>	<b>SEQUENTIAL LOGIC CIRCUITS</b>				<b>9</b>
Static Latches and Registers, Dynamic Latches and Registers, Timing Issues, Pipelines, Pulse and sense amplifier based Registers, Nonbistable Sequential Circuits.					
<b>UNIT – IV</b>	<b>ARITHMETIC BUILDING BLOCKS AND IMPLEMENTATION TECHNIQUES</b>				<b>9</b>
Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters. Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.					
<b>UNIT – V</b>	<b>VERILOG HDL</b>				<b>9</b>
Verilog HDL Coding Style: Basic Concept - Ports and Modules – Operators - Gate Level Modeling - Data Flow Modeling - Behavioral level Modeling -Tasks & Functions - Test Bench.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals of MOS transistor principles, CMOS logic and VLSI design methodologies.				Understand
<b>CO2:</b>	Apply combinational and sequential circuit design techniques for optimizing speed and power efficiency.				Apply
<b>CO3:</b>	Develop arithmetic circuits and FPGA-based designs for VLSI applications.				Apply
<b>CO4:</b>	Analyze different CMOS logic families, timing issues and performance trade-offs in circuit design.				Analyze
<b>CO5:</b>	Examine the role of design methodologies and FPGA architectures in modern VLSI systems.				Analyze
<b>CO6:</b>	Evaluate Verilog-based hardware descriptions and testbenches for efficient digital system implementation.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated circuits: A design perspective”. Second Edition, Prentice Hall of India, 2003.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>N.Weste, K.Eshraghian, “Principles of CMOS VLSI DESIGN”, A system Perspective, Addison Wesley, 2nd Edition, 2004.</li><li>A.Pucknell, Kamran Eshraghian, “BASIC VLSI DESIGN”, Prentice Hall of India, 3rd Edition, 2007.</li><li>M.J. Smith, “Application Specific Integrated Circuits”, Addison Wesley, 1997.</li><li>R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2005.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3		2		2								2	2
CO4	3	2		2								2	2	
CO5	3	2		2									2	2
CO6	3	2	2	2	2							2	2	2
CAM	2.83	2	2	2	2							2	2	2

Course Code	Course Title	L	T	P	C
19UBM929	MEDICAL WASTE MANAGEMENT	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To provide a basic understanding of healthcare hazard control and accidents.</li><li>To enhance students to practice medical waste management and disposal of the hazardous waste.</li><li>To engage the students to work as a team to solve health issues caused by medical waste.</li><li>To help students to investigate safety aspects and transport of the medical waste.</li><li>To expose students to explore medical waste management and enhance patient safety from infections and hazardous agent.</li></ul>					
<b>UNIT – I</b>	<b>HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS</b>				<b>9</b>
Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Accident Analysis, Accident Prevention, Workers" Compensation, Orientation, Education, and Training.					
<b>UNIT – II</b>	<b>BIOMEDICAL WASTE MANAGEMENT</b>				<b>9</b>
Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.					
<b>UNIT – III</b>	<b>HAZARDOUS MATERIALS</b>				<b>9</b>
Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.					
<b>UNIT – IV</b>	<b>FACILITY SAFETY</b>				<b>9</b>
Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and Vehicle Safety.					
<b>UNIT – V</b>	<b>INFECTION CONTROL, PREVENTION AND PATIENT SAFETY</b>				<b>9</b>
Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Healthcare-Associated Infections, Medication Safety.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the concepts of medical waste management and and its impact on human health.				Understand
<b>CO2:</b>	Identify health hazards from hazardous materials and apply neutralizing agents for mitigation.				Apply
<b>CO3:</b>	Detect infectious and carcinogenic agents in medical waste and the human body using in vitro or in vivo assays.				Apply
<b>CO4:</b>	Analyze cancer-causing agents in medical waste and evaluate potential approaches for addressing carcinoma risks.				Analyze
<b>CO5:</b>	Assess blood-borne pathogen risks and design biosensor-based methods for infectious pathogen monitoring.				Analyze
<b>CO6:</b>	Evaluate waste segregation, labeling, handling, and disposal strategies to enhance patient safety.				Evaluate
<b>TEXT BOOKS:</b> <ul style="list-style-type: none"><li>Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).</li><li>Anantpreet Singh, SukhjitKaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).</li></ul>					

**REFERENCES:**

1. Khalid Maryam, Evaluation of Biomedical Waste Management System, LAP Lambert Academic Publishing, 2015.
2. Peter A. Reinhardt, Infectious and Medical Waste Management, CRC Press, 1991.
3. Ram Chandra, Environmental Waste Management, CRC Press, 2015.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3											2	2	
CO3	3											2	2	
CO4	3	3				2	2	2				2	2	
CO5	3	3				2	2		2			2	2	
CO6	3	3	2	2		3	3	3	2			2	2	
CAM	2.83	3	2	2		2.33	2.33	2.5	2			2	2	

Course Code	Course Title	L	T	P	C
19UBM930	DIGITAL SYSTEM DESIGN	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To impart knowledge in digital circuits using simplified Boolean functions</li><li>To impart knowledge for design and analysis of combinational circuits</li></ul>					
<b>UNIT – I</b>	<b>BOOLEAN ALGEBRA AND LOGIC GATES</b>	<b>9</b>			
Number Systems - Arithmetic Operations - Binary Codes - Boolean Algebra and Logic Gates - Theorems and Properties of Boolean Algebra - Boolean Functions - Canonical and Standard Forms - Simplification of Boolean Functions using Karnaugh Map - Logic Gates – NAND and NOR Implementations					
<b>UNIT – II</b>	<b>COMBINATIONAL LOGIC</b>	<b>9</b>			
Combinational Circuits – Analysis and Design Procedures - Binary Adder-Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator - Decoders – Encoders – Multiplexers - Introduction to HDL – HDL Models of Combinational circuits.					
<b>UNIT – III</b>	<b>SYNCHRONOUS SEQUENTIAL LOGIC</b>	<b>9</b>			
Sequential Circuits - Storage Elements: Latches, Flip-Flops - Analysis of Clocked Sequential Circuits - State Reduction and Assignment - Design Procedure - Registers and Counters - HDL Models of Sequential Circuits.					
<b>UNIT – IV</b>	<b>ASYNCHRONOUS SEQUENTIAL LOGIC</b>	<b>9</b>			
Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.					
<b>UNIT – V</b>	<b>MEMORY AND PROGRAMMABLE LOGIC</b>	<b>9</b>			
RAM – Memory Decoding – Error Detection and Correction - ROM - Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain Boolean algebra, logic gates and simplification techniques for digital circuit design.	Understand			
<b>CO2:</b>	Apply combinational circuit design techniques to implement arithmetic and logic functions.	Apply			
<b>CO3:</b>	Design synchronous sequential circuits using flip-flops, registers and counters.	Apply			
<b>CO4:</b>	Analyze asynchronous sequential circuits for state reduction, race conditions and hazard elimination.	Analyze			
<b>CO5:</b>	Examine different memory architectures and programmable logic devices for digital system design.	Analyze			
<b>CO6:</b>	Evaluate the effectiveness of HDL-based implementations for combinational and sequential circuits.	Evaluate			
<b>TEXT BOOKS:</b> 1. M. Morris R. Mano, Michael D. Ciletti, —Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6th Edition, Pearson Education, 2017.					
<b>REFERENCES:</b> 1. G. K. Kharate, Digital Electronics, Oxford University Press, 2010 2. John F. Wakerly, Digital Design Principles and Practices, Fifth Edition, Pearson Education, 2017. 3. Charles H. Roth Jr, Larry L. Kinney, Fundamentals of Logic Design, Sixth Edition, CENGAGE Learning, 2013 4. Donald D. Givone, Digital Principles and Design, Tata Mc Graw Hill, 2003.					

<b>CO</b>	<b>POs</b>												<b>PSOs</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>CO1</b>	2													
<b>CO2</b>	3		2										2	
<b>CO3</b>	3		2										2	2
<b>CO4</b>	3	2											2	
<b>CO5</b>	3	2		2									2	2
<b>CO6</b>	3	2	2	2									2	
<b>CAM</b>	<b>2.83</b>	<b>2</b>	<b>2</b>	<b>2</b>									<b>2</b>	<b>2</b>

Course Code	Course Title	L	T	P	C
19UBM931	BIO-SIGNAL PROCESSING	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To learn discrete Fourier transform and its properties</li><li>To introduce the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals</li><li>To discuss Finite word length effects</li><li>To introduce the concept of Multirate and adaptive filters</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO BIOMEDICAL SIGNALS</b>	<b>9</b>			
Biosignal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrogastrogram (EGG), Electroneurogram (ENG), Event related potentials (ERPs), Phonocardiogram (PCG), Speech signal, Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.					
<b>UNIT – II</b>	<b>FILTERING FOR REMOVAL OF ARTIFACTS</b>	<b>9</b>			
Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF) filter design using frequency translation					
<b>UNIT – III</b>	<b>CARDIOVASCULAR APPLICATIONS</b>	<b>9</b>			
Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA). Segmentation of PCG, intensity patterns, Spectral modeling and analysis of PCG signals					
<b>UNIT – IV</b>	<b>NEUROLOGICAL APPLICATIONS</b>	<b>9</b>			
EEG rhythms & waveforms, EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models - Nonlinear modeling of EEG - artifacts in EEG & their characteristics and processing – Nonparametric spectral analysis, Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis - correlation analysis of EEG channels - coherence analysis of EEG channels. Evoked potentials- noise characteristics, Noise reduction by linear filtering.					
<b>UNIT – V</b>	<b>ANALYSIS ON WAVESHAPE, SIGNAL CLASSIFICATION AND RECOGNITION</b>	<b>9</b>			
Modeling intramuscular EMG-Intramuscular signal decomposition-Fractal analysis of EMG signals. Statistical analysis of VAG signals. Analysis on amplitude and latency of MEG signals. Analysis of ERP effect. Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Analysis of EEG using Empirical mode decomposition (EMD).					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain the characteristics and challenges of biomedical signals and their significance in diagnosis.	Understand			
<b>CO2:</b>	Apply filtering techniques to remove artifacts from biomedical signals for improved analysis.	Apply			
<b>CO3:</b>	Implement signal processing techniques for cardiovascular applications.	Apply			
<b>CO4:</b>	Analyze EEG signals for neurological applications.	Analyze			
<b>CO5:</b>	Examine signal classification and recognition techniques for biomedical signal interpretation.	Analyze			
<b>CO6:</b>	Evaluate advanced signal processing methods such as wavelet analysis and empirical mode decomposition for biomedical applications.	Evaluate			

**TEXT BOOKS:**

1. Rangayyan, "Biomedical Signal Analysis", Wiley 2002.
2. Semmlow, "Biosignal and Biomedical Image Processing", Marcel Dekker, 2004

**REFERENCES:**

1. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc., Boca Rato, Florida 1999.
2. D.C.Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 2005.
3. Willis J Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993
4. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001.
5. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier 2005.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	2
CO3	3	2	2		2							2	3	2
CO4	3	2	2		2								3	3
CO5	3	3		2								2	3	2
CO6	3	3	2	2	2							2	3	3
CAM	2.83	2.5	2	2	2							2	2.8	2.4



Course Code	Course Title	L	T	P	C
19UBM932	PRINCIPLES OF MACHINE LEARNING	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To discuss different learning techniques.</li><li>To understand various machine learning procedures.</li><li>To learn various algorithms.</li></ul>					
<b>UNIT – I</b>	<b>FOUNDATIONS OF MACHINE LEARNING</b>	<b>9</b>			
Types of machine learning: Supervised learning – Unsupervised learning – Reinforcement Learning – Machine Learning Process – Terminologies: Weight Space, Curse of Dimensionality, Over fitting, Training, Testing, Validation Sets Performance Measures: Confusion Matrix, Accuracy Metrics, Receiver Operator Characteristic (ROC) Curve, Measurement Precision – Model selection – No free lunch theorem – Bias –Variance Tradeoff.					
<b>UNIT – II</b>	<b>SUPERVISED LEARNING</b>	<b>9</b>			
Linear Classification – Probability and Bayes learning – Naive Bayes – Bayesian Network – Perceptron – Perceptron Learning – Neural Networks – Back propagation – Support Vector Machines.					
<b>UNIT – III</b>	<b>REGRESSION AND TREE BASED MODELS</b>	<b>9</b>			
Linear Regression – Multivariate Regression – Logistic Regression – Principal Component Regression – Decision Trees, Regression Trees.					
<b>UNIT – IV</b>	<b>ENSEMBLE LEARNING</b>	<b>9</b>			
Ensemble Methods – Bagging, Committee Machines and Stacking, Boosting – Gradient Boosting, Adaptive Boosting, Random Forests – Multi-class Classification.					
<b>UNIT – V</b>	<b>UNSUPERVISED LEARNING</b>	<b>9</b>			
Introduction to Clustering – Partitional Clustering – Hierarchical Clustering – Birch Algorithm – CURE Algorithm – Density based Clustering – Expectation Maximization.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain the different types of machine learning techniques and their significance in data analysis.	Understand			
<b>CO2:</b>	Apply appropriate supervised and unsupervised learning algorithms to solve specific problems.	Apply			
<b>CO3:</b>	Implement regression and tree-based models for predictive analytics and decision-making.	Apply			
<b>CO4:</b>	Analyze different ensemble learning techniques and compare their effectiveness in classification tasks.	Analyze			
<b>CO5:</b>	Analyze clustering techniques and assess their suitability for various real-world datasets.	Analyze			
<b>CO6:</b>	Evaluate and modify existing machine learning models to improve performance for specific applications.	Evaluate			
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Stephen Marsland, “Machine Learning - An Algorithmic Perspective” 2nd Edition, CRC Press, 2015.</li><li>EthemAlpaydin, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.</li><li>K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.</li><li>C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.</li><li>Tom M. Mitchell, “Machine Learning”, McGraw Hill Indian Edition, 2013.</li><li>Yagang Zhang, “Machine Learning”, InTech, 2010.</li></ol>					

[illegible]

Course Code	Course Title	L	T	P	C
19UBM933	BIO STATISTICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To introduce the techniques used in statistical &amp; regression analysis.</li><li>To compare the various parameters used in statistical significance</li><li>To use the meta analysis for the research activities</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION</b>	<b>9</b>			
Biostatistics - Statistical problems in Biomedical research – Basic concepts: Population, Samples and Variables - Basic probability, likelihood & odds, distribution variability.					
<b>UNIT – II</b>	<b>STATISTICAL PARAMETERS</b>	<b>9</b>			
Parameterized Distributions, Measurement of Parameters, Statistical parameters p-values, computation and level chi square test and distribution					
<b>UNIT – III</b>	<b>CORRELATION AND REGRESSION ANALYSIS</b>	<b>9</b>			
Correlation – Correlation coefficient – linear correlation, Regression – Linear regression – Multiple linear regression – Multiple colinearity, Determining Best regression – Non linear regression – Logistic regression – Poisson regression					
<b>UNIT – IV</b>	<b>INTERPRETING DATA</b>	<b>9</b>			
Data interpretation methods - The qualitative and quantitative data interpretation method, Life table: Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.					
<b>UNIT – V</b>	<b>META ANALYSIS</b>	<b>9</b>			
META analysis for research activities, purpose and reading of META analysis, Forest graph, Funnel plots, Radial plots, L'Abbe plots, Criticisms of Meta analysis.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the concepts of statistical parameters, correlation and regression analysis.				Understand
<b>CO2:</b>	Explain the data tables and its interpretations in community health.				Understand
<b>CO3:</b>	Apply appropriate statistical tests based on the characteristics of the data and research question.				Apply
<b>CO4:</b>	Analyze the biomedical research data and report the study results.				Analyze
<b>CO5:</b>	Analyze and interpret complex statistical results, including identifying potential confounding factors or biases.				Analyze
<b>CO6:</b>	Interpret and critically evaluate statistical results and draw appropriate conclusions in the context of biomedical research.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Joseph A. Ingel finger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware ‘Biostatistics in Clinical Medicine’, Singapore, 3rd Edition, 1994.</li><li>Gerald van Belle, Lloyd D. Fisher, Patrick J. Heagerty, Thomas Lumley, ‘Biostatistics: A Methodology For the Health Sciences’, John Wiley &amp; Sons, 2004.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Julien I.E. Hoffman, ‘Biostatistics for Medical and Biomedical Practitioners’, Elsevier Press, 2015.</li><li>James F. Jekel, ‘Epidemiology, Biostatistics, and Preventive Medicine’, Elsevier Health Sciences, 2007.</li><li>Ray M. Merrill, ‘Fundamentals of Epidemiology and Biostatistics, Jones &amp; Bartlett Learning, 2013.</li><li>Robert H. Carver and Jane Gradwohl Nash. Doing Data Analysis with SPSS Version 18.0, (Indian Edition), Cengage Learning, New Delhi, 2012.</li></ol>					

<b>CO</b>	<b>POs</b>												<b>PSOs</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>CO1</b>	2												2	
<b>CO2</b>	3												2	
<b>CO3</b>	3	3											3	2
<b>CO4</b>	3	3		2									3	2
<b>CO5</b>	3	3		2									3	2
<b>CO6</b>	3	2		3									3	3
<b>CAM</b>	<b>2.83</b>	<b>2.75</b>		<b>2.33</b>									<b>2.67</b>	<b>2.25</b>

Course Code	Course Title	L	T	P	C
19UBM934	ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues</li><li>To tutor the basics of EMI, EMC.</li><li>To instill knowledge on the EMI coupling mechanism and its mitigation techniques.</li><li>To impart comprehensive insight about the current EMC standards and about various measurement techniques</li></ul>					
<b>UNIT – I</b>	<b>BASIC CONCEPTS</b>				<b>7</b>
Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.					
<b>UNIT – II</b>	<b>COUPLING MECHANISM</b>				<b>9</b>
Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.					
<b>UNIT – III</b>	<b>EMI MITIGATION TECHNIQUES</b>				<b>10</b>
Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.					
<b>UNIT – IV</b>	<b>STANDARDS AND REGULATION</b>				<b>7</b>
Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.					
<b>UNIT – V</b>	<b>TEST METHODS AND INSTRUMENTATION</b>				<b>12</b>
EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamental concepts of EMI & EMC and their impact on electronic systems.				Understand
<b>CO2:</b>	Apply EMI coupling mechanisms to analyze interference.				Apply
<b>CO3:</b>	Implement EMI mitigation techniques in practical applications.				Apply
<b>CO4:</b>	Analyze various EMC standards and regulations to ensure compliance with national and international guidelines.				Analyze
<b>CO5:</b>	Examine EMI/EMC test methods and instrumentation in various environments.				Analyze
<b>CO6:</b>	Evaluate EMI mitigation strategies in real-world applications.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>V.P. Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, New York, 2nd Edition, 2010</li><li>Henry W.Ott., “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, New York, 2009.</li></ol>					

**REFERENCES:**

1. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech house, Norwood, 1987
3. C.R. Paul, "Introduction to Electromagnetic Compatibility", John wiley& sons Inc. 2006.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3	2	2									2	2	
CO4	3	2											2	2
CO5	3	2		2			2					2	3	
CO6	3	2	2	2								2	3	2
CAM	2.83	2	2	2			2					2	2.4	2

Course Code	Course Title	L	T	P	C
19UBM935	SMART HEALTHCARE ENGINEERING AND ARTIFICIAL INTELLIGENCE	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the introduction of Smart Healthcare system</li><li>To discuss the challenges of AI In Healthcare</li></ul>					
<b>UNIT – I</b>	<b>INTRODUCTION TO SMART HEALTHCARE</b>				<b>9</b>
Introduction and Classification of smart Health care-Architectures: Requirements, components, characteristics - Different physical elements to form Healthcare networks - Attributes and configuration of smart Healthcare - Services available through smart healthcare - Using ICT for Healthcare - Domains in Healthcare system.					
<b>UNIT – II</b>	<b>TRENDS IN HEALTHCARE SYSTEM</b>				<b>9</b>
Using IOT in Healthcare system: Smart computing-Remote monitoring - Wearable's-connectivity -Big data - Nano Smart Healthcare - AI in healthcare - Industry Trends and Products - Challenges and opportunities of smart Health care system					
<b>UNIT – III</b>	<b>ARTIFICIAL INTELLIGENCE IN HEALTHCARE</b>				<b>9</b>
Introduction to Artificial Neural Networks – Characteristics - learning methods – taxonomy – Evolution of neural networks - AI in healthcare – Classification - Technologies of AI in Healthcare -Role of Artificial Intelligence in Healthcare - Applying AI to EHR Data: EHR Data security, Analysis, Transformation, Building models.					
<b>UNIT – IV</b>	<b>AI IN MEDICAL IMAGING</b>				<b>9</b>
Clinical fundamentals of medical imaging - Exploratory Data Analysis - Deep Learning Methods - Classification Models of Medical Images - Deploying AI Algorithms in the Real World					
<b>UNIT – V</b>	<b>APPLICATIONS OF AI SYSTEM IN HEALTHCARE</b>				<b>9</b>
Aidoc/Maxq - CT brain bleed diagnosis, IDx-DR-Detect signs of Diabetic retinopathy, iCAD-Breast density via mammography, Quantx-Breast Lesions, Coronary calcium scoring, Bay Labs-ECG EF determination, Neural Analytics, Icometrix-MRI brain implementation, Viz.ai-Stroke Diagnosis					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain the fundamentals, architecture and components of smart healthcare systems.				Understand
<b>CO2:</b>	Apply IoT and AI technologies in healthcare applications.				Apply
<b>CO3:</b>	Implement AI models for electronic health record analysis and security.				Apply
<b>CO4:</b>	Analyze AI-based medical imaging techniques and classification models.				Analyze
<b>CO5:</b>	Examine real-world AI applications in healthcare diagnostics.				Analyze
<b>CO6:</b>	Evaluate AI-driven healthcare solutions for efficiency and effectiveness.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Yen-Wei,Howlett, RobertJ.Jain, “Innovation in medicine and healthcare –Proceedings of international conference on innovation in medicine and healthcare”,2017.</li><li>Arvin Agah, “Medical applications of Artificial Intelligence”,2013</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Erik R.ranschaert,Sergey Morozov, Paul R.Algra, “Artificial intelligence in medical imaging: opportunities, applications and risk”,2019</li><li>Fernando Koch, Andrew Koster, David Riano, “Artificial Intelligence in health”, 2019</li><li>Robbie Melton, “Emerging technologies and smart health care apps and gadgets innovation”,2015</li><li>Joost van Hoof, George Demiris, Eveline J.M.Wouters, “Handbook of smart homes,Health care and well-being”,2017.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	2
CO3	3	2	2		2							2	3	2
CO4	3	2											2	2
CO5	3	2		2	2							2	3	3
CO6	3	2	2	2	2							2	3	3
CAM	3	2	2	2	2							2	2.6	2.4



## LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UBM971	Biomedical Instrumentation Systems	3	0	0	3
2.	19UBM972	Computer Applications in Medicine	3	0	0	3
3.	19UBM973	Forensic Science in Health Care	3	0	0	3
4.	19UBM974	Radiotherapy and Nuclear Medicine	3	0	0	3
5.	19UBM975	Occupational Safety and Health in Public Health Emergencies	3	0	0	3

## LIST OF INTER-DISCIPLINARY COURSES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UGM951	Electrical Hazards and Safety In Hospitals	3	0	0	3
2.	19UGM952	Bio-Fluid Mechanics	3	0	0	3

Course Code	Course Title	L	T	P	C
19UBM971	BIOMEDICAL INSTRUMENTATION SYSTEMS	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To provide a possibility for the student to acquire knowledge about the impact and interaction of light with biological tissue.</li><li>To understand practical applications of optics related to medicine.</li></ul>					
<b>UNIT – I</b>	<b>BASIC CONCEPTS OF MEDICAL INSTRUMENTATION</b>	<b>9</b>			
Medical Instrumentation systems – Classification of Biomedical instruments –Transducers Selection criteria – Bio-potentials – Electrical activity of excitable cells – Bio-potential Electrodes – Types of electrodes - Electrode behavior and circuit models.					
<b>UNIT – II</b>	<b>BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS</b>	<b>9</b>			
Types and Classification of biological signals – Electrical parameters acquisition: Origin, recording schemes – ECG, EEG, EMG – Lead systems and recording methods – Typical waveforms – Noise and artifacts – Electrical safety: Physiological Effect of Electrical Current, shock hazards – leakage current.					
<b>UNIT – III</b>	<b>MEASUREMENT OF NON ELECTRICAL PARAMETERS</b>	<b>9</b>			
Measurement of blood pressure – Cardiac output – Blood flow – Heart rate – Heart sound – Pulmonary function measurements – Spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analyzers, pH of blood – Measurement of blood pCO2, pO2, fingertip oximeter.					
<b>UNIT – IV</b>	<b>MEDICAL IMAGING SYSTEMS AND TELEMETRY</b>	<b>9</b>			
X-ray machine - Computer radiography – Computer tomography – Magnetic resonance imaging - Single photo emission computer tomography – Positron emission tomography – Ultrasonography – Endoscopy – Thermal Imaging - Different types of biotelemetry systems.					
<b>UNIT – V</b>	<b>LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES</b>	<b>9</b>			
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the fundamentals of medical instrumentation, medical imaging and therapeutic devices.				Understand
<b>CO2:</b>	Apply methods for measuring biological signals and non-electrical parameters in clinical settings.				Apply
<b>CO3:</b>	Utilize medical imaging systems, biotelemetry, and life-assisting devices for patient monitoring and treatment. .				Apply
<b>CO4:</b>	Analyze the interaction of light with tissues and the performance of diagnostic systems.				Analyze
<b>CO5:</b>	Analyze the performance of therapeutic and robotic devices in healthcare.				Analyze
<b>CO6:</b>	Evaluate the effectiveness and safety of therapeutic and robotic devices in clinical environments.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007.</li><li>Paras N. Prasad, “Introduction to Bio photonics”, A. John Wiley and sons, Inc. Publications, 2003.</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Press LLC, 2003.</li><li>Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.</li><li>R. Splinter and B.A. Hooper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007.</li><li>Helena Jelinkova, “Lasers for Medical Applications: Diagnostics, Therapy and Surgery”, Woodhead Publishing, 1st Edition, 2013.</li></ol>					



Course Code	Course Title	L	T	P	C
19UBM972	COMPUTERS APPLICATIONS IN MEDICINE	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To teach PC hardware and its related interfacing</li><li>To understand the basics of computerized data acquisition</li><li>To study the concepts of Computer Assisted Instruction and computers in patient education</li></ul>					
<b>UNIT – I</b>	<b>PC HARDWARE AND OVERVIEW</b>				<b>9</b>
System Unit – Overview of Mother Boards – Processors, Memory, Adapter cards, Ports, Power supply – BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board logics – Memory and I/O map					
<b>UNIT – II</b>	<b>PERIPHERAL INTERFACING AND CONTROLLERS</b>				<b>9</b>
Keyboard and Mouse Interfaces – Memory types: RAM, SDRAM and RDRAM, Cache memory, ROM, Flash memory – Adapter Cards – Sound Card, Modem card, Video card, Network Card – I/O slots: ISA, PCI and AGP bus slots – Ports: Serial and Parallel ports, USB, FireWire port, MIDI, SCSI, IRDA, Bluetooth Connectors – System Bus: ISA, EISA, PCI, AGP and PCI bus – Disk controllers.					
<b>UNIT – III</b>	<b>DATA ACQUISITION AND MEDICAL INFORMATION RETRIEVAL</b>				<b>9</b>
Plug-in-data acquisition and Control Boards – Data acquisition using GPIB and Serial Interfaces – Medical Information Retrieval – MEDLARS – Unified Medical Language System(UMLS) – Semantics Net – Finding useful information from the Internet					
<b>UNIT – IV</b>	<b>COMPUTER ASSISTED INSTRUCTION (CAI) IN MEDICINE</b>				<b>9</b>
Computer Assisted Instruction – Learning Process – Preclinical CAI – Visible Human Project – Active Learning Centre – Clinical Simulations – Virtual Patient Project – Problems with CAI – Interactive Multimedia Education in Medicine – Computer as an Evaluator – Computer Based Testing (CBT)					
<b>UNIT – V</b>	<b>COMPUTER ASSISTED PATIENT EDUCATION</b>				<b>9</b>
Computer Prescription – Need for computerized prescription – Health online – Electronic Communication with Patients – Patient Self-Management Education – Computers in the care of critically ill patients – Clinical notes – Clinical Information System - Computers in patient monitoring - Physiological monitoring, Automated ICU, information flow in a clinical lab.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the basics of computer hardware, data acquisition and the role of computers in medicine. [Understand]				Understand
<b>CO2:</b>	Apply peripheral interfacing, controllers and medical data acquisition systems for healthcare applications. [Apply]				Apply
<b>CO3:</b>	Utilize medical information retrieval systems and CAI tools for patient information management and education. [Apply]				Apply
<b>CO4:</b>	Analyze the role of CAI and multimedia in medical education and virtual patient simulations. [Analyze]				Analyze
<b>CO5:</b>	Analyze the application of computers in patient education, prescription management and ICU monitoring systems. [Analyze]				Analyze
<b>CO6:</b>	Evaluate the implementation, security and interoperability of Electronic Health Records in healthcare systems. [Evaluate]				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Ramachandra Lele, “Computers in Medicine Progress in Medical Informatics”, Tata McGraw Hill Publishing Company, New Delhi, 2005</li><li>N.Mathivanan, “PC Based Instrumentation: Concepts and Practice”, Prentice Hall of India, New Delhi 2007</li></ol>					

**REFERENCES:**

1. B.Govindarajalu, "IBM PC and Clones: Hardware, Trouble shooting and Maintenance", Tata McGraw Hill Publishing Company, New Delhi, 2005
2. Mohan Bansal, "Medicl informatics", Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2											
CO2	3											
CO3	3											
CO4	3	2										2
CO5	3	2		2								2
CO6	3	2		2								2
CAM	2.83	2		2								2

Course Code	Course Title	L	T	P	C
19UBM973	FORENSIC SCIENCE IN HEALTH CARE	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To explain the basic principles of forensic science, crime and criminal justice system, police organization, the role of investigator and tools and techniques used in crime science</li><li>To emphasize the importance of scientific methods in crime identification and detection.</li><li>To deal with the modus operandi and role of modus operandi bureau in crime investigation</li></ul>					
<b>UNIT – I</b>	<b>FORENSIC SCIENCE</b>	<b>9</b>			
Introduction – Definition – Principles – Laws of Forensic Science – Historical Background of Forensic Science in India - Need of Forensic Science in present scenario – Forensic Science Laboratories – their types and Divisions – Forensic Examination – Organizational set up of Forensic Science Laboratories at central and state level - Code of conduct for Forensic Scientists.					
<b>UNIT – II</b>	<b>CRIME</b>	<b>9</b>			
Definition – types of crime – causes of crime, prevention of crime – Difference in blue and white collar crime – Introduction of Cybercrime – Criminal Justice System – Criminal behavior - Functions of Police in analyzing a crime scene.					
<b>UNIT – III</b>	<b>POLICE ORGANIZATION</b>	<b>9</b>			
Organizational set up of Police at central and state level, Functions of Police – Relationship of Police and Forensic Scientist – History of different paramilitary forces.					
<b>UNIT – IV</b>	<b>CRIME SCENE</b>	<b>9</b>			
Introduction, Significance-Role of Investigator-Evaluation of crime scene – protection of crime scene – Photography of Crime scene – Tools and techniques – Significance of Photography and Videography-Introduction of Sketching – Purpose of Sketching – Making of Sketches.					
<b>UNIT – V</b>	<b>MODUS OPERANDI &amp; ROLE OF MODUS OPERANDI BUREAU IN CRIME INVESTIGATION</b>	<b>9</b>			
Investigation & examination of various types of cases – Murder – Burglary – Railway & Air Crashes – Road Accidents etc.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explicate the principles and importance of forensic science in crime investigation.				Understand
<b>CO2:</b>	Apply forensic tools, techniques and scientific methods for crime analysis.				Apply
<b>CO3:</b>	Utilize crime scene investigation techniques to document and preserve crucial information.				Apply
<b>CO4:</b>	Analyze different types of crimes, their causes, and the role of law enforcement agencies.				Analyze
<b>CO5:</b>	Examine forensic evidence such as fingerprints, DNA, ballistics and blood spatter in criminal cases.				Analyze
<b>CO6:</b>	Evaluate forensic methodologies in crime scene investigation and criminal justice.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher"s, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).</li><li>Saferstein, Richard. "Criminalistics—An Introduction to Forensic Science", 11<sup>th</sup> ed. Prentice Hall, Saddle River, NJ. 2011</li></ol>					

**REFERENCES:**

1. H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
2. V.J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton (2006).
3. T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2											
CO2	3											
CO3	3											
CO4	2	2		2			2	2				
CO5	3	2	2	2				2				
CO6	3	2	2	2		2	2	2				
CAM	2.67	2	2	2		2	2	2				

Course Code	Course Title	L	T	P	C
19UBM974	RADIOTHERAPY AND NUCLEAR MEDICINE	3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>To introduce the basic principles radiology, computed tomography and nuclear medicine</li><li>To impart knowledge on radioactivity, radiation measurement techniques and detectors</li><li>To understand the basic physics of various imaging modalities in nuclear medicine.</li><li>To gain knowledge about various detectors used in nuclear medicine.</li></ul>					
<b>UNIT – I</b>	<b>BASIC PHYSICS BEHIND RADIOACTIVITY</b>	<b>9</b>			
Physics of Radioactivity: Radionuclide Decay Terms and Relationships – Activity – Physical half Life – Fundamental Decay Equation, Nuclear Transformation – Alpha Decay, Beta Decay – Electron Capture – Isomeric Transition-Compton scattering, Pair productions- Particle interactions					
<b>UNIT – II</b>	<b>PRODUCTION OF RADIOACTIVE ELEMENTS AND RADIOACTIVITY DETECTORS</b>	<b>9</b>			
Radionuclide Production-Radiopharmaceuticals – Characteristics, applications, quality control and regulatory issues in medical imaging, Radiopharmaceutical mechanisms of localization- Radionuclide detection and measurement - Type of detectors - spectroscopy, Gas Filled detectors, Scintillation detectors, Semiconductor detectors, Pulse height spectroscopy					
<b>UNIT – III</b>	<b>NUCLEAR IMAGING</b>	<b>9</b>			
Planar Nuclear Imaging: Anger Scintillation Camera – Design and principles of operation- performance – design factors, Computers in Nuclear Imaging – Digital image formats – image acquisition – Image processing in nuclear medicine					
<b>UNIT – IV</b>	<b>DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF RADIONUCLIDE</b>	<b>9</b>			
DIAGNOSIS - PET, SPECT, Radio iodine therapy for Thyrotoxicosis, Differentiated thyroid cancers, Palliative treatment for bone metastasis - <sup>32</sup> P and <sup>89</sup> Strontium Dosage. THERAPY - Intravascular particulate radio nuclide Therapy, Receptor targeted therapy, <sup>131</sup> I- MIBG Therapy, Targeted internal radiation in HCC: <sup>90</sup> Y, Radio-synovectomy using Yttrium					
<b>UNIT – V</b>	<b>RECENT ADVANCES IN NUCLEAR MEDICINE TECHNIQUES</b>	<b>9</b>			
Recent advances in imaging and image processing techniques - image guiding for radiotherapy - Advances in equipments - SPECT, PET-CT, PET-MRI - Recent advances in Radiopharmaceuticals - PET Tracers - Cyclotron - Neuro & cardio Radiopharmaceuticals – Telemedicine - Newer computer application in nuclear medicine					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b>					
<b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the principles of radioactivity and nuclear imaging.				Understand
<b>CO2:</b>	Apply radionuclide production and radiation detection in medical imaging.				Apply
<b>CO3:</b>	Apply nuclear imaging techniques for diagnostics and therapy.				Apply
<b>CO4:</b>	Analyze the performance of imaging devices and processing techniques.				Analyze
<b>CO5:</b>	Analyze the therapeutic applications of radionuclides.				Analyze
<b>CO6:</b>	Evaluate recent advancements in nuclear medicine.				Evaluate
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"><li>Jerrold T Bushberg, J.Anthony Seibert, Edwin M Leidholdt,John M Boone, Lippincott, “The Essential Physics of Medical Imaging” Williams &amp; Wilkins,3<sup>rd</sup> edition,2011</li><li>Webb’s, “Physics of Medical Imaging”, Taylor and Francis Group”, CRC Press,2nd edition, 2012</li><li>Fred A Mettler, Milton J Guiberteau, “Essentials of nuclear Medicine and molecular imaging” 7th Edition, Elseiver, 2018</li></ol>					
<b>REFERENCES:</b>					
<ol style="list-style-type: none"><li>R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill, 2nd edition, 2003.</li><li>Gopal B.Saha, Physics and Radiation biology of NuclearMedicine-2006.</li></ol>					



CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2											
CO2	3											
CO3	3											
CO4	3	2										2
CO5	3	2										2
CO6	3	2		2								2
CAM	2.83	2		2								2

Course Code	Course Title	L	T	P	C
19UBM975	OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To impart knowledge on occupational safety and health (OSH) in public health emergencies.</li><li>To discuss about risks faced by emergency responders during disease outbreaks and other emergencies</li><li>To introduce various strategies for managing OSH in emergency situations</li></ul>					
<b>UNIT – I</b>	<b>MANAGEMENT ASPECTS</b>				<b>9</b>
Management system approach to occupational safety and health hazards and risks – rights, duties and responsibilities of employers and workers during outbreaks and emergencies – Emergency responders health monitoring and surveillance					
<b>UNIT – II</b>	<b>STRATEGIES AND TOOLS</b>				<b>9</b>
International Health Regulations, 2005 – Incident command system for managing outbreaks and emergencies – Occupational safety and health controls – Strategies for infection prevention and control					
<b>UNIT – III</b>	<b>COMMON RISKS FOR SAFETY AND HEALTH IN EMERGENCIES</b>				<b>9</b>
Vector-borne diseases, water and food-borne diseases, Vaccine-preventable diseases – Heat stress - Slips, trips and falls - Road traffic injuries – Ergonomic hazards - Violence – Psychological stress during outbreaks and injuries					
<b>UNIT – IV</b>	<b>OCCUPATIONAL SAFETY AND HEALTH IN CHEMICAL INCIDENTS</b>				<b>9</b>
Emergencies caused by chemical incidents – occupational safety and health hazards and risks of chemicals – Personal Protective Equipment – Decontamination of emergency response personnel – medical surveillance of emergency responders					
<b>UNIT – V</b>	<b>OCCUPATIONAL SAFETY AND HEALTH IN RADIATION INCIDENTS</b>				<b>9</b>
Sources and scenarios of radiation incidents – guidance for protection of emergency responders - Occupational health surveillance of persons occupationally exposed to radiation in emergencies					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Describe the significance of occupational safety and health in public health emergencies.				Understand
<b>CO2:</b>	Apply safety strategies and tools during outbreaks and emergencies.				Apply
<b>CO3:</b>	Apply appropriate risk management techniques for addressing common hazards in emergency situations.				Apply
<b>CO4:</b>	Analyze safety measures for various emergency risks.				Analyze
<b>CO5:</b>	Evaluate the effectiveness of safety protocols in emergency situations.				Analyze
<b>CO6:</b>	Evaluate the overall occupational safety and health response to public health emergencies,				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>Emergency responder health monitoring and surveillance. National Response Team technical assistance document. Atlanta (GA): National Institute for Occupational Safety and Health; 2012.</li><li>Emergency response framework (ERF). Geneva: World Health Organization; 2013</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Guidelines on occupational safety and health management systems, second edition. Geneva: International Labour Organization; 2009.</li><li>OSH management system: a tool for continual improvement. Geneva: International Labour Organization; 2011</li><li>OECD Environmental Outlook to 2050: the consequences of inaction. Paris: Organization for Economic Co-operation and Development; 2012.</li></ol>					

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2											
CO2	3											2
CO3	3					2	2					3
CO4	3	2				2	3					3
CO5	3	2					2					3
CO6	3	2				2	3					3
CAM	2.83	2				2	2.5					2.8

Course Code	Course Title	L	T	P	C
19UGM951	ELECTRICAL HAZARDS AND SAFETY IN HOSPITALS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To gain knowledge in the theory and characteristics of fluid mechanics.</li><li>To study the characteristics of flow.</li><li>To familiarize the concepts of cardiovascular physiology.</li><li>To understand the biomechanics of the human circulation.</li></ul>					
<b>UNIT – I</b>	<b>REVIEW OF BIOPOTENTIAL AND RECORDING</b>	<b>9</b>			
Electrodes as bioelectric transducers: The electrode-electrolyte interface; Specification and selection criteria for electrodes; Surface, needle, implanted electrodes; Polarisable and non-polarisable electrodes; Practical considerations for optimum performance; Reduction of interference, grounding, safety.					
<b>UNIT – II</b>	<b>ELECTRICAL STIMULATION AND ITS PARAMETERS</b>	<b>9</b>			
Use in generating evoked potentials – therapeutic correction (ECT, pacemakers, defibrillation), Safety limits and precautions; Safety: Hazards associated with the use of electrical /electronic instruments; Provisions for safety; Clinical safety norms.					
<b>UNIT – III</b>	<b>RADIATION HAZARDS &amp; SAFETY</b>	<b>9</b>			
Retorted Potentials and concepts of radiation, Radiation from a small current element. Radiation resistance: Introduction to Electromagnetic Interference and Electromagnetic compatibility, EMI coupling modes, Methods of eliminating interference, shielding, grounding, conducted EMI, EMI testing: emission testing, susceptibility testing.					
<b>UNIT – IV</b>	<b>HOSPITAL SAFETY</b>	<b>9</b>			
Security & Safety of Hospital -Property, Staff & Patients, Safety precautions, Factors Contributing to Medical Errors: Health Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA).					
<b>UNIT – V</b>	<b>ELECTRICAL &amp; FIRE SAFETY</b>	<b>9</b>			
Sources of shocks, macro & micro shocks - Hazards, monitoring and interrupting the operation from leakage current – Elements of fire, causes of fire, Action to be taken in case of fire in a Hospital.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Understand electrical safety, hazards and protocols in healthcare.	Understand			
<b>CO2:</b>	Apply safety measures when using medical equipment.	Apply			
<b>CO3:</b>	Implement safety procedures for radiation hazards and fire safety.	Apply			
<b>CO4:</b>	Analyze electrical and fire hazards and propose mitigation solutions.	Analyze			
<b>CO5:</b>	Examine and assess hospital safety standards for electrical and fire risks.	Analyze			
<b>CO6:</b>	Evaluate and improve hospital safety systems and emergency protocols.	Evaluate			
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>M.J. Aminoff , Electrodiagnosis in Clinical Neurology, 3rd edition, Churchill Livingstone, USA, 1992.</li><li>J.A. Delisa, H.J. Lee, E.M. Baran, K.S. Lai &amp; N. Spielholz , Manual of Nerve Conduction and Clinical Electrophysiology, 3rd Edition, Academic Press, New York, 1993.</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>Sharon Myers “Patient Safety &amp; Hospital Accreditation - A Model for Ensuring Success”, Springer Publishers, 2012.</li><li>Webster J.G and Albert M.Cook, Clinical Engg, Principles &amp; Practices, Prentic Hall Inc., Engle wood Cliffs, New Jersy, 1979.</li><li>Cadick, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel ; Electrical Safety Handbook by John 2005 , McGraw-Hill Professional; 3 edition</li><li>Joseph F Dyro “Clinical Engineering Handbook”, Elsevier Publishers, 2004.</li></ol>					

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3												2	
CO3	3	2					2					2	2	
CO4	3												2	
CO5	3	2		2			2					2	2	
CO6	3	2		2									2	
CAM	2.83	2		2			2					2	2	

Course Code	Course Title	L	T	P	C
19UGM952	BIOFLUID MECHANICS	3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"><li>To gain knowledge in the theory and characteristics of fluid mechanics.</li><li>To familiarize the concepts of cardiovascular physiology.</li><li>To understand the biomechanics of the human circulation.</li><li>To study the characteristics of flow.</li></ul>					
<b>UNIT – I</b>	<b>BASICS OF FLUID MECHANICS</b>	<b>9</b>			
Units and dimensions – Properties of fluids – mass density, specific weight, specific volume specific gravity, viscosity, Newton law of viscosity, compressibility, vapour pressure, surface tension and capillarity, Types of fluid, Fluid Pressure.					
<b>UNIT – II</b>	<b>FLOW CHARACTERISTICS AND FLUID DYNAMICS</b>	<b>9</b>			
Types of flow: Laminar, Turbulent, steady, unsteady, uniform, non-uniform flows, stream line, streak line, path line – continuity equation, Reynolds equation of motion,Navier stokes equation.					
<b>UNIT – III</b>	<b>FLOW THROUGH CIRCULAR CONDUITS</b>	<b>9</b>			
Boundary layer – Boundary layer thickness – Viscous flow – Hagen poiseuille equation – Major loss – Darcy Weisbach equation –friction factor – Moody diagram – minor losses.					
<b>UNIT – IV</b>	<b>CARDIOVASCULAR PHYSIOLOGY AND RHEOLOGY OF BLOOD</b>	<b>9</b>			
Introduction – Heart – Cardiac Valves – Systemic Circulation – Coronary Circulation – Pulmonary Circulation and Gas Exchange in the Lungs – Cerebral and Renal circulations – Microcirculation, Rheology of blood flow –Regulation of the Circulation – Rheology of Blood – Vascular Mechanics.					
<b>UNIT – V</b>	<b>BIOMECHANICS OF THE HUMAN CIRCULATION</b>	<b>9</b>			
<b>Static and Steady Flow Models:</b> Introduction – Hydrostatics in the Circulation – Applications of the Bernoulli Equation – Rigid Tube Flow Models – Estimation of Entrance Length and Its Effect on Flow Development in Arteries – Flow in Collapsible Vessels.					
<b>Unsteady Flow and Non-uniform Geometric Models:</b> Introduction – Windkessel Models for the Human Circulation – Continuum Models for Pulsatile Flow Dynamics – Hemodynamic Flow through Curved Arteries and Bifurcations.					
<b>TOTAL : 45 PERIODS</b>					
<b>COURSE OUTCOMES:</b> <b>At the end of the course the student will be able to:</b>					
<b>CO1:</b>	Explain fluid mechanics principles and their relevance to human circulation.				Understand
<b>CO2:</b>	Apply fluid dynamics concepts to analyze flow in circulatory systems.				Apply
<b>CO3:</b>	Use fluid mechanics equations to assess flow in biological conduits.				Apply
<b>CO4:</b>	Analyze cardiovascular mechanics, including blood rheology and circulation regulation.				Analyze
<b>CO5:</b>	Appraise human circulation using Windkessel and Bernoulli models.				Analyze
<b>CO6:</b>	Assess blood flow efficiency and its impact on cardiovascular health.				Evaluate
<b>TEXT BOOKS:</b> <ol style="list-style-type: none"><li>John F. Douglas, Janusz M. Gasiorek, John A. Swaffield, Lynne B. Jack, “Fluid Mechanics” Pearson/Prentice Hall, 2005</li><li>David Rubenstein, Wei Yin, Mary D. Frame “Biofluid Mechanics: An Introduction to Fluid Mechanics, Macrocirculation, and Microcirculation”, Academic Press, 2015</li></ol>					
<b>REFERENCES:</b> <ol style="list-style-type: none"><li>A. K. Mohanty, “Fluid Mechanics”, PHI Learning Pvt. Ltd., 1994</li><li>Shiv Kumar, “Fluid Mechanics: Basic Concepts &amp; Principles”, Ane Books Pvt Ltd, 2010</li><li>Krishnan B. Chandran, Stanley E. Rittgers, Ajit P. Yoganathan “Biofluid Mechanics: The Human Circulation,” Second Edition CRC Press, 2012.</li><li>Mazumdar Jagannath, “Biofluid Mechanics” Second Edition, World Scientific, 2015.</li></ol>					

[illegible]