SETHU INSTITUTE OF TECHNOLOGY

PULLOOR, KARIAPATTI – 626115

(An Autonomous Institution Affiliated to Anna University Chennai)

B.E. BIOMEDICAL ENGINEERING

CURRICULUM & SYLLABUS

REGULATION 2021

CHOICE BASED CREDIT SYSTEM

(Applicable to candidates admitted in the Academic Year 2021–2022)

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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

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.

SETHU INSTITUTE OF TECHNOLOGY (Autonomous)

B.E. BIOMEDICAL ENGINEERING

CURRICULUM - REGULATION 2021

(Choice Based Credit System)

OVERALL COURSE STRUCTURE

S.No.	Course Category	Total No. of Courses	Credits	Credit Percentage
1	Humanities and Social Sciences (HS)	5	9	5.56 %
2	Basic Science courses (BS)	10	28	17.28 %
3	Engineering Science courses (ES)	8	20.5	12.65 %
4	Professional Core courses (PC)	24	59.5	36.73 %
5	Professional Elective (PE)	6	18	11.11 %
6	Open Elective (OE)	4	12	7.41 %
7	Project work (P)	4	14	8.64 %
8	Mandatory Courses (MC)	9	1	0.62 %
	TOTAL	70	162	100

SEMESTER-WISE COURSE STRUCTURE – NUMBER OF COURSES

Semester	HS	BS	ES	PC	PE	OE	P	MC	TOTAL
I	1	4	4					1	10
II	1	3	3					1	8
III		1		7				1	9
IV		1	1	5				1	8
V	1			5	1	1	1	1	10
VI	1	1		4	2	1	1	1	11
VII	1			3	2	1	1	2	10
VIII					1	1	1	1	4
TOTAL	5	10	8	24	6	4	4	9	70

SEMESTER-WISE COURSE STRUCTURE – CREDITS

Semester	HS	BS	ES	PC	PE	OE	P	MC	TOTAL
I	2	11	9						22
II	1.5	8	7.5						17
III		4		18					22
IV		4	4	13					21
V	1.5			13.5	3	3	1	1	23
VI	1	1		10	6	3	4		25
VII	3			5	6	3	1		18
VIII					3	3	8		14
TOTAL	9	28	20.5	59.5	18	12	14	1	162

SEMESTER I

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UEN101	English for Technical Communication (Common to ALL Branches – Except CSBS)	HS	2	0	0	2
2.	21UMA102	Matrix and Calculus (Common to ALL Branches – Except CSBS)	BS	3	1	0	4
3.	21UPH103	Engineering Physics (Common to ALL Branches – Except CSBS)	BS	3	0	0	3
4.	21UCY105	Applied Chemistry (Common to ECE, EEE, CSE, IT, BME, BT, CSD & AIDS)	BS	3	0	0	3
5.	21UCS108	Problem Solving and Python Programming (Common to ALL Branches – Except CSBS)	ES	3	0	0	3
6.	21UME109	Engineering Graphics (Common to All Branches – Except CSBS, CSD and AIDS)	ES	3	1	0	4
Laboratory Courses							
7.	21UCS110	Problem Solving and Python Programming Laboratory (Common to ALL Branches – Except CSBS)	ES	0	0	2	1
8.	21UCS112	Engineering Fundamentals Laboratory (Common to ECE, CSE, IT, BME & BT)	ES	0	0	2	1
9.	21UGS113	Basic Sciences Laboratory – I (Common to ALL Branches – Except CSBS)	BS	0	0	2	1
Mandatory Course							
10.	21UGM131	Induction Program (Common to ALL Branches)	MC	0	3	0	P/F
			Total	17	5	6	22
Total Credits : 22							

SEMESTER II

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UEN201	Communication Skills for Professionals (Common to ALL Branches – Except CSBS)	HS	1	0	1	1.5
2.	21UMA207	Calculus, Complex Analysis and Transform Techniques (Common to AGRI, BME & BT)	BS	3	1	0	4
3.	21UPH209	Medical Physics	BS	3	0	0	3
4.	21UBM204	Human Anatomy and Physiology	ES	3	0	0	3
5	21UBM205	Electrical Circuits and Measurements	ES	3	0	0	3
Laboratory Courses							
6.	21UGS210	Basic Sciences Laboratory – II (Common to ALL Branches – Except CSBS)	BS	0	0	2	1
7.	21UBM211	Electrical Circuits Laboratory	ES	0	0	3	1.5
Mandatory Course							
8.	21UGM231	Environmental Science (Common to ALL Branches)	MC	3	0	0	P/F
			Total	16	1	6	17
Total Credits : 17							

SEMESTER III

S.No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UMA326	Transform Techniques and Partial Differential Equations (Common to AGRI, BME & BT)	BS	3	1	0	4
2.	21UBM302	Biochemistry	PC	3	0	0	3
3.	21UBM303	Principles of Signals and Systems	PC	3	0	0	3
4.	21UBM304	Semiconductor Devices and Circuits	PC	3	0	0	3
5.	21UBM305	Sensors and Measuring Techniques	PC	3	0	0	3
6.	21UBM306	Digital Logic Circuits (Integrated Course)	PC	3	0	2	4
Laboratory Courses							
7.	21UBM307	Semiconductor Devices and Circuits Laboratory	PC	0	0	2	1
8.	21UBM308	Biochemistry and Human Physiology Laboratory	PC	0	0	2	1
Mandatory Course							
9.	21UGM332	Biology for Engineering Applications (for BME only)	MC	2	0	0	P/F
			Total	20	1	6	22
Total Credits : 22							

SEMESTER IV

S.No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UMA424	Probability and Inferential Statistics (Common to BME & BT)	BS	3	1	0	4
2.	21UBM402	Principles of Digital Signal Processing	PC	3	0	0	3
3.	21UBM403	Communication Systems	PC	3	0	0	3
4.	21UBM404	Analog Integrated Circuits (Integrated Course)	PC	2	0	2	3
5.	21UBM405	Pathology and Microbiology (Integrated Course)	PC	2	0	2	3
6.	21UIT426	Data Structures using Object Oriented Programming (Integrated Course)	ES	3	0	2	4
Laboratory Courses							
7.	21UBM407	Signal Processing Laboratory	PC	0	0	2	1
Mandatory Course							
8.	21UGM431	Gender Equality (Common to ALL Branches)	MC	1	0	0	P/F
			Total	17	1	8	21
Total Credits : 21							

SEMESTER V

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UBM501	Embedded Systems and IoMT	PC	3	0	0	3
2.	21UBM502	Bio Control System	PC	3	0	0	3
3.	21UBM503	Virtual Bio Instrumentation	PC	3	0	0	3
4.	21UBM504	Biomedical Instrumentation (Integrated Course)	PC	2	0	3	3.5
5.	PE - I	Professional Elective – I	PE	3	0	0	3
6.	OE - I	Open Elective – I	OE	3	0	0	3
Laboratory Courses							
7.	21UBM507	Creative Thinking and Innovation	PW	0	0	2	1
8.	21UBM508	Embedded Systems and IoMT Laboratory	PC	0	0	2	1
9.	21UGS533	Interpersonal Skills Laboratory (Common to Mech, Civil, BME & BT)	HS	0	0	3	1.5
Mandatory Course							
10.	21UGT140	தமிழர் மரபு /Heritage of Tamil	MC	1	0	0	1
			Total	18	0	10	23
Total Credits : 23							

SEMESTER VI

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UBM601	Diagnostic and Therapeutic Equipment	PC	3	0	0	3
2.	21UBM602	Medical Imaging Equipment	PC	3	0	0	3
3.	21UBM603	Artificial Intelligence and Machine Learning Techniques	PC	3	0	0	3
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
7.	21UGS631	Logical Reasoning and Aptitude (Common to CIVIL, BME & BT)	BS	1	0	0	1
Laboratory Courses							
8.	21UBM607	Product Development Project	PW	2	0	4	4
9.	21UBM608	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	2	1
10.	21UGS632	Soft skills and Communication Laboratory (Common to Mech, ECE, Civil, BME & BT)	HS	0	0	2	1
Mandatory Course							
11.	21UGM631	Indian Constitution (Common to ALL Branches)	MC	1	0	0	P/F
			Total	22	0	8	25
Total Credits : 25							

SEMESTER VII

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UME701	Project Management and Finance (Common to ALL Branches – Except CSBS & Agri))	HS	3	0	0	3
2.	21UBM702	Medical Image Processing	PC	3	0	0	3
3.	PE – IV	Professional Elective – IV	PE	3	0	0	3
4.	PE – V	Professional Elective – V	PE	3	0	0	3
5.	OE – III	Open Elective – III*	OE	3	0	0	3
Laboratory Courses							
5.	21UGE710	Multi-disciplinary Project (Phase-I)*	PW	0	0	6	3
6.	21UBM707	Hospital Training	PC	0	0	2	1
7.	21UBM708	Medical Image Processing Laboratory	PC	0	0	2	1
8.	21UBM735	Internship	PW	-	-	-	1
Mandatory Courses							
9.	21UGM731	Sports and Social Development	MC	-	-	-	P/F
10.	21UGM732	Skill Development	MC	-	-	-	P/F
			Total	15	0	4	18
Total Credits : 18							

***** The Students those who opt for Multi-disciplinary Project (Phase-I) are exempted from taking Open Elective III

SEMESTER VIII

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	PE - VI	Professional Elective – VI	PE	3	0	0	3
2.	OE - IV	Open Elective – IV	OE	3	0	0	3
Laboratory Courses							
3.	21UBM801	Project work	PW	0	0	16	8
	21UGE810	Multi-disciplinary Project (Phase-II)	PW	0	0	16	8
Mandatory Course							
4.	21UGM831	Professional Ethics and Human Values (Common to ALL Branches)	MC	2	0	0	P/F
			Total	8	0	16	14
Total Credits : 14							

* The Students those who opt for Multi-disciplinary Project (Phase-I) are allowed to take Multi-disciplinary Project (Phase-II)

LIST OF PROFESSIONAL ELECTIVES

S. No.	Course Code	Course Title	L	T	P	C
Vertical - I : 21BMV100 Bio Engineering						
1.	21BMV101	Biomaterials, Artificial Organs and Implants	3	0	0	3
2.	21BMV102	Biomedical Optics and Biophotonics	3	0	0	3
3.	21BMV103	Principles of Tissue Engineering	3	0	0	3
4.	21BMV104	Neural Engineering	3	0	0	3
5.	21BMV105	Drug Delivery Systems	3	0	0	3
6.	21BMV106	Fundamentals of Cancer Biology	3	0	0	3
Vertical - II : 21BMV200 Medical Device Innovation and Development						
1.	21BMV201	Foundation Skills in Integrated Product Development	3	0	0	3
2.	21BMV202	Medical Device Design	3	0	0	3
3.	21BMV203	Patient safety, Standards and Ethics	3	0	0	3
4.	21BMV204	Medical Device Regulations	3	0	0	3
5.	21BMV205	Medical Innovation and Entrepreneurship	3	0	0	3
6.	21BMV206	Rapid Prototyping	3	0	0	3
Vertical - III : 21BMV300 Management (Healthcare)						
1.	21BMV301	Clinical Engineering	3	0	0	3
2.	21BMV302	Hospital Planning and Management	3	0	0	3
3.	21BMV303	Medical Waste management	3	0	0	3
4.	21BMV304	Forensic Science in Health Care	3	0	0	3
5.	21BMV305	Bio Statistics	2	0	2	3
6.	21BMV306	Economics and Management for Engineers	3	0	0	3
Vertical - IV : 21BMV400 Mechanics						
1.	21BMV401	Biomechanics	3	0	0	3
2.	21BMV402	Rehabilitation Engineering	3	0	0	3
3.	21BMV403	Physiological Modeling	3	0	0	3
4.	21BMV404	Ergonomics and Regenerative Medicine	3	0	0	3
5.	21BMV405	Haptics in Healthcare	3	0	0	3
6.	21BMV406	Assistive and Augmentative Technologies	3	0	0	3
Vertical - V : 21BMV500 Signal and Image Processing						
1.	21BMV501	Bio-Signal Processing	3	0	0	3
2.	21ECV107	Machine Vision (Common to ECE & BME)	3	0	0	3
3.	21ECV102	Speech and Audio Signal Processing (Common to ECE & BME)	3	0	0	3
4.	21BMV504	Medical Video Processing	3	0	0	3
5.	21BMV505	Brain Computer Interface and Applications	3	0	0	3
6.	21BMV506	Biometric Systems	3	0	0	3
7.	21BMV507	AI in Healthcare	3	0	0	3

Vertical - VI : 21BMV600 Communication (Healthcare)						
1.	21BMV601	Medical Wearable Devices	3	0	0	3
2.	21BMV602	Telehealth Technology	3	0	0	3
3.	21BMV603	Body Area Networks and Mobile Healthcare	3	0	0	3
4.	21BMV604	Virtual Reality and Augmented Reality in Healthcare	3	0	0	3
5.	21BMV605	Medical Informatics	3	0	0	3
6.	21BMV606	Advanced Communication Technologies for Healthcare	3	0	0	3
7.	21BMV607	Antenna's in Wearable and Implantable Devices	3	0	0	3
Vertical - VII : 21BMV700 Advanced Healthcare Devices						
1.	21BMV701	Bio-MEMS and Nano Electronics	3	0	0	3
2.	21BMV702	Human Assist Devices (Common to BME & ECE)	3	0	0	3
3.	21BMV703	Critical Care and Operation Theatre Equipment	3	0	0	3
4.	21BMV704	Therapeutic Equipment (Common to BME & ECE)	3	0	0	3
5.	21BMV705	Advancements in Healthcare Technology	3	0	0	3
6.	21BMV706	Robotics in Medicine	3	0	0	3

INDUSTRY DESIGNED COURSES / VALUE ADDED COURSES

S. No.	Course Code	Course Title	L	T	P	C
1.	21UBM861	Python Programming for Biomedical Applications	0	0	2	1
2.	21UBM862	Virtual Learning of Anatomy and Physiology	0	0	2	1
3.	21UBM863	Multi Medical Equipment Operating Skills Laboratory	0	0	2	1
4.	21UBM864	3D Printing applicable to Medical Field	0	0	2	1
5.	21UBM865	Troubleshooting and Quality Control in Medical Equipment	0	0	2	1
6.	21UBM866	Role of Biomedical Engineers in Disaster Management	1	0	0	1
7.	21UBM867	Occupational Emergency Care	1	0	0	1
8.	21UBM868	Entrepreneurship for Biomedical Engineers	1	0	0	1
9.	21UBM869	Medical Coding	1	0	0	1
10.	21UBM870	Cloud Computing for Biomedical Applications	1	0	0	1
11.	21UBM871	Data Analytics for Biomedical Engineering	1	0	0	1
12.	21VBM01	Calibration and Testing of Medical Equipment	Value added Course			
13.	21VBM02	Medical Equipment Product based Training	Value added Course			
14.	21VBM03	Hospital oriented Biomedical Equipment and Calibration Training	Value added Course			
15.	21VBM04	Advanced level Biomedical Equipment Training	Value added Course			

LIST OF OPEN ELECTIVES

(Offered for Other Branch Students)

S.No.	Course Code	Course Title	L	T	P	C
1.	21UBM971	Forensic Science	3	0	0	3
2.	21UBM972	Biomedical Instrumentation Systems	3	0	0	3
3.	21UBM973	Computer Applications in Medicine	3	0	0	3
4.	21UBM974	Assistive Technology	3	0	0	3
5.	21UBM975	Robotics in Health Care	3	0	0	3

COURSE OFFERED FOR OTHER PROGRAMMES

(Mandatory Course)

S. No.	Course Code	Course Title	L	T	P	C
1.	21UGM231	Biology for Engineers (Common to ALL Branches – Except BME & BT)	2	0	0	P/F

SEMESTER I

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UEN101	English for Technical Communication (Common to ALL Branches – Except CSBS)	HS	2	0	0	2
2.	21UMA102	Matrix and Calculus (Common to ALL Branches – Except CSBS)	BS	3	1	0	4
3.	21UPH103	Engineering Physics (Common to ALL Branches – Except CSBS)	BS	3	0	0	3
4.	21UCY105	Applied Chemistry (Common to ECE, EEE, CSE, IT, BME, BT, CSD, AIDS & AIML)	BS	3	0	0	3
5.	21UCS108	Problem Solving and Python Programming (Common to ALL Branches – Except CSBS)	ES	3	0	0	3
6.	21UME109	Engineering Graphics (Common to All Branches – Except CSBS, CSD, AIDS and AIML)	ES	3	1	0	4
Laboratory Courses							
7.	21UCS110	Problem Solving and Python Programming Laboratory (Common to ALL Branches – Except CSBS)	ES	0	0	2	1
8.	21UCS112	Engineering Fundamentals Laboratory (Common to ECE, CSE, IT, BME & BT)	ES	0	0	2	1
9.	21UGS113	Basic Sciences Laboratory – I (Common to ALL Branches – Except CSBS)	BS	0	0	2	1
Mandatory Course							
10.	21UGM131	Induction Program (Common to ALL Branches)	MC	0	3	0	P/F
			Total	17	5	6	22
Total Credits : 22							

21UEN101 ENGLISH FOR TECHNICAL COMMUNICATION

(Common to ALL Branches – Except CSBS)

L	T	P	C
2	0	0	2

OBJECTIVES:

- To enhance the vocabulary of students.
- To strengthen the application of functional grammar and basic skills.
- To improve the language proficiency of students.

UNIT – I PRESENTING ESSENTIALS OF CORRESPONDENCE 6

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 – **Vocabulary Development:** Technical Word Formation – Prefix – suffix – Synonyms and Antonyms Phrases and Clauses.

UNIT – II COMMUNICATION SKILLS 6

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 – **Grammar:** Tense – **Vocabulary Development:** Words from other languages in English.

UNIT – III CORRESPONDENCE AND VOCATION IMPROVEMENT 6

Listening: Motivational speech by Great Speakers – **Speaking:** Narrating daily events – **Reading:** Newspaper reading – **Writing:** Job application letter – Transformation of Information (Transcoding) – **Grammar:** Voice – **Vocabulary Development:** Same word in different parts of speech.

UNIT – IV PORTRAYAL AND SUMMATION 6

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:** Subject-Verb Agreement (Concord) – **Vocabulary Development:** One word substitution.

UNIT – V CRITICAL THINKING 6

Listening: Listening important messages based on news report – **Speaking:** retelling short stories – **Reading:** Organization Profile, news report – **Writing:** Precise writing, Developing Hints – Report Writing (Industrial, Accident) – **Grammar:** Spot the Errors in English

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Apply grammar effectively in writing meaningful sentences and paragraphs. [Apply]

CO2: Exhibit reading skills and comprehension to express the ideas in the given text. [Understand]

CO3: Develop writing skills to present the ideas in various formal situations. [Create]

CO4: Develop oral fluency to express the ideas in various formal situations. [Create]

CO5: Prepare Reports for various purposes. [Create]

TEXT BOOKS:

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,EnglishforTechnicalCommunication,Chennai, Scitech Publications (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								2	3		2		2
CO2	3								2	3		2		2
CO3	3								2	3		2		2
CO4	3								2	3		2		2
CO5	3								2	3		2		2
CAM	**3**								**2**	**3**		**2**		**2**

21UMA102 MATRIX AND CALCULUS

(Common to ALL Branches – Except CSBS)

L	T	P	C
3	1	0	4

OBJECTIVES:

- 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.
- To widen the students' knowledge base on linear algebra, growth rate computation and application of integrals.
- Able to integrating various types of functions using various integration methods.
- To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions
- To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field.

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 (nth 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, 8th 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, 42nd Edition, 2012.

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, 2010.
2. Glyn James, "Advanced Engineering Mathematics", Pearson Education, New Delhi, 7th Edition, 2007.
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, 3rd Edition, 2007.
4. Bharati Krishna Tirthaji, "Vedic Mathematics - Mental Calculation", Motilal Banarsi Dass Publications, New Delhi, 1st Edition, 1965.
5. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley & Sons, New York, 10th 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**	

21UPH103 ENGINEERING PHYSICS

(Common to ALL Branches – Except CSBS)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To develop the research interest in crystal physics.
- To use the principles of Lasers and its types.
- To apply principles of Quantum physics in engineering field.
- To develop knowledge on properties of materials.

UNIT – I CRYSTAL STRUCTURE 9

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 LIGHT 9

Introduction to light – optical medium – Reflection and Refraction – Total internal reflection – wave front – mathematical representation of a plane wave – wave characteristics of light superposition interference of light young's double slit experiment – bandwidth coherence thin film interference air wedge – colors in thin films Newton's rings – application of interference.

UNIT – III PHOTONICS 9

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 – IV INTRODUCTION TO QUANTUM MECHANICS 9

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 – V PROPERTIES OF SOLIDS 9

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:

1. Dr.Mani.P, “Engineering Physics”, Dhanam Publications, Edition 2018, Chennai.
2. Rajendran.V, “Engineering Physics”, Tata Mc-Graw Hill Publishing Company limited, New Delhi, Revised Edition 2018.
3. Palanisami P.K., “Physics For Engineers”, Scitech Publications (India), Pvt Ltd., Chennai, 2018.

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	2	
CO2	3	2										2		
CO3	3	2										2	2	
CO4	2	3										2		
CO5	2	3										2	2	
CO6	2	3							2			2	2	
CAM	**2.33**	**2.6**							**2**			**2**	**2**	

21UCY105 APPLIED CHEMISTRY

(Common to CSE, ECE, EEE, IT, BME, BT, AIDS, CSD, AIML, CSE(CS), CSE(IoT))

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart the knowledge on Chemical bonding and types.
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To explain the importance of smart material and green chemistry and energy storage devices.

UNIT – I CHEMICAL BONDING 9

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^2,sp^3) (C_2H_2, C_2H_4, CH_4) – bond strength and bond energy – Hydrogen bonding, Vander Waals forces.

UNIT – II WATER AND ITS TREATMENT TECHNOLOGIES 9

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.

UNIT – III SMART MATERIALS 9

Introduction to smart materials and their structure – Organic Light Emitting Diodes – Principles and applications, Liquid crystals – definition and applications.

UNIT – V GREEN CHEMISTRY 9

Introduction to Green Chemistry, the 12 Principles of Green Chemistry, toxicology and Green Chemistry, Environmental Issues, Climate and Green Chemistry, Energy and Green Chemistry, e- waste disposal.

UNIT – IV ENERGY STORAGE DEVICES 9

Batteries, fuel cells and super capacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell and application.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

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: Explain the principles and application of organic light emitting diodes, liquid crystals and green chemistry. [Understand]

CO3: Apply the knowledge of chemical bonding to identify the types of bonds in molecules. [Apply]

CO4: Apply the knowledge of the basic electrochemical cell terminology to select suitable type of energy storage devices for engineering application. [Apply]

CO5: Analyze the impurities of water to find its hardness and remove the hardness causing substances. [Analyze]

CO6: Write a report on chemical application for Industries. [A2- Respond]

TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2010.
2. Dr.Sunita Rattan, “A Textbook of Engineering Chemistry” S.K. Kataria & Sons, New Delhi, 2013.
3. Pradeep. T “A textbook of Nanoscience and Nanotechnology”, Tata McGraw - Hill education private ltd, 2012.

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.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2											1		
CO3	3													
CO4	3					2	1					1	1	
CO5		3				1	1					1		
CO6						2								
CAM	**2.5**	**3**				**1.67**	**1**					**1**	**1**	

21UCS108 PROBLEM SOLVING AND PYTHON PROGRAMMING

(Common to All B.E./ B.Tech. Branches - Except CSBS)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart the concepts in problem solving for computing.
- To familiarize the logical constructs of programming.
- To illustrate programming in Python.

UNIT – I INTRODUCTION 9

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.

UNIT – II INTRODUCTION TO PYTHON 9

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.

UNIT – III CONTROL CONSTRUCTS 9

Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-elseif-else); Iteration: state, while, for, break, continue, pass – Solving problems involving decision making and iterations.

UNIT – IV FUNCTIONS AND PACKAGES 9

Functions – function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition – Anonymous or Lambda Function, recursion – packages.

UNIT – V LISTS, TUPLES, DICTIONARIES AND STRINGS 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension – Strings: string slices; immutability, string functions and methods, string module.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the concepts of Python used to solve the computing problems. [Understand]

CO2: Apply the knowledge of arithmetic & sequential logic to solve problems related to mathematical expressions. [Apply]

CO3: Apply the concepts of Python to solve computer applied complex engineering problems that meet specified needs. [Apply]

CO4: Analyze the suitable control constructs to provide solutions to computer applied complex engineering problems. [Analyze]

CO5: Formulate problems to provide solutions to computer applied complex engineering problems using modularity. [Analyze]

CO6: Work individually or in teams and demonstrate the solutions to the given exercises through presentation. [Affective Domain]

TEXT BOOKS:

1. Ashok Namdev Kamthane & Amit Ashok Kamthane, “Problem solving and python programming”, McGraw Hill Education, 2018 (copyright)
2. Anurag Gupta & G P Biswas, “Python Programming – Problem solving, packages and libraries”, McGraw Hill Education, 2020 (copyright).

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 Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, “Fundamentals of Python: First Programs‖, 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 Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

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

21UME109 ENGINEERING GRAPHICS

(Common to All Branches – Except CSBS, CSD and AIDS)

L	T	P	C
3	1	0	4

OBJECTIVES:

- 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.
- To impart knowledge in development of surfaces and isometric projections.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 4

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.

UNIT – I PROJECTION OF SOLIDS 9

Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.

UNIT – II SECTION OF SOLIDS 9

Section of solids – simple position with cutting plane parallel, perpendicular and inclined to one of the plane.

UNIT – III DEVELOPMENT OF SURFACES 9

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids and cylinders and cones – Development of lateral surfaces of sectioned solids.

UNIT – IV ISOMETRIC PROJECTIONS 9

Principles of isometric projection – isometric scale – isometric view – isometric projections of simple solids and cut solids.

UNIT – V ORTHOGRAPHIC PROJECTION 9

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Draw orthographic projections of basic geometrical entities in various positions and translate the Geometric information of engineering objects into engineering drawings. [Understand]

CO2: Apply the principles of orthographic projections to draw projections of solids and sections of solids. [Apply]

CO3: Develop lateral surfaces of regular and sectioned solids. [Apply]

CO4: Prepare isometric drawings of simple solids from orthographic views. [Apply]

CO5: Construct orthographic projection from the given pictorial view. [Apply]

CO6: Analyze the projections of various solid models using different resting conditions. [Analyze]

TEXT BOOKS:

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 McGraw Hill 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	2													
CO2	3													
CO3	3													
CO4	3	2	2	2										
CO5	3	3	2	2										
CO6	3	2	3	3										
CAM	**2.83**	**2.33**	**2.33**	**2.33**										

21UCS110 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

(Common to All Branches - Except CSBS)

L	T	P	C
0	0	2	1

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 of180. 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:
    (i) Amount he spent for a day for diesel filling is: Rs. 15,000
    (ii) Amount he spent for a day for Driver and cleaner beta is: Rs. 3,000
    (iii) Ticket amount for a Single person is Rs: 950
    (iv) If all the seats are filled, what would be the result?
    (v) 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:

    (i) Move a tower of height-1 to an intermediate pole, using the final pole.
    (ii) Move the remaining disk to the final pole.
    (iii) 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 academyabout 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 inthe selected students list or not.
(ii) State academy selector has to order the height of students in anincremental 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 : 30 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Formulate algorithms for simple problems and translate the algorithms to a working program. [Apply]
- **CO2:** Formulate algorithms and programs for arithmetic computations and sequential logic. [Apply]
- **CO3:** Develop programs using functions, packages and use recursion to reduce redundancy. [Apply]
- **CO4:** Manipulate data using lists, tuples, and dictionaries through a program. [Analyze]
- **CO5:** Analyze the suitable control constructs to provide solutions to computer applied complex engineering problems that meet specified needs. [Analyze]
- **CO6:** Work individually or in teams and demonstrate the solutions to the given exercises through presentation [Affective Domain]

HARDWARE AND SOFTWARE REQUIRMENTS:

Hardware Requirements:

Personal Computers with 4GB RAM, 500GB HDD,
Monitor, Keyboard and Mouse – 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
CO1	3												3	
CO2	3												3	
CO3	3												3	
CO4		3											3	
CO5		3											3	
CO6									2	2			3	
CAM	3	3							2	2			3	

21UCS112 ENGINEERING FUNDAMENTALS LABORATORY
(Common to ECE, CSE, IT, BME & BT)

L	T	P	C
0	0	2	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

GROUP - A : (COMPUTER) - 15 Periods

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.

GROUP – B : (ELECTRONICS) - 15 Periods

1. 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
2. Study of logic gates
3. Soldering practice – components devices and circuits - using general purpose PCB
4. Characteristics of LED
5. Interfacing of PIR sensor with microcontroller
6. Switch control with microcontroller
7. Temperature measurement with microcontroller.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the knowledge of assembling the hardware components of computer for building the system. [Apply]
CO2: Select appropriate software components to install for proper functioning of computer system. [Apply]
CO3: Configure personal computers to link with local area network settings. [Apply]
CO4: Demonstrate the function of electronics components. [Apply]
CO5: Develop code for interfacing sensors with microcontroller. [Apply]
CO6: Work individually or in teams and demonstrate the solutions to the given exercise. [Affective domain]

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

GROUP - A : (COMPUTER)

Hardware:

LAN system with 30 nodes (or) standalone PCs – 30 Nos.

Software:

OS – UNIX clone (License free Linux)

GROUP – B : (ELECTRONICS)

EQUIPMENT:

Sl.NO.	Name of the Equipment / Software	Quantity
1.	Logic Trainer Kit	2
2.	CRO And AFO	2
3.	Small Multipurpose PCBS	5
4.	Soldering Guns	5
5.	Multimeters	5
6.	DC Ammeter	10
7.	DC Voltmeter	10
8.	Variable DC Power Supply	5
9.	Node MCU Development Board	10
10.	PIR Sensor (HC-SR501)	5
11.	Temperature Sensor (IM35 or DHT11)	5
12.	PC With Windows 7	3

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	2
CO6	3								2	2			2	2
CAM	**3**								**2**	**2**		**2**	**2**	**2**

21UGS113 BASIC SCIENCES LABORATORY – I

(Common to All B.E./ B.Tech. Branches except CSBS)

L	T	P	C
0	0	2	1

PHYSICS LABORATORY

OBJECTIVES:

- To create scientific Temper among the students.
- To know how to execute experiments properly, presentation of observations and arrival of conclusions.
- To view and realize the theoretical knowledge acquired by the students through experiments.

LIST OF EXPERIMENTS: (A minimum of FIVE experiments shall be offered)

1. Laser – Determination of particle size and wavelength of Laser source using Diode Laser.
2. Ultrasonic Interferometer - Determination of velocity of sound in liquid and compressibility of liquid.
3. Poiseuille's method - Determination of Coefficient of viscosity of liquid.
4. Spectrometer – Determination of dispersive power of a prism.
5. Air Wedge method - Determination of thickness of a thin wire.
6. Uniform bending method – Determination of Young's modulus of the given rectangular beam.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the principles of Optics, Laser physics and Elasticity to determine the Engineering properties of materials. [Apply]

CO2: Analyze the given liquid sample to determine the viscosity and compressibility of the liquid. [Analyze]

CO3: Apply the principles of Elasticity to determine the Young's modulus of the materials. [Apply]

CHEMISTRY LABORATORY

OBJECTIVES:

- To impart knowledge on basic concepts in applications of chemical analysis
- Train the students to handle various instruments.
- To acquire knowledge on the chemical analysis of various metal ions.

LIST OF EXPERIMENTS: (A minimum of FIVE experiments shall be offered)

1. Preparation of molar and normal solutions of the following substances – Oxalic acid, Sodium Carbonate, Sodium Hydroxide and Hydrochloric acid.
2. Conductometric Titration of strong acid with strong base.
3. Conductometric Titration of Mixture of Acids.

4. Estimation of Iron by Potentiometry
5. Determination of Strength of given acid using pH metry.
6. Determination of molecular weight of polymer by Viscometry.
7. Comparison of the electrical conductivity of two samples - Conductometric method.
8. Estimation of copper in brass by EDTA method.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO4: Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis. [Apply]

CO5: Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents. [Apply]

CO6: Analyze the given solution quantitatively using titration. [Analyze]

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**

21UGM131 INDUCTION PROGRAM

(Common to All Branches)

L	T	P	C
0	3	0	P/F

OBJECTIVES:

- To rejuvenate the Body and Mind.
- To strengthen Attitude and soft skills.
- To practice Moral values of life.

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 **0**

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 DEPTATMENT 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 programme of study. [Apply]

TEXT BOOKS:

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
Theory Courses							
1.	21UEN201	Communication Skills for Professionals (Common to ALL Branches – Except CSBS)	HS	1	0	1	1.5
2.	21UMA207	Calculus, Complex Analysis and Transform Techniques (Common to AGRI, BME & BT)	BS	3	1	0	4
3.	21UPH209	Medical Physics	BS	3	0	0	3
4.	21UBM204	Human Anatomy and Physiology	ES	3	0	0	3
5	21UBM205	Electrical Circuits and Measurements	ES	3	0	0	3
Laboratory Courses							
6.	21UGS210	Basic Sciences Laboratory – II (Common to ALL Branches – Except CSBS)	BS	0	0	2	1
7.	21UBM211	Electrical Circuits Laboratory	ES	0	0	3	1.5
Mandatory Course							
8.	21UGM231	Environmental Science (Common to ALL Branches)	MC	3	0	0	P/F
			Total	16	1	6	17
Total Credits : 17							

21UEN201 **COMMUNICATION SKILLS FOR PROFESSIONALS**
(Common to ALL Branches – Except CSBS)

L	T	P	C
1	0	1	1.5

OBJECTIVES:

- To improve the communication skills
- To develop the public speaking skills
- To develop their confidence and ability to speak in public
- To develop the leadership capacity

UNIT – I ERROR FREE LANGUAGE **3**

Parliamentary English words, Pronounce the words with stress, Words often confused. Finding Common Errors.

UNIT – II LUCID WRITING **3**

Principles of Communicative English, Business Letters, Writing Technical Proposal.

UNIT – III INDIVIDUAL AND TEAM WORK **3**

Creative Writing – Writing Paragraph, Dialogue Writing (Various situations), Rearrange the jumbled sentences.

UNIT – IV LIFE SKILLS **3**

Professional Ethics, Code of Conduct, Relative Clauses

UNIT – V INTERPERSONAL SKILLS **3**

Swot Analysis& Life Positions.

5 ORAL PROJECTS

PROJECT – 1 SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE (Time: 5 to 7 minutes)

- To Speak in front of an audience with courage.
- Make your message clear, with supporting material.
- Create a strong opening and conclusion.

PROJECT – 2 SPEAK ON THE CHOSEN CONTENT (Time: 5 to 7 minutes)

- Select a general topic and bring out specific purposes.
- Avoid using notes.
- Use symbolic ideas to develop your ideas.

PROJECT – 3 USE EFFECTIVE BODY LANGUAGE & INTONATION (Time: 5 to 7 minutes)

- Use appropriate posture, gestures, facial expressions and eye contact to express your ideas.
- Use proper intonation and adequate speech module.

PROJECT – 4 PRESENT YOUR TOPIC WITH VISUAL AIDS (Time: 5 to 7 minutes)

- Persuade your points with suitable illustration, specific facts, examples
- Use suitable visual aids to present your topic with confidence.

PROJECT – 5 GRASP THE ATTENTION OF THE AUDIENCE (Time: 5 to 7 minutes)

- Influence your listeners by adopting holistic viewpoint.
- Use emotions, stories, and positive quotes in your speech.

TOTAL : 15 + 15 = 30 PERIODS

COURSE OUTCOMES:

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

CO1: Communicate orally with fluency and clarity in a given contextual situation. [Responding – A2]

CO2: Adapt them to work in a group as a member or leader for effectively executing the task. [Organizing – A4]

CO3: Write language appropriately without error in any given circumstances. [Responding – A2]

CO4: Communicate information ideas and opinions in any given situations. [Responding – A2]

CO5: Present the ideas creatively with coherence for given topic. [Organizing – A4]

TEXT BOOKS:

1. Competent Communication – A Practical Guide to becoming a better speaker, Toastmasters International, USA.
2. Raman, Meenakshi, Sangeetha Sharma, Business Communication, New Delhi, Oxford University Press, 2014.
3. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.

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**		

21UMA207 CALCULUS, COMPLEX ANALYSIS AND TRANFORM TECHNIQUES

(Common to AGRI, BME & BT)

L	T	P	C
3	1	0	4

OBJECTIVES:

- 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.
- 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.
- To make the student to acquire sound knowledge of Laplace transform techniques and its applications in getting the solution of certain linear differential equations.

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 knowledge of vector calculus to solve Engineering problems. [Apply]

CO3: Apply the knowledge of complex derivatives and transformation to solve engineering problems. [Apply]

CO4: Apply the knowledge of complex integration to solve engineering problems. [Apply]

CO5: Apply the knowledge of Laplace transform to solve engineering problems. [Apply]

CO6: Explain the concept of particular integral, scalar potential, poles and periodic function. [Understand]

TEXT BOOKS:

1. Veerarajan, T. "Engineering Mathematics" Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, 2008.
3. Grewal, B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 43rd Edition, 2014.

REFERENCES:

1. Ramana, B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, 2010.
2. Brown, J.W. and Churchil R.V." Complex Variable and Applications" 7th Edition McGraw Hill Publishing Company 2004.
3. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House Pvt. Ltd., New Delhi, 3rd Edition, 2007.
4. Ince E.L "Ordinary Differential Equations", Dover Publications 1958.

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

21UPH209 MEDICAL PHYSICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Summarize the principles and effects of ionizing and non-ionizing radiation in human body.
- Explore the effects of radiation in matter and how isotopes are produced
- Understand various detectors for detecting the presence of ionizing radiation.

UNIT – I NONIONIZING RADIATION AND ITS MEDICAL APPLICATION 9

Overview of non-ionizing radiation effects – Tissue as 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.

UNIT – II PRINCIPLES OF RADIOACTIVE NUCLIDES 9

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture – Sources of Radioisotopes – Natural and Artificial radioactivity – Radionuclide used in Medicine and Technology – Decay series – Production of radio nuclides – Cyclotron produced Radionuclide – Reactor produced Radio-nuclide-fission and electron Capture reaction, radio nuclide Generator – Milking process (Technetium generator).

UNIT – III INTERACTION OF RADIATION WITH MATTER 9

Interaction of charged particles with matter – Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter – Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.

UNIT – IV PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS 9

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.

UNIT – V BASIC RADIATION QUANTITIES 9

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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the effect of non-ionizing radiation in human body and applications in the field of medicine. [Understand]

CO2: Explain the instrumental setup for measuring the intensity of light. [Understand]

CO3: Apply the suitable methods for detecting and recording the ionizing radiation and its

interaction with matter. [Apply]

CO4: Measure and record the radiation exposure to health care workers in hospitals and diagnostic centers. [Apply]

CO5: Apply the principles of radioactive nuclides in medicine. [Apply]

CO6: Analyze the interaction of ionizing and non-ionizing radiation with the human body and it's clinical significance. [Analyze]

TEXT BOOKS:

1. Gopal B.Saha, "Physics and Radiobiology of Nuclear Medicine", 4th Edition, Springer, 2013.
2. B H Brown, R H Small wood, D C Barber, P V Lawford and D R Hose, "Medical Physics and Biomedical Engineering", 2nd Edition, IOP Publishers, 2001.

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 Livingston epvt. Ltd, 2000.

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	2											2		
CO4	2	2										2		
CO5	2											2	2	
CO6	2	2										2		
CAM	**2.33**	**2**										**2**	**2**	

21UBM204 HUMAN ANATOMY AND PHYSIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explore the structural and functional elements of human body.
- To explain structure and functions of various types of organ systems of human body.
- To familiarize the fundamental relation between human anatomy and physiology.

UNIT – I CELL: STRUCTURE AND FUNCTIONS 9

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.

UNIT – II CARDIOVASCULAR AND RESPIRATORY SYSTEM 9

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 sounds to Heart pumping – classification of circulatory system – Volume and pressure changes and regulation of heart rate. Respiratory system – Lungs: Structure and functions – Types and phases of respiration – Breathing mechanism – Respiratory tract – Pulmonary ventilation and Pulmonary circulation – Regulation of respiration.

UNIT – III NERVOUS SYSTEM 9

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.

UNIT – IV DIGESTIVE AND EXCRETORY SYSTEM 9

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.

UNIT – V SKELETAL AND SENSORY SYSTEM 9

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).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the structure and functional mechanism of various organs in human body. [Understand]

CO2: Discuss and infer the diseases, disorders and conditions commonly found in human beings. [Understand]

CO3: Apply the knowledge of human anatomy to the clinical scenarios. [Apply]

CO4: Analyze various cell structures at tissue and organ levels to maintain the homeostasis condition. [Analyze]

CO5: Comparatively analyze the human heart and nervous system for the healthy people and people suffering from an illness. [Analyze]

CO6: 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											2	3	
CO3	3											2	3	
CO4	3	3											3	
CO5	3	3											3	2
CO6	3	3	2	2		3	2	2				2	3	
CAM	**2.67**	**3**	**2**	**2**		**3**	**2**	**2**				**2**	**3**	**2**

21UBM205 ELECTRICAL CIRCUITS AND MEASUREMENTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of DC and AC circuits behavior.
- To introduce different methods of circuit analysis using Network theorems.
- To study the transient and steady state response of the circuits.
- To discuss the construction and working of basic electrical instruments.

UNIT – I BASIC CIRCUITS ANALYSIS 9

Electrical circuit elements (R, L and C) – Dependent and independent sources – Ohm's Law – Kirchhoff's laws – Nodal analysis, Mesh analysis (Analysis with independent sources only). AC Circuits and Parameters: Peak, Average and RMS Values, Instantaneous power, real power, reactive power and apparent power – power factor – phasor analysis – Introduction to three phase circuits.

UNIT – II NETWORK THEOREMS 9

Network theorems – Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem and Maximum power transfer theorem – Application of Network theorems – Network reduction – voltage and current division, source transformation – star delta conversion.

UNIT – III RESONANCE, COUPLED CIRCUITS AND TRANSIENTS 9

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Transient response of RL, RC and RLC Circuits with DC excitation.

UNIT – IV BASIC ELECTRICAL MEASUREMENTS 9

Introduction – Classification of instruments – Operating principles & essential features of measuring instruments (elementary Treatment only) – Moving coil, permanent magnet (PMMC) instruments, Moving Instruments, Energy meter, Watt meter, Current Transformer, Potential Transformer.

UNIT – V ELECTRICAL WIRING AND SAFETY 9

Cable and wire types and applications, Service mains, meter board and distribution board – Brief discussion on concealed conduit wiring – Two-way and three-way control – Elementary discussion on Circuit protective devices: fuse and Miniature Circuit Breaker (MCB's) – Electric shock, precautions against shock, Objectives for Neutral and Earthing, types of earthing, pipe and plate earthing, Residual current circuit breaker.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the basic electrical elements and electromechanical Indicating Instruments. [Understand]

CO2 Elucidate the various types of wiring terminologies and electrical safety in hospitals. [Understand]

CO3: Apply the basic laws and theorems to compute voltage and current in AC and DC circuits. [Apply]

CO4: Estimate the values of various lumped network elements of resonant and coupled circuits. [Apply]

CO5: Analyze the different parameters of Electromechanical Instruments. [Analyze]

CO6: Evaluate the performance of transient circuits in bio-medical equipment. [Evaluate].

TEXT BOOKS:

1. Sudhakar A and Shyam Mohan S.P., “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2007.
2. Sawhney A.K., “Electrical & Electronic Measurement & Instruments”, Dhanpat Rai & Co. Publications, 2005.

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	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**	

21UGS210 BASIC SCIENCES LABORATORY – II

(Common to All B.E./ B.Tech. Branches except CSBS)

L	T	P	C
0	0	2	1

PHYSICS LABORATORY

OBJECTIVES:

- To analyze the Band gap, moment of inertia, thermal conductivity and rigidity modulus of the materials.
- To gain knowledge in Photonics.

LIST OF EXPERIMENTS: (A minimum of FIVE experiments shall be offered)

1. Determination of Energy band gap of a semiconductor.
2. Torsion pendulum – Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire.
3. Spectrometer - Determination of wavelength of mercury spectrum using grating.
4. Laser – Determination of numerical aperture and acceptance angle of an optical fiber.
5. Newton's rings – Determination of radius of curvature of a convex lens.
6. Lee's Disc - Determination of thermal conductivity of a bad conductor.
7. Determination of Solar cell Characteristics using optical transducers kit.
8. Digital Logic gates (Virtual lab)

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the Principles of Optics, Light and Elasticity to determine the Engineering properties of materials. [Apply]

CO2: Analyze the thermal conductivities of different bad conductors. [Analyze]

CO3: Analyze the Characteristics of a semiconductor. [Analyze]

CHEMISTRY LABORATORY

OBJECTIVES:

- To describe the theoretical concepts to perform lab experiments.
- To explain the water quality parameters.
- To impart the knowledge on water quality parameters for the analysis of industrial effluents.

LIST OF EXPERIMENTS: (A minimum of FIVE experiments shall be offered)

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of Chloride in water sample (Argentometric method).
4. Determination of DO in water.
5. Estimation of chromium in tannery wastes.
6. Estimation of available chlorine in bleaching powder.
7. Estimation of iron by Spectrophotometry.
8. Determination of acidity of industrial effluents.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO4: Apply the basic knowledge of testing methods of water to identify the water quality for environmental sustainability. [Apply]

CO5: Estimate the quality of water parameters that suits for domestic application. [Analyze]

CO6: Analyze the industrial effluents to identify the quality parameters and impurities to prevent water pollution. [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		
CAM	**3**	**3**				**3**	**3**		**3**			**2**	**2**	**2**

21UBM211 ELECTRICAL CIRCUITS LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To familiarize the basic electrical laws and network theorems.
- To determine the resonance and transient responses of RLC circuits.

LIST OF EXPERIMENTS:

1. Verification of Ohm's law.
2. Verification of Kirchoff's laws.
3. Verification of Mesh and Nodal Analysis
4. Verification of Thevenin's theorem.
5. Verification of Norton's theorem.
6. Verification of Reciprocity theorem.
7. Verification of Super Position Theorem
8. Verification of maximum power transfer
9. Determination of Resonance Frequency of Series & Parallel RLC Circuits.
10. Transient analysis of RL and RC circuits.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Validate the basic electrical laws for the given circuits. [Apply]

CO2: Apply network theorems to analyze electrical circuits. [Apply]

CO3: Design and test RLC series and parallel circuits to compute the resonant frequency and bandwidth. [Apply]

CO4: Analyze the transient response of RL & RC Circuits. [Analyze]

CO5: Verify the network theorems, resonance and transient analysis using software tools. [Analyze]

CO6: Function effectively as an individual for efficiently executing the given task. [Organize - Affective Domain]

HARDWARE REQUIRMENTS:

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

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	
CO4	3	3											2	
CO5	3	3			3									
CO6									3	3				
CAM	**3**	**3**			**3**				**3**	**3**		**2**	**2**	

21UGM231 ENVIRONMENTAL SCIENCE
(Common to All Branches)

L	T	P	C
2	0	0	P/F

OBJECTIVES:

- To explain the concepts of Environment ecosystem and Pollution.
- To impart the environmental issues in the society and the impact of environment related to human health.
- To describe the knowledge in alternative energies.

UNIT – I ENVIRONMENT AND ECOSYSTEMS 9

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.

UNIT – II ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution – pollution case studies – Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – III SOCIAL ISSUES AND THE ENVIRONMENT 9

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).

UNIT – IV HUMAN POPULATION AND THE ENVIRONMENT 9

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.

UNIT – V FUTURE POLICY AND ALTERNATIVES 9

Introduction to future policy and alternatives – fossil fuels – nuclear energy-solar energy – wind energy – hydroelectric energy – geothermal energy – tidal energy – sustainability – green power – nanotechnology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the environmental issues, consequences and suitable solution. [Understand]

CO2: Explain the various types of renewable energy sources for sustainable development of natural resources. [Understand]

CO3: Apply the principles of value education with respect to human population to preserve environment. [Apply]

CO4: Apply the knowledge of various pollution types to prevent the ecosystem and Environment. [Apply]

CO5: Analyze the environmental problem to report the social issues and provide sustainable solution. [Analyze]

CO6: Write a report on environmental issues and provide solution for sustainable

development. [Respond – A2]

TEXT BOOKS:

1. Anubha Kaushik, kaushik C.P., “Environmental Science and Engineering”, Third Edition, New Age International, New Delhi, 2009.
2. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.

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	3					2		
CO2	2					2	3					2		
CO3	3					2	3	3				2		1
CO4	3					2	3					2		1
CO5		3				2	3					2		1
CO6						2	3					2		
CAM	2.5	3				2	3	3				2		1

SEMESTER III

S.No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UMA326	Transform Techniques and Partial Differential Equations (Common to AGRI, BME & BT)	BS	3	1	0	4
2.	21UBM302	Biochemistry	PC	3	0	0	3
3.	21UBM303	Principles of Signals and Systems	PC	3	0	0	3
4.	21UBM304	Semiconductor Devices and Circuits	PC	3	0	0	3
5.	21UBM305	Sensors and Measuring Techniques	PC	3	0	0	3
6.	21UBM306	Digital Logic Circuits (Integrated Course)	PC	3	0	2	4
Laboratory Courses							
7.	21UBM307	Semiconductor Devices and Circuits Laboratory	PC	0	0	2	1
8.	21UBM308	Biochemistry and Human Physiology Laboratory	PC	0	0	2	1
Mandatory Course							
9.	21UGM332	Biology for Engineering Applications (for BME only)	MC	2	0	0	P/F
			Total	20	1	6	22
Total Credits : 22							

21UMA326 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to AGRI, BME, BT & CHE)

L	T	P	C
3	1	0	4

OBJECTIVES:

- To make the student knowledgeable in formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.
- 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.
- 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.

UNIT – I FOURIER SERIES 9 + 3

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.

UNIT – II FOURIER TRANSFORM 9 + 3

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.

UNIT – III Z-TRANSFORM AND DIFFERENCE EQUATIONS 9 + 3

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value Theorems - Formation of difference equations – Solution of difference equations.

UNIT – IV PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

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.

UNIT – V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

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.

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 Fourier series to solve Engineering problems. [Apply]

CO2: Apply the knowledge of Fourier transform and its properties to solve Engineering problems. [Apply]

CO3: Apply the knowledge of Z transform to solve the Engineering problems. [Apply]

CO4: Apply the knowledge of PDE in solving linear, higher order and one dimensional Wave, Heat flow Apply the knowledge of partial differential equation to solve the Engineering problems. [Apply]

CO5: Apply the knowledge of Applications of PDE to solve the Engineering problems. [Apply]

CO6: Explain the concepts of Fourier series, Transforms and PDE. [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	2	
CO2	3											1	2	
CO3	3											1	2	
CO4	3											1	2	
CO5	3											1	2	
CO6	2											1	2	
CAM	**2.83**											**1**	**2**	

21UBM302 BIOCHEMISTRY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about fundamentals of chemical foundations of biology.
- To explore the principle of general techniques and study its biomedical applications.
- To study structural & functional properties of carbohydrates, proteins, lipids and nucleic acids.
- To emphasize the overview of metabolic pathways of bio-molecules and their biomedical significance.

UNIT – I BIOCHEMISTRY : CHEMICAL BASIS OF LIFE 9

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.

UNIT – II METABOLISM OF CARBOHYDRATES 9

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.

UNIT – III PROTEINS, AMINO AND NUCLEIC ACIDS 9

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.

UNIT – IV ENZYME AND LIPID METABOLISM 9

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.

UNIT – V ENVIRONMENTAL BIOCHEMISTRY AND GENERAL TECHNIQUES 9

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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the structural and functional components of bio-molecules and enzymes. [Understand]

CO2: Analyze the physical and chemical properties of bio-molecules and enzymes. [Analyze]

CO3: Apply the knowledge of body fluid composition and function to interpret the clinical laboratory reports. [Apply]

CO4: Analyze biochemical processes involved in the metabolic pathways of bio-molecules and its metabolic activity in normal and abnormal conditions. [Analyze]

CO5: Apply the characteristics of genetic materials to determine the genetic disorder. [Apply]

CO6: 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	
CO2	3	2											2	
CO3	3	2				2	2	2					2	
CO4	3	3		2					2	2			2	
CO5	3	3							2	2		2	2	
CO6	3	3	2	2			3					3	2	
CAM	**2.83**	**2.6**	**2**	**2**		**2**	**2.5**	**2**	**2**	**2**		**2.5**	**2**	

21UBM303 PRINCIPLES OF SIGNALS AND SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain classifications and properties of signal & systems
- To introduce Laplace Transform, Fourier transform, Z transform and their properties.
- To characterize LTI systems in the Time domain and various Transform domains.

UNIT – I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

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.

UNIT – II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series analysis – Spectrum of Continuous Time (CT) signals – Fourier and Laplace Transforms in CT Signal Analysis – Properties.

UNIT – III LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS 9

Differential Equation – Block diagram representation – impulse response, convolution integrals – Fourier and Laplace transforms in Analysis of CT systems.

UNIT – IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling – DTFT – Properties of DTFT – Z Transform – Properties of Z Transform.

UNIT – V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Difference Equations – Block diagram representation – Impulse response – Convolution sum – Discrete Fourier and Z Transform Analysis of Recursive & Non-recursive systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the fundamental concepts of continuous time and discrete time signals and systems. [Understand]

CO2: Classify the signals and systems by applying their properties. [Apply]

CO3: Apply various transform techniques to solve the problems related to signals and systems. [Apply]

CO4: Analyze the LTI systems to different input signals considering factors such as system stability, transient response and frequency response. [Analyze]

CO5: Evaluate the characteristics of continuous time and discrete time systems using properties of convolution. [Evaluate]

CO6: Assess the effectiveness of various transforming techniques in solving real world engineering problems. [Evaluate]

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, Indian Reprint, 2nd Edition, 2015.
2. S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2nd Edition, 2007.

REFERENCES:

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
4. M.J.Roberts, “Signals & Systems - Analysis using Transform Methods & MATLAB”, Tata McGraw Hill, 2012.

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	2						2	2		2	3	3
CAM	**2.83**	**2.6**	**2**		**2**				**2**	**2**		**2**	**2.17**	**2.17**

21UBM304 SEMICONDUCTOR DEVICES AND CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the working of various semiconductor devices.
- To explain the concept of amplifiers, regulators and oscillators using transistors.
- To learn the required functionality of positive and negative feedback systems.

UNIT – I SEMICONDUCTOR DIODES &TRANSISTOR 9

PN Junction – Structure and Operation – Current components in a PN diode – Junction capacitance – Junction diode switching time – Rectifiers – 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.

UNIT – II FET, UJT and SCR 9

JFET – Characteristics and parameters – JFET biasing, self-bias, voltage divider bias – Q point – MOSFET – Characteristics and parameters – Characteristics of UJT and SCR.

UNIT – III AMPLIFIERS 9

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).

UNIT – IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – Voltage/current, series/shunt feedback – Positive feedback – Condition for oscillators – Phase shift – Wein Bridge – Hartley-Colpitts and Crystal oscillators.

UNIT – V PULSE CIRCUITS AND REGULATORS 9

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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the structure and working of basic electronic devices. [Understand]

CO2: Identify the various transistor biasing and compensation circuit parameters. [Apply]

CO3: Analyze the different characteristics of diodes, transistors and amplifiers. [Analyze]

CO4: Design a power supply, regulator and filter for the given requirements. [Apply]

CO5: Estimate the exact analysis and approximate analysis for amplifiers. [Evaluate]

CO6: Design the Oscillators and wave shaping circuits for given specifications. [Create]

TEXT BOOKS:

1. Millman and Halkias, "Electronic Devices and Circuits", Tata McGraw–Hill, 2007.
2. Floyd, T.L, "Electronic Device" 7th Edition, Pearson Education, 2008.

REFERENCES:

1. Millman, J., PrakashRao., M.S. and Taub, H., “Pulse Digital and Switching Wave Forms", McGraw-Hill, 2nd Edition, 2007.
2. Streetman,B. and Sanjay,B., “Solid State Electronic Devices", Prentice-Hall of India, 5th Edition, 2005.
3. Mottershead, A., “Electronic Devices and Circuits an Introduction", Prentice Hall of India, 2003.
4. Boylsted and Nashelsky, “Electronic Devices and Circuit Theory”, Prentice Hall of India, 6th Edition, 1999.

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	
CO4	3	2			2				2			2	3	
CO5	3	3	2										2	
CO6	3	3	2						2			2	3	
CAM	**2.83**	**2.5**	**2**		**2**				**2**			**2**	**2.5**	

21UBM305 SENSORS AND MEASURING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the purpose of measurement, the methods of measurements and errors associated with measurements.
- To explore the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
- To familiarize the different bridges, signal analyzers, display and recording devices.

UNIT – I MEASUREMENT SYSTEM AND BASICS OF TRANSDUCERS 9

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.

UNIT – II DISPLACEMENT, PRESSURE AND TEMPERATURE SENSORS 9

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.

UNIT – III PHOTOELECTRIC, PIEZOELECTRIC AND OTHER SENSORS 9

Phototube – Scintillation counter – Photo Multiplier Tube (PMT) – Photovoltaic, Photo conductive cells – Photo diodes – Phototransistor – Comparison of photoelectric transducers – Spectrophotometric applications of photo electric transducers – Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer – Digital Transducers – Introduction to MEMS and Nano sensors.

UNIT – IV BRIDGE CIRCUITS AND SIGNAL ANALYZERS 9

AC and DC Bridges – Wheat stone bridge, Kelvin, Maxwell, Hay, Wien, Schering bridges – Function generator – Wave analyzer – Spectrum analyzer.

UNIT – V DISPLAY AND RECORDING DEVICES 9

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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the concepts of instrumentation and measurement system. [Understand]

CO2: Apply the fundamentals of physics to the various sensors and measuring devices. [Apply]

CO3: Select appropriate sensors and signal conditioning circuits for given requirements. [Apply]

CO4: Analyze the performance of the various sensors and display/recording devices for specific biomedical application. [Analyze]

CO5: Analyze the impact of environmental factors on the performance of bridge circuits and photo/piezoelectric transducers-based medical devices. [Analyze]

CO6: Evaluate new sensor technologies / measurement methodologies to address the emerging challenges in healthcare. [Evaluate]

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., "Measurement Systems – Applications and Design", Tata McGraw-Hill Education Pvt. Ltd., 6th Edition, 2011.
2. Albert D.Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.

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											3	
CO4	3	3	2			2		2	2	2		2	3	
CO5	3	3					3					2	3	
CO6	3	3	2	2		2		2	2	2		2	3	2
CAM	**2.83**	**2.6**	**2**	**2**		**2**	**3**	**2**	**2**	**2**		**2**	**2.83**	**2**

21UBM306 DIGITAL LOGIC CIRCUITS
(Integrated Course)

L	T	P	C
3	0	2	4

OBJECTIVES:

- Minimize Boolean expressions in different forms and implement them using logic gates.
- Design and Analyze combinational circuits.
- Design synchronous and asynchronous sequential circuits for a given specification.
- Analyze the characteristics and structure of different memory systems and programmable logic devices.

UNIT – I LOGIC GATES AND MINIMIZATION TECHNIQUES 9 + 6

Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR – Boolean Algebra – Minimization Techniques: Boolean postulates and laws – De–Morgan's Theorem – Principle of Duality – Boolean expression – Standard Form, Canonical Form, Minimization of Boolean expressions using Boolean laws and theorem – Sum of Products (SOP) – Product of Sums (POS) – Don't care conditions – Minimization of Boolean expressions up to 5 variables using Karnaugh map and Quine McCluskey method.

Laboratory Experiments:

1. Verification of Logic Gates.
2. Verify the NAND and NOR gates as universal logic gates.
3. Verification of Boolean theorems using logic gates in both SOP and POS forms.

UNIT – II COMBINATIONAL CIRCUITS 9 + 9

Design procedure – Half / Full adder – Half / Full subtractor – Parallel binary adder / Subtractor – Serial Adder / Subtractor – Carry Look Ahead adder – BCD adder – Binary Multiplier – Binary Divider – Multiplexer / Demultiplexer – Decoder – Encoder – Parity checker – Parity generators – Code converters – Magnitude Comparator.

Laboratory Experiments:

1. Implementation of Adder/ Subtractor circuits.
2. Design and implementation of code converters using logic gates (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa.
3. Design and implementation of Multiplexer and De-multiplexer circuits using logic gates.
4. Design and implementation of encoder and decoder circuits using logic gates.
5. Design and implementation of odd/even parity checker and generator.
6. Design and implementation of 2 bit Magnitude Comparator using logic gates.

UNIT – III SEQUENTIAL CIRCUITS 9 + 6

Latches, Flip flops – SR, D, JK, T and Master-Slave – Characteristic table and equation – Application table – Edge and level Triggering – Realization of one flip flop using other flip flops – Asynchronous Ripple counter – Synchronous counters – Up/Down counters – Design of Synchronous counters – Modulo-n counter – Shift registers – Ring counter – Shift counter.

Laboratory Experiments:

1. Verification of Flip-flops using basic and universal logic gates.

2. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters.
3. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip-flops.

UNIT – IV DESIGN OF SEQUENTIAL CIRCUITS 9 + 6

Synchronous Sequential Circuits: General Model – Classification – Design and analysis of Synchronous Sequential Circuits – Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – races and hazards – Design of Hazard Free Switching circuits.

Laboratory Experiments:

1. Design and implementation of 3-bit synchronous up/down counter.
2. Design and implementation mealy and moore machines.

UNIT – V MEMORY DEVICES AND PROGRAMMABLE LOGIC DEVICES 9 + 6

Classification of memories – ROM, PROM, EPROM, EEPROM, EAPROM – RAM –- Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using ROM, PLA, PAL.

Laboratory Experiments:

1. Design logic circuits using PLD.

TOTAL : 30 (L) + 30 (P) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the functional blocks of digital circuits. [Understand]

CO2: Apply the fundamental concepts of digital electronics to design digital Logic circuits. [Apply]

CO3: Design various combinational and sequential circuits to meet the given functional requirements. [Apply]

CO4: Analyze the digital circuits to verify their functionalities for various input conditions. [Analyze]

CO5: Analyze the structure and characteristics of various memory devices and programmable logic devices. [Analyze]

CO6: Simulate and analyze digital circuits using software tools. [Analyze]

TEXT BOOKS:

1. M.Morris Mano and Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL”, 5th Edition, Pearson Education Pvt. Ltd., 2012.
2. S.Salivahanan and S.Arivazhagan, “Digital Circuits and Design”, 5th Edition, Oxford University Press, 2018.

REFERENCES:

1. John F.Wakerly, “Digital Design: Principles and Practices”, 4th Edition, Pearson/PHI, 2005.
2. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 1996.
3. Charles H.RothJr&Larry L Kinney, “Fundamentals of Logic Design”, 7th Edition, Cenage Learning, 2013.

4. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 7th Edition, TMH, 2011.
5. William H. Gothmann, “Digital Electronics: An Introduction to Theory and Practice”, 2nd Edition, PHI, 2009.
6. Thomas L. Floyd, “Digital Fundamentals”, 11th Edition, Pearson Education Inc, 2015
7. Donald D.Givone,“Digital Principles and Design”, TMH, 2003.

HARDWARE / SOFTWARE REQUIREMENTS:

Sl. No.	Name of the equipment	Quantity required
1.	Digital IC trainer Kit	8
2.	Digital Multimeter	5
3.	Bread boards	10
4.	Chip IC – 7400	20
5.	Chip IC – 7402	20
6.	Chip IC – 7408	20
7.	Chip IC – 7432	20
8.	Chip IC – 7486	15
9.	Chip IC – 7411	5
10.	Chip IC – 7410	10
11.	Chip IC – 74153	10
12.	Chip IC – 7474	10
13.	Chip IC – 7490	10
14.	Chip IC – 7447	10
15.	Chip IC – 7476	10
16.	Chip IC – 7420	10
17.	Chip IC – 7404	20
18.	Digital IC Tester	1
19.	Personal Computer 8GB RAM 1TB HDD	5
20.	Open source Simulation Software LTSPICE	5

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	3	2									2	2	
CO3	3	3	2									2	2	
CO4	3	3		2								2	2	
CO5	3	3		2								2	2	
CO6	3	2	2	2	3							2	3	
CAM	**2.83**	**2.8**	**2**	**2**	**3**							**2**	**2.17**	

21UBM307 SEMICONDUCTOR DEVICES AND CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

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

TOTAL : 30 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: Simulate and analyze circuits using suitable software tool. [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 REQUIRMENTS:

S.No	Name of the equipment	Range / Specification	Quantity Required
1.	Regulated Power Supply	0-30V, 2A	8
2.	CRO	30MHZ	3
3.	Function Generator	3MHZ	3
4.	Digit digital multimeter	500mA/250V	8
5.	Bread Boards	-----	10
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, 0-50mA, 0-30mA	15
14.	Micro Ammeter	(0-100mA), (0-50mA)	5
15.	Low range voltmeter	(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												2	
CO2	3	2											2	
CO3	3	2											3	
CO4	3	3	3		3	2						2		
CO5	3	2			2	2			3	2		2		
CO6						2			3	2		2		
CAM	**2.8**	**2.25**	**3**		**2.5**	**2**			**3**	**2**		**2**	**2.33**	

21UBM308 BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

To impart knowledge on:

- Estimation and quantification of biomolecules.
- Separation of macromolecules.
- Interpretation of metabolic changes in pathological conditions.

LIST OF EXPERIMENTS:

Biochemistry:

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of solutions: Percentage solutions, Molar solutions, and Normal solutions
3. Standardization of pH meter, preparation of buffers, emulsions.
4. Separation of amino acids by thin layer chromatography.
5. Preparation of serum and plasma from blood and estimation of Haemoglobin
6. Estimation of blood glucose & cholesterol.
7. Estimation of creatinine.
8. Estimation of urea and Uric acid
9. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
10. Separation of DNA by agarose gel electrophoresis. (demo)
11. Separation of proteins by SDS electrophoresis. (demo)

Human Physiology:

12. Identification of Blood groups
13. Differential count of Blood cells
14. Total RBC and WBC count.
15. ESR, PCV, MCH, MCV and MCHC estimation.
16. Assay of SGOT/SGPT.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate various biochemical reactions using human body fluids or in given samples and quantify the bio-molecules. [Apply]

CO2: Examine normal and abnormal biochemical reactions in human body and quantitative analysis of blood glucose, creatinine, urea and cholesterol. [Analyze]

CO3: Evaluate the composition of blood and urine samples. [Evaluate]

CO4: Implement experimental protocols and adapt to plan and carryout simple investigations. [Create]

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 REQUIRMENTS:

S.No	Name of the equipment	Quantity Required
1.	Spectrophotometer	1
2.	Microscope	3
3.	Colorimeter	2
4.	pH meter	1
5.	Refrigerator	1
6.	Vortex Shaker	2
7.	SDS gel electrophoresis	1
8.	TLC plates	1
9.	Wintrobes tube	1
10.	Centrifuge Normal	1
11.	Microslides	2 packets
12.	Lancet	5 boxes
13.	Test Tubes	2 boxes
14.	Neubaur's Chamber	1
15.	Heparinized Syringe	1 box
16.	Haemoglobinometer	1
17.	Capillary tubes	1 box
18.	Blood grouping kit	1
19.	Cover slip	1 box
20.	Water bath	1
21.	Oven	1
22.	PCV tube	2
23.	Weighing Machine	1

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					3	
CO3	3	3							2	2		2	2	
CO4	3	3	2					2	2	2		2	3	
CO5	3	2				2		2	3	2		2		
CO6									3	2		2		
CAM	**3**	**2.8**	**2**			**2**	**2**	**2**	**2.5**	**2**		**2**	**2.5**	

21UGM332 BIOLOGY FOR ENGINEERING APPLICATIONS
(for BME only)

L	T	P	C
2	0	0	P/F

OBJECTIVES:

- To explain the essentials of basic biological principles.
- To familiarize the different clinical and industrial applications of biology for solving societal problems with engineering tools.

UNIT – I INTRODUCTION TO LIFE 5

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.

UNIT – II BIODIVERSITY 5

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.

UNIT – III BASICS OF CELL AND MOLECULAR BIOLOGY 6

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.

UNIT – IV HUMAN DISEASES 7

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.

UNIT – V BIOLOGY AND ITS INDUSTRIAL AND CLINICAL APPLICATION 7

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.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of living things, their classification, cell structure and biochemical constituents. [Understand]

CO2: Apply the concept of plant, animal and microbial systems and growth in real life situations. [Apply]

CO3: Analyze biological engineering principles, procedures needed to solve societal issues. [Analyze]

TEXT BOOKS:

1. Satyanarayana, U. “Biotechnology”, 4th Edition, Books and Allied Pvt. Ltd. Kolkata, 2007.
2. Carol D. Tamparo and Marcia A. “Diseases of the Human Body”, Lewis, F.A. Davis Company, 2011.
3. R. Khandpur, “Biomedical instrumentation - Technology and applications”, McGraw Hill Professional, 2004.

REFERENCES:

1. Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry”, CBS Publications 2017.
2. Arthur T. Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2nd Edition, 2019.
3. 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.
4. B.D. Singh, “Biotechnology: Expanding horizon”, Kalyani Publishers, 2015.

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

SEMESTER IV

S.No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UMA424	Probability and Inferential Statistics (Common to BME & BT)	BS	3	1	0	4
2.	21UBM402	Principles of Digital Signal Processing	PC	3	0	0	3
3.	21UBM403	Communication Systems	PC	3	0	0	3
4.	21UBM404	Analog Integrated Circuits (Integrated Course)	PC	2	0	2	3
5.	21UBM405	Pathology and Microbiology (Integrated Course)	PC	2	0	2	3
6.	21UIT426	Data Structures using Object Oriented Programming (Integrated Course)	ES	3	0	2	4
Laboratory Courses							
7.	21UBM407	Signal Processing Laboratory	PC	0	0	2	1
Mandatory Course							
8.	21UGM431	Gender Equality (Common to ALL Branches)	MC	1	0	0	P/F
			Total	17	1	8	21
Total Credits : 21							

21UMA424 PROBABILITY AND INFERENTIAL STATISTICS
(Common to BME & BT)

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide necessary basic probability concepts and standard distributions that can describe real life phenomena.
- To make the student acquire skills in handling situations involving more than one random variable and functions of random variables.
- To make the student understand and characterize phenomena which evolve with respect to time in probabilistic manner.
- To familiarize the student to analyze the response of random inputs to linear time invariant systems.

UNIT – I PROBABILITY & STATISTICAL DISTRIBUTIONS 9 + 3

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.

UNIT – II TWO DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint probability distributions – Marginal and Conditional distributions – Covariance – Correlation and Regression – Transformation of random variables – Central limit theorem.

UNIT – III CORRELATION AND SPECTRAL DENSITIES 9 + 3

Random Process – Introduction – Auto Correlation Functions – Cross Correlation Functions – Properties – Power Spectral density – Cross spectral density – Applications of correlations and Spectral Densities.

UNIT – IV LINEAR SYSTEMS WITH RANDOM INPUTS 9 + 3

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output – White noise.

UNIT – V TESTING OF HYPOTHESIS 9 + 3

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.

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 probability to solve Engineering problems. [Apply]

CO2: Analyze the concept of correlation and Regression to solve Engineering problems. [Analyze]

CO3: Apply the knowledge of correlations and spectral densities in random process. [Apply]

CO4: Apply the knowledge of random process in linear system with random inputs in the areas of communication and signal processing. [Apply]

CO5: Analyze the concept of testing of hypothesis for small and large samples in Real life Problems. [Analyze]

CO6: Explain the basic concept of probability, Random Variable and statistics. [Understand]

TEXT BOOKS:

1. Veerarajan, "Probability and Random Processes", 4th edition, 2015.
2. Gupta S.C, Kapoor V.K. "Fundamental of Mathematical Statistics" 10th Edition, Sultan Chand and Sons, New Delhi, 2002.

REFERENCES:

1. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India, Bangalore, 2nd Edition, 2012.
2. Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Asia, 3rd 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, 8th 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, 1st Indian Reprint, 2007.
6. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, New Delhi, 4th Edition, 2002.

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

21UBM402 PRINCIPLES OF DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn discrete Fourier transform and its computation techniques
- To impart knowledge on design techniques of digital filters
- To discuss the concept of Finite word length effects
- To introduce the concept of Signal Processing and Digital Signal Processors

UNIT – I DISCRETE FOURIER TRANSFORM 9

Review of discrete time signals & systems – Discrete Fourier Transform (DFT) – Properties of DFT – Circular Convolution – Linear filtering using DFT – Filtering long data sequences – overlap save and overlap add method – FFT Algorithms – Decimation in time Algorithms, Decimation in frequency Algorithms – Radix 2 method – Linear filtering using FFT.

UNIT – II IIR FILTER DESIGN 9

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

UNIT – III FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Fourier Series – Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window) – Frequency sampling techniques.

UNIT – IV FINITE WORD LENGTH EFFECTS 9

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.

UNIT – V MULTIRATE SIGNAL PROCESSING AND DIGITAL SIGNAL PROCESSORS

Introduction to Multi-rate signal processing – Decimation – Interpolation – Polyphase decomposition of FIR filter – Multistage implementation of sampling rate conversion – Applications of Multi-rate signal processing – Digital Signal Processors – circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the functions and fundamental concepts of various DSP algorithms and processors. [Understand]

CO2: Apply transformation techniques to design and implement digital filters for specific signal processing requirements. [Apply]

CO3: Apply the digital signal processing algorithms to process the real time signals. [Apply]

CO4: Analyze the impact of design parameters and DSP architecture for different application based on requirements. [Analyze]

CO5: Evaluate various signal transformation techniques and the impact of finite word length effects. [Evaluate]

CO6: Simulate various DSP algorithms for real-time applications using open source software. [Apply]

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2010.
2. S.Salivahanan, A.Vallavaraj, C.Gnanapriya” Digital Signal Processing”, Tata McGraw Hill, 2007.

REFERENCES:

1. Oppenheim A V,” Discrete Time Signal Processing”, Prentice Hall India, New Delhi, 2010.
2. Emmanuel C.Ifeachor, & Barrie.W.Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.
3. David J. Defatta, Joseph G. Lucas, William S. Hodgkiss,” Digital signal processing: A system design approach”, John Wiley, 1995.
4. B.Venkataramani, M.Bhaskar,” Digital Signal Processor, Architecture, Programming and Applications”, Tata McGraw Hill, 2011.

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	2		3			2				2	3	2
CO4	3	3	3	2					2			2	3	3
CO5	3	3											2	
CO6	3	2			3							2	2	3
CAM	**2.83**	**2.5**	**2.5**	**2**	**3**			**2**	**2**			**2**	**2.5**	**2.5**

21UBM403 COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of analog and digital communication
- To provide the knowledge of various coding techniques for data transmission
- To gain knowledge on spread spectrum and multiple access techniques

UNIT – I ANALOG COMMUNICATION 9

Introduction to Communication Systems – Modulation – Types – Need for Modulation – Amplitude Modulation – DSBSC, SSBSC, VSB – Angle modulation – PM and FM – Comparison of various Analog Communication Systems (AM - FM - PM) – Modulators and Demodulators.

UNIT – II DIGITAL TRANSMISSION 9

Introductions to Pulse modulation – Pulse Code Modulation – PCM sampling – Sampling Rate – Quantization and Folded Binary Code – Dynamic Range – Signal-to-Quantization Noise Ratio – Analog companding – Digital companding - Delta modulation – Adaptive Delta Modulation.

UNIT – III DIGITAL COMMUNICATION 9

Introduction – Digital Amplitude Modulation – Frequency shift keying – Binary Phase shift keying – Quadrature phase shift keying – 8-PSK – 16-PSK – Quadrature Amplitude Modulation.

UNIT – IV ERROR CONTROL CODING TECHNIQUES 9

Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes (CRC) – Convolutional codes – Viterbi decoding (Soft/Hard decision decoding).

UNIT – V SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES 9

Introduction – Pseudo-noise sequence – DS spread spectrum with coherent binary PSK – Processing gain – FH spread spectrum – Multiple access techniques – FDMA – TDMA – CDMA – OFDMA.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basic concepts of different modulation techniques in communication systems. [Understand]

CO2: Apply the knowledge of mathematical theory to construct the analog and digital transmission schemes for various medical conditions. [Apply]

CO3: Apply the knowledge of coding techniques and information theory for efficient baseband signals in medical field. [Apply]

CO4: Analyze the performance of efficient source/error control coding and multiple access techniques. [Analyze]

CO5: Analyze the different approaches of modulation techniques related to biomedical applications. [Analyze]

CO6: Evaluate the applications of communication systems in the biomedical field. [Evaluate]

TEXT BOOKS:

1. Simon Haykin and Michael Moher, “Communication Systems” John Wiley & Sons, Fifth Edition, 2016.

2. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson New International Edition, 2014.

REFERENCES:

1. John G Proakis, and MasoudSalehi, “Fundamentals of Communication Systems” Pearson, 2nd Edition, 2014.
2. H.Taub, D L Schilling, G Saha,”Principles of Communication”, 3rd Edition, 2007.
3. B.P.Lathi,”Modern Analog and Digital Communication systems”, 3rd Edition, Oxford University Press, 2007.
4. Dennis Roddy and John Coolen,” Electronic Communications”, 4th Edition, Pearson Education India, 2008.

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	2	2
CO3	3	2	2										2	2
CO4	3	3		2									2	2
CO5	3	3		2					2	2			2	2
CO6	3	3		3		2			2	2		2	2	2
CAM	**2.83**	**2.6**	**2**	**2.33**		**2**			**2**	**2**		**2**	**2**	**2**

21UBM404 ANALOG INTEGRATED CIRCUITS
(Integrated Course)

L	T	P	C
2	0	2	3

OBJECTIVES:

- To determine the ac and dc characteristics of op-amp.
- To employ op-amp for a variety of engineering applications.
- To analysis different types of analog to digital and digital to analog conversion.

UNIT – I CIRCUIT CONFIGURATION FOR LINEAR ICS 6 + 6

General operational amplifier stages – Differential amplifier – CMRR – DC and AC performance characteristics – slew rate – Open and closed loop configurations – Inverting and Non-Inverting Amplifier.

Experiments:

1. Design and testing of Inverting, Non-inverting and differential amplifiers.

UNIT – II APPLICATIONS OF OPERATIONAL AMPLIFIERS 6 + 6

Voltage Follower – Adder – Subtractor – Instrumentation amplifier – V to I and I to V converters – Precision rectifier – Peak detector – Clipper – Clamper – Sample and hold – Log & antilog amplifiers – Differentiator – Integrator – Comparator – Schmitt trigger – Multivibrators – Triangular wave generator.

Experiments:

1. Design and testing of Integrator and Differentiator.
2. Design and testing of Instrumentation amplifier.
3. Design and testing of Astable & Monostable multivibrators and Schmitt Trigger using op-amp.

UNIT – III ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 6 + 6

Analog and Digital Data Conversions – specifications – D/A converter – weighted resistor type, R-2R Ladder type – Voltage Mode and Current Mode – R-2R Ladder types – high speed sample-and-hold circuits – A/D Converters – Flash type – Dual Slope type – Successive Approximation type.

Experiments:

1. Design and testing of R-2R Ladder Type D-A Converter using Op-amp.
2. Design and testing of two bit Flash ADC.

UNIT – IV ACTIVE FILTERS AND VOLTAGE REGULATORS 6 + 6

First and Second order Low pass and High pass filters – IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator – Monolithic switching regulator, Low Drop-Out (LDO) Regulators.

Experiments:

1. Design and testing of Active low-pass and High-pass filters.
2. Design and testing of Voltage Regulator using IC723.

UNIT – V TIMER, PLL AND SPECIAL ICs 6 + 6

IC555 Timer – Functional block description – Monostable & Astable multivibrator operations – PLL – Basics, Phase detector/comparator, Voltage controlled oscillator – F to V and V to F converters – Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC – Analog multiplier ICs.

Experiments:

1. Design and testing of Astable and monostable multivibrators using NE555 Timer.
2. Study of VCO and PLL ICs
   a) Voltage to frequency characteristics of NE/ SE 566 IC.
   b) Frequency multiplication using NE/SE 565 PLL IC.

TOTAL : 30 (L) + 30 (P) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the construction, operation and applications of linear integrated circuits. [Understand]

CO2: Develop linear and non-linear applications using operational amplifiers and special function ICs to meet specific requirements. [Apply]

CO3: Design filters and data converters using op-amp for a given specification. [Apply]

CO4: Analyze the impact of parameter variations and performance on integrated circuits. [Analyze]

CO5: Design circuits for biomedical applications using operational amplifier and/or timer IC's. [Create]

CO6: Analyze the performance of filters, multivibrators and data converters using software tools. [Analyze]

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 5th Edition, 2018.
2. S.Salivahanan& V.S. KanchanaBhaskaran, “Linear Integrated Circuits”, TMH, 2008.

REFERENCES:

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, 3rd Edition, Tata McGraw-Hill, 2007.
2. B.S.Sonde, “System design using Integrated Circuits” , New Age Pub, 2nd Edition, 2001.
3. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2005.
4. J.Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 1996.
5. William D.Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 2004.

HARDWARE / SOFTWARE REQUIREMENTS:

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	Probe	10
6	Bread board	10
7	Chip IC – 555	10

8	Chip IC – 741	25
9	Chip IC – LM723	2
10	Diode – IN4001	4
11	Resistors (Various ranges)	50
12	Capacitors (Various ranges)	25
13	Personal Computer 8GB RAM 1TB HDD	5
14	Open source Simulation software LTSPICE	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	2	2										2	
CO5	3	3	3		2	2			2	2			2	
CO6	3	2			3								2	
CAM	**2.83**	**2.6**	**2.5**		**2.5**	**2**			**2**	**2**			**2**	

21UBM405 PATHOLOGY AND MICROBIOLOGY (Integrated Course)

L	T	P	C
2	0	2	3

OBJECTIVES:

- To explain the purpose of structural and functional aspects of living organisms
- To explore the etiology and remedy in treating the pathological diseases
- To familiarize the different types of microscopes and microbial cultures for diagnosing disease.
- To impart the knowledge on various immunological techniques for diagnosing the pathological diseases.
- To confidant on bio-chemical examinations, Cryoprocessing, Histopathological examinations etc.

UNIT – I CELL DEGENERATION, REPAIR AND NEOPLASIA 6+6

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.

Experiments:

1. Histopathological slides of benign and malignant tumours.
2. Manual paraffin tissue processing and section cutting (demonstration)
3. Cryo processing of tissue and cryosectioning (demonstration)

UNIT – II FLUID AND HEMODYNAMIC DERANGEMENTS 6+6

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.

Experiments:

1. Bleeding time and clotting time
2. Haematology slides of anemia and leukemia

UNIT – III MICROBIAL CULTURES 6+6

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.

Experiments:

1. Media preparation and sterilization techniques
2. Isolation of microorganisms by plating techniques.
3. Biochemical techniques for identification of microorganisms.

UNIT – IV MICROSCOPES AND MICROBIAL GENETICS 6+6

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. 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 E.coli – RNA phages – RNA viruses – Retroviruses – Basic concept of microbial genomics.

Experiments:

1. Study the parts of compound microscope.
2. Simple stain, Gram stain, AFB stain.
3. Basic staining – Hematoxylin and eosin staining.

UNIT – V IMMUNOLOGY 6+6

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.

Experiments:

1. Antigen-Antibody reaction : Immuno diffusion and Immuno electrophoresis.

TOTAL : 30 (L) + 30 (P) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the structure and function of living organisms and their association with various diseases. [Understand]

CO2: Apply staining and immunological techniques for diagnosing various disease-causing microbes. [Apply]

CO3: Apply diverse diagnostic methods to identify hematological, histopathological and immunological disorders. [Apply]

CO4: Analyze the different techniques employed for tissue processing to determine tissue morphology using microscopes. [Analyze]

CO5: Analyze the effectiveness of modern treatment method with the ancient treatment method for infectious diseases. [Analyze]

CO6: 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”, 10th edition: South Asia Edition Elsevier India, 2020.
2. Ananthanarayanan & Panicker, “Microbiology” Orientblackswan, 2017 10th edition.

REFERENCES:

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

HARDWARE REQUIREMENTS:

Sl. No.	Name of the equipment	Quantity required
1	Microscope	3
2	Wax dispenser	1
3	Slide warming	1
4	Microtome	1
5	Slides	1 box
6	Cover slip	1 box
7	Distillation Unit	1
8	Water bath normal	1
9	Autoclave	1
10	Oven	1
11	Lancet	1 box
12	Refrigerator	1
13	Weighing Machine	1
14	Laminar Air Flow	1
15	Capillary tube	1 box

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

21UIT426 DATA STRUCTURES USING OBJECT ORIENTED PROGRAMMING (Integrated Course)

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the principles of object oriented programming.
- To explain the systematic way of solving problems using various linear and non-linear data structures.
- To demonstrate implement the different linear and non-linear data structures.

UNIT – I PRINCIPLES OF OBJECT ORIENTED PROGRAMMING 9+6

Introduction – Tokens – Expressions - Control structures - Functions in C++, Classes and Objects, Constructors and Destructors, Operator overloading.

Experiments:

1. Program to implement operator overloading.
2. Program to implement constructor, destructor and copy constructor.

UNIT – II ADVANCED OBJECT ORIENTED PROGRAMMING 9+6

Inheritance - Extending classes, pointers, virtual functions and polymorphism, File handling, Templates, Manipulating strings, Exception handling.

Experiments:

1. Program to implement inheritance concepts
2. Program to implement templates and manipulating string

UNIT – III LINEAR DATA STRUCTURES 9+6

Abstract Data Types (ADTs) - List ADT – Array based implementation - Linked list implementation - Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications, Stack ADT – Operations – Applications, Queue ADT – Operations- Applications.

Experiments:

1. Program to implement stack ADT using array and linked list
2. Program to implement queue ADT use array and linked list

UNIT – IV NON-LINEAR DATA STRUCTURES 9+6

Tree – Tree Traversal – Binary Trees – Binary Search Tree – AVL Tree - Priority Queues - Binary Heaps, Graph – Representation of Graphs – Topological Sort – Shortest Path Algorithms - Minimum Spanning Tree.

Experiments:

1. Program to implement binary search tree.
2. Program to implement insertion and deletion in AVL trees

UNIT – V SORTING AND HASHING TECHNIQUES 9+6

Sorting – Bubble sort, Insertion sort, Selection sort, Shell sort, Merge sort, Quick sort, Hashing – Hash Functions – Separate Chaining – Open Addressing.

Experiments:

1. Program to implement merge sort.
2. Program to implement quick sort.

TOTAL : 45 (L) + 30 (P) = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the use of linear, non-linear data structures and object oriented approaches to solve the problems in real time applications. [Understand]

CO2: Apply the linear, non-linear data structures and object oriented approaches to solve variety of computational problems. [Apply]

CO3: Analyze the efficiency of various algorithmic approach through object oriented programming to solve real world applications with approach. [Analyze]

CO4: Design and develop efficient and effective algorithms to solve problems. [Create]

CO5: Select and apply appropriate data structures to design algorithms using modern tool. [Apply]

CO6: Work individually or in teams and demonstrate the solutions to the given exercises through presentation. [Value - Affective Domain]

TEXT BOOKS:

1. E.Balagurusamy,"Object Oriented Programming with C++", Tata McGraw Hill, 6th Edition, 2013.
2. Weiss. M.A, "Data Structures and Algorithm Analysis in C++", Pearson Education, 4th Edition, 2014.

REFERENCES:

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

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

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

21UBM407 SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To demonstrate signal processing functions using Simulation Software.
- To demonstrate signal processing techniques using DSP processor.

LIST OF EXPERIMENTS:

Simulation using MATLAB/ Equivalent software:

1. Generation of elementary Discrete-Time sequences
2. Verification of Sampling theorem and effect of aliasing
3. Analysis of Quantization effects in a first order system
4. Linear and Circular convolutions of two given sequences
5. Auto correlation and Cross Correlation of given sequences
6. Computation of N point DFT of a given sequence and plot magnitude and phase spectrum.
7. Design and implementation of FIR filters (LPF/HPF/BPF/BSF) to meet given specifications.
8. Design and implementation of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) to meet given specifications.
9. Implementation of Decimation and Interpolation process
10. Design and implementation of Multi-rate Filters to meet given specifications.
11. Event Detection: QRS in ECG & alpha, beta, gamma and theta activity in EEG.

DSP Processor based Implementation:

12. Study of architecture of Digital Signal Processor
13. Perform MAC operation using various addressing modes
14. Linear and Circular convolution.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Generate & Perform different operations on discrete time signals. [Apply]

CO2: Verify the effect of Sampling, quantization and multi-rate signal processing. [Apply]

CO3: Perform convolution and correlation of given sequences to evaluate the response of a system. [Apply]

CO4: Analyze the frequency response characteristics of digital FIR and IIR filters. [Analyze]

CO5: Analyze QRS complexes in ECG signals and brain wave patterns in EEG signals. [Evaluate]

CO6: Function effectively as an individual for efficiently executing the given task. [Organize - Affective domain]

HARDWARE / SOFTWARE REQUIRMENTS:

Sl. No.	Name of the equipment	Quantity required
1.	Personal Computer 8GB RAM 1TB HDD	30 Nos.
2.	MATLAB or equivalent open source software SCILAB	30 Nos.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			3									
CO2	3	2			3							2	2	3
CO3	3	2			3								2	2
CO4	3	3		2	3								2	3
CO5	3	3		2	3							2	3	3
CO6						2			3	2		2		
CAM	**3**	**2.4**		**2**	**3**	**2**			**3**	**2**		**2**	**2.25**	**2.75**

21UGM431 GENDER EQUALITY
(Common to All Branches)

L	T	P	C
2	0	0	P/F

OBJECTIVES:

- To introduce basic concepts relating to gender and to provide logical understanding of gender roles.

UNIT – I GENDER SENSITIZATION 10

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.

UNIT – II GENDER EQUALITY AND CONSTITUTION 10

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 – University 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.

UNIT – III GENDER ROLES & EQUALITY 10

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.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the social construction of gender and sexuality and their influence in social context. [Understand]

CO2: Analyze how the concepts of gender equality are created, maintained, and/or challenged. [Analyze]

CO3: Apply concepts of gender roles and equality in classroom, school, disciplinary or interdisciplinary creative, scholarly, and/or activist project. [Apply]

REFERENCES:

1. Sheila Aikman and Elaine Unterhalter, "Practising Gender Equality in Education", Oxfam GB, 2007.
2. Pasadena and Hackensack, "Gender roles and Equality", Salem Press, 2011.

SEMESTER V

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UBM501	Embedded Systems and IoMT	PC	3	0	0	3
2.	21UBM502	Bio Control System	PC	3	0	0	3
3.	21UBM503	Virtual Bio Instrumentation	PC	3	0	0	3
4.	21UBM504	Biomedical Instrumentation (Integrated Course)	PC	2	0	3	3.5
5.	PE - I	Professional Elective – I	PE	3	0	0	3
6.	OE - I	Open Elective – I	OE	3	0	0	3
Laboratory Courses							
7.	21UBM507	Creative Thinking and Innovation	PW	0	0	2	1
8.	21UBM508	Embedded Systems and IoMT Laboratory	PC	0	0	2	1
9.	21UGS533	Interpersonal Skills Laboratory (Common to Mech, Civil, BME & BT)	HS	0	0	3	1.5
Mandatory Course							
10.	21UGT140	தமிழர் மரபு /Heritage of Tamil	MC	1	0	0	1
			Total	18	0	10	23
Total Credits : 23							

21UBM501 EMBEDDED SYSTEMS AND IoMT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
- To understand the hardware architecture and features of embedded microcontrollers and peripherals.
- To understand programming aspects of embedded system design.
- To understand IoT architecture and Build simple IoT systems using embedded target boards.
- To understand IoMT infrastructure for healthcare applications.

UNIT – I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Introduction to embedded processors - Application Areas - Categories of embedded processors - Challenges in Embedded System Design, Design Process - Requirements – Specifications - Hardware architecture - Software architecture-Introduction to Harvard & Von Neuman architectures - CISC & RISC Architectures. CPU Bus - Bus Protocols - Bus Organisation, Memory Devices, and their Characteristics - RAM, EEPROM - Flash Memory - DRAM. BIOS, POST, Device Drivers.

UNIT – II PERIPHERAL INTERFACING 9

I/O Devices-Timers and Counters - Watchdog Timers, Interrupt Controllers - A/D and D/A, Interfacing - Memory interfacing with a case study - I/O Device Interfacing with case Study - Programmed IO-Memory Mapped IO, Interfacing Protocols - SPI, I^2C, USB, CAN, Ethernet/WiFi, Bluetooth.

UNIT – III EMBEDDED SOFTWARE TOOLS FOR PROGRAMMING 9

Application Software, System Software – Embedded software development Process, Host and Target machine, Linking and Locating Software, Getting embedded software into the target system, Converting embedded C programming into Machine codes - Simple programs, High level language descriptions of software for embedded system.

UNIT – IV DESIGN AND DEVELOPMENT OF IOT 9

Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT. Cybersecurity – vulnerability, penetration & encryption technologies.

UNIT – V INTERNET OF MEDICAL THINGS 9

Body temperature measurement, Stepper motor control. Embedded system in biomedical application, Wireless sensor technologies, Body sensor network, and Patient monitoring system. Case study - Healthcare Application Development in Mobile and Cloud Environments.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the design concepts of embedded systems. [Understand]

CO2: Develop embedded software to Integrate real-world field devices with microcontrollers. [Apply]

CO3: Design and implement an IoT architecture to meet specific applications. [Apply]

CO4: Design and implement IoT-enabled embedded control strategies for specific applications. [Apply]

CO5: Analyze the functional components in Embedded Systems design process. [Analyze]

CO6: Estimate the solution for given societal challenges in healthcare using IoMT. [Evaluate]

TEXT BOOKS:

1. Embedded Systems – A Contemporary Design Tool, James K Peckol, , John Weily, 2008, ISBN: 0- 444-51616-6.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
3. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, “Internet of Things and Personalized Healthcare Systems”, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

REFERENCES:

1. Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790 3.
2. Embedded Software Primer, David E.Simon, ,Addison Wesley, ISBN-13: 978-0201615692.
3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
4. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
6. Michael Margolis, Arduino Cookbook, “Recipes to Begin, Expand, and Enhance Your Projects”, OReilly Media, 2nd Edition.

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**

21UBM502 BIO CONTROL SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- To discuss system concept and different mathematical techniques to model engineering systems
- To learn to do the analysis of given system in time domain and frequency domain.
- To practice the techniques of plotting the responses in both domain analysis.
- To apply modeling concepts to biological systems.

UNIT – I MODELING OF SYSTEMS 8

System concepts – Open and Closed loop systems – Mathematical Modeling of systems – Block diagram and Signal flow graph representation of systems – Conversion of Block diagram to Signal flow graph – Reduction of Signal flow graphs – Introduction to Physiological control systems – Linear models of physiological systems – Difference between engineering and physiological control systems

UNIT – II TIME RESPONSE ANALYSIS 10

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.

UNIT – III FREQUENCY RESPONSE ANALYSIS 9

Frequency domain specifications - Polar plots - Bode plots - Nyquist plot - Nyquist stability criterion, closed loop stability - Constant M and N circles - Nichol‘s chart.

UNIT – IV STATE VARIABLE ANALYSIS 9

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.

UNIT – V PHYSIOLOGICAL CONTROL SYSTEM ANALYSIS 9

Simple models of muscle stretch reflex action – steady state analysis of muscle stretch reflex action – transient response analysis of neuromuscular reflex model action – frequency response of circulatory control model – Stability analysis of Pupillary light reflex.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the fundamental concepts of control systems. [Understand]

CO2: Develop mathematical models of feedback control systems. [Apply]

CO3: Determine the system parameters and assess system stability using time-domain approach. [Apply]

CO4: Analyze the performance and stability of system through frequency domain approach. [Analyze]

CO5: Explore the concept of modeling basic physiological systems. [Analyze]

CO6: Simulate and analyze the system response and stability of the system using software tools. [Analyze]

TEXT BOOKS:

1. I.J. Nagarath and M. Gopal, Control Systems Engineering, New Age International Publishers, 1st September, 2018.
2. Michael C K Khoo, Physiological Control Systems, IEEE Press, Prentice Hall India, 2005.

REFERENCES:

1. Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., Control Systems Engineering, Pearson Education India, 2015.
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3. Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, Vol 4, Prentice-Hall, 2002.

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	
CO4	3	3	2	2								2	3	
CO5	3	3	2						2			2	3	
CO6	3	3			3								2	2
CAM	**2.83**	**2.75**	**2**	**2**	**3**				**2**			**2**	**2.5**	**2**

21UBM503 VIRTUAL BIO INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce virtual instrumentation concepts and applications.
- To have a conversation on the structure of programming in LabVIEW.
- To conduct a hardware analysis of the data collection system.
- To deduce information on VI programmes for a variety of purposes.
- To get an understanding of the fundamentals of virtual instrumentation.
- To develop biomedical applications using virtual instrumentation software via programming.

UNIT – I REVIEW OF VIRTUAL INSTRUMENTATION 9

Overview: Virtual Instruments, Need of VI, advantages, block diagram and architecture of a Virtual Instrument - Conventional Instruments versus virtual Instruments graphical user interfaces 'G' programming, comparison with conventional programming.

UNIT – II VI PROGRAMMING TECHNIQUES 9

LabVIEW: Key terms, front panel, block diagram, Graphical programming pallets - Sub VI's, icon and connector panels - Data types Data flow programming - Editing, debugging and running a virtual instrument, object properties and their configuration Typical examples.

UNIT – III PROGRAMMING STRUCTURE 9

Loops, auto- indexing - Shift registers - CASE structure - State machine - Formula node - Sequence structures: flat and stacked - Arrays and clusters functions, polymorphism, error clusters and error handling functions - Visual displays: Waveform charts, waveform graphs, XY graphs and intensity graphs - Strings and string functions - File I/O - Attribute modes: Local and global variables.

UNIT – IV DATA ACQUISITION FUNDAMENTALS 9

Overview - Key terms, DAQ and other data acquisition acronyms - Connecting computer to real world - Signals - Selecting and configuring DAQ measurement hardware - Data acquisition in LabVIEW - Understanding analog and digital I/O - NIDAQmx Tasks - VISA.

UNIT – V BIOMEDICAL APPLICATIONS 9

VI based temperature monitor - VI based cardiac monitor (ECG) Bio bench - A virtual instrument application for data acquisition and analysis of physiological signals ECG signal processing - controlling assistive devices.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Demonstrate the basics of LabVIEW programming. [Understand]

CO2: Comprehend the components of virtual instrumentation and apply them for PC-based measurements. [Apply]

CO3: Design and develop virtual instruments using programming languages and software tools. [Apply]

CO4: Use virtual bio instrumentation tools to analyze and interpret biological signals and data. [Analyze]

CO5: Compare and contrast different programming approaches and techniques for VI development. [Analyze]

CO6: Create innovative virtual bio instrumentation solutions for emerging biomedical challenges. [Create]

TEXTBOOKS:

1. Richard Jennings," LabVIEW Graphical Programming", PRINT ISBN 5th edition 2020.
2. Gary Jonson ," Labview Graphical Programming", McGraw Hill, NewYork, 4th edition 2018.
3. S. Sumathi, P.Surekha, "LabVIEW based Advanced Instrumentation Systems", Springer 2007.

REFERENCES:

1. Jon B Olansen and Eric Rosow, "Vitrual Bio-Instrumentation Biomedical, Clinical and Healthcare Applications in LabVIEW" 2001.
2. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki "LabVIEW: Advanced Programming Techniques" Second Edition, CRC press, 2007.
3. Lisa K. Wells & Jeffrey Travis, 'LabVIEW for Everyone', Prentice Hall Inc., First edition 1997.
4. S. Gupta, J.P. Gupta, 'PC interfacing for Data Acquisition & Process Control', Instrument Society of America, Second Edition, 1994.
5. Andrew McDonough, "LABVIEW: Data Acquisition and Analysis for movement Sciences, Prentice Hall, USA 2000".

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**

21UBM504 BIOMEDICAL INSTRUMENTATION
(Integrated Course)

L	T	P	C
2	0	3	3.5

OBJECTIVES:

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals.
- To study and design Bio amplifiers.
- To explain the different techniques used for measurement of non-electrical bio-parameters.
- To explain the biochemical measurement techniques as applicable for diagnosis and treatment.
- To provide hands on training on Measurement of physiological parameters.

UNIT – I ELECTRODE CONFIGURATIONS 6 + 0

Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT – II BIOSIGNAL CHARACTERISTICS 6 + 12

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

Experiments:

1. Design a suitable circuit to detect QRS complex and measure heart rate.
2. Design of frontal EEG amplifier.
3. Design of EMG amplifier.

UNIT – III BIOAMPLIFIERS 6 + 15

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 – Chopper amplifier – Power line interference – Band pass filtering – Artifacts and removal.

Experiments:

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's.
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design a right leg driven ECG amplifier.
4. Design and study the characteristics of optical Isolation amplifier.
5. Design a PCB layout for any bio amplifier using suitable software tool.

UNIT – IV MEASUREMENT OF BIO SIGNALS 6 + 9

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

Experiments:

1. Measurement of blood pressure using sphygmomanometer.
2. Measurement of respiration rate.

UNIT – V BIOCHEMICAL MEASUREMENTS 6 + 9

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.

Experiments:

1. Measurement of pH and conductivity
2. Measurement of pulse-rate using Photo transducer.

TOTAL : 30 (L) + 45 (P) = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the fundamentals of bio signal recording and measurement. [Understand]

CO2: Apply bio-potential recording concepts to diagnostic applications. [Apply]

CO3: Apply the principles of biochemical measuring instruments in clinical settings. [Apply]

CO4: Select an appropriate acquisition method for analyzing various vital bio-signal parameters. [Analyze]

CO5: Design and implement amplifiers for various bio electrical signal measurements. [Create]

CO6: Design a PCB layout for bio-amplifiers using software tools. [Apply]

TEXT BOOKS:

1. John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and Sons, New York, 4th Edition, 2009.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 3rd Edition, 2014.

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.

HARDWARE / SOFTWARE REQUIREMENTS:

Sl. No.	Name of the equipment	Quantity required
1.	pH meter and conductivity meter	1 No.
2.	Photo transducer for pulse measurement	1 No.

3.	Function Generator	6 Nos.
4.	Regulated Power Supply	6 Nos.
5.	Sphygmomanometer and Stethoscope	1 No.
6.	PHOTOTRANSDUCER FOR PULSE MEASUREMENT	1 No.
7.	Multiparameter (ECG, EMG, EEG) Simulator	1 No.
8.	CRO	5 Nos.
9.	DSO	1 No.
10.	Bread boards	10 Nos.
11.	IC 555 Timer	10 Nos.
12.	ICs LM324, AD620	5 Nos.
13.	ICs INA series 126 128 etc.	5 Nos.
14.	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	3		2								3	2
CO3	3	2	3			2						2	3	
CO4	3	3	2									2	3	
CO5	3	3	2									2	3	
CO6	3	3	3	2					3			3	3	2
CAM	**2.83**	**2.6**	**2.6**	**2**	**2**	**2**			**3**			**2.25**	**2.83**	**2**

21UBM507 CREATIVE THINKING AND INNOVATION

L	T	P	C
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:

CO1: Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice. [Valuing – Affective Domain]

CO2: Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development. [Organization – Affective Domain]

CO3: 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	3			2		2				2	2	1
CO2	3	3	3			2	3	2				2	2	1
CO3	3	3	3			2		2	3			2	2	1
CAM	**3**	**3**	**3**			**2**	**3**	**2**	**3**			**2**	**2**	**1**

21UBM508 EMBEDDED SYSTEMS AND IoMT LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To acquire knowledge and understand the hardware architecture and programming aspects of embedded system design.
- To understand IoT architecture and Build simple IoT Systems using embedded target boards.
- To understand IoMT infrastructure for healthcare applications.

LIST OF EXPERIMENTS:

1. Study of Arduino evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED with Arduino and write an Embedded C Program to turn on /off with specified delay.
4. Write Embedded C Program to test interrupt and timers.
5. Explore different communication Methods with IoT devices.
6. Write an embedded C Program for Interfacing stepper Motor.
7. Set up the programming environment in Raspberry Pi by loading the operating system with relevant hardware.
8. Interconnect physical components such as sensors, LED, buzzer etc with Raspberry Pi.
9. Develop an IoT system to monitor the temperature using LM35 LCD display.
10. Develop IR Sensor Based Security System.
11. Develop an IoT based Heart Rate Monitoring System with Arduino.
12. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.
13. Develop an IoT based Ultrasonic Distance Measurement with Raspberry Pi.
14. Mini Project.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Develop an embedded C program for various I/O interfacing. [Apply]
CO2: Build simple IoT systems using the embedded target boards. [Apply]
CO3: Develop Applications using modern tools like KEIL, Arduino, and Raspberry Pi. [Apply]
CO4: Develop the IoMT infrastructure for healthcare applications. [Apply]
CO5: Evaluate the cost effectiveness of embedded controllers in various applications. [Evaluate]
CO6: Design simple healthcare applications using IoMT. [Create]

HARDWARE / SOFTWARE REQUIRMENTS:

Sl. No.	Name of the equipment	Quantity Required
1	ARM Controller board	5
2	Ardino board UNO	5

3	Raspberry Pi kit	3
4	Stepper motor	2
5	IR Sensor	2
6	LCD display	2
7	Buzzer	5
8	LED	20
9	Temperature sensor LM35	2
10	Heart rate sensor Module (MAX30100)	1
11	Ultrasonic Distance Sensor Module (HC-SR04)	2
12	Personal Computer with 8GB RAM 1TB HDD	10
13	KEIL Software	5
14	ESIM Software	5

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

21UGS533 INTERPERSONAL SKILLS LABORATORY

(Common to Mech, Civil, BME & BT)

L	T	P	C
0	0	3	1.5

LIST OF EXERCISES:

Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6. Speech Master of the Day
7. General Evaluator
8. Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Communicate orally with fluency and clarity in a given contextual situation. [Responding - Affective Domain]

CO2: Evaluate a speech and offer constructive evaluation of the speech. [Evaluating - Cognitive Domain]

CO3: Adapt themselves to work in a group as a member or a leader for efficiently executing the given task. [Organization – Affective Domain]

CO4: Analyze a problem and find appropriate solution. [Analyze – Cognitive Domain]

CO5: Take decision by organizing relevant information and defining alternatives. [Create – Cognitive Domain]

21UGT140 HERITAGE OF TAMIL / தமிழர் மரபு

(Common to All Branches)

L	T	P	C
1	0	0	1

OBJECTIVE:

- To provide insight regarding the cultural heritage of the Tamils and Sangam Literature, Religion, Art & Architecture during ancient periods.

UNIT – I HERITAGE AND CIVILIZATION OF TAMIL THROUGH ARCHAEOLOGY **4**

Introduction - Basics of archaeology – Historical Source - Archaeological Excavations in Keeladi - Findings based on Keeladi Excavation - Excavations near Mayiladumparai - Excavations near Sivagalai - Excavations at Adichanallur - An Analysis of the excavations in Tamil Nadu.

UNIT – II TAMIL HERITAGE IN SANGAM AGE **3**

Introduction - Sangam Literature - Political History of Sangam Period - Sangam Polity and Administration - Sangam Society - Position of Women during Sangam Age - Economy of the Sangam Age.

UNIT – III SOURCES OF ANCIENT TAMIL HERITAGE AND HISTORY **4**

Evidences of Tamilakam in Greek and Roman Literature - Archaeological sources - Evidence for economic activities - Literary sources in Tamil - Literary Evidences about Tamil History in other languages - Epigraphical sources - Cave inscriptions - Pottery inscriptions - Numismatic (Coins) sources

UNIT – IV EVIDENCE FOR ANCIENTNESS OF TAMIL LITERAURE AND HERITAGE **4**

Tamil Literature - India's Earliest Script: Tamili (Tamil Brahmi) - Literary work of Ancient Tamil - Tolkappiam - Thirukkural & Naladiyar - Tracing Ancient Tamil Literature by U.V. Saminaytha Iyer - Tamil, a Classical Language.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the Heritage and Civilization of Tamil through Archaeology. [Understand]

CO2: Interpret the Tamil Literature and Civilization in historical manner. [Understand]

CO3: Demonstrate the ability to appreciate the ancientness Tamil heritage and literature. [Valuing – Affective Domain]

CO4: Analyze the sources of Tamil Civilization relating to Indus Valley Civilization. [Analyze]

TEXT-CUM-REFERENCE BOOKS:

1. தமிழக வரலாறு மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தமிழ்நாடு அரசு தொல்லியல் துறை வெளியீடு)
4. பொருநை ஆற்றங்கரை நாகரிகம். (தமிழ்நாடு அரசு தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text BookandEducationalServicesCorporation,TamilNadu).
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER VI

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UBM601	Diagnostic and Therapeutic Equipment	PC	3	0	0	3
2.	21UBM602	Medical Imaging Equipment	PC	3	0	0	3
3.	21UBM603	Artificial Intelligence and Machine Learning Techniques	PC	3	0	0	3
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
7.	21UGS631	Logical Reasoning and Aptitude (Common to CIVIL, BME & BT)	HS	1	0	0	1
Laboratory Courses							
8.	21UBM607	Product Development Project	PW	0	0	8	4
9.	21UBM608	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	2	1
10.	21UGS632	Soft skills and Communication Laboratory (Common to Mech, ECE, Civil, BME & BT)	HS	0	0	2	1
Mandatory Course							
11.	21UGM631	Indian Constitution (Common to ALL Branches)	MC	1	0	0	P/F
			Total	20	0	12	25
Total Credits : 25							

21UBM601 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the devices for measurement of parameters related to cardiology.
- To illustrate the recording and measurement of EEG
- To demonstrate EMG recording unit and its uses.
- To explain diagnostic and therapeutic devices related to respiratory parameters.
- To understand the various sensory measurements that hold clinical importance.

UNIT – I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT – II NEUROLOGICAL EQUIPMENT 9

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

UNIT – III MUSCULAR AND BIOMECHANICAL EQUIPMENT 9

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.

UNIT – IV RESPIRATORY MEASUREMENT AND ASSIST SYSTEM 9

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT – V SENSORY DIAGNOSTIC EQUIPMENT 9

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

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Elucidate the fundamentals of diagnostics and therapeutic equipment. [Understand]

CO2: Apply physics and engineering principles to design and operate ECG machines, cardiac devices, and monitoring equipment. [Apply]

CO3: Develop innovative solutions to overcome technical and clinical challenges associated with diagnostic and therapeutic equipment. [Apply]

CO4: Analyze the clinical significance of equipment in diagnostic and therapeutic systems. [Analyze]

CO5: Analyze the performance and troubleshooting requirements of diagnostic and therapeutic equipment. [Analyze]

CO6: Evaluate the principles and techniques involved in the design and implementation of biofeedback instrumentation. [Evaluate]

TEXTBOOKS:

1. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India PvtLtd,New Delhi, 2015
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson education, 2012

REFERENCES:

1. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008.
2. Khandpur.R.S.,“Handbook of BiomedicalInstrumentation”.SecondEdition.Tata McGrawHill Pub. Co.,Ltd. 2003.
3. Antony Y.K.Chan,”Biomedical Device Technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson Education, New Delhi, 2007..

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3					2						3	3	2
CO3	3			2		3						3	3	2
CO4	3	2				3						3	3	
CO5	3	2		2								3	3	2
CO6	3	3	2	2								2	3	2
CAM	**2.83**	**2.33**	**2**	**2**		**2.67**						**2.8**	**3**	**2**

21UBM602 MEDICAL IMAGING EQUIPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principle of different imaging equipment.
- To explore the different equipment for various diagnosis.
- To apply the concept of radioisotopes in the medical field of imaging.

UNIT – I X – RAYS **9**

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

UNIT – II COMPUTED TOMOGRAPHY **9**

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

UNIT – III MAGNETIC RESONANCE IMAGING **9**

Fundamentals of magnetic resonance- 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.

UNIT – IV NUCLEAR IMAGING AND OTHER IMAGING TECHNIQUES **9**

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.

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

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.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the principles and working mechanisms of various medical imaging equipment. [Understand]

CO2: Apply the knowledge of imaging technologies to operate medical imaging equipment effectively in clinical settings. [Apply]

CO3: Identify the suitable medical imaging techniques for specific pathology. [Apply]

CO4: Analyze the components and functioning of advanced imaging systems to identify their roles in medical imaging workflows. [Analyze]

CO5: Analyze safety considerations and radiation effects to recommend best practices for medical imaging and therapy. [Analyze]

CO6: Evaluate imaging techniques based on diagnostic accuracy, safety and efficiency to recommend suitable modalities for clinical applications. [Evaluate]

TEXTBOOKS:

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
3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi “Medical Imaging Technology”, Springer Singapore, 2015

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.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2				2						2	3	
CO3	3	2							2	2		2	3	2
CO4	3	3										3	3	2
CO5	3	3		2		3	3		2	2		3	3	
CO6	3	3	2	2		2	2		2	2		3	3	2
CAM	**2.83**	**2.6**	**2**	**2**		**2.33**	**2.5**		**2**	**2**		**2.6**	**3**	**2**

21UBM603 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study about uninformed and Heuristic search techniques.
- To learn techniques for reasoning under uncertainty.
- To introduce Machine Learning and supervised learning algorithms.
- To study about ensembling and unsupervised learning algorithms.
- To learn the basics of deep learning using neural networks.

UNIT – I PROBLEM SOLVING 9

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP).

UNIT – II PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT – III SUPERVISED LEARNING 9

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

UNIT – IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT – V NEURAL NETWORKS 9

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (also known as the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Elucidate the fundamental principles and techniques of AI and machine learning for problem solving. [Understand]

CO2: Apply problem-solving strategies and probabilistic reasoning methods to address uncertainty and decision-making scenarios. [Apply]

CO3: Apply various learning techniques to solve real-world data-driven problems. [Apply]

CO4: Analyze neural network structures, optimization algorithms and training methods to design and optimize deep learning models. [Analyze]

CO5: Evaluate AI and machine learning models by assessing their accuracy, efficiency and real-world application suitability. [Evaluate]

CO6: Design and implement machine learning algorithms to solve a given problem using software tools. [Create]

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.

REFERENCES:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007.
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/).
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
6. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.
7. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014.
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

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	3	3
CO3	3	2			2							3	3	3
CO4	3	3			2							2	3	3
CO5	3	3	2	3	3				2	2		3	3	3
CO6	3	3	3	3	3				2	2		3	3	3
CAM	**2.83**	**2.6**	**2.5**	**3**	**2.4**				**2**	**2**		**2.6**	**2.83**	**2.83**

21UGS631 LOGICAL REASONING AND APTITUDE
(Common to CIVIL, BME & BT)

L	T	P	C
1	0	0	1

OBJECTIVES:

- To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.
- To familiarize the student with various principles involved in solving mathematical problems.
- To develop an understanding of the basic concepts of reasoning skills.

UNIT – I QUANTITATIVE APTITUDE 8

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.

UNIT – II VERBAL AND NON VERBAL REASONING 7

Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams - Data Sufficiency – Data interpretation – Syllogism - Coding – Decoding.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO1: Select an appropriate technique to solve the quantitative problems within the stipulated time. [Apply]

CO2: Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning. [Apply]

CO3: Analyze the direction to solve equations involving one are more unknowns. [Analyze]

TEXT BOOKS:

1. Dr. R.S.Agarwal, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20th Edition, (2013).
2. Abijit Guha, “Quantitative Aptitude for Competitive Examinations”, Tata McGraw Hill Publication, New Delhi, 4th Edition, (2011).
3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2nd Edition, (2013).

REFERENCES:

1. Ashish Aggarwal, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition, (2014).
2. Dr.V.A.Sathgurunath’s “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition, (2011). Wiley and Sons, New York, 2006.

WEBSITES:

www.m4maths.com, www.indiabix.com, www.fresherworld.com,
www.campusgate.co.in, www.indianstudyhub.in, www.tcyonline.com.

21UBM607 PRODUCT DEVELOPMENT PROJECT

L	T	P	C
0	0	8	4

OBJECTIVES:

- To develop competency with a set of tools and methods for product design, manufacturing and marketing functions in creating a new product.

PROJECT DESCRIPTION:

Product development is the process of delivering a new product or improving and existing product for customers. This course helps students to convert an idea into a product. Eight periods per week will be allotted in the time table and this time shall be utilized by the students to receive directions from the guide, for library reading, laboratory work, computer analysis and field work as assigned by the guide. There shall be periodical seminar presentations about the progress made in the project. The progress of the project is evaluated based on a minimum of three reviews.

TOTAL : 120 PERIODS

COURSEOUTCOMES:

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	3	2
CO2				3									3	2
CO3					3			3					3	2
CO4		3			3								3	2
CO5									3		3		3	2
CO6										3			3	2
CAM	3	3	3	3	3	3	3	3	3	3	3	3	3	2

21UBM608 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To provide practice on recording and analysis of different Bio potentials.
- To demonstrate the function of different Therapeutic equipment.

LISTOFEXPERIMENTS:

1. Simulation of ECG – detection of QRS complex and heart rate.
2. Simulation of EEG – detection of alpha waves.
3. Simulation of Electromyogram.
4. Galvanic skin resistance (GSR) measurement.
5. Study of shortwave and ultrasonic diathermy.
6. Measurement of various physiological signals using biotelemetry.
7. Measurement of Respiratory parameters using spirometer.
8. Study of medical stimulator.
9. Study of ESU – cutting and coagulation modes.
10. Recording of Audiogram using audiometer.
11. Recording Heart sounds using Phonocardiograph.
12. Study of Electrical safety measurements.
13. Study of Bidirectional Positive Airway Pressure (BIPAP) Ventilator and Humidifier.

TOTAL: 45 PERIODS

COURSEOUTCOMES:

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

CO1: Measure different bioelectrical signals using various methods. [Apply]
CO2: Record the various physiological signals using telemetry. [Apply]
CO3: Analyze the different bio signals using suitable tools. [Analyze]
CO4: Exhibit various diagnostic and therapeutic techniques. [Apply]
CO5: Examine the electrical safety measurements. [Analyze]
CO6: Evaluate the functioning of medical devices for diagnostic and therapeutic purposes. [Evaluate]

HARDWARE / SOFTWAREREQUIRMENTS:

S. 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.	BIPAP 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	3											3	2	2
CO2	3				3							3	3	3
CO3	3	2			2							2	3	2
CO4	3	3	2									2	2	
CO5	3	3					2					3	3	
CO6	3		3	2					2	2		2	3	2
CAM	**3**	**2.67**	**2.5**	**2**	**2.5**		**2**		**2**	**2**		**2.5**	**2.67**	**2.25**

21UGS532 SOFT SKILLS AND COMMUNICATION LABORATORY

(Common to Mech, ECE, Civil, BME & BT)

L	T	P	C
0	0	2	1

OBJECTIVES:

- To develop a requisite knowledge in Communication skills and Soft skills.
- To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.

UNIT – I SPEAKING SKILLS 6

Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills.

UNIT – II WRITING SKILLS 6

Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation.

UNIT – III READING AND LISTENING SKILLS 6

Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking.

UNIT – IV SOFT SKILLS 6

Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution.

UNIT – V INTERVIEW SKILLS 6

Types of Interviews – Body Language – Professional Grooming – Basic Etiquette.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Answer the queries precisely after carefully listening to the conversation or speech. [Affective domain – Responding]

CO2: Communicate orally with fluency and clarity in each contextual situation. [Affective domain – Responding]

CO3: Debate with clarity of thought and expression to convey their ideas politely to others. [Affective domain – Valuing]

CO4: Apply correct usage of English grammar in writing, fluent speaking and comprehending. [Cognitive Domain – Apply]

CO5: Present the ideas creatively with coherence for given topic. [Affective domain – Valuing]

REFERENCES:

1. Skills for Success, Listening and Speaking – Level 4 by Brooks and Margret – Oxford University Press, Oxford 2011 Edition.
2. Professional Communication by Raman, Meenakshi and Sangeetha Sharma – Oxford University Press, 2014 Edition.
3. Developing Soft Skills by Sherfield, Robert M, R J Montgomery and Patricia G Moody – Pearson Education Publishers. 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	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
CAM									**2**	**3**		**2**		

21UGM631 INDIAN CONSTITUTION
(Common to All Branches)

L	T	P	C
1	0	0	P/F

OBJECTIVES:

- The students will be exposed to fundamental rights & duties in Indian Constitution.
- The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development.
- 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…
- The student will know about the functions of judiciary and electoral process followed in the country.

UNIT – I INTRODUCTION ON INDIAN CONSTITUTION 4

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.

UNIT – II PARLIAMENTARY SYSTEM 4

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.

UNIT – III JUDICIARY AND ELECTION COMMISSION 4

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.

UNIT – IV LOCAL ADMINISTRATION 3

Local Administration: Powers and functions of Municipalities and Panchayats System - Panchayat Raj – Co-operative Societies and Constitutional and Non-constitutional Bodies.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

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

CO1: Apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations. [Apply]

CO2: Manage complex societal issues in society with the knowledge of judiciary and local administration. [Analyze]

CO3: Interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills. [Evaluate]

CO4: Elaborate the ethical responsibilities of municipalities, panchayats and co-operative societies. [Understand]

CO5: Describe and distinguish the functioning of the parliamentary system followed in

various countries. [Understand]

TEXT BOOKS:

1. Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” by Cengage Learning India Private Limited, 2018.
2. Subhash C. Kashyap,”Our Constitution: An Introduction to India’s Constitution and constitutional Law”, NBT, 2018.
3. Brij Kishore Sharma,“Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., New Delhi, 2011.
4. M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.
5. Durga Das Basu, “Introduction to the Constitution on India”, Prentice Hall, 2001.

SEMESTER VII

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	21UME701	Project Management and Finance (Common to ALL Branches – Except CSBS)	HS	3	0	0	3
2.	21UBM702	Medical Image Processing	PC	3	0	0	3
3.	PE – IV	Professional Elective – IV	PE	3	0	0	3
4.	PE – V	Professional Elective – V	PE	3	0	0	3
5.	OE – III	Open Elective – III*****	OE	3	0	0	3
Laboratory Courses							
6.	21UBM707	Hospital Training	PC	0	0	2	1
7.	21UBM708	Medical Image Processing Laboratory	PC	0	0	2	1
8.	21UBM735	Internship	PW	-	-	-	1
9.	21UGE710	Multi-disciplinary Project (Phase-I)*****	PW	0	0	6	3
Mandatory Courses							
10.	21UGM731	Sports and Social Development	MC	-	-	-	P/F
11.	21UGM732	Skill Development	MC	-	-	-	P/F
			Total	15	0	4	18
Total Credits : 18							

***** The Students those who opt for Multi-disciplinary Project (Phase-I) are exempted from taking Open Elective III

21UME701 PROJECT MANAGEMENT AND FINANCE
(Common to ALL Branches – Except CSBS)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge to find solutions and approaches for various projects.
- To familiarize the utilization of project within time, resource and financial constraints.

UNIT – I PROJECT MANAGEMENT CONCEPTS 9

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.

UNIT – II PROJECT PLANNING 9

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.

UNIT – III RESOURCE SCHEDULING & CRITICAL CHAIN SCHEDULING 9

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.

UNIT – IV PROJECT QUALITY MANAGEMENT 9

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.

UNIT – V FINANCIAL ACCOUNTING 9

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.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the concept and characteristics of project management and application of resource scheduling and critical chain scheduling. [Understand]

CO2: Apply the concepts of CPM and PERT to develop the project network [Apply]

CO3: Estimate the suitable resources required for given project work. [Apply]

CO4: Examine the various tools and techniques at different stages of Quality management. [Analysis]

CO5: Construct the balance sheet to identify the fund flow and cash flow statements. [Apply]

CO6: Evaluate the decision related to forecasting, inventory, quality control problems etc. for

the industries. [Evaluate]

TEXTBOOKS:

1. Prasanna Chandra, - 'Fundamentals of Financial Management', Tata Mcgraw – Hill Publishing Ltd, 2015.
2. Jack Meredith, Samuel J.Mantel, "Project Management – A Managerial Approach" John Wiley and Sons.

REFERENCES:

1. Clifford F Gray, Erik W Larson, —Project Management-The Managerial Process‖, Tata Mcgraw-Hill Publishing Co Ltd.
2. John M Nicholas, 'Project Management for Business and Technology', Prentice Hall of India PvtLtd.
3. Paresh Shah, —Basic Financial Accounting for Management‖, Oxford University Press, 2020.

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

21UBM702 MEDICAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To analyze the mathematical transforms necessary for medical image processing and different medical image enhancement techniques.
- To analyze medical image restoration procedures and medical image segmentation techniques.
- To analyze the medical image compression procedures.

UNIT – I IMAGE PROCESSING FUNDAMENTALS 9

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.

UNIT – II IMAGE ENHANCEMENT 9

Basic Intensity Transformations – Histogram equalization and specification techniques – Spatial Smoothing Filters, Spatial sharpening Filters – Frequency domain Smoothing and Sharpening Filters – Selective Filtering, Homomorphic filtering.

UNIT – III IMAGE RESTORATION 9

Image Restoration – Noise models – Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering – linear position – Invariant degradation – Estimation of degradation function, Inverse filter, Weiner filtering.

UNIT – IV IMAGE SEGMENTATION AND VISUALISATION 9

ROI definition – Detection of discontinuities – Edge linking via Hough transform and boundary detection – Region based segmentation – Region growing, Region splitting and Merging – Thresholding – Visualization – Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image.

UNIT – V APPLICATIONS 9

Medical Image compression – DCT and Wavelet transform based image compression, Preprocessing of medical images – Retinal images, Ultrasound – liver, kidney, Mammogram – Segmentation of ROI – blood vessels, lesions, tumour, lung nodules, feature extraction – shape and texture, Computer aided diagnosis system.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the fundamental concepts and transform domain operations associated with medical image processing. [Understand]

CO2: Apply the mathematical concepts to enhance and compress to improve the quality of medical images. [Apply]

CO3: Apply segmentation techniques to extract important anatomical structures from medical images. [Apply]

CO4: Analyze various image restoration methods to determine the best approach for reducing noise and recovering lost medical image details. [Analyze]

CO5: Develop mathematical models for various image processing techniques images to

analyze their performance on medical images. [Analyze]

CO6: Assess the Computer aided diagnosis system for medical Images. [Evaluate]

TEXTBOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, 3rd edition, 2016.
2. Isaac N. Bankman, Handbook of Medical Image Processing and Analysis, 2nd Edition, Elsevier, 2009.
3. Wolfgang Birkfellner, Applied medical Image Processing: A Basic course, CRC Press, 2011

REFERENCES:

1. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, 2003.
2. Atam P.Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA 2003
3. Rangaraj M. “Rangayyan, Biomedical Image Analysis”, 1st Edition, CRC Press,Published December 30, 2004.
4. Joseph V.Hajnal, Derek L.G.Hill, David J Hawkes, “Medical image registration”, Biomedical Engineering series, CRC press,2001.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3				3							2	3	3
CO3	3	2			3							2	3	3
CO4	3	3			2							2	3	3
CO5	3	3	2		2							2	3	3
CO6	3	3	3	3	3	2		2	3	3		3	3	3
CAM	**2.83**	**2.75**	**2.5**	**3**	**2.6**	**2**		**2**	**3**	**3**		**2.2**	**3**	**3**

21UBM707 HOSPITAL TRAINING

L	T	P	C
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

ASSESSMENT:

- Students need to complete training in any leading Multi-speciality 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 10. The students can give a 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
11	Nuclear Medicine
12	Pulmonology
13	Obstetrics and Gynaecology
14	Emergency Medicine
15	Biomedical Engineering Department
16	Histo Pathology
17	Biochemistry
18	Paediatric/Neonatal
19	Dental
20	Oncology
21	PAC’s
22	Medical Records / Telemetry

TOTAL : 30 PERIODS

COURSEOUTCOMES:

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

CO1: Demonstrate their skills in solving problems in patient centered approach in health care. [Apply]

CO2: Use the knowledge of their own role and those of other professions and thereby justifying healthcare needs of populations and patients served. [Analyze]

CO3: Propose a patient-centered inter-professional health improvement plan based upon the patient's perceived needs. [Evaluate]

CO4: Communicate with other health professionals in a respectful and responsible manner. [Responding - Affective Domain]]

CO5: Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs. [Characterizing – Affective Domain]

CO6: Collate on-the-field career related experience and communicate effectively with multidisciplinary teams on medical equipment working and safety issues. [Responding - Affective Domain]

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

21UBM608 MEDICAL IMAGE PROCESSING LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To practice the basic medical image processing techniques.
- To compute magnitude and phasor representation of medical images.
- To understand the concepts of medical image restoration and segmentation.
- To explore the applications of medical image processing.

LIST OF EXPERIMENTS:

Simulation using MATLAB/ Equivalent software:

1. Medical image acquisition and pre-processing, display image in gray scale.
2. Image sampling and quantization levels on medical image quality.
3. Implement and demonstrate 2-D DFT & DCT Transforms on medical image.
4. Implement and demonstrate Histogram Processing.
5. Implement and demonstrate Inverse Filtering and Wiener Filtering.
6. Implement and demonstrate Mean and Order Statistic Filters.
7. Implement and demonstrate Line and Edge Detection Techniques and Edge linking.
8. Implement and demonstrate medical image registration.
9. Implement and demonstrate Extract boundary and regional features.
10. Medical Image Enhancement - Spatial filtering.
11. Medical Image Enhancement - Filtering in frequency domain.
12. Implement and demonstrate thresholding techniques in medical images.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Apply basic image processing techniques, transforms and histogram processing to enhance medical images. [Apply]

CO2: Apply different filtering methods to enhance medical images. [Apply]

CO3: Execute restoration and segmentation techniques in medical images. [Apply]

CO4: Implement and evaluate medical image segmentation techniques to extract meaningful information from medical images. [Analyze]

CO5: Apply image processing technique to solve real health care problems. [Apply]

CO6: Design and evaluate the use of image processing fundamentals in healthcare applications, as well as their impact on health and society, and any underlying ethical issues, then communicate effectively through reflections, reports, and presentations.

HARDWARE / SOFTWARE REQUIRMENTS:

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

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	3	2			3									
CO5	3	3		3	3							3		
CO6	3				3	3	3	3	3	3		3	2	3
CAM	**3**	**2.5**		**3**	**3**	**3**	**3**	**3**	**3**	**3**		**3**	**2**	**3**

SEMESTER VIII

S. No.	Course Code	Course Title	Course Category	L	T	P	C
Theory Courses							
1.	PE - VI	Professional Elective – VI	PE	3	0	0	3
2.	OE - IV	Open Elective – IV	OE	3	0	0	3
Laboratory Courses							
3.	21UBM801	Project work	PW	0	0	16	8
4.	21UGE810	Multi-disciplinary Project (Phase-II)	PW	0	0	16	8
Mandatory Course							
5.	21UGM831	Professional Ethics and Human Values (Common to ALL Branches)	MC	2	0	0	P/F
			Total	8	0	16	14
Total Credits : 14							

* The Students those who opt for Multi-disciplinary Project (Phase-I) are allowed to take Multi-disciplinary Project (Phase-II)

21UBM801 PROJECT WORK

L	T	P	C
0	0	16	8

OBJECTIVES:

The student should be made to:

- To investigate the societal issues in the healthcare and develop engineering solutions to human health problems.
- To engage the student in integrated activities of researching the problems in healthcare field and identifying novel solution for the unaddressed technical issues.
- To enrich the communication skills of the student and to create awareness on recent development in the medical field through project work.

COURSE REQUIREMENTS:

In this course, 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 7^{th} semester. The project work is also guided by the allocated faculty member for tuning up the report. There shall be three reviews for the project work during the semester by the project review committee. The review committee consisting of the project guide and a senior faculty member, nominated by the Head of the department, in the related field of the project. 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. The product should be demonstrated at the time of examination. At the end of the project period, the marks shall be awarded by the same committee for the report and viva-voce.

COURSEOUTCOMES:

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

CO1: Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge. [Create]

CO2: Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion. [Apply]

CO3: Utilize the new tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice. [Apply]

CO4: Test and evaluate the performance of the developed solution using appropriate techniques and tools. [Evaluate]

CO5: Apply management principles to function effectively in the project team for project execution. [A4-Organize]

CO6: Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs. [A3-Value]

CO7: Write effective reports and make clear presentation to the engineering community and society. [A2-Respond]

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	3
CO6						3	3					3	3	3
CO7										3			3	3
CAM	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

21UGM831 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
2	0	0	P/F

OBJECTIVES:

- 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.

UNIT – I HUMAN VALUES **7**

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

UNIT – II ENGINEERING ETHICS **7**

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.

UNIT – III UNIVERSAL HARMONY **4**

Engineering Harmony in the family – Harmony in the society – Trust and Respect – Universal harmonious order.

UNIT – IV IMAGE SEGMENTATION AND VISUALISATION **6**

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.

UNIT – V GLOBAL ISSUES **6**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development– Engineers as Managers – Consulting Engineers – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society. [Apply]

TEXTBOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics– Concepts and Cases", Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and

Engineers", Oxford University Press, Oxford, 2001.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, „ Value Education", Vethathiri publications, Erode, 2011.

LIST OF PROFESSIONAL ELECTIVES

S. No.	Course Code	Course Title	L	T	P	C
Vertical - I : 21BMV100 Bio Engineering						
1.	21BMV101	Biomaterials, Artificial Organs and Implants	3	0	0	3
2.	21BMV102	Biomedical Optics and Biophotonics	3	0	0	3
3.	21BMV103	Principles of Tissue Engineering	3	0	0	3
4.	21BMV104	Neural Engineering	3	0	0	3
5.	21BMV105	Drug Delivery Systems	3	0	0	3
6.	21BMV106	Fundamentals of Cancer Biology	3	0	0	3
Vertical - II : 21BMV200 Medical Device Innovation and Development						
1.	21BMV201	Foundation Skills in Integrated Product Development	3	0	0	3
2.	21BMV202	Medical Device Design	3	0	0	3
3.	21BMV203	Patient safety, Standards and Ethics	3	0	0	3
4.	21BMV204	Medical Device Regulations	3	0	0	3
5.	21BMV205	Medical Innovation and Entrepreneurship	3	0	0	3
6.	21BMV206	Rapid Prototyping	3	0	0	3
Vertical - III : 21BMV300 Management (Healthcare)						
1.	21BMV301	Clinical Engineering	3	0	0	3
2.	21BMV302	Hospital Planning and Management	3	0	0	3
3.	21BMV303	Medical Waste management	3	0	0	3
4.	21BMV304	Forensic Science in Health Care	3	0	0	3
5.	21BMV305	Bio Statistics	2	0	2	3
6.	21BMV306	Economics and Management for Engineers	3	0	0	3
Vertical - IV : 21BMV400 Mechanics						
1.	21BMV401	Biomechanics	3	0	0	3
2.	21BMV402	Rehabilitation Engineering	3	0	0	3
3.	21BMV403	Physiological Modeling	3	0	0	3
4.	21BMV404	Ergonomics and Regenerative Medicine	3	0	0	3
5.	21BMV405	Haptics in Healthcare	3	0	0	3
6.	21BMV406	Assistive and Augmentative Technologies	3	0	0	3
Vertical - V : 21BMV500 Signal and Image Processing						
1.	21BMV501	Bio-Signal Processing	3	0	0	3
2.	21ECV107	Machine Vision (Common to ECE & BME)	3	0	3	3
3.	21ECV102	Speech and Audio Signal Processing (Common to ECE & BME)	3	0	0	3
4.	21BMV504	Medical Video Processing	3	0	0	3
5.	21BMV505	Brain Computer Interface and Applications	3	0	0	3

6.	21BMV506	Biometric Systems	3	0	0	3
7.	21BMV507	AI in Healthcare	3	0	0	3
Vertical - VI : 21BMV600 Communication (Healthcare)						
1.	21BMV601	Medical Wearable Devices	3	0	0	3
2.	21BMV602	Telehealth Technology	3	0	0	3
3.	21BMV603	Body Area Networks and Mobile Healthcare	3	0	0	3
4.	21BMV604	Virtual Reality and Augmented Reality in Healthcare	3	0	0	3
5.	21BMV605	Medical Informatics	3	0	0	3
6.	21BMV606	Advanced Communication Technologies for Healthcare	3	0	0	3
7.	21BMV607	Antenna's in Wearable and Implantable Devices	3	0	0	3
Vertical - VII : 21BMV700 Advanced Healthcare Devices						
1.	21BMV701	Bio-MEMS and Nano Electronics	3	0	0	3
2.	21BMV702	Human Assist Devices (Common to BME & ECE)	3	0	0	3
3.	21BMV703	Critical Care and Operation Theatre Equipment	3	0	0	3
4.	21BMV704	Therapeutic Equipment (Common to BME & ECE)	3	0	0	3
5.	21BMV705	Advancements in Healthcare Technology	3	0	0	3
6.	21BMV706	Robotics in Medicine	3	0	0	3

VERTICAL - I

21BMV100 BIO ENGINEERING

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV101	Biomaterials, Artificial Organs and Implants	3	0	0	3
2.	21BMV102	Biomedical Optics and Biophotonics	3	0	0	3
3.	21BMV103	Principles of Tissue Engineering	3	0	0	3
4.	21BMV104	Neural Engineering	3	0	0	3
5.	21BMV105	Drug Delivery Systems	3	0	0	3
6.	21BMV106	Fundamentals of Cancer Biology	3	0	0	3

21BMV101 BIOMATERIALS, ARTIFICIAL ORGANS AND IMPLANTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand different metals, ceramics and its nanomaterial's characteristics as biomaterials.
- To learn characteristics and classification of biomaterials and polymeric materials and its combinations that could be used as a tissue replacement implants.
- To get familiarized with the concepts of Nano Science and Technology.
- To understand the concept of biocompatibility and the methods for biomaterials testing.
- To have an overview of artificial organs & transplants.
- To describe the principles of implant design with a case study and to explain the implant design parameters and solution in use.

UNIT – I BIO-MATERIALS: METALLIC AND CERAMIC MATERIALS 9

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants. Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

UNIT – II POLYMERIC IMPLANT MATERIALS AND TESTING OF BIOMATERIALS 10

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach. Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, *In vitro* and *In vivo* testing.

UNIT – III PRINCIPLES AND PARAMETERS OF IMPLANT DESIGN 9

Principles of implant design, Clinical problems requiring implants for solution, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration. Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, corrosion, wear and tear, Implants for bone, dental and nerve regeneration.

UNIT – IV TISSUE REPLACEMENT IMPLANTS 9

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

UNIT – V ARTIFICIAL ORGANS & TRANSPLANTS 8

ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process; TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Elucidate the basic properties of biomaterials, implant materials and artificial organs that are used in biomedical applications. [Understand]

CO2: Apply the techniques and the concepts of biomaterials to design biodegradable biomaterials with high acceptability. [Apply]

CO3: Apply innovative ideas to overcome clinical challenges associated with bioinert biomaterials in human. [Apply]

CO4: Analyze various biomaterials and their compositions to design suitable implant materials that should be fit to the patient. [Analyze]

CO5: Analyze various tissue scaffolding and engineering techniques to develop and implement artificial organs. [Analyze]

CO6: Evaluate novel biomaterials and test its toxicity and biocompatibility using *in vitro* or *in vivo* model. [Evaluate]

TEXTBOOKS:

1. Joon park, R.S Lakes, “Biomaterials An Introduction ”Springer, 2007.
2. Sujata V. Bhat “Biomaterials” springer 2007.
3. Larry L. Hench and Julian R. Jones, Biomaterials, artificial organs and tissue engineering, CRC Press 2010.
4. Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976.

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													**2**
CO2	3	2											2	**2**
CO3	3	2											2	**2**
CO4	2	3	3	2					2	2			3	**2**
CO5	2	3	2	2					2	3			2	**2**
CO6	2	3	2	2					2	2			3	**2**
CAM	**2.33**	**2.6**	**2.3**	**2**					**2**	**2.66**			**2.4**	**2**

21BMV102 BIOMEDICAL OPTICS AND BIOPHOTONICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge about the physical properties of light and optical properties of tissues.
- To learn the design and working principle of various optical components.
- To understand the principles and applications of optical biosensors.
- To apply the concepts of engineering and practical applications of optics related to diagnostic and surgical applications.
- To get familiarized with the phenomenon of laser tissue interaction and practical knowledge of optics related to therapeutic applications.

UNIT – I OPTICAL PROPERTIES 9

Basic principles of light - Reflection - Refraction - Absorption - Polarization - Interference - Coherence, Basic laws of light - Beer Lambert law - Snell's law, Optical properties of tissues - Absorption - Scattering - Anisotropy..

UNIT – II OPTICAL INSTRUMENTATION 9

Working principle of light sources - Lasers - LEDs, Working principle of optical detectors - Photodiode - Spectrometer - CMOS and CCD cameras - Lens - Optical filters - Optical fibers.

UNIT – III OPTICAL BIOSENSORS 9

Principles of Optical bio sensing - Immobilization of bio-recognition elements, Types of optical biosensor - Fiber optic - Planar waveguide - Evanescent - Interferometry - Surface Plasmon resonance – Advantages and disadvantages - Applications.

UNIT – IV APPLICATIONS OF LASERS 9

Diagnostic - Optical coherence tomography, Fluorescence, Raman, Photo acoustic tomography, Laser induced breakdown spectroscopy (LIBS), Hyper spectral imaging. Surgical - Lasers in dentistry, Dermatology, Ophthalmology.

UNIT – V LASER TISSUE INTERACTION 9

Laser tissue interactions via photochemical, Photo thermal, Photomechanical techniques, Photodynamic therapy (PDT) - Oncological and non-oncological applications, Low level laser therapy (LLLT) - Bio stimulation applications.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the principles of light propagation, optical properties of tissues, optical bio-instrumentation and laser applications. [Understand]

CO2: Apply light-tissue interaction, optical components, and biosensors in biomedical applications. [Apply]

CO3: Utilize various optical imaging and laser-based therapeutic techniques for disease diagnosis and treatment. [Apply]

CO4: Analyze the impact of optical properties of tissues and optical instrumentation on the performance and sensitivity of biosensors used in medical applications. [Analyze]

CO5: Examine the effectiveness of laser-based diagnostic and surgical applications. [Analyze]

CO6: Evaluate the clinical impact of Photodynamic Therapy and Low-Level Laser Therapy in Oncological and non-oncological applications. [Evaluate]

TEXTBOOKS:

1. Tuan VoDinh, “Biomedical Photonics –Handbook, CRC Press, Bocaraton, 2014.
2. Jurgen Popp, Valery V. Tuchin, Arthur Chiou and Stefen Heinemann, Handbook of Biophotonics, Vol 2: Photonics for Healthcare, John Wiley and Sons, 1st Edition, 2011.

REFERENCES:

1. Markolf H. Niemz, “Laser-Tissue Interaction Fundamentals and Applications” Springer,2007.
2. Splinter R and Hooper B. A., “An Introduction to Biomedical Optics”, Taylor and Francis, 2006.
3. Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”,Academic Press, 2006.
4. Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and sons, Inc. Publications,2003.

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

21BMV103 PRINCIPLES OF TISSUE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study various cell types, stem cells and its applications.
- To understand the basic concepts, methods and design involved in tissue engineering and stem cell technologies.
- To familiarize various advanced engineering methods and design concepts in the domain of tissue engineering.

UNIT – I INTRODUCTION TO CELL BIOLOGY 9

Cell types - Progenitor cells - Cell growth and differentiation - Cell culture: Expansion - Transfer - Storage and Characterization - Cell signaling molecules - Growth factors - Cell attachment: Differential cell adhesion, Receptor-ligand binding - Cell surface markers

UNIT – II FUNDAMENTALS OF TISSUE ENGINEERING 9

History and scope of tissue engineering - Tissue organization - Tissue types: Epithelial, Connective - Vascularity and angiogenesis - Wound healing - Extra Cellular Matrix: Matrix molecules and their ligands - Tissue culture – Materials in tissue engineering

UNIT – III STEM CELLS 9

Definition of stem cells – Types of stem cells – Differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pleuripotent stem cells..

UNIT – IV ENGINEERING METHODS AND DESIGN 9

Soft lithography - Self-assembled monolayer, Micro contact printing, Micro fluidic patterning - Laminar flow patterning - Cell interaction with Polymer scaffolds and gels - Polymer scaffolds fabrications: Electro spinning - Solvent casting and particulate leaching - Micro fabrication of cell seeded scaffolds.

UNIT – V APPLICATION OF TISSUE ENGINEERING 9

Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver - Regenerative engineering: Peripheral Nerve regeneration, Cardiac tissue regeneration, Muscle regeneration – Regulation, Commercialization and Patenting.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the basic concepts of cell biology, stem cell technology and tissue engineering. [Understand]

CO2: Apply the concepts of natural cell biology, and stem cell technologies for tissue engineering. [Apply]

CO3: Apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies. [Apply]

CO4: Analyze various tissue regeneration and organ replacement issues to develop and implement artificial tissues/organs. [Analyze]

CO5: Review a particular problem about tissue or organ replacement and analyze it through literature survey and give your suggestion by case study. [Evaluate]

CO6: Design and develop different biomaterial in tissue engineering applications. [Create]

TEXTBOOKS:

1. Robert P lanza, Robert Langer, Joseph Vacanti, "Principles of Tissue Engineering", Academic Press, United States, 2020.
2. Donglu Shi, Qing Liu, “Tissue Engineering and Nanotheranostics”, World Scientific Publications, Singapore, 2018.

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												2	
CO2	3	2	2										3	2
CO3	3						3	2		2			2	
CO4	3	2	3	2									2	3
CO5	3	2	2	2						2			2	
CO6	3	3	3	2									3	3
CAM	**2.83**	**2.25**	**2.5**	**2**			**3**	**2**		**2**			**2.33**	**2.67**

21BMV104 NEURAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basis of nervous system, function and their disorders
- To be exposed to neuronal diseases and disorders and find the solution to complex neural diseases or neural disorder.
- To familiarize the concepts of nerve reconstruction and rehabilitation for give their suggestions to solve nerve disorders.

UNIT – I BASICS OF NEURON 9

Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure – function – classification. Glial cells – myelination. Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons.

UNIT – II BRAIN AND SPINAL CORD 9

Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Blood supply to Brain and spinal cord.

UNIT – III NEURONAL DISEASES AND DISORDERS 9

Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration. Neuronal plasticity – CNS acting drugs and their pharmacokinetics. Alzheimer‘s, Parkinson‘s and Prion diseases

UNIT – IV NEUROPHYSIOLOGY & NEURORADIOLOGY 9

Physiology of nerve conduction. Peripheral nerves – structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system. Neuromotor-machine interface: human voluntary motor control system.

UNIT – V NERVE RECONSTRUCTION AND REHABILITATION 9

Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the structure and functions of human nervous system neuronal diseases, and rehabilitation techniques. [Understand]

CO2: Apply the concepts of sensory and motor tracts of spinal cord to solve the disorders associated with nervous system. [Apply]

CO3: Analyze visualization and radiological techniques to enhance neuromotor- machine interface and improve nervous system. [Analyze]

CO4: Apply nerve reconstruction and rehabilitation concepts to solve various neural disorders. [Apply]

CO5: Review a neural disorder problem and analyze it through literature survey and give your suggestion and advanced techniques by case study. [Evaluate]

CO6: Evaluate novel rehabilitation techniques and regeneration approaches and analyze its test methods for human applications. [Evaluate]

TEXTBOOKS:

1. Mathews G.G., “Neurobiology”, 2nd edition, Blackwell Science, UK, 2000
2. Malcom Carpenter, “Textbooks of Neuroanatomy”, Mc. Graw hill Edition, 1996

REFERENCES:

1. W. Mark Saltzman, “Tissue Engineering – Engineering principles for design of replacement organs and tissue’’, Oxford University Press Inc New York, 2004.
2. Park J.B., “ACS Biomaterials Science and Engineering”, Plenum Press, 2014. Saunders, 2006.

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	2
CO3	3	2	3	2									3	2
CO4	3	2	2	2									3	3
CO5	3	2	2	3						2			3	2
CO6	3	2	2	3		3						2	2	3
CAM	**2.83**	**2.2**	**2.2**	**2.5**		**3**				**2**		**2**	**2.67**	**2.4**

21BMV105 DRUG DELIVERY SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation.
- To emphasize the importance of various drug delivery systems and their usage in hospitals.
- To deal with the formulation and evaluation of Novel drug delivery systems.

UNIT – I CONTROLLED DRUG DELIVERY SYSTEM 9

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 – bioavailibility assessment of CR systems.

UNIT – II DESIGN AND FABRICATION OF TECHNOLOGY BASED CR SYSTEMS 9

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.

UNIT – III PARENTERAL SYSTEM 9

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.

UNIT – IV TRANSDERMAL DRUG DELIVERY SYSTEM 9

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.

UNIT – V TARGETED DRUG DELIVERY 8

History – concept, Types and key elements – ideal carrier system and approach with special reference to organ targeting. Vaccine delivery systems. Drug delivery: liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications. Developing the next generation of drug delivery technologies.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the basic concepts of different types of drug delivery systems. [Understand]

CO2: Apply the drug delivery concepts to biopharmaceutical techniques. [Apply]

CO3: Analyze the mechanism of action of transdermal and targeted drug delivery systems to improve the traditional methods. [Analyze]

CO4: Investigate various targeted drug delivery systems and its key elements for targeting tactics. [Analyze]

CO5: Review several different types of drug delivery system and analyze it through literature survey and give your suggestion and advanced approach by case study. [Evaluate]

CO6: Evaluate novel drug delivery system and analyze its efficiency and also minimize its side effect for human applications. [Analyze]

TEXTBOOKS:

1. Tozer T N, Rowland M, “Introduction of Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy”, Williams & Wilkins, 2006.
2. Howard C. Ansel, NIcholos G. Popvich, lyold V. Allen , “Pharmaceutical dosage forms and Drug Delivery system”, 1st edition, 2014.
3. Jain N.K and Sharma S.N. “A text book of professional pharmacy”, 1st edition 1995.

REFERENCES:

1. Samuel Harder and GlennV. Buskirk. “Pilot Plant Scale-Up Techniques. In The Theory and Practice of Industrial Pharmacy”. 3rd 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”. 3rd 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												2	
CO2	3	2	2										3	2
CO3	3	3	2										3	2
CO4	3	2	3	2									3	3
CO5	3	2	2	3		2				2			3	2
CO6	3	2	2	3		2				2			3	3
CAM	**2.83**	**2.2**	**2.2**	**2.67**		**2**				**2**			**2.83**	**2.4**

21BMV106 FUNDAMENTALS OF CANCER BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To import knowledge on Cancer Biology fundamentals and principles of carcinogenesis.
- To discuss about molecular cancer cell biology and metastasis.
- To introduce various therapeutic procedures for treating carcinoma.
- To emphasize knowledge of the historical background for the development of the tumor microenvironment.

UNIT – I FUNDAMENTALS OF CANCER BIOLOGY 9

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.

UNIT – II PRINCIPLES OF CARCINOGENESIS 9

Theory of carcinogenesis – Chemical carcinogenesis – Metabolism of carcinogenesis, principles of physical carcinogenesis – x-ray radiation – mechanisms of radiation carcinogenesis – Diet and cancer.

UNIT – III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 9

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.

UNIT – IV PRINCIPLES OF CANCER METASTASIS 9

Molecular principles of metastasis. Clinical significances of invasion – Heterogeneity of metastatic phenotype – metastatic cascade, basement membrane disruption – Proteinases and tumour cell invasion.

UNIT – V CANCER THERAPY 9

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.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the basic concepts of cell cycle, mutations in pathway that causes cancer and carcinogenesis. [Understand]

CO2: Apply the principles of molecular biology of cancer cells to diagnose cancer cells in human body. [Apply]

CO3: Apply the molecular principles of metastasis to treat currently available cancer. [Apply]

CO4: Analyze the molecular mechanisms behind carcinogenesis and their impact in human cells. [Analyze]

CO5: Investigate the various treatment procedures for cancer and analyze it with previous report and give your opinion to treat very rare cancers. [Evaluate]

CO6: Distinguish scientific explanations that show how the Multi-step tumorigenesis takes place and develop solution for the specific type of cancer. [Evaluate]

TEXTBOOKS:

1. Becker's World of the Cell 9th Edition By Jeff Hardin, Gregory Paul Bertoni, and Lewis J. Kleinsmith Pearson (Publisher), 2017.
2. Roger John Benjamin King,, "Cancer Biology", Pearson/Prentice Hall, 2006.
3. Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.

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											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**	**2.6**	**2**	**2.67**		**2**							**2.83**	**2**

VERTICAL - II

21BMV200 MEDICAL DEVICE INNOVATION AND DEVELOPMENT

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV201	Foundation Skills in Integrated Product Development	3	0	0	3
2.	21BMV202	Medical Device Design	3	0	0	3
3.	21BMV203	Patient safety, Standards and Ethics	3	0	0	3
4.	21BMV204	Medical Device Regulations	3	0	0	3
5.	21BMV205	Medical Innovation and Entrepreneurship	3	0	0	3
6.	21BMV206	Rapid Prototyping	3	0	0	3

21BMV201 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT – I BASICS OF PRODUCT DEVELOPMENT 9

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

UNIT – II REQUIREMENTS AND SYSTEM DESIGN 9

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

UNIT – III DESIGN AND TESTING 9

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

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

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal interface: human voluntary motor control system.

UNIT – V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical,

Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the importance of defining and analyzing problems in the context of innovation and product development. [Understand]

CO2: Identify the process and ensure the required specifications and standards in product development. [Apply]

CO3: Develop solutions to problems that align with the innovation and product development process. [Apply]

CO4: Compare and contrast different approaches to problem-solving in innovation and product Development. [Analyze]

CO5: Analyze the sustainability of products and processes using quantitative and qualitative metrics. [Analyze]

CO6: Assess the effectiveness of problem-solving techniques used in innovation and product development projects. [Evaluate]

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2	3								2		3	
CO3	3	3	3	2							2		3	
CO4	3	3	2	2							2	2	3	
CO5	3	2	2	2		2	3			2		2	3	
CO6	3	3	3	3					2	2	3	2	3	2
CAM	2.83	2.6	2.6	2.25		2	3		2	2	2.25	2	2.83	2

21BMV202 MEDICAL DEVICE DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- Introduce the Medical device standards and requirements.
- Illustrate the design procedure of medical devices.
- Outline the quality assessment in design.
- Describe about the design realization.
- Understand the validation and verification of various medical devices

UNIT – I NEEDS FINDING AND CONCEPT GENERATION 9

Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping – final concept selection.
Safety and Risk Management - Tools, Documents and Deliverables.

UNIT – II MEDICAL DEVICES STANDARDS AND REQUIREMENTS 9

FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO13485, ISO 14971, IEC60601-1, IEC 62304. Reliability, Concept of failure, Product Design and Development Process.

UNIT – III DESIGN ENGINEERING 9

Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.

UNIT – IV TESTING AND VALIDATION 9

Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

UNIT – V DESIGN TRANSFER AND MANUFACTURING 9

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the importance of safety, efficacy, and usability in medical device design. [Understand]

CO2: Apply tools and techniques to ensure that medical devices meet the required standards and regulations. [Apply]

CO3: Apply hardware and software design principles to solve problems and make decisions in product and service development. [Apply]

CO4: Analyze the design of existing medical devices and identify opportunities for improvement. [Analyze]

CO5: Conduct an analysis of a variety of medical device design transfer and production processes. [Analyze]

CO6: Create new and innovative testing and validation strategies that meet the needs of specific hardware and software designs. [Create]

TEXTBOOKS:

1. Zenios, Makower and Yock, —Biodesign – The process of innovating medical technologiesll, Canbridge University Press, 2009
2. Theodore R. Kucklick , The Medical Device R&D Handbook, Second Edition, CRC Press, 2012
3. Peter Ogrodnik,Medical Device Design Innovation from Concept to Market, Elsevier, 2013

REFERENCES:

1. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design,2ndedition, 2005.
2. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.
3. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau‘Handbook of Human Factors in Medical Device Design‘,CRC press,2010.
4. Jagdish Chaturvedi, Inventing medical devices: A perspective from India, Create Space Independent Publishing Platform, 1st edition, 2015.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					3		2					2	
CO2	3	2				3		3			2		3	
CO3	3	3	2		2						2		3	3
CO4	3	3	2	2							2	2	3	2
CO5	3	2	2	3							3	2	3	
CO6	3	3	3	3	3	2		2		2	2	3	3	3
CAM	2.83	2.6	2.25	2.67		2.67		2.33		2	2.2	2.33	2.83	2.67

21BMV203 PATIENT SAFETY, STANDARDS AND ETHICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the importance of patient safety against electrical hazards
- To explain the patient safety laws and regulations
- To understand the standards and testing of patient
- To know the patient safety specialties in clinical
- To know about the health care organization

UNIT – I EFFECTS OF ELECTRICITY 9

Physiological effects of electricity - important susceptibility parameters – microshock – macroshock hazards -patients electrical environment - isolated power system - conductive surfaces.

UNIT – II PATIENT SAFETY LAWS AND REGULATIONS 9

Mandatory Reporting systems. Anatomy of a patient safety Law: Compliance Tips, Federal patient safety Legislation Initiatives, Medical Device Reporting, Clinical trials and Adverse-Event.

UNIT – III STANDARDS AND TESTING 9

Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-1 2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system Reporting, Patient safety Goals and standards, The Quality Assessment and performance Improvement rule.

UNIT – IV PATIENT SAFETY IN MAIN CLINICAL SPECIALITIES 9

Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology

UNIT – V MEDICAL ETHICS 9

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society, Case Studies.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Outline the importance of patient safety, safety laws, standards and medical ethics. [Understand]

CO2: Explain the ethical principles that underpin patient safety and how they relate to care quality indicators. [Understand]

CO3: Apply safety standards and testing methods for compliance in medical settings. [Apply]

CO4: Apply patient safety principles to minimize risks in clinical scenarios. [Apply]

CO5: Analyze the impact of medical ethics on patient safety, care quality, and the professional responsibilities of healthcare providers. [Analyze]

CO6: Evaluate the effectiveness of safety standards and protocols in clinical environments. [Evaluate]

TEXTBOOKS:

1. John G.Webster, “Medical Instrumentation Application and design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Liam Donaldson, Walter Ricciardi, “Textbook of patient safety and clinical Risk management”, Springer.
3. Fay A. Rozovsky, James R. Woods, Jr, “ The Handbook of Patient Safety Compliance”, 2016

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					3		3						
CO2	3					3		3						
CO3	3		2	2		3		3			2		2	
CO4	3	2	2			3		2					2	
CO5	3	2				3		3		2		2	2	
CO6	3	2		3		3		2		2	2	2	3	
CAM	**2.83**	**2**	**2**	**2.5**		**3**		**2.67**		**2**	**2**	**2**	**2.25**	

21BMV204 MEDICAL DEVICE REGULATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the regulation of medical devices, process of development, ethical and quality considerations.
- To learn the various ISO standards of quality and risk management for regulatory purposes
- To explore the process of approval and marketing of medical devices.
- To comprehend the regulatory process for medical devices in India, US, and EU.
- To familiarize with clinical evaluation and investigation of medical devices.

UNIT – I MEDICAL DEVICE REGULATIONS 9

History of medical device regulation, regulatory affairs professional's roles, required competencies, medical device classification: scope, definitions, main classifications, Risk based classification, practical examples, labeling of medical devices: definition, elements, risk management, clinical evaluation and labeling, language level and intended users. differentiating medical devices IVDs and combination products from that of pharmaceuticals.

UNIT – II ISO STANDARDS 9

ISO 13485:2016: Requirements for regulatory purposes: Quality Management Systems, certification process. ISO 14971: Application of Risk management to medical Devices.

UNIT – III IEC, REGULATORY SYSTEMS IN USA & EU 9

IEC international standards and conformity assessment for medical devices, Good submission process, medical device regulatory system in the USA and European Union..

UNIT – IV INDIAN REGULATORY SYSTEM 9

India: Medical device regulatory system: market environment, functions undertaken by DGGI, central government, FDA and state governments, guidance documents, details of key regulators, IMDRF and CDSCO, regulatory overview in India, product registration on conformity assessment, quality system regulation, technical material and labeling requirements, commercial aspects, upcoming regulation changes.

UNIT – V CLINICAL TRIALS AND DIGITAL REGULATIONS 9

Regulatory strategy and competitive advantage, Preclinical and Clinical Trial Design for Medical Devices in India; FDA approved devices, post-market surveillance/vigilance, Digital health regulations: Connected care, intelligent design control, reducing design time and cost with in-silico clinical trials

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Understand the key concepts in medical device regulation, classifications, standards, and regulatory systems. [Understand]

CO2: Apply ISO standards and regulatory systems for medical devices. [Apply]

CO3: Apply the Indian regulatory framework for medical devices. [Apply]

CO4: Analyze risk management and regulatory strategies for ensuring device safety and compliance. [Analyze]

CO5: Analyze clinical trials and post-market surveillance for medical devices across regions. [Analyze]

CO6: Evaluate global regulatory strategies and their impact on medical device development and digital health regulations. [Evaluate]

TEXTBOOKS:

1. Medical Regulatory Affairs: An International Handbook for Medical Devices and Healthcare Products, 3rd Edition, Taylor & Francis Group, 2021

REFERENCES:

1. Reliable Design of Medical Devices, Second Edition by Richard Fries, CRC Press, 2006
2. Medical Device Quality Assurance and Regulatory Compliance by Richard C Fries, CRC Press, 1998.
3. Product Safety in the European Union by GaborCzitan, Attila Gutassy, Ralf Wilde, TUV Rheinl and Akademia, 2008

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			2		3	
CO3	3		2			2		3			2		3	
CO4	3	3	2			2		3		2	2	2	3	
CO5	3	3		3		2		2		2	2	2	3	2
CO6	3	2	2	2		2		2		2	3	3	3	3
CAM	**2.83**	**2.67**	**2**	**2.5**		**2**		**2.5**		**2**	**2.2**	**2.33**	**2.83**	**2.5**

21BMV205 MEDICAL INNOVATION AND ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn fundamentals of entrepreneurship
- To apply the methods of entrepreneurship in medical field
- To evaluate the medical devices and market trends

UNIT – I CREATIVITY, INNOVATION AND IPR 9

The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

UNIT – II SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP 9

Definition– Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study

UNIT – III NEW VENTURE 9

Developing an Effective Business Model: The Importance of a Business Model – Starting a small- scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. case study.

UNIT – IV FINANCING THE NEW VENTURE AND GLOBALIZATION 9

Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.

UNIT – V MARKETING FUNCTION 9

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Interpret the various models and approaches to medical innovation and entrepreneurship. [Understand]

CO2: Understand the different sources of funding available for biomedical startups, including grants, investors, venture capitalists, and strategic partners. [Understand]

CO3: Apply problem-solving techniques to specific problems in the context of medical innovation and entrepreneurship. [Apply]

CO4: Apply financial analysis techniques to evaluate the viability of a new venture and its potential for global expansion. [Apply]

CO5: Analyze the results of marketing research to identify key market trends and opportunities. [Analyze]

CO6: Analyze the effectiveness of the marketing plan by identifying its strengths and weaknesses. [Analyze]

TEXTBOOKS:

1. Jen-Shih Lee “Biomedical Engineering Entrepreneurship”, World Scientific Publishing, USA. 2010
2. Vasant Desai, —The Dynamics of Entrepreneurial Development and Management‖, Himalaya Publishing House, 2010.

REFERENCES

1. Brant Cooper, Patrick Vlaskovits, “The Lean Entrepreneur”, Wiley, 2nd edition, New Jersy, 2016.
2. Nathan Furr, Jeff Dyer, “The Innovator's Method: Bringing the Lean Start-up into Your Organization”, Harvard Business Press, Boston, 2014.
3. Donald F.Kuratkoand Richard M.Hodgetts, “Entrepreneurship”, South-Western.
4. Gupta S.L., Arun Mittal, “Entrepreneurship Development”, International Book House, 2012.
5. Prasanna Chandra, “Projects Planning, Analysis, Financing, Implementation and review ‖, TATA McGraw Hill, 2012.
6. Sudha G. S., “Management and Entrepreneurship Development”, Indus Valley Publication, 2009.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2													
CO3	3	3	2						2		2	2	2	2
CO4	3	2		2							3	2		
CO5	3	2		2						2	2	2		2
CO6				2						2	2	2		2
CAM	2.6	2.33	2	2					2	2	2.25	2	2	2

21BMV206 RAPID PROTOTYPING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Learn the need and fundamentals of rapid prototyping
- Understand the concepts of design and assembling of various parts
- Study the process and material selection for UV and Laser based AM
- Investigate the process of fused deposition moulding and sheet lamination
- Explore droplet formation and beam deposition process

UNIT – I INTRODUCTION 9

Overview – Need - Development of Additive Manufacturing Technology - Principle – AM Process Chain-Classification – Rapid Prototyping - Rapid Tooling – Rapid Manufacturing – Applications-Benefits – Case studies.

UNIT – II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing – Tool path generation-Design for Additive Manufacturing: Concepts and objectives - AM unique capabilities – DFAM for part quality improvement - Customised design and fabrication for medical applications.

UNIT – III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA - Photo curable materials – Process - Advantages and Applications. Powder Bed Fusion: SLS - Process description – powder fusion mechanism – Process Parameters – Typical Materials and Application. Electron Beam Melting.

UNIT – IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bio extrusion. Sheet Lamination Process: LOM-Gluing or Adhesive bonding – Thermal bonding.

UNIT – V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies – Continuous mode – Drop on Demand mode –Three Dimensional Printing – Advantages – Bioplotter - Beam Deposition Process: LENS-Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the basic principles behind various rapid prototyping techniques. [Understand]

CO2: Explain the concepts of design for additive manufacturing, including its unique capabilities and customization for medical applications. [Understand]

CO3: Use additive manufacturing tools and software to design and create basic 3D models. [Apply]

CO4: Apply knowledge of rapid prototyping to solve real-world design challenges and develop innovative solutions. [Apply]

CO5: Examine the design and assembly process for various parts, identify potential errors, and develop solutions. [Analyze]

CO6: Design and fabricate a prototype for a complex application using rapid techniques. [Create]

TEXTBOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, World Scientific Publishers, Third edition, 2010.
2. Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.
3. Kamrani A.K. and Nasr E.A., Rapid Prototyping: Theory and practice, Springer, 2006.

REFERENCES:

1. Ian Gibson, David W.Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2. Tom Page Design for Additive Manufacturing, LAP Lambert Academic Publishing, 2012.
3. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	2												3	
CO3	3	2	3		3							2	2	2
CO4	3	3	3	2									3	3
CO5	3	3	2	3								2	2	2
CO6	3	2	3	3								2	3	
CAM	**2.67**	**2.5**	**2.75**	**2.67**	**3**							**2**	**2.5**	**2.33**

VERTICAL - III

21BMV300 MANAGEMENT (HEALTHCARE)

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV301	Clinical Engineering	3	0	0	3
2.	21BMV302	Hospital Planning and Management	3	0	0	3
3.	21BMV303	Medical Waste management	3	0	0	3
4.	21BMV304	Forensic Science in Health Care	3	0	0	3
5.	21BMV305	Bio Statistics	2	0	2	3
6.	21BMV306	Economics and Management for Engineers	3	0	0	3

21BMV301 CLINICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a basic understanding of the clinical engineering profession, qualifications, roles, activities, and expectations.
- To enhance students to practice medical equipment and analyze challenges with their healthcare technology.
- To engage the students to work as a team to address problems and errors in medical devices.

UNIT – I INTRODUCTION 9

Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.

UNIT – II MEDICAL TECHNOLOGY MANAGEMENT PRACTICES 9

Strategic Medical Technology Planning, Scope , Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequist for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT – III ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP) 9

Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis.

UNIT – IV CLINICAL ENGINEERING PROGRAM INDICATOR 9

Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

UNIT – V ADVANCED TECHNOLOGY FOR PATIENT SAFETY 9

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

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology. [Understand]

CO2: Identify and resolve medical equipment errors to enhance patient safety. [Apply]

CO3: Apply healthcare technology management and clinical engineering indicators to develop and enhance EHTP for better equipment performance and patient safety. [Apply]

CO4: Implement computer-based automated systems using CPOE for improved medical equipment operation. [Apply]

CO5: Identify and examine patient safety errors to determine potential risks and suggest improvements for a patient safety package system. [Analyze]

CO6: Assess medical device complexities and propose justified solutions. [Evaluate]

TEXTBOOKS:

1. Ernesto Iadanza, Joseph Dyro, “Clinical Engineering Handbook”, Elsevier Academic Press, 2014
2. Robert Miniati, “Clinical Engineering from Devices to Systems”, Academic Press, 23-Dec-2015 - Technology & Engineering

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 2012
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., Engle wood Cliffs, New Jersy, 1979.

CO	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2												2	
CO2	2	3	3			2			2				3	
CO3	3	2	3			1							3	
CO4	3	2	3		3								2	
CO5	2		3	2		2							2	
CO6	3		3	3									2	2
CAM	**2.5**	**2.33**	**3**	**2.5**		**1.67**			**2**				**2.33**	**2**

21BMV302 HOSPITAL PLANNING AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- The student should be made to understand the principles, practices and areas of application in Hospital management.

UNIT – I OVERVIEW OF HOSPITAL ADMINISTRATION 9

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

UNIT – II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT – III MARKETING RESEARCH & CONSUMER BEHAVIOUR 9

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

UNIT – IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

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

UNIT – V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH- JCAHO (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation). Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the principles, practices and applications of hospital management and discuss the significance of supportive services. [Understand]

CO2: Describe the process of HRM and manpower planning in hospitals. [Understand]

CO3: Incorporate computerization in various departments of Hospital. [Apply]

CO4: Assess the quality measures and systems in health care services. [Apply]

CO5: Analyze the importance of sterilization and waste management in health care services. [Analyze]

CO6: Evaluate the ethics in healthcare laboratories and the standards and rules for hospital operations and planning. [Evaluate]

TEXTBOOKS:

1. "Healthcare Operations Management" by Daniel B. McLaughlin, John R. Olson, and Robert A. Pearson, 2018.
2. "Introduction to Health Care Management" by Sharon B. Buchbinder and Nancy H. Shanks, 2017.
3. R.C.Goyal,"Hospital Administration and Human Resource Management", PHI – 4th Edition, 2006.

REFERENCES:

1. "Hospital Operations: Principles of High Efficiency Health Care" by Wallace J. Hopp and William S. Lovejoy, 2016.
2. "Healthcare Facility Planning: Thinking Strategically" by Cynthia Hayward, 2015.
3. "Hospital Management: Text and Cases" by K. Shridhar Rao, 2014.

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

21BMV303 MEDICAL WASTE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- The student should be made to understand the principles, practices and areas of application in Hospital management.

UNIT – I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT – II BIOMEDICAL WASTE MANAGEMENT 9

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, collection, storage and transportation, treatment and disposal.

UNIT – III HAZARDOUS MATERIALS 9

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

UNIT – IV FACILITY SAFETY 9

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT – V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY 9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Blood borne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the concepts of medical waste management and and its impact on human health. [Understand]

CO2: Identify health hazards from hazardous materials and apply neutralizing agents for mitigation. [Apply]

CO3: Detect infectious and carcinogenic agents in medical waste and the human body using in vitro or in vivo assays. [Apply]

CO4: Analyze cancer-causing agents in medical waste and evaluate potential approaches for addressing carcinoma risks. [Analyze]

CO5: Assess blood-borne pathogen risks and design biosensor-based methods for infectious pathogen monitoring. [Evaluate]

CO6: Evaluate waste segregation, labeling, handling, and disposal strategies to enhance patient safety. [Evaluate]

TEXTBOOKS:

1. "Medical Waste Management: A Practical Guide" by Phillip Malina, 2021.
2. "Medical Waste Management and Control" by James E. Woods, 2019.

REFERENCES:

1. "Handbook of Medical Waste Management and Disposal" by Syed Imtiaz Ahmad, 2017.
2. "Medical Waste Management: Global Perspectives" edited by Anshu Mathur and Gaurav Agnihotri, 2016.
3. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis, 2014.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2						3							
CO2	2	2					3						2	2
CO3	3	3					2						3	2
CO4	3	2	2	2			3						3	2
CO5	3	3	3										3	2
CO6	3		3	2		2	3					2	2	2
CAM	**2.67**	**2.5**	**2.67**	**2**		**2**	**2.8**					**2**	**2.6**	**2**

21BMV304 FORENSIC SCIENCE IN HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an overview of the principles and practices of forensic science in healthcare, including the roles and responsibilities of healthcare professionals in forensic investigations.
- To explore the legal and ethical issues related to forensic science in healthcare, including the collection, preservation, and presentation of evidence.
- To develop an understanding of the various forensic techniques used in healthcare, including forensic pathology, forensic toxicology, and forensic nursing.

UNIT – I BASICS OF FORENSIC SCIENCE 9

Forensic science, Introduction to the Forensic Sciences, History and Development of Forensic Science, Deductive Reasoning, Organization of a Crime Laboratory Case Studies: The Enrique Camarena Case. A Forensic Nightmare Organization of forensic science laboratories of center and state -NCRA AND NICFS, fundamental rights, criminal profiling, concept of quality control management in forensic institutions.

UNIT – II OBSERVATION AND CRIME SCENE 9

Observational Skills - Sherlock Holmes and Deductive Reasoning - Observations by Witnesses. Case Studies. The Crime Scene -Locard's Exchange Principle, Securing and Recording the Crime Scene, Legal Considerations at the Crime Scene, Evidence Collection and Recordation Techniques. Mock Crime Scene: Processing and Documenting a Crime Scene

UNIT – III FORENSIC MICROSCOPE AND ANTHROPOLOGY 9

Forensic Use of the Microscope -The Compound, Comparison, and Stereoscopic Microscope, The Scanning Electron Microscope (SEM). Forensic Anthropology-Introduction, Human Anatomy–The Skeletal System, Skeletal Determination of Demographic Data from Skeletal Remains, Determining Types of Trauma and Disease from Skeletal Remains, Case Studies.

UNIT – IV BLOOD STAIN IDENTIFICATION 9

Detection and identification of Blood stains, Determination of species of origin, Blood Group systems, Techniques of Determination of Blood groups of Blood stains, Determination of seminal and other fluids and their Blood Grouping, DNA, DNA Phenotyping and RNA Profiling & their applications. Wildlife forensics.

UNIT – V FINGERPRINT APPLICATION 9

Fingerprints -Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track marks, Case Studies.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the basic principles of forensic science. [Understand]

CO2: Apply the scientific knowledge to the investigation of crimes. [Apply]

CO3: Develop protocols for handling and storing forensic evidence in healthcare settings. [Apply]

CO4: Analyze the forensic evidences in crime scene and the role of investigator in sketching and examination of crime scene. [Analyze]

CO5: Analyze the impact of forensic evidence on healthcare legal and ethical issues. [Analyze]

CO6: Investigate and examine the modus operandi and role of modus operandi bureau in crime investigation. [Evaluate]

TEXTBOOKS:

1. "Forensic Science in Healthcare: Caring for Patients, Preserving the Evidence" by Connie Darnell, 2021.
2. "Forensic Science and Medicine: A Guide to Healthcare Professionals" by Nages Nagaratnam, Anil Aggrawal, and Leanne West 2020.

REFERENCES:

1. "Forensic Healthcare: A Guide for Healthcare Professionals" by Paul C. Rosenblatt, 2018.
2. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi.

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

21BMV305 BIO STATISTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an understanding of the fundamental principles of biostatistics, including the collection, analysis, and interpretation of data in biomedical research.
- To understand the different types of data and measurement scales used in biomedical research, and the appropriate statistical tests and methods for each.

UNIT – I INTRODUCTION 9

Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and medical data analysis, Introduction to probability, likelihood & odds, distribution variability.

UNIT – II STATISTICAL PARAMETERS 9

Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, ratio of two population variances and tests of goodness of fit, tests of independence, tests of homogeneity.

UNIT – III REGRESSION AND CORRELATION ANALYSIS 9

Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient

UNIT – IV INTERPRETING DATA 9

Interpreting life tables clinical trials, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT – V ANALYSIS OF VARIANCE 9

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the concepts of statistical parameters, correlation and regression analysis. [Understand]

CO2: Explain the data tables and its interpretations in community health. [Understand]

CO3: Apply appropriate statistical tests based on the characteristics of the data and research question. [Apply]

CO4: Analyze the biomedical research data and report the study results. [Analyze]

CO5: Analyze and interpret complex statistical results, including identifying potential confounding factors or biases. [Analyze]

CO6: Interpret and critically evaluate statistical results and draw appropriate conclusions in the context of biomedical research. [Evaluate]

TEXTBOOKS:

1. Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, JohnWiley & Sons Publication, 10th Edition, 2013.
2. Peter Armotage, Geoffrey Berry and J.N.S.Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001.
3. Bernard Rosner. Fundamentals of biostatistics. Nelson Education, 8th Edition 2015 ISBN: 978-1-305-26892-0
4. Editors: Chandan K. Reddy, Charu C. Agarwal, Healthcare Data Analytics, CRC Press,

REFERENCES:

1. Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2ndEdition, 2018.
2. Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014.
3. Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 2006.

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											3	2
CO4	3	3		2									3	2
CO5	3	3		2									3	2
CO6	3	2		3									3	3
CAM	**2.83**	**2.75**		**2.33**									**2.67**	**2.25**

21BMV306 ECONOMICS AND MANAGEMENT FOR ENGINEERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of Economics with respect to the demand and supply analysis.
- To analyze the theory of production and the analysis of the cost parameter by using the Elasticity.
- To manage and plan the situation with the help of the available strategies to support the decision making process.

UNIT – I INTRODUCTION TO ECONOMICS 9

Introduction to Economics – Scope of Economics – Positive and Normative Science – Methodology of Economics – Economic Laws - Economy and its basic problems: Economy and its working – Kinds of economy systems – Basic problems of economy.

UNIT – II DEMAND AND SUPPLY ANALYSIS 9

The Law of Demand – The Law of Supply – Elasticities of Demand and Supply: Price Elasticity of Demand - Price Elasticity and Consumption Expenditure- Cross Elasticity of Demand – Income Elasticity of Demand – The Elasticity of Price Expectations – The uses of Elasticity– Price Elasticity of Supply.

UNIT – III THEORY OF PRODUCTION AND ANALYSIS OF COST 9

Meaning of Production – Production concepts – Production Function – Laws of Production – Cost Concepts - Short-Run Cost Output Relations – Long Run Cost output relations – Economics of Scale.

UNIT – IV INTRODUCTION TO MANAGEMENT 9

Management: Overview – Management Defined – Managerial skills – Managerial roles – Management responsibilities – Management functions. Evolution of Management: Classical approaches to Management – Contemporary Management Perspectives.

UNIT – V PLANNING 9

Planning and Forecasting: Importance of Planning – Principles of effective Planning – Planning process – Types of Plans. Strategic Planning: Strategic Planning process – Rational decision making.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Discuss the role of financial management in engineering projects. [Understand]

CO2: Elucidate the business plan for an engineering project. [Understand]

CO3: Apply financial management techniques to engineering projects. [Apply]

CO4: Analyze the impact of economic systems and policies on engineering projects. [Analyze]

CO5: Analyze the effectiveness of management practices in achieving project goals. [Analyze]

CO6: Propose innovative solutions to improve the efficiency, sustainability, and profitability of engineering projects. [Evaluate]

TEXT BOOKS:

1. D.N.Dwivedi, “Principles of Economics”, Second Edition, Vikas Publishing House (P) Limited, New Delhi, 2012.
2. "Engineering Economic Analysis" by Donald G. Newnan, Ted G. Eschenbach, and Jerome P. Lavelle, 14th edition, 2020.
3. "Engineering Management: Challenges in the New Millennium" by C.M. Chang and T.S. Dillon, 2nd edition, 2015.

REFERENCES:

1. Ranbir Singh, “Principles of Engineering Economics and Management”, S.K.Kataria & Sons, New Delhi, 2013.
2. Manish Varshney and VidhanBanerjee, “Engineering and Managerial Economics”, First Edition, CBS Publishers and Distributors Pvt. Ltd., 2015.
3. "Engineering Management: Principles and Practices" by Benjamin S. Blanchard and Wolter J. Fabrycky, 2nd edition, 2011.
4. "Management Science: The Art of Modeling with Spreadsheets" by Stephen G. Powell and Kenneth R. Baker, 5th edition, 2019.

CO	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2					1					2			
CO2	3		2						2		2			1
CO3	3		3								3		2	
CO4	3			3		2					3		2	
CO5	3	2		2					3	2	2			
CO6	3	2		2			3				2	2		
CAM	**2.83**	**2**	**2.5**	**2.33**		**1.5**	**3**		**2.5**	**2**	**2.33**	**2**	**2**	**1**

VERTICAL - IV

21BMV400 MECHANICS

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV401	Biomechanics	3	0	0	3
2.	21BMV402	Rehabilitation Engineering	3	0	0	3
3.	21BMV403	Physiological Modeling	3	0	0	3
4.	21BMV404	Ergonomics and Regenerative Medicine	3	0	0	3
5.	21BMV405	Haptics in Healthcare	3	0	0	3
6.	21BMV406	Assistive and Augmentative Technologies	3	0	0	3

21BMV401 BIOMECHANICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the fundamental concepts of the principles of mechanics.
- To understand the basics of biofluid mechanics.
- To review the mechanical properties of musculoskeletal elements.
- To study the biomechanics of joints and implants.
- To learn the application of biomechanics into modeling and ergonomic design.

UNIT – I INTRODUCTION TO MECHANICS 9

Introduction – Scalars and vectors, Statics –Resolution and composition of forces, Moments, couple, Resultant, equilibrium of coplanar forces, Dynamics – Linear motion, Newton's laws of motion, Velocity and acceleration, Kinematics – Models, Transducers Constitutive equations – Non- viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid

UNIT – II BIOFLUID MECHANICS 9

Intrinsic fluid properties, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube, Structure of blood vessels, Material properties and modelling of Blood vessels, Heart – Cardiac muscle characterization, Native heart valves, Prosthetic heart valve fluid dynamics.

UNIT – III MUSCULOSKELETAL MECHANICS 9

Constitutive equation of viscoelasticity – Maxwell, Voight and Kelvin models, anisotropy, Hard Tissues – Structure, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modelling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle, Bone fracture mechanics, Implants for bone fractures

UNIT – IV BIOMECHANICS OF JOINTS AND IMPLANTS 9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video

UNIT – V MODELLING AND ERGONOMICS 9

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; models for voice biomechanics, Ergonomics –Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted and whole-body vibrations.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the fundamental principles of mechanics and their application in biofluids and musculoskeletal systems. [understand]

CO2: Apply principles of statics, dynamics and kinematics to analyze mechanical forces and motion in biological systems. [Apply]

CO3: Apply viscoelastic models to analyze the biomechanics of tissues, bone fractures, and implants. [Apply]

CO4: Analyze the mechanics of fluid dynamics in cardiovascular systems to assess their functional roles and design implications. [Analyze]

CO5: Analyze finite element models and ergonomic designs in preventing musculoskeletal disorders and improving workplace environment. [Analyze]

CO6: Assess biomechanical models and workplace designs for safety and efficiency. [Evaluate]

TEXTBOOKS:

1. Y.C. Fung, Bio-Mechanics- Mechanical Properties of Tissues, Springer-Verlag, 1998.
2. Subrata Pal, Textbook of Biomechanics, Viva Books Private Limited, 2009
3. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, Biofluid Mechanics:The Human Circulation, Taylor and Francis, 2007.
4. Özkaya, Nihat, Dawn Leger, David Goldsheyder, and Margareta Nordin. Fundamentals of biomechanics: equilibrium, motion, and deformation. Springer, 2016.

REFERENCES:

1. Sheraz S. Malik and Shahbaz S. Malik, Orthopaedic Biomechanics Made Easy,Cambridge University Press, 2015.
2. Jay D. Humphrey, Sherry De Lange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer Science Business Media, 2004.
3. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.
4. Neil J. Mansfeild, Human Response to Vibration, CRC Press, 2005.
5. Carl J. Payton, Biomechanical Evaluation of movement in sports and Exercise, 2008.

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**

21BMV402 REHABILITATION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of sensory augmentation, orthopedic prosthetics, and orthotics.
- To learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- To understand virtual reality in rehabilitation, rehabilitation medicine and advocacy.

UNIT – I INTRODUCTION TO REHABILITATION 9

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activitiesof daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT – II ENGINEERING CONCEPTS IN SENSORY AUGMENTATION AND SUBSTITUTION 9

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system - Tactual augmentation, Tactual substitution

UNIT – III ORTHOPEDIC PROSTHETICS AND ORTHOTICS 9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT – IV VIRTUAL REALITY 9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT – V REHABILITATION MEDICINE AND ADVOCACY 9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the concept of sensory augmentation, orthopedic prosthetics and orthotics. [Understand]

CO2: Apply the knowledge of sensory augmentation and orthotics to the visual and artificial limp approaches. [Apply]

CO3: Use virtual reality principles in robotics and prosthetic applications. [Apply]

CO4: Analyze rehabilitation engineering concepts to develop innovative solutions that reduce patient complications. [Analyze]

CO5: Analyze various sensory augmentation approaches and provide feedback for real-time problem-solving. [Analyze]

CO6: Conduct a literature review on arm or hand function restoration and offer suggestions

based on a case study. [Evaluate]

TEXTBOOKS:

1. Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press, 2000.
2. Robinson C.J, “Rehabilitation Engineering”, CRC Press, 2006.
3. 3.Sunder, “Textbooks of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, 2007.

REFERENCES:

1. Sashi S Kommu, “Rehabilitation Robotics”, 1st edition, CRC Press, 2007.
2. Horia- Nocholai Teodorecu, L.C.Jain, “Intelligent systems and technologies in rehabilitation Engineering”, CRC Press, 2000.
3. Keswick. J., “What is Rehabilitation Engineering, Annual Reviews of Rehabilitation”, Springer Verlag, New York, 1982.
4. Warren E. Finn, Peter G. Lopressor, “Handbook of Neuroprosthetic Methods”, CRC Press, 2002.
5. Roy A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), “An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering” CRC Press, 2000

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

21BMV403 PHYSIOLOGICAL MODELING

L	T	P	C
3	0	0	3

OBJECTIVES:

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

UNIT – I INTRODUCTION 9

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

UNIT – II MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM 9

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

UNIT – III NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS 9

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

UNIT – IV COMPARTMENTENTAL PHYSIOLOGICAL MODEL 9

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

UNIT – V SIMULATION OF PHYSIOLOGICALSYSTEMS 9

Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceivedintensity. Neuromuscular model, Renal System, Drug Delivery Model.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Illustrate the mathematical modeling of various physiological systems. [Understand]

CO2: Apply methods and techniques to analyze non-linear, dynamic and multi-compartmental systems. [Apply]

CO3: Apply software tools like MATLAB and OpenCV for simulating physiological systems. [Apply]

CO4: Analyze mathematical modeling and provide suggestions for pupil control systems and thermoregulation. [Analyze]

CO5: Examine the simulation of physiological systems and analyze dynamic responses of physiological models. [Analyze]

CO6: Evaluate concepts related to parametric systems in physiological modeling. [Evaluate]

TEXTBOOKS:

1. Michel C Khoo, “Physiological Control Systems -Analysis, simulation and estimation”, Prentice Hall of India, 2001.
2. Marmarelis, “Nonlinear Dynamic Modeling of Physiological Systems”, Wiley-IEEE Press,2004.

REFERENCES:

1. Benjamin C Kuo, “Automatic control systems”, Tenth Edition, McGraw-Hill Education, 2017.
2. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,“Advanced Computational Methods in Life System Modeling and Simulation”, Springer,2017
3. DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, Wiley-IEEE Press, 2003.

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
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							3	2
CAM	**2.83**	**2**	**2.8**	**2**	**2.5**	**2**		**2**					**3**	**2.33**

21BMV404 ERGONOMICS AND REGENERATIVE MEDICINE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get exposed to principles of visual capabilities.
- To learn the mechanics of muscle physiology and significance of rest cycle.
- To learn spatial compatibility and the relation between control orders and control response.
- To know about the measurements and proportions of the human body.
- To Learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- To Understand virtual reality in rehabilitation, rehabilitation medicine and advocacy.

UNIT – I VISUAL AND AUDITORY ERGONOMICS 9

Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display – process of hearing – principles of auditory display. Measures for monitoring control & mitigation.

UNIT – II MUSCLE PHYSIOLOGY 9

Muscle physiology – muscle metabolism – respiratory response – joint motion study – measure of physiological in-efficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.

UNIT – III CONTROLS AND DISPLAYS 9

Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task.

UNIT – IV ANTHROPOMETRY 9

Anthropometry – anthropometric design principles – Physical workload and energy expenditure - work space envelope – factors in design of workspace surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

UNIT – V REHABILITATION MEDICINE AND ADVOCACY 9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the principles of ergonomics and their application in enhancing human performance and safety. [Understand]

CO2: Apply ergonomic principles to design effective workspaces and manual handling systems. [Apply]

CO3: Apply ergonomic principles to the design of anthropometric systems and rehabilitation equipment. [Apply]

CO4: Analyze the impact of ergonomics on human physiology and workspace design to improve performance. [Analyze]

CO5: Analyze the relationship between workspace design, anthropometry and human error to enhance system efficiency. [Analyze]

CO6: Evaluate the effectiveness of rehabilitation therapies in enhancing functional recovery. [Evaluate]

TEXTBOOKS:

1. Pascale Carayon, “Handbook of Human Factors and Engineering”, Second Edition, CRC Press, 2011
2. Martin Helander, “Guide to Human Factors and Ergonomics”, Second Edition, CRC Press,2005
3. Benjamin W.Niebel, “Motion and Time Study”, Richard, D. Irwin Inc., Seventh Edition, 2002

REFERENCES:

1. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press2007.
2. George Kanawaty, “Introduction to work study”, ILO, 3rd edition, Oxford & IBH publishing, 2001
3. Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, 2005

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**

21BMV405 HAPTICS IN HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To expose the basic principles of Haptics and their property.
- To give knowledge on machines in haptics.
- To learn types of sensors and actuators.
- To understand basic concepts of human locomotion, biomechanical analysis using Finite Element Analysis.

UNIT – I HUMAN HAPTICS 9

Neurophysiological and physiological aspects: Anatomy of receptors- Physiological mechanisms of the receptor system- Neural basis of haptic perception- The neural bases of haptic working memory- Neuronal plasticity of the haptic system. Psychological aspects: Haptic perception in the human foetus- Haptic behavior in social interaction- Learning effects in haptic perception- Implicit and explicit memory effects in haptic perception- Attention in sense of touch- Haptic object identification.

UNIT – II MACHINE HAPTICS 9

Introduction- Haptic Interfaces: Robotics Perspective- Haptic Interface System. Design of Haptic devices; The Tactile Mouse- CyberTouch Glove - The Displaced Temperature Sensing System - Other Tactile Commercial Interfaces. Performance Specifications: Physical Attributes- Spatial Attributes- Temporal Attributes.

UNIT – III BIOINSPIRED ACTUATORS AND SENSORS 9

Introduction- Sensory and motor systems of the living world: Sensory systems in living systems-Movements in living systems- Interactions between species of different kingdoms. Bio-inspired designs of sensors, actuators: Bio-inspired morphing structures- Bio-inspired tactile sensors- Synthetic photon energy harvesting system- Bioinspired optical layered structures, structured colors, camouflage skin, and color change strain sensor- Bioinspired inchworm actuators.

UNIT – IV COMPUTATIONAL HAPTICS 9

Introduction- Haptic Rendering Subsystem-Collision Detection Techniques and Bounding Volumes-Penetration Depth and Collision Response- Haptic Rendering of Surface Properties-Haptic Rendering for Other Representation Methods- Haptic Rendering of More Than 3-DOF-Control Methods for Haptic Systems-Benchmarking Haptic Rendering Systems-Haptic Software Frameworks-Closing Remarks.

UNIT – V HAPTICS FOR MEDICAL APPLICATIONS 9

Haptics for Sensory Impairments: Enabling Learning Experiences for Visually Impaired - Haptically-Assisted Interfaces for Persons with Visual Impairments. - Haptics for Sensory Substitution. Haptics for Health and Wellbeing: Haptics in Rehabilitation, Exergames and Health- Therapeutic Haptics for Mental Health and Wellbeing- Applications of Haptics in Medicine.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the principles of haptics, bioinspired actuators and sensors for humans. [Understand]

CO2: Apply computational haptics and sensors to address human health issues. [Apply]

CO3: Use appropriate haptics approaches for medical applications. [Apply]

CO4: Analyze suitable sensors, actuators and computational methods for haptics. [Analyze]

CO5: Examine various computational and medical haptics and provide suggestions for specific human health issues. [Analyze]

CO6: Evaluate finite element analysis, design workstations based on haptics, and suggest improvements for better haptics implementation. [Evaluate]

TEXTBOOKS:

1. Kay M.Stanney, Handbook of Virtual Environments: Design, Implementation, and Applications, Lawrence Erlbaum Associates, Publications. N. I. Durlach and A. S. Mavor, eds., Virtual Reality: Scientific and Technological Challenges, National Academy Press, Washington, D.C., 1994.
2. G.C. Burdea, Force and Touch Feedback for Virtual Reality, John Wiley & Sons, 1996.
3. Kandel, Eric R., et al., eds. Principles of neural science. Vol. 4. New York: McGraw-hill, 2000.

REFERENCES:

1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012.
2. Marc J. Madou, Fundamentals of Micro fabrication: the Science of miniaturization,CRC Press, 2002.
3. Nadim Maluf and Kirt Williams, An introduction to Microelectro Mechancial Systems Engineering, Second Edition, Artech House Inc, MA,2004.
4. Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey,USA,2006.
5. Nitaigour Premch and Mahalik, MEMS, Tata McGraw Hill Publishing Company, New Delhi, 2007

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	2
CO3	3	2	3										3	2
CO4	3	3		3									2	2
CO5	3	3		3		2							3	2
CO6	3		2	2								2	2	3
CAM	2.83	2.5	2.5	2.67		2						2	2.4	2.2

21BMV406 ASSISTIVE AND AUGMENTATIVE TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology
- To understand augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality.
- Simulate and Apply Virtual/Augmented Reality to varieties of Applications

UNIT – I CARDIAC ASSIST DEVICES **9**

Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves

UNIT – II HEMODIALYSERS **9**

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters

UNIT – III HEARING AIDS **9**

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids

UNIT – IV PROSTHETIC, ORTHOTIC DEVICES AND TENS **9**

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices. Transcutaneous electrical nerve stimulator, bio-feedback

UNIT – V AUGMENTED REAITYL (AR) **9**

Reality Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the use of assistive, orthotic, and prosthetic devices. [Understand].

CO2: Apply the knowledge of materials to design suitable prosthetic, orthotic and assistive devices. [Apply]

CO3: Use external counter-pulsation techniques and hearing aid principles to develop prosthetic heart valves and DSP-based hearing aids. [Apply]

CO4: Analyze different assistive devices for rehabilitation and provide valuable suggestions. [Analyze]

CO5: Analyze various feedback systems to make appropriate system for the given electrical stimulation.[Analyze].

CO6: Assess various augmented methods in prosthesis and orthosis approaches and offer suitable suggestions to patients. [Evaluate]

TEXTBOOKS:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006
2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

REFERENCES:

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola, Elsevier 2019 ISBN 978 -0-323-662116
4. Sanni Siltanen, S., (2012), “Theory and applications of marker-based augmented reality,” Julkaisija –Utgivare Publisher, ISBN: 9789513874490

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											3	
CO4	3	2	2									2	3	2
CO5	3	2	2										3	2
CO6	3	2	2	2								2	3	2
CAM	**2.83**	**2**	**2**	**2**				**2**				**2**	**3**	**2**

VERTICAL - V

21BMV500 SIGNAL AND IMAGE PROCESSING

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV501	Bio-Signal Processing	3	0	0	3
2.	21ECV107	Machine Vision (Common to ECE & BME)	3	0	3	3
3.	21ECV102	Speech and Audio Signal Processing (Common to ECE & BME)	3	0	0	3
4.	21BMV504	Medical Video Processing	3	0	0	3
5.	21BMV505	Brain Computer Interface and Applications	3	0	0	3
6.	21BMV506	Biometric Systems	3	0	0	3
7.	21BMV507	AI in Healthcare	3	0	0	3

21BMV501 BIO-SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the characteristics of different bio signals
- To learn linear and non-linear filtering techniques to extract desired information
- To understand various techniques for automated classification and decision making to aid diagnosis

UNIT – I BIOSIGNAL AND SPECTRAL CHARACTERISTICS 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT – II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT – III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT – IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats

UNIT – V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

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

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the characteristics of biosignals, filtering techniques, spectral analysis and classification methods. [Understand]

CO2: Apply time-series analysis and spectral estimation techniques for biosignal processing. [Apply]

CO3: Apply adaptive filtering and wavelet techniques for noise removal and feature extraction in bio-signals. [Apply]

CO4: Analyze spectral features, time-series models, and adaptive filtering in biosignal processing. [Analyze]

CO5: Analyze bio-signal classification methods and evaluate their effectiveness in medical diagnosis. [Analyze]

C06: Evaluate time-frequency and multivariate analysis techniques for biosignal characterization and data compression. [Evaluate]

TEXTBOOKS:

1. Rangaraj M. Rangayyan, “Biomedical Signal Analysis-A case study approach”, Wiley, 2nd Edition, 2016.
2. Willis J. Tompkins, “Biomedical Digital Signal Processing”, Prentice Hall of India, New Delhi, 2003.
3. Arnon Cohen, “Bio-Medical Signal Processing Vol I and Vol II”, CRC Press Inc., Boca Rato, Florida, 1999

REFERENCES:

1. Kayvan Najarian and Robert Splerstor, “Biomedical signals and Image processing’’, CRC – Taylor and Francis, New York, 2nd Edition, 2012.
2. K.P.Soman, K.Ramachandran, “Insight into wavelet from theory to practice”, PHI, New Delhi, 3rd Edition, 2010.
3. D.C.Reddy, “Biomedical Signal Processing – Principles and Techniques’’, Tata McGraw-Hill Publishing Co. Ltd, 2005.
4. John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications’’, Taylor& Francis Inc, 2004.

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								3	2
CO4	3	3			2								3	2
CO5	3	3	2	2	2					2			2	3
CO6	3	3		2									3	3
CAM	2.83	2.6	2	2						2			2.67	2.5

21ECV107 MACHINE VISION
(Common to ECE & BME)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand Camera model and feature detecting techniques.
- To study segmentation, object recognition and it applications.

UNIT – I INTRODUCTION TO COMPUTER VISION AND PROJECTIVE GEOMETRY **9**

Introduction to Computer Vision, Applications, Camera Model- Pinhole camera, Camera parameters, intrinsic and extrinsic parameters, Projective Geometry- Perspective Projection, Orthographic Projection, Affine Projection, camera parameters for perspective projection.

UNIT – II FACE DETECTION, MATCHING AND ALIGNMENT **9**

interest point detection, corner detection, SIFT, Feature matching- RANSAC, matching strategy and error rates, 2D Feature based Alignment- Least squares method.

UNIT – III SEGMENTATION AND CLUSTERING **9**

Segmentation - Thresholding and Connected component algorithm, Contour Detection, Region Segmentation, Motion Segmentation- Grouping- K- means clustering, Graph cut.

UNIT – IV OBJECT RECOGNITION **9**

Object detection, Object Modeling, Model based object recognition, Scene and Object based recognition, Shape based recognition.

UNIT – V APPLICATIONS **9**

Face Recognition, Emotion Recognition Scene Understanding, Action Recognition, Augmented Reality.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Comprehend and describe basic concepts of image processing. [Understand]

CO2: Apply various feature extraction methods and matching algorithms to find the similarities of two regions. [Apply]

CO3: Apply numerous segmentation techniques and grouping the regions into meaningful segments. [Apply]

CO4: Analyze object recognitions techniques to understand the shape and scene of an image. [Analyze]

CO5: Analyze the various segmentation and object recognition techniques. [Analyze]

CO6: Simulate and analyze different computer vision algorithms using modern tools. [Analyze]

TEXTBOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2011.
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.

3. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.

REFERENCES:

1. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.
2. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
3. Concise Computer Vision: An Introduction into Theory and Algorithms, by Reinhard Klette, 2014.

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	2
CO3	3	2			2								3	2
CO4	3	3			2								3	2
CO5	3	3			2								2	3
CO6	2	3		2	3								3	3
CAM	**2.67**	**2.6**		**2**	**2.2**								**2.67**	**2.4**

21ECV102 SPEECH AND AUDIO SIGNAL PROCESSING
(Common to ECE & BME)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of speech.
- To discuss the analysis features of speech.
- To familiarize Speech quantization and coding.
- To explain the speech processing applications.

UNIT – I INTRODUCTION **9**

Basics of speech production- LTI model, LTV model, voiced and unvoiced decision making, speech parameters, pitch and formants, pitch frequency measurement using AMDF and autocorrelation, Parallel processing approach, pitch period measurement using spectral domain, cepstral domain, relation between formants and LPC, evaluation of formants using cepstrum, log spectrum and Power spectral density estimate.

UNIT – II TIME DOMAIN MODELS FOR SPEECH PROCESSING **9**

Time Domain models for Speech Processing: Introduction – Window considerations, Short time energy, average magnitude, average zero crossing rate, Speech vs Silence discrimination using energy and zero crossing, pitch period estimation using a parallel processing approach, the short time autocorrelation function, average magnitude difference function, pitch period estimation using the autocorrelation function.

UNIT – III LINEAR PREDICTIVE CODING (LPC) ANALYSIS **9**

Linear Predictive Coding (LPC) Analysis : Basic principles of Linear Predictive Analysis : The Autocorrelation Method, The Covariance method, Solution of LPC Equation :Cholesky Decomposition Solution for Covariance Method, Durbin‘s Recursive Solution for the Autocorrelation Equations, comparison between the methods of solution of the LPC Analysis Equations, Applications of LPC Parameters : Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT – IV HOMOMORPIC & AUTOMATIC SPEECH RECOGNITIO **9**

Homomorpic speech analysis: Definition of the ceptstrum and complex ceptstrum, short time ceptstrum, homomorphic filtering of speech, Application: pitch detection-pattern recognition. Automatic Speech Recognition: problem of automatic speech recognizer, building a speech recognition system, decision recognition system, decision process in ASR, representation recognition performance, challenges in ASR technology.

UNIT – V AUDIO CODING **9**

Audio Coding : Lossless Audio Coding, Lossy Audio coding, Psychoacoustics , ISO-MPEG-1 Audio coding , MPEG- 2 Audio coding, MPEG - 2 Advanced Audio Coding, MPEG - 4 Audio Coding.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the basic concept of speech signals, speech production, speech analysis, speech coding and parameter representation of speech. [Understand]

CO2: Develop linear predictive coding algorithm for speech signal and extract the LPC coefficient used to synthesis or compress the speech. [Apply]

CO3: Apply speech coding and enhancement algorithms on speech signals. [Apply]

CO4: Develop MATLAB code for processing audio and speech signals. [Apply]

CO5: Analyze the speech in time domain and various coding technique to extract various parameters. [Analyze]

CO6: Design basic audio coding methods using existing code. [Create]

TEXTBOOKS:

1. Rabiner. L. R and Schaffer. R. W., "Digital Processing of Speech signals", Prentice Hall, 1978
2. Andreas Spanias, Ted Painter, Venkatraman AttiWayne Tomasi, "Audio signal processing and coding", John Wiley & Sons, 2007

REFERENCES:

1. Udo Zölzer , Digital Audio Signal Processing, A John Wiley& sons Ltd Publication, Second Edition, 2008.
2. Mark Kahrs, Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio And Acoustics", KLUWER ACADEMIC PUBLISHERS NEW YORK, BOSTON, DORDRECHT,LONDON, MOSCOW, 2002.
3. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
4. Martin S. Roden, "Analog and Digital Communication System", Prentice Hall of India, 3rd Edition, 2002.
5. Sklar. B, "Digital Communication Fundamentals and Applications" Pearson Education, 2nd 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								3	2
CO3	3	3			2								3	2
CO4	3	3	3	2	3								3	3
CO5	3	3	3	3	2								3	2
CO6	3	3	3	3	3								3	3
CAM	**2.83**	**3**	**3**	**2.67**	**2.4**								**2.83**	**2.4**

21BMV504 MEDICAL VIDEO PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To analyze the mathematical transforms necessary for video processing and different image enhancement techniques.
- To analyze video restoration procedures and video segmentation techniques.
- To analyze the video processing applications in medicine.

UNIT – I VIDEO PROCESSING FUNDAMENTALS: 9

Introduction to medical imaging: Types of medical imaging and their uses, image formation and acquisition, image processing pipeline – Video processing fundamentals: Image and video representation, color models, image and video enhancement, filtering, compression, and reconstruction.

UNIT – II MEDICAL VIDEO UNDERSTANDING AND ANALYSIS: 9

Motion analysis, pattern recognition. Spatiotemporal sampling and sampling structure conversion. Two- and three-dimensional motion estimation techniques. Optical flow, block-based and pel-recursive methods for motion estimation. Still image and video compression methods and standards. Interface compression and model-based methods for video compression.

UNIT – III VIDEO SEGMENTATION, OBJECT DETECTION AND TRACKING: 9

Techniques for segmenting videos into regions with similar motion and appearance, clustering: K-means clustering and hierarchical clustering, graph-based methods, and deep learning-based approaches- Mask R-CNN, and 3D convolutional neural networks (3D CNNs) – Techniques for detecting and tracking objects in videos, deep learning-based object detection methods- YOLO and tracking algorithms- Kalman filter, particle filter

UNIT – IV TELEMEDICINE AND VIDEO ENDOSCOPY 9

History of Telemedicine, Block diagram of telemedicine system, Definition of telemedicine, Tele health, Tele care, origins and Development of Telemedicine, Scope, Benefits and limitations of Telemedicine. video endoscopy- types of video endoscopy.

UNIT – V APPLICATIONS OF BIOLOGICAL VIDEO PROCESSING 9

Tele radiology: Basic parts of Teleradiology system: Image Acquisition system, Display system, Communication network, Interpretation. Tele Pathology: Multimedia databases, color images of sufficient resolution: Dynamic range, spatial resolution, compression methods, Interactive control of colour, Controlled sampling, security and confidentiality tools. Tele cardiology, Teleoncology, Telesurgery.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the fundamentals of video processing and its applications in medical imaging. [Understand]

CO2: Apply the various video processing techniques in medical videos. [Apply]

CO3: Apply video segmentation, object detection, and tracking methods in medical videos. [Apply]

CO4: Analyze motion estimation, compression methods, and deep learning approaches in video processing. [Analyze]

CO5: Analyze telemedicine and video endoscopy applications in healthcare. [Analyze]

CO6: Design and develop algorithms for medical video processing applications. [Create].

TEXTBOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing', 3rd Edition, Pearson Education, 2011.
2. "Video Processing and Communications" by Yao Wang and Jôrn Ostermann.

REFERENCES:

1. Olga Ferrer-Roca, M.Sosa Ludicissa, Handbook of Telemedicine, IOS press 2002.
2. A.C.Norris, Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.
3. Video Processing in the Cloud" by Bogdan Ionescu

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	
CO2	3	2	2		2								2	1
CO3	3	3	2		2								3	2
CO4	3	3		2	3								2	2
CO5	3			3	2					2			2	3
CO6	3	2	2	2	3					2		2	3	3
CAM	**2.83**	**2.5**	**2**	**2.33**	**2.4**					**2**		**2**	**2.5**	**2.2**

21BMV505 BRAIN COMPUTER INTERFACE AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT – I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT – II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT – III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA,ARMA models – PCA – Linear and Non-Linear Features.

UNIT – IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT – V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the architecture and components of a BCI system. [Understand]

CO2: Apply EEG signal acquisition techniques to capture brain signals for BCI applications. [Apply]

CO3: Apply various modeling techniques for feature translation and classification. [Apply]

CO4: Analyze the variations and factors influencing Mu rhythm and related brain signals. [Analyze]

CO5: Evaluate the performance of feature extraction and translation models. [Evaluate]

CO6: Design innovative neuroprosthetic solutions for functional restoration and external device control. [Create]

TEXTBOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.

REFERENCES:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

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	3	2								2	2
CO5	3	2	2	2									3	2
CO6	3	2	3	2	2	2						2	3	
CAM	**2.83**	**2.33**	**2.33**	**2.33**	**2**	**2**						**2**	**2.8**	**2**

21BMV506 BIOMETRIC SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To study the technologies of fingerprint, iris, face and speech recognition.
- To study of evaluation of biometrics systems.

UNIT – I INTRODUCTION TO BIOMETRICS 9

Introduction and back ground – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate- Derived metrics-Biometrics and Privacy.

UNIT – II FINGERPRINT TECHNOLOGY 9

History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT – III FACE RECOGNITION AND HAND GEOMETRY 9

Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images, Neural networks for face recognition, Hand geometry – scanning – Feature Extraction – classification.

UNIT – IV IRIS RECOGNITION 9

Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde‘s approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.

UNIT – V VOICE SCAN AND MULTIMODAL BIOMETRICS 9

Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC).

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the applications of biometrics in security, access control, and identification. [Understand]

CO2: Apply fingerprint enhancement techniques to improve the quality of fingerprint images. [Apply]

CO3: Apply techniques for accurate iris representation and localization. [Apply]

CO4: Analyze the performance and reliability of Mel frequency cepstral coefficients in speaker recognition. [Analyze]

CO5: Analyze variations in biometric traits such as face shape and texture for recognition performance. [Analyze]

CO6: Evaluate the effectiveness of the NIST Speaker Recognition Evaluation Program in advancing biometric technology. [Evaluate]

TEXTBOOKS:

1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 1st Edition, 2011
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004

REFERENCES:

1. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint recognition system'', Springer, 2003.
2. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint andFace Recognition", CRC Press, 1st Edition, 1999.
3. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003.

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**

21BMV507 **AI IN HEALTHCARE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various fundamental characteristics of Artificial Intelligence.
- To Learn represent knowledge in solving healthcare problems.

UNIT – I INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE 9

Introduction to Human and Artificial Intelligence: terminologies- Future of Artificial Intelligence - Behavioral Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to healthcare problems.

UNIT – II PROBLEM SOLVING METHODS and AI DECISION TREE 9

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems - Constraint Propagation - Backtracking Search. Learning methods, Rule-based systems- Decision tree learning- Reinforcement learning. AI in Medical diagnosis.

UNIT – III KNOWLEDGE REPRESENTATION 9

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering-Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT – IV SOFTWARE AGENTS AND APPLICATIONS 9

Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining - Argumentation among Agents - Trust and Reputation in Multi-agent systems. Blood pressure control, Speech Recognition – Robot control for surgical applications - Hardware - Perception - Planning – Moving image guidance.

UNIT – V BIOMEDICAL APPLICATIONS 9

Unique characteristics and challenges in medicine and healthcare, Clinical decision-making and intelligent systems to support evidence-based medicine, Analysis of tissue morphology and other medical imaging applications, Tools and Technologies for implementing AI methods,

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Understand the basics of Artificial Intelligence and its application in healthcare. [Understand]

CO2: Apply appropriate search algorithms for solving medical problems. [Apply]

CO3: Apply AI problem-solving techniques for healthcare applications. [Apply]

CO4: Analyze the design of software agents and their applications in healthcare. [Analyze]

CO5: Evaluate the development and impact of AI applications in healthcare. [Evaluate]

CO6: Develop simple intelligent systems for medical diagnosis. [Create]

TEXTBOOKS:

1. M. Tim Jones, “Artificial Intelligence: A Systems Approach ”, Jones and Bartlett Publishers, Inc.; First Edition, 2015 Reprint.
2. Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press, 2009.

REFERENCES:

1. William F. Clocksin and, Christopher S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2012.
2. Ian Millington, John Funge, “Artificial intelligence for Games”, Second edition, Morgan Kaufmann Publishers, CRC Press, 2012.
3. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2016.
4. David L. Poole and Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, Cambridge University Press, 2010.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	3	3		2							2	2	3
CO3	3	3	3		3							2	2	3
CO4	3	2		3	3	2						2		2
CO5	3	2	2	2	2	2			2	2	2	3		2
CO6	3	2	3	1	3				2	2	2	2		3
CAM	**2.83**	**2.4**	**2.75**	**2**	**2.6**	**2**			**2**	**2**	**2**	**2.2**	**2**	**2.6**

VERTICAL - VI

21BMV600 COMMUNICATION (HEALTHCARE)

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV601	Medical Wearable Devices	3	0	0	3
2.	21BMV602	Telehealth Technology	3	0	0	3
3.	21BMV603	Body Area Networks and Mobile Healthcare	3	0	0	3
4.	21BMV604	Virtual Reality and Augmented Reality in Healthcare	3	0	0	3
5.	21BMV605	Medical Informatics	3	0	0	3
6.	21BMV606	Advanced Communication Technologies for Healthcare	3	0	0	3
7.	21BMV607	Antenna’s in Wearable and Implantable Devices	3	0	0	3

21BMV601 MEDICAL WEARABLE DEVICES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT – I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT – II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

UNIT – III WIRELESS HEALTH SYSTEMS 9

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

UNIT – IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques-Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study-smart fabric for monitoring biological parameters - ECG, respiration

UNIT – V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the principles, components and applications of wearable systems and sensors in healthcare. [Understand]

CO2: Apply signal processing and energy harvesting methods in wearable devices for medical use. [Apply]

CO3: Implementing the concept of smart textile technology in biological parameters. [Apply]

CO4: Analyze challenges in wearable device design, focusing on energy and sensor issues. [Analyze]

CO5: Analyze the role of wireless communication and Body Area Network in healthcare. [Analyze]

CO6: Evaluate the effectiveness of wearable devices in medical diagnostics and monitoring.

[Evaluate]

TEXTBOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. EdwardSazonovandMichealRNeuman,WearableSensors:Fundamentals, Implementation and Applications, Elsevier, 2014
4. MehmetR.YuceandJamilY.Khan, WirelessBody AreaNetworks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

CO	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2													
CO2	3											2	3	2
CO3	3	2										2	3	2
CO4	3	3	2	2								2	3	
CO5	3	3		2								2	3	2
CO6	3	2	2	3		3	2	2	2	2		3	3	2
CAM	**2.83**	**2.5**	**2**	**2.33**		**3**	**2**	**2**	**2**	**2**		**2.2**	**3**	**2**

21BMV602 TELEHEALTH TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the key principles for telemedicine and health
- To understand telemedical technology.
- To familiarize telemedical standards, mobile telemedicine and its application

UNIT – I FUNDAMENTALS OF TELEMEDICINE 9

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

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

Audio, video, still images, text and data, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT – III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9

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

UNIT – IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

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

UNIT – V APPLICATIONS OF TELEMEDICINE 9

Tele-radiology, tele-pathology, tele-cardiology, tele-oncology, tele-dermatology, tele-surgery. Remote psychotherapy, Remote imaging, Remote surgery, Tele Medicine in Pediatrics.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the fundamentals of telemedicine and its components. [Understand]

CO2: Examining protocols behind encryption techniques for secure transmission of healthcare data. [Apply]

CO3: Apply telemedicine technologies in PACS and various healthcare domains. [Apply]

CO4: Analyze ethical, legal challenges and applications of telemedicine in healthcare specialties. [Analyze]

CO5: Analyze emerging trends and future directions in telemedicine. [Analyze]

CO6: Evaluate the various communication models and their applications in RTOS. [Evaluate]

TEXTBOOKS:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, “Handbook of Telemedicine”, IOS Press, Netherland, 3. 2002
2. Khandpur R S, “TELEMEDICINE – Technology and Applications”, PHI Learning Pvt Ltd., New Delhi, 2017.
3. Norris A C, “Essentials of Telemedicine and Telecare”, John Wiley, New York, 2002

REFERENCES:

1. H K Huang, “PACS and Imaging Informatics: Basic Principles and Applications” Wiley, New Jersey, 2010.
2. Khandpur R S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003
3. Keith J Dreyer, Amit Mehta, James H Thrall, “Pacs: A Guide to the Digital Revolution”, Springer, New York, 2002.
4. Garrett Grolemund, Hands–On Programming with R, O'Reilly , 1 edition , 2014.
5. Michael Dawson, Python Programming for the Absolute Beginner, Course Technology , 3rd edition ,2010
6. MageshJayakumar, ArduinoandAndroidUsingMitAppInventor,Createspace Independent Publishing Platform , 1.0 edition ,2016

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

21BMV603 BODY AREA NETWORKS AND MOBILE HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an overview of the technical background of Body Area Networks (BAN) and its application in health care using mobile technology
- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

UNIT – I BODY AREA NETWORKS 9

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

UNIT – II HARDWARE FOR BAN 9

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.

UNIT – III WEARABLE SENSORS AND STANDARDS FOR BAN 9

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.

UNIT – IV MOBILE DEVICES FOR HEALTHCARE 9

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

UNIT – V MOBILE HEALTH TECHNOLOGIES AND APPLICATIONS 9

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

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Comprehend technical challenges in body area networks. [Understand]

CO2: Apply BAN knowledge to provide innovative mHealthcare solutions. [Apply]

CO3: Examine multiple sensors for wearable applications. [Apply]

CO4: Analyze effectiveness and limitations of existing Body Area Networks. [Analyze]

CO5: Compare different network architectures and protocols to meet specific medical requirements. [Analyze]

CO6: Evaluate BANs and healthcare systems for specific healthcare use cases. [Evaluate]

TEXTBOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013.

REFERENCES:

1. Canjun Yang , G.S.Virk, Huayong yang , “Wearable sensors and Robots”, Proceeding of international conference on wearable sensors and robots, 2017
2. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
3. Guang-ZhongYang(Ed.), “Body Sensor Networks’’, Springer, 2006.
4. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012

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

21BMV604 VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues.
- To understand virtual reality, augmented reality and use them to build Biomedical engineering applications.
- To know the intricacies of these platforms to develop PDA applications with better optimality.
- To learn the various applications of VR..

UNIT – I INTRODUCTION 9

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT – II VR DEVELOPMENT PROCESS 9

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model management.

UNIT – III CONTENT CREATION CONSIDERATIONS 9

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT – IV VR ON THE WEB & VR ON THE MOBILE 9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google 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

UNIT – V APPLICATIONS 9

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the principles of VR and AR in healthcare. [Understand]

CO2: Apply VR modeling concepts into real-time operations. [Apply]

CO3: Analyze the benefits and limitations of VR-related issues. [Analyze]

CO4: Analyze a system process to meet given specifications with realistic constraints. [Analyze]

CO5: Analyze the effectiveness and impact of VR and AR on patient safety outcomes. [Analyze]

CO6: Evaluate simple and portable VR applications using appropriate software. [Evaluate]

TEXTBOOKS:

1. C. Burdea & Philippe Coiffet, “Virtual Reality Technology”, Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

REFERENCES:

1. 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
2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1 edition, 2016.
4. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 2015.
5. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1 edition, 2014.
6. Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2	3		2								2	3
CO3	3			2	2	2							2	2
CO4	3	2	3	2	2								2	2
CO5	3			2	2	3	2						2	2
CO6	3	2	3	2	3								2	3
CAM	2.83	2	3	2	2.2	2.5	2						2	2.4

21BMV605 MEDICAL INFORMATICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the applications of information technology in health care management.
- To provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT – I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT – II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING 9

Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory InformationSystem - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclearmedicine, ultrasoundimaging, computed X- ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT – III COMPUTERISED PATIENT RECORD 9

Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients

UNIT – IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system - General model of CMD, Computer–assisteddecisionsupportsystem-productionrulesystem. Cognitive model, semantic networks, decisions analysis in clinical medicine - computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT – V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, virtual endoscopy, Computer Assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health-Medical education and health care information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the structure, functionality, and applications of Medical Informatics. [Understand]

CO2: Apply the concepts of Hospital Information Systems and automated clinical laboratory systems to real-life healthcare management. [Apply]

CO3: Implement decision support systems and computerized patient records in clinical settings. [Apply]

CO4: Analyze the role and effectiveness of neural networks and artificial intelligence in medical decision-making processes. [Apply]

CO5: Examine the use of medical informatics technologies in modern healthcare. [Analyze]

CO6: Evaluate the integration of medical informatics in automated systems and surgery. [Evaluate]

TEXTBOOKS:

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

REFERENCES:

1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 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	3								2	2
CO4	3	2		2	3								2	3
CO5	3	2		2								2	2	3
CO6	3	2		2								2	2	3
CAM	**2.83**	**2**		**2**	**3**							**2**	**2**	**2.75**

21BMV606 ADVANCED COMMUNICATION TECHNOLOGY FOR HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of wireless body area network.
- To develop the E-Health care system.
- To demonstrate the big data analytics in healthcare.
- To evaluate the AR/VR technology and medical 4.0 technology.
- To understand the various healthcare communication technologies.

UNIT – I BASICS FOR WIRELESS BODY NETWORK 9

Overview of wireless body area network-Application of policy based agent in wireless body sensor mesh network for patient monitoring system-QoS concept and architecture for WBAN for healthcare application

UNIT – II E-HEALTHCARE SYSTEMS AND WIRELESS COMMUNICATIONS 9

Legal issue in legal E-Healthcare system-RFID Application in E-healthcare system-Android based telemedicine system for patient monitoring-Mobile based medical alert system- Kinet application in healthcare-pervasive mobile care- Critical factors in development, implementation and evaluation in telemedicine-Surugical tele monitoring.

UNIT – III BIG DATA ANALYTICS IN HEALTHCARE 9

Definition and applications of big data analytics in healthcare-Tools and techniques used in big data analytics-Impact of big data analytics on healthcare delivery and patient outcomes.

UNIT – IV VR/AR TECHNOLOGY IN HEALTHCARE 9

Introduction of AR/VR-Features of AR/VR Technologies in healthcare-Augumentating dental care- Application of VR in Healthcare

UNIT – V MEDICAL 4.0 TECHNOLOGY IN HEALTHCARE 9

Introduction of medical 4.0 technology-Features of medical 4.0 technology- Application of Medical 4.0 technology for healthcare.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the role of advanced communication technologies in patient engagement and patient-centered care. [Understand]

CO2: Apply WBAN and mobile healthcare for patient monitoring. [Apply]

CO3: Apply big data analytics and AR/VR technologies for healthcare system improvements. [Apply]

CO4: Analyze the impact of big data analytics on healthcare outcomes and delivery. [Analyze]

CO5: Analyze the role of AR/VR and Medical 4.0 technologies in enhancing healthcare systems. [Analyze]

CO6: Evaluate the implementation of wireless communications and AR/VR technologies in healthcare systems. [Evaluate]

TEXTBOOKS:

1. Joel J.P.C. Rodrigues “Digital Advances in Medicine, E-Health, and Communication Technologies” Pearson education, 2013.

2. Tarik A. Rashid, Chinmay Chakraborty, Kym Fraser “Advances in Telemedicine for Health Monitoring Technologies, design and applications”, 2020.

REFERENCES:

1. Mohamed K. Watfa “E-Healthcare Systems and Wireless Communications: Current and future challenges”,October,2011.
2. Matthew N O Sadiku, Rotimi A K Jaiyesimi, Joyce B Idehen” Emerging technology for healthcare and medicine”, October,2021.

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		2	2								3	3
CO5	3	2		2						2			3	3
CO6	3	2	2	2	2								3	3
CAM	**2.83**	**2.33**	**2**	**2**	**2**					**2**			**2.5**	**3**

21BMV607 ANTENNA'S FOR WEARABLE AND IMPLANTABLE DEVICES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make the students to get familiarized with various wearable antenna's and implantable devices
- To enable the students to understand various antenna fabrication techniques
- To make the students understand the requirements of practical design and optimal performance.

UNIT – I FUNDAMENTAL CONCEPTS 9

Biomedical Engineering design, Clinical problems and engineering approaches, Technical considerations of wearable technologies, Wearable computers, minimally invasive devices and techniques, Health and Fitness wearables, Bionics, Promise and perils of wearable systems, Security and privacy risks.

UNIT – II ANTENNAS FOR BODY AREA NETWORKS 9

Wearable antennas, Flexible antenna designs, Metamaterial and AMC based antenna structures, Organic Paper based antennas, Flexible Optically transparent antennas, Diversity antennas, Conformal antennas, GPS aided VHF Animal Collar antenna, Textile based rectennas, Biodegradable antennas Parametric analysis.

UNIT – III FABRICATION AND MEASUREMENT TECHNIQUES 9

Material selection, Parameter Characterization, Impedance matching strategy, Printing technologies, Meshed antenna, Transparent and conductive oxides, Smart skins-flexible chemical sensing components, Nano wires

UNIT – IV IOT TRIGGERED BODY AREA NETWORKS 9

Intelligent wearable device, Biosensors, Wearing sensors inside and outside of the human body for the early detection of diseases. External parts of implantable devices, Internal structure layout, Data Telemetry unit, Central Processing unit, Memory storage, Analog Front end, Neural simulation and charge balancing approaches.

UNIT – V HEALTHCARE ANTENNAS 9

Case studies on design of wearable and implantable antennas - Smart ambulance traffic management system, power efficient health monitoring system for the aging population.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the fundamental concepts of wearable technology and its components. [Understand]

CO2: Apply the knowledge of wearable antennas and fabrication techniques in body area network systems. [Apply]

CO3: Implement IoT-triggered body area networks and wearable antennas for health monitoring. [Analyze]

CO4: Analyze wearable antennas' performance, materials and impedance matching in body area networks. [Analyze]

CO5: Examine the fabrication and measurement techniques for wearable and implantable antennas. [Analyze]

CO6: Assess the effectiveness of healthcare antennas in applications like smart ambulances and health monitoring. [Evaluate]

TEXTBOOKS:

1. Haider Khaleel, “Innovation in Wearable and Flexible Antennas, WIT Transactions on Stateof-the-art in Science and Engineering, 2015, ISBN: 978-1-84564-986-9.
2. Nilanjan Dey, Amira S. Ashour, Simon James Fong, Chintan Bhatt, “Wearable and Implantable Medical Devices: Applications and Challenges”, Academic Press, 2019.
3. Edward Sazonov, “Wearable Sensors: Fundamentals, Implementation and Applications”, Elsevier, 14-Aug-2014 - Technology & Engineering.
4. Vinod Kumar Khanna, “Implantable Medical Electronics: Prosthetics, Drug Delivery, and Health Monitoring”, Springer, 10-Dec-2015 - Technology & Engineering..

REFERENCES:

1. Andrés D. Lantada, “Handbook on Advanced Design and Manufacturing Technologies for Biomedical Devices”. Springer London 2013.
2. “Management Association, Information Resources. Wearable Technologies: Concepts, Methodologies, Tools, and Applications” (3 Volumes). IGI Global, 2018. 1-1571. Web. 23 Oct. 2019. doi:10.4018/978-1-5225-5484-4.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2											3	2
CO3	3	2				2							3	2
CO4	3	3	2	2									3	3
CO5	3	2	3	2		2							3	3
CO6	3	3	2	3			2						3	3
CAM	2.83	2.4	2.33	2.33		2	2						2.83	2.6

VERTICAL - VII

21BMV700 ADVANCED HEALTHCARE DEVICES

S. No.	Course Code	Course Title	L	T	P	C
1.	21BMV701	Bio-MEMS and Nano Electronics	3	0	0	3
2.	21BMV702	Human Assist Devices (Common to BME & ECE)	3	0	0	3
3.	21BMV703	Critical Care and Operation Theatre Equipment	3	0	0	3
4.	21BMV704	Therapeutic Equipment (Common to BME & ECE)	3	0	0	3
5.	21BMV705	Advancements in Healthcare Technology	3	0	0	3
6.	21BMV706	Robotics in Medicine	3	0	0	3

21BMV701 BIOMEMS AND NANO ELECTRONICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce various MEMS fabrication techniques.
- To impart knowledge on different types of sensors and actuators and their principles of operation at the micro scale level.
- To discuss the applications of MEMS in different fields of medicine

UNIT – I MEMS MATERIALS AND FABRICATION 9

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.

UNIT – II SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – 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.

UNIT – III THE PROSPECT OF NANOMEDICINE 9

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

UNIT – IV NANOSENSORS & NANOSCALE SCANNING 9

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

UNIT – V NANODEVICES FOR MEDICINE & SURGERY 9

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.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Summarize the fundamentals of BioMEMS, nanoelectronics and their applications in medicine. [Understand]

CO2: Apply MEMS materials and fabrication techniques to design microsensors and actuators. [Apply]

CO3: Implement nanosensors and nanomedicine techniques for medical applications. [Apply]

CO4: Analyze the mechanics of MEMS design and the impact of nanomedicine on healthcare. [Analyze]

CO5: Evaluate nanosensor technologies and nanodevices for diagnostics and treatment. [Analyze]

CO6: Assess nanotechnology-based drug delivery systems and nano-robotics in surgery. [Evaluate]

TEXTBOOKS:

1. Chang Liu," Foundations of MEMS", Pearson Education International, New Jersey, USA, 2nd Edition, 2011.
2. Robert .A. Freital.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	2											2	
CO3	3	3	2										3	
CO4	3	2	2									2	3	2
CO5	3	2		2								2	3	
CO6	3	3	2	2				2				2	3	2
CAM	**2.83**	**2.4**	**2**	**2**				**2**				**2**	**2.8**	**2**

21BMV702 HUMAN ASSIST DEVICES

(Common to BME & ECE)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs,
- To study various mechanical techniques that help a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications

UNIT – I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT – II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra-Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques

UNIT – III ARTIFICIAL KIDNEY 9

Indication and Principle of Hemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT – IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT – V RECENT TRENDS 9

Transcutaneous Electrical Nerve Stimulator (TENS): key features – important considerations – applications – Bio-feedback: working – types – applications – effectiveness and considerations – Diagnostic and point-of-care platforms.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the concepts, types and working principles of human assist devices. [Understand]

CO2: Demonstrate the principles and design of respiratory devices, hearing aids, and artificial kidneys. [Apply]

CO3: Apply appropriate techniques in designing and implementing cardiac assist devices. [Apply]

CO4: Analyze the working mechanisms of different assistive devices and their impact on patient health. [Analyze]

CO5: Identify challenges and limitations in the usage of assistive devices and modern rehabilitation technologies. [Analyze]

CO6: Assess various assistive technologies and select optimal solutions for real-time healthcare applications. [Evaluate]

TEXTBOOKS:

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering Marcel Dekker Inc New York 2004.
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

REFERENCES:

1. Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980.
2. Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.
3. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010

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	2									2	3	2
CO4	3	2		2									3	2
CO5	3	3		2								2	3	2
CO6	3	2	2	3	2				2	2		2	3	3
CAM	**2.83**	**2.25**	**2**	**2.33**	**2**				**2**	**2**		**2**	**3**	**2.2**

21BMV703 CRITICAL CARE AND OPERATION THEATRE EQUIPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To offer clear understanding of various intensive care equipment and their working.
- To understand the necessity of different operation theatre equipment.
- To know about different dialyzers and ventilators.

UNIT – I INTENSIVE CARE UNIT EQUIPMENT 9

Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer

UNIT – II CRITICAL CARE EQUIPMENT 9

Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators.

UNIT – III OPERATION THEATRE EQUIPMENT 9

Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator,, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyles apparatus. Endoscopy – Laparoscopy - Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, - surgical microscope.

UNIT – IV CENTRALISED SYSTEMS 9

Centralized Oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.

UNIT – V PATIENT SAFETY 9

Patient electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, Hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the principles and working of critical care and operation theatre equipment. [Understand]

CO2: Apply the knowledge of intensive care and critical care equipment for effective hospital usage. [Apply].

CO3: Validate the functionality of operation theatre equipment and centralized hospital systems. [Apply]

CO4: Assess the efficiency and reliability of intensive and critical care equipment. [Analyze]

CO5: Analyze the performance and detect potential issues in operation theatre and centralized systems. [Analyze]

CO6: Evaluate maintenance strategies to ensure the safety and effectiveness of medical equipment. [Evaluate]

TEXTBOOKS:

1. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India PvtLtd,New Delhi, 2015
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson education, 2012
3. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGrawHill Pub. Co.,Ltd. 2003

REFERENCES:

1. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008.
2. Antony Y.K.Chan,”Biomedical Device Technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.
3. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson Education, New Delhi, 2007.

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										2	3	2
CO4	3	3		2								2	3	2
CO5	3	2		2					2			2	3	3
CO6	3	2	2	2					2			2	3	3
CAM	**2.83**	**2.25**	**2**	**2**					**2**			**2**	**3**	**2.4**

21BMV704 THERAPEUTIC EQUIPMENT

(Common to BME & ECE)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

UNIT – I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT 9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter.

Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.

UNIT – II BIOMECHANICAL THERAPEUTIC EQUIPMENT 9

Electro diagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.

UNIT – III BODY CARE EQUIPMENT 9

Skin Treatment: Ultrasonic spot remover, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.

UNIT – IV DENTAL CARE EQUIPMENT 9

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed hand piece, High-speed hand piece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

UNIT – V HEAT & PHOTON THERAPY EQUIPMENT 9

High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the principles and working of various therapeutic equipment. [Understand]

CO2: Apply concepts of cardiac, respiratory, and biomechanical therapeutic devices in clinical settings. [Apply].

CO3: Utilize body care, dental and heat & photon therapy equipment in healthcare applications. [Apply]

CO4: Analyze the functionality and effectiveness of cardiac, respiratory and biomechanical devices. [Analyze]

CO5: Assess the efficiency and safety of body care, dental, and laser-based therapeutic equipment. [Analyze].

CO6: Evaluate the role of heat therapy and laser applications in rehabilitation. [Evaluate]

TEXTBOOKS:

1. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003
2. John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition. Wiley &s ons, Inc., NewYork. 2009

REFERENCES:

1. Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2000.
2. John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition. Butterworth Heinemann Ltd. 2000.
3. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

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				2			2			2	3	2
CO4	3	2										2	3	2
CO5	3	2		2		2			2				3	3
CO6	3	3	2	2								2	3	3
CAM	**2.83**	**2.25**	**2**	**2**		**2**			**2**			**2**	**3**	**2.4**

21BMV705 ADVANCEMENTS IN HEALTHCARE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand the needs for wearable devices and the technology
- Learn the concepts in digital health care and digital hospitals
- Apply the tools in design, testing and developing digital health care equipment

UNIT – I DIGITAL HEALTH 9

Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT – II DIGITAL RADIOLOGY 9

Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT – III E-HEALTH 9

E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology.

UNIT – IV M-HEALTH CARE AND WEARABLE DEVICES 9

Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT – V MODALITY AND STANDARDS FOR INTER-OPERABILITY 9

Multimodality registration in daily clinical practice. Mobile healthcare. Selection and Implementation in e-Health project, design of medical equipment based on user needs. Security and privacy in digital health care. Case study.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the fundamental concepts, principles and ethical considerations of digital health technology. [Understand]

CO2: Utilize digital radiology and e-health technologies in modern healthcare applications. [Apply]

CO3: Implement mobile healthcare and wearable devices for improved patient monitoring and diagnosis. [Apply]

CO4: Assess the impact of digital healthcare technologies on hospital efficiency and patient care. [Analyze]

CO5: Examine the interoperability and integration challenges of digital health systems. [Analyze]

CO6: Evaluate security, privacy, and quality standards in digital healthcare technologies. [Evaluate]

TEXTBOOKS:

1. Christoph Thuemmler, Chunxue Bai, “Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare”, Springer, 1st ed. 2017

2. Wlater Hruby, “Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006
3. Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, “Requirements Engineering For Digital Health”, Springer, 2015

REFERENCES:

1. Rick Krohn (Editor), David Metcalf, Patricia Salber, “Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013.
2. Khandpur,R.S,”Handbook of Biomedical Instrumentation ”,Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003
3. John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, New Delhi. 2013.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3											2	3	3
CO3	3	2										2	3	3
CO4	3	3				2						3	3	3
CO5	3	3	2									3	3	3
CO6	3	3	2	2				2				3	3	3
CAM	**2.83**	**2.75**	**2**	**2**		**2**		**2**				**2.6**	**3**	**3**

21BMV706 ROBOTICS IN MEDICINE

L	T	P	C
3	0	0	3

OBJECTIVES:

- Learn the basics of robotics and position analysis, and have your questions answered.
- Get an understanding of parallel robotics, the many forms of motion, and force analysis. Become familiar with the fundamentals of motion control systems, trajectory planning, and actuators.
- Have an understanding of the many different types of sensors and visual systems
- Familiarize yourself with fuzzy control and the applications of robotics in medical research

UNIT – I FUNDAMENTALS AND POSITION ANALYSIS 9

Fundamentals – Classification, Advantages and disadvantages, Components, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Characteristics, Workspace, Languages, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Forward and inverse kinematics, Denavit Hartenberg Representation, Degeneracy and Dextrerity, Screw based robots, Position analysis of Articulated robot Case studies

UNIT – II PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS 9

Parallel robots – Physical characteristics, Forward and Inverse Kinematic approaches, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics, Moments of Inertia, Dynamic Equations of Multiple DOF Robots, Static force analysis, Transformation of forces and moments between coordinate frames, Case studies.

UNIT – III TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS 9

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Block diagrams, Laplace Transform, Block diagram Algebra, Transfer Functions, Characteristic equation, Steady state error, Root locus, Proportional, Integral and Derivative controllers, Compensators, Bode, Loops, Multiple IO systems, Control - State space and Digital, Nonlinear systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators, Speed reduction, Case studies.

UNIT – IV SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS 9

Sensor Characteristics, Position, Velocity, Acceleration, Force, Pressure and Torque, Microswitches, Visible and IR, Touch, Proximity, Range finders, Sniff, Vision, Transforms – Fourier, Hough, Resolution, Quantization, Sampling, Image processing, Segmentation, Region growing and splitting, Operations, Object recognition, Depth, Specialized lighting, Compression, Colour images, Heuristics,Case studies

UNIT – V FUZZY CONTROL AND APPLICATIONS IN MEDICINE 9

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering, Applications in rehabilitation, Nano bots in medicine, Clinical diagnosis and Surgery – Cardiac and abdominal procedures with tele operated robots, Orthopedic surgery with cooperative robots, Case studies.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the principles of robotics, motion control and their medical applications. [Understand]

CO2: Apply kinematic and dynamic models to analyze robotic motion and force interactions. [Apply]

CO3: Utilize trajectory planning, control systems and actuators for robotic applications. [Apply]

CO4: Analyze the role of sensors, vision systems, and image processing in medical robotics. [Analyze]

CO5: Examine fuzzy control techniques and their impact on robotic medical applications. [Analyze]

CO6: Evaluate robotic-assisted surgical and rehabilitation systems in clinical practice. [Evaluate]

TEXTBOOKS:

1. S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020.
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
3. Fu Gonzales and Lee, Robotics, McGraw Hill, 1987.
4. J Craig, Introduction to Robotics, Pearson Education, 2005.

REFERENCES:

1. Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012.
2. Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989.
3. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003.
4. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999.
5. Mikell P. Groover, Mitchell Weiss, Industrial robotics, technology, Programming and Applications, McGraw Hill International Editions, 1986.
6. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Robotic engineering - An Integrated Approach, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	2
CO3	3	3	2										2	2
CO4	3	3		2					2			2	3	3
CO5	3	3		2									3	2
CO6	3	3	2	2		2	2		2			2	3	3
CAM	**2.83**	**2.8**	**2**	**2**		**2**	**2**		**2**			**2**	**2.6**	**2.4**

LIST OF OPEN ELECTIVES

(Offered for Other Branch Students)

S.No.	Course Code	Course Title	L	T	P	C
1.	21UBM971	Forensic Science	3	0	0	3
2.	21UBM972	Biomedical Instrumentation Systems	3	0	0	3
3.	21UBM973	Computer Applications in Medicine	3	0	0	3
4.	21UBM974	Assistive Technology	3	0	0	3
5.	21UBM975	Robotics in Health Care	3	0	0	3

21UBM971 FORENSIC SCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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.
- To emphasize the importance of scientific methods in crime identification and detection.
- To deal with the modus operandi and role of modus operandi bureau in crime investigation

UNIT – I INTRODUCTION TO FORENSIC SCIENCE 9

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.

UNIT – II TOOLS AND TECHNIQUES IN FORENSIC SCIENCE 9

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.

UNIT – III CRIME AND POLICE ORGANIZATION 9

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.

UNIT – IV CRIME SCENE 9

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

UNIT – V FORENSIC EVIDENCES, ANALYSIS AND MODUS OPERANDI 9

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.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explicate the principles and importance of forensic science in crime investigation. [understand]

CO2: Apply forensic tools, techniques and scientific methods for crime analysis. [Apply]

CO3: Utilize crime scene investigation techniques to document and preserve crucial information. [Apply]

CO4: Analyze different types of crimes, their causes, and the role of law enforcement agencies. [Analyze]

CO5: Examine forensic evidence such as fingerprints, DNA, ballistics and blood spatter in criminal cases. [Analyze]

CO6: Evaluate forensic methodologies in crime scene investigation and criminal justice. [Evaluate]

TEXTBOOKS:

1. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher‟s, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
2. Saferstein, Richard. “Criminalistics—An Introduction to Forensic Science”, 11th ed. Prentice Hall, Saddle River, NJ. 2011

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	2										
CO3	3	3	2				2	2				
CO4	2	3		2	3		2	3				
CO5	3	2	2	2				3				
CO6	3	2	2	2	2	2	2	2				
CAM	**2.67**	**2.4**	**2**	**2**	**2.5**	**2**	**2**	**2.5**				

21UBM972 BIOMEDICAL INSTRUMENTATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a possibility for the student to acquire knowledge about the impact and interaction of light with biological tissue.
- To understand practical applications of optics related to medicine.

UNIT – I BASIC CONCEPTS OF MEDICAL INSTRUMENTATION 9

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.

UNIT – II BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS 9

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.

UNIT – III MEASUREMENT OF NON ELECTRICAL PARAMETERS 9

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.

UNIT – IV MEDICAL IMAGING SYSTEMS AND TELEMETRY 9

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.

UNIT – V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

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.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Describe the fundamentals of medical instrumentation, medical imaging and therapeutic devices. [Understand]

CO2: Apply methods for measuring biological signals and non-electrical parameters in clinical settings. [Apply]

CO3: Utilize medical imaging systems, biotelemetry, and life-assisting devices for patient monitoring and treatment. [Apply]

CO4: Analyze the interaction of light with tissues and the performance of diagnostic systems. [Analyze]

CO5: Analyze the performance of therapeutic and robotic devices in healthcare. [Analyze]

CO6: Evaluate the effectiveness and safety of therapeutic and robotic devices in clinical environments. [Evaluate]

TEXTBOOKS:

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

REFERENCES:

1. Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Press LLC, 2003.
2. Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.
3. R. Splinter and B.A. Hooper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007.
4. Helena Jelinkova, “Lasers for Medical Applications: Diagnostics, Therapy and Surgery’’, Wood head Publishing, 1st Edition, 2013.

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

21UBM973 COMPUTERS APPLICATIONS IN MEDICINE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To teach PC hardware and its related interfacing
- To understand the basics of computerized data acquisition
- To study the concepts of Computer Assisted Instruction and computers in patient education.

UNIT – I PERIPHERAL INTERFACING AND CONTROLLERS 9

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.

UNIT – II DATA ACQUISITION AND MEDICAL INFORMATION RETRIEVAL 9

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

UNIT – III COMPUTER ASSISTED INSTRUCTION (CAI) IN MEDICINE 9

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) - Robotic surgery.

UNIT – V COMPUTER ASSISTED PATIENT EDUCATION 9

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.

UNIT – V ELECTRONIC HEALTH RECORDS (EHRS) 9

Introduction to Electronic Health Records (EHRs) and their role in healthcare - Components and architecture of EHR systems - Standards and interoperability in EHRs - Security and privacy issues in EHR implementation.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Elucidate the basics of computer hardware, data acquisition and the role of computers in medicine. [Understand]

CO2: Apply peripheral interfacing, controllers and medical data acquisition systems for healthcare applications. [Apply]

CO3: Utilize medical information retrieval systems and CAI tools for patient information management and education. [Apply]

CO4: Analyze the role of CAI and multimedia in medical education and virtual patient simulations. [Analyze]

CO5: Analyze the application of computers in patient education, prescription management and ICU monitoring systems. [Analyze]

CO6: Evaluate the implementation, security and interoperability of Electronic Health Records in healthcare systems. [Evaluate]

TEXTBOOKS:

1. Ramachandra Lele, “Computers in Medicine Progress in Medical Informatics”, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, “PC Based Instrumentation: Concepts and Practice”, Prentice Hall of India, New Delhi 2007

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	2										
CO3	3	2										
CO4	3	2		2								2
CO5	3	2		2								2
CO6	3	2		2					2	2		2
CAM	**2.83**	**2**		**2**					**2**	**2**		**2**

21UBM974 ASSISTIVE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology
- To understand augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality.
- Simulate and Apply Virtual/Augmented Reality to varieties of Applications

UNIT – I CARDIAC ASSIST DEVICES 9

Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves

UNIT – II HEMODIALYSERS 9

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters

UNIT – III HEARING AIDS 9

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids

UNIT – IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.

UNIT – V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Interpret the principles and applications of assistive devices. [Understand]

CO2: Apply cardiac assist devices and hemodialysis technology in clinical settings. [Apply]

CO3: Apply knowledge of hearing aids and prosthetics/orthotics for patient rehabilitation. [Apply]

CO4: Analyze hemodialysis systems and hearing aids for effectiveness and limitations. [Analyze]

CO5: Analyze prosthetic, orthotic, and sensory assist devices along with recent trends like nerve stimulators. [Analyze]

CO6: Evaluate the effectiveness of transcutaneous electrical nerve stimulators and bio-feedback in rehabilitation. [Evaluate]

TEXTBOOKS:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006

2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

REFERENCES:

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola , Elsevier 2019 ISBN 978 -0-323-662116
4. Sanni Siltanen, S., (2012), “Theory and applications of marker-based augmented reality,” Julkaisija –Utgivare Publisher, ISBN: 9789513874490

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

R21UBM975 ROBOTICS IN HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand the basic concepts of robots and types of robots, manipulators, actuators and grippers.
- Study about various types of sensors and power sources.
- Study the various applications of robot in the medical field.

UNIT – I INTRODUCTION OF ROBOTICS 9

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

UNIT – II ACTUATORS AND GRIPPERS 9

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator models

UNIT – III MANIPULATORS AND BASIC KINEMATICS 9

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator. Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems.

UNIT – IV POWER SOURCES AND SENSORS 9

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

UNIT – V ROBOTICS IN MEDICINE 9

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

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO1: Explain the principles of robotics, motion control and their medical applications. [Understand]

CO2: Apply robotics subsystems, actuators, and kinematics to design medical robots. [Apply]

CO3: Implement sensors, power sources, and control systems in medical robotic applications. [Apply]

CO4: Analyze robotic manipulators and actuators for healthcare effectiveness. [Analyze]

CO5: Analyze the role of sensors and power sources in surgical robotic systems. [Analyze]

CO6: Evaluate the performance and limitations of medical robotic systems in surgery. [Evaluate]

TEXTBOOKS:

1. Nagrath and Mittal, “Robotics and Control”, Tata McGraw-Hill, First edition, 2003.
2. Spong and Vidhyasagar, “Robot Dynamics and Control”, John Wiley and Sons, First edition, 2008.

REFERENCES:

1. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, “Principles of Robot Motion: Theory, Algorithms, and Implementations”, Prentice Hall of India, First edition, 2005.
2. Jacob Rosen, Blake Hannaford & Richard M Satava, “Surgical Robotics: System Applications & Visions”, Springer 2011.
3. Barbara Webb and Thomas Consi. R, “BioRobotics: Methods & Applications”, AAAI Press/MIT Press, First Edition, 2001.
4. ConstantinosMavroidis, Antoine Ferreira, “Nanorobotics: Current approaches and Techniques”, Springer 2011.
5. Fu.K.S, Gonzalez.R.C. Lee, C.S.G, “Robotics, control, sensing, Vision and Intelligence”, Tata McGraw Hill International, First edition, 2008.

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

COURSE OFFERED FOR OTHER PROGRAMMES

(MANDATORY COURSE)

S. No.	Course Code	Course Title	L	T	P	C
1.	R21UGM231	Biology for Engineers (Common to ALL Branches – Except BME & BT)	2	0	0	P/F

R21UGM231 BIOLOGY FOR ENGINEERS

(Common to All B.E/B.Tech. Branches - except BME & BT)

L	T	P	C
2	0	0	P/F

OBJECTIVES:

- To provide a basic understanding of biological mechanisms of living organisms and the human biology from the perspective of engineers.
- To encourage engineering students to think about solving biological problems with engineering principles and tools.

UNIT – I INTRODUCTION AND CLASSIFICATION 5

Introduction to Biology – Comparison of Biology and Engineering – Eye and Camera – Bird flying and Aircraft – Brownian motion and Thermodynamics – Classification – Unicellular or multicellular – Unicellular: Bacteria, Protozoa, Yeast – Multi Cellular: Animals, Humans, Plants, fungi etc. – Ultra structure: prokaryotes or eukaryotes – Habitat: aquatic or terrestrial.

UNIT – II DIGESTIVE & RESPIRATORY SYSTEMS – ENZYME 6

Study of digestive – Respiratory systems and their functions –.Enzyme – Classification of Enzyme – Mechanism of Enzyme activity – Enzymes for Industrial Applications: Waste management – Food processing industry – Beverages – Pharmaceutical – Paper Industry etc.

UNIT – III GENETICS AND BIO MOLECULES (Basics only) 7

Basics of Genes – DNA structure – Genes and hereditary – Genetic Code – Coding and decoding Genetic information – Gene Mapping – Gene Interactions – Mutations – Genetic disorders – Gene therapy – Biomolecules: Carbohydrates, lipids, nucleic acids, proteins. Biological Applications in Engineering: Genetic Algorithm – Computer Application in Genetic Engineering – Genetic Programming – Genetic Computers.

UNIT – IV NERVOUS SYSTEM AND CELL SIGNALING 7

Central Nervous System: Brain and Spinal Cord – Peripheral Nervous System – Sensory Division – Motor Division – Neurons – sensory, motor, and interneurons – Signals – Transfer of Information – Bio Signals – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electrooculography (EOG) – X-ray – CT Scan – MRI scan – Biological Applications in Engineering – Neurons and Neural Network.

UNIT – V BIOLOGY AND ITS INDUSTRIAL APPLICATION 5

Bioreactors – Biopharming – Recombinant vaccines – Cloning – Drug discovery – Bioremediation – Biofertilizer – Biocontrol – Biofilters – Biosensors – Biopolymers – Bioenergy – Biomaterials – Biochips.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of living things, their classification, cell structure and biochemical constituents. [Understand]

CO2: Apply the concept of plant, animal and microbial systems and growth in real life situations. [Apply]

CO3: Analyze biological engineering principles and procedures needed to solve societal issues. [Analyze]

TEXT BOOKS:

1. R.C.Dubey, “A Text book of Biotechnology”, S. Chand Higher Academic Publications, 2013.
2. R. Khandpur, “Biomedical instrumentation - Technology and applications”, McGraw Hill Professional, 2004.

REFERENCES:

1. Arthur T. Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2nd Edition, 2019.
2. 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.
3. Gerard J. Tortora and Bryan H.Derrickson, “Principles of Anatomy and Physiology”, 15th Edition,Wiley publications, 2016.