



# **JERUSALEM COLLEGE OF ENGINEERING**

**(An Autonomous Institution)**

**(Approved by AICTE, Affiliated to Anna University,**

**Accredited by NBA and NAAC with 'A' Grade)**

**Velachery Main Road, Narayanapuram, Pallikaranai, Chennai – 600100**

## **DEPARTMENT OF BIOMEDICAL ENGINEERING**

### **VISION OF THE INSTITUTION**

Jerusalem College of Engineering is committed in emerging as an international institution of excellence in imparting finest quality engineering, technology and management education rooted in ethical and societal values through various academic programmes, multi-disciplinary research, consultancy and entrepreneurship activities and hence to contribute towards social transformation and nation building.

### **MISSION OF THE INSTITUTION**

- Generating abundant resources and making conducive policies, the management led by the Chief Executive Officer strives towards promoting globally competitive academic programmes augmented with value added courses, in-plant training activities, co-curricular activities and ambience that support intellectual growth and skill acquisition
- Promoting collaborative trans-border research programmes continuing education in synergy with academia, industries and research organizations leading to real time solutions and life-long learning
- Transforming young men and women into competent professionals and entrepreneurs motivated by a passion for professional excellence, driven by human values and proactively engage in the betterment of the society through innovative practices and academic excellence
- Facilitating effective interaction among faculty members and students and fostering network of alumni, industries, institutions and other stake-holders for successful career gain and placement

## **VISION OF THE DEPARTMENT**

Department of Biomedical Engineering is committed to produce Biomedical Engineers with ethical and social considerations and to foster their intellectual growth in multi-disciplinary fields for improving human condition and healthy nation building.

## **MISSION OF THE DEPARTMENT**

1. Providing technical knowledge through skilled innovative practices and experiments in ethical learning environment.
2. Creating new knowledge and enabling technologies in devising simple and low-cost methods for diagnosis and therapy at different medical fields through research and developmental activities.
3. Providing quality education and design activities in developing entrepreneurship qualities.

## PROGRAMME OUTCOMES (POs):

**The graduates will have the ability to**

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO 4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning:** 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.

## **PROGRAMME EDUCATIONAL OBJECTIVES – REVISED**

**PEO 1:** To enable the graduates to develop prototype models and biomedical devices through the core foundation and knowledge acquired with multi-disciplinary approach.

**PEO 2:** To facilitate the graduates to adapt to the contemporary technologies and support healthcare providers at various levels with effective communication and team work.

**PEO 3:** To demonstrate the analytical skills to enhance and innovate with ethical commitment.

**PEO 4:** To empower the graduates to grow as pioneers in the healthcare sector.

## **PROGRAMME SPECIFIC OUTCOMES**

**The graduates will have the ability to**

**PSO1:** Development of innovative tools: an ability to design innovative tools to analyze and diagnose various pathological disorders.

**PSO2:** Medical Equipment maintenance and management: an ability to develop strategies to address the challenges of medical equipment maintenance and hospital management.

## CREDIT SUMMARY

S.NO	CATEGORY	CREDITS AS PER SEMESTER								TOTAL CREDITS
		1	2	3	4	5	6	7	8	
1	HS	3	3	-	-	1	-	-	-	7
2	BS	10	6	3	3	-	-	-	-	22
3	ES	10	13	-	5	4	-	-	-	32
4	PC	-	-	19	13	6	10	6	-	54
5	PE	-	-	-	-	3	6	6		15
6	OE	-	-	-	-	3	3	6	-	12
7	EEC	-	-	-	1	1	2	4	10	18
<b>TOTAL</b>		<b>23</b>	<b>22</b>	<b>22</b>	<b>22</b>	<b>18</b>	<b>21</b>	<b>22</b>	<b>10</b>	<b>160</b>
NCM Courses			1			1			1	

**JERUSALEM COLLEGE OF ENGINEERING**  
**(AN AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI)**  
**B.E. BIOMEDICAL ENGINEERING**  
**REGULATION 2019**  
**CHOICE BASED CREDIT SYSTEM**  
**I TO VIII SEMESTERS CURRICULUM AND SYLLABUS**

**SEMESTER - I**

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JHS1121	Communicative English and Soft Skills I	HS	4	2	0	2	3
2	JMA1101	Matrices and Calculus	BS	4	2	2	0	3
3	JPH1101	Engineering Physics	BS	3	3	0	0	3
4	JCY1101	Engineering Chemistry	BS	3	3	0	0	3
5	JGE1101	Engineering Basics	ES	3	3	0	0	3
6	JGE1102	Programming in C	ES	3	3	0	0	3
<b>PRACTICALS</b>								
7	JPC1111	Physics and Chemistry Laboratory	BS	2	0	0	2	1
8	JGE1112	Programming in C Laboratory	ES	4	0	0	4	2
9	JGE1111	Design Appreciation Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>30</b>	<b>16</b>	<b>2</b>	<b>12</b>	<b>23</b>

**SEMESTER - II**

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JHS1221	Technical English and Soft Skills II	HS	4	2	0	2	3
2	JMA1201	Vector Calculus and Complex Analysis	BS	4	2	2	0	3
3	JBE1221	Applied Science for Biomedical Engineering	BS	4	2	0	2	3
4	JGE1203	Electric Circuits and Electronic Devices	ES	4	2	2	0	3
5	JGE1201	Python Programming	ES	3	3	0	0	3
6	JGE1202	Engineering Graphics and Design	ES	5	1	0	4	3
7	JNC1261	Environmental Science	NCM	3	3	0	0	0
<b>PRACTICALS</b>								
8	JGE1211	Python Programming Laboratory	ES	4	0	0	4	2
9	JGE1213	Electric Circuits and Electronic Devices Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>35</b>	<b>15</b>	<b>4</b>	<b>16</b>	<b>22</b>

### SEMESTER – III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JMA1301	Transforms and Linear Algebra	BS	4	2	2	0	3
2	JBM1301	Electronic Circuits for Biomedical Engineers	PC	3	3	0	0	3
3	JBM1302	Human Anatomy and Physiology	PC	3	3	0	0	3
4	JBM1303	Clinical Biochemistry	PC	3	3	0	0	3
5	JBM1304	Bio Sensors and Measurements	PC	3	3	0	0	3
6	JBM1305	Biomaterials for Medical Implants	PC	3	3	0	0	3
<b>PRACTICALS</b>								
7	JPT1001	Soft Skills and Aptitude - 1	EEC	2	0	0	2	*
8	JBM1311	Electronic Circuits Laboratory	PC	4	0	0	4	2
9	JBM1312	Human Physiology & Biochemistry Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>29</b>	<b>17</b>	<b>2</b>	<b>10</b>	<b>22</b>

\*Only Internal Assessment



## SEMESTER – IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JMA1401	Applied Probability and Numerical Methods	BS	4	2	2	0	3
2	JBM1401	Analog and Digital Integrated Circuits	ES	3	3	0	0	3
3	JBM1402	Pathology and Microbiology	PC	3	3	0	0	3
4	JBM1403	Biomedical Instrumentation	PC	3	3	0	0	3
5	JBM1404	Bio Control systems	PC	3	3	0	0	3
<b>PRACTICALS</b>								
6	JPT1001	Soft Skills and Aptitude - II	EEC	2	0	0	2	1
7	JBM1411	Analog and Digital Integrated Circuits Laboratory	ES	4	0	0	4	2
8	JBM1412	Pathology and Microbiology Laboratory	PC	4	0	0	4	2
9	JBM1413	Biomedical Instrumentation Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>30</b>	<b>14</b>	<b>02</b>	<b>14</b>	<b>22</b>

## SEMESTER – V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JEE1501	Micro processors and Micro controllers	ES	4	2	0	2	3
2	JEC1304	Signals and Systems	PC	4	2	2	0	3
3	JBM1501	Radiological Equipment	PC	3	3	0	0	3
4	-	Professional Elective 1	PE	3	3	0	0	3
5	-	Open Elective 1	OE	3	3	0	0	3
6	JNC1361	Essence of Indian Traditional Knowledge	NCM	2	2	0	0	0
<b>PRACTICALS</b>								
7	JPT1002	Technical Skills and Aptitude I	EEC	2	0	0	2	*
8	JHS1511	Professional Communication	HS	2	0	0	2	1
9	JBM1511	Programming Tools for Biomedical Engineers	ES	2	0	0	2	1
10	JBM1521	Mini Project	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>27</b>	<b>17</b>	<b>0</b>	<b>10</b>	<b>18</b>

\*Only Internal Assessment

## SEMESTER – VI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JBM1601	Diagnostic and Therapeutic Equipment	PC	3	3	0	0	3
2	JEC1501	Discrete Time Signal Processing	PC	4	2	2	0	3
3	-	Professional Elective 2	PE	3	3	0	0	3
4	-	Professional Elective 3	PE	3	3	0	0	3
5	-	Open Elective 2	OE	3	3	0	0	3
<b>PRACTICALS</b>								
6	JPT1002	Technical Skills and Aptitude II	EEC	2	0	0	2	1
7	JBM1611	Diagnostic and Therapeutic Equipment Laboratory	PC	4	0	0	4	2
8	JEC1511	Discrete Time Signal Processing Laboratory	PC	4	0	0	4	2
9	JBM1641	Internship	EEC	0	0	0	2**	1
<b>TOTAL</b>				<b>25</b>	<b>15</b>	<b>0</b>	<b>12</b>	<b>21</b>

\*Internship of two weeks may be undertaken in Industry through semesters 4, 5, 6 leading to award of 1 credit in Semester VI

### SEMESTER - VII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JBM1701	Digital Image Processing	PC	3	3	0	0	3
2	-	Professional Elective 4	PE	3	3	0	0	3
3	-	Professional Elective 5	PE	3	3	0	0	3
4	-	Open Elective 3	OE	3	3	0	0	3
5	-	Open Elective 4	OE	3	3	0	0	3
<b>PRACTICALS</b>								
6	JBA1711	Entrepreneurship for Engineers	EEC	2	0	0	2	1
7	JBM1711	Digital Image Processing Laboratory	PC	4	0	0	4	2
8	JBM1712	Hospital Training	PC	2	0	0	2	1
9	JBM1731	Project Work –Phase 1	EEC	6	0	0	6	3
<b>TOTAL</b>				<b>30</b>	<b>15</b>	<b>0</b>	<b>14</b>	<b>22</b>

### SEMESTER - VIII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JNC1861	Indian Constitution	NCM	3	3	0	0	0
<b>PRACTICALS</b>								
2	JBM1811	Comprehension and Technical Seminar	EEC	2	0	0	2	1
3	JBM1832	Project Work - Phase 2	EEC	18	0	0	18	9
<b>TOTAL</b>				<b>25</b>	<b>3</b>	<b>0</b>	<b>23</b>	<b>10</b>

## OPEN ELECTIVES TO BE OFFERED BY OTHER DEPARTMENTS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>IV SEM</b>								
1	JBM9001	Human Biology for Engineers	OE	3	3	0	0	3
2	JBM9002	Introduction to Medical Instrumentation	OE	3	3	0	0	3
3	JBM9003	Introduction to Biosensors and its Applications	OE	3	3	0	0	3
<b>V SEM</b>								
4	JBM9004	Biomedical Equipment	OE	3	3	0	0	3
5	JBM9005	Hospital Planning and Management	OE	3	3	0	0	3
6	JBM9006	Introduction to Biometric Systems	OE	3	3	0	0	3
<b>VI SEM</b>								
7	JBM9007	Basics of Image Processing	OE	3	3	0	0	3
8	JBM9008	Computers in medicine	OE	3	3	0	0	3
9	JBM9009	Nano technology in Medicine	OE	3	3	0	0	3
<b>VII SEM</b>								
10	JBM9010	Telemedicine and its application	OE	3	3	0	0	3
11	JBM9011	Material Science for Bioimplants	OE	3	3	0	0	3
12	JBM9012	Human Assistive Technology	OE	3	3	0	0	3

### HUMANITIES AND SOCIAL SCIENCES (HS)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JHS1121	Communicative English and Soft Skills I	HS	4	2	0	2	3
2	JHS1221	Technical English and Soft Skills II	HS	4	2	0	2	3
3	JHS1511	Professional Communication	HS	2	0	0	2	1

### BASIC SCIENCES (BS)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JMA1101	Matrices and Calculus	BS	4	2	2	0	3
2	JPH1101	Engineering Physics	BS	3	3	0	0	3
3	JCY1101	Engineering Chemistry	BS	3	3	0	0	3
4	JPC1111	Physics and Chemistry Laboratory	BS	2	0	0	2	1
5	JMA1201	Vector Calculus and Complex Analysis	BS	4	2	2	0	3
6	JBE1221	Applied Science for Biomedical Engineering	BS	4	2	0	2	3
7	JMA1301	Transforms and Linear Algebra	BS	4	2	2	0	3
8	JMA1401	Applied Probability and Numerical Methods	BS	4	2	2	0	3

## ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JGE1101	Engineering Basics	ES	3	3	0	0	3
2	JGE1102	Programming in C	ES	3	3	0	0	3
3	JGE1112	Programming in C Laboratory	ES	4	0	0	4	2
4	JGE1111	Design Appreciation Laboratory	ES	4	0	0	4	2
5	JGE1203	Electric Circuits and Electronic Devices	ES	4	2	2	0	3
6	JGE1201	Python Programming	ES	3	3	0	0	3
7	JGE1202	Engineering Graphics and Design	ES	5	1	0	4	3
8	JGE1211	Python Programming Laboratory	ES	4	0	0	4	2
9	JGE1213	Electric Circuits and Electronic Devices Laboratory	ES	4	0	0	4	2
10	JBM1401	Analog and Digital Integrated Circuits	ES	3	3	0	0	3
11	JBM1411	Analog and Digital Integrated Circuits Laboratory	ES	4	0	0	4	2
12	JEE1501	Micro processors and Micro controllers	ES	4	2	0	2	3
13	JBM1511	Programming Tools for Biomedical Engineers	ES	2	0	0	2	1

### PROFESSIONAL CORE (PC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JBM1301	Electronic Circuits for Biomedical Engineers	PC	3	3	0	0	3
2	JBM1302	Human Anatomy and Physiology	PC	3	3	0	0	3
3	JBM1303	Clinical Biochemistry	PC	3	3	0	0	3
4	JBM1304	Bio Sensors and Measurements	PC	3	3	0	0	3
5	JBM1305	Biomaterials for Medical Implants	PC	3	3	0	0	3
6	JBM1311	Electronic Circuits Laboratory	PC	4	0	0	4	2
7	JBM1312	Human Physiology & Biochemistry Laboratory	PC	4	0	0	4	2
8	JBM1402	Pathology and Microbiology	PC	3	3	0	0	3
9	JBM1403	Biomedical Instrumentation	PC	3	3	0	0	3
10	JBM1404	Bio Control systems	PC	3	3	0	0	3
11	JBM1412	Pathology and Microbiology Laboratory	PC	4	0	0	4	2
12	JBM1413	Biomedical Instrumentation Laboratory	PC	4	0	0	4	2
13	JEC1304	Signals and Systems	PC	4	2	2	0	3
14	JBM1501	Radiological Equipment	PC	3	3	0	0	3
15	JBM1601	Diagnostic and Therapeutic Equipment	PC	3	3	0	0	3
16	JEC1501	Discrete Time Signal Processing	PC	4	2	2	0	3
17	JBM1611	Diagnostic and Therapeutic Equipment Laboratory	PC	4	0	0	4	2
18	JEC1511	Discrete Time Signal Processing Laboratory	PC	4	0	0	4	2
19	JBM1701	Digital Image Processing	PC	3	3	0	0	3
20	JBM1711	Digital Image Processing Laboratory	PC	4	0	0	4	2
21	JBM1751	Hospital Training	PC	2	0	0	2	1



## EMPLOYMENT ENHANCEMENT COURSES (EEC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JPT1001	Soft Skills and Aptitude I	EEC	2	0	0	2	*
2	JPT1001	Soft Skills and Aptitude II	EEC	2	0	0	2	1
3	JPT1002	Technical Skills and Aptitude I	EEC	2	0	0	2	*
4	JPT1002	Technical Skills and Aptitude II	EEC	2	0	0	2	1
5	JBM1521	Mini Project	EEC	2	0	0	2	1
6	JBM1641	Internship	EEC	0	0	0	2**	1
7	JBA1711	Entrepreneurship for Engineers	EEC	2	0	0	2	1
8	JBM1731	Project Work -Phase1	EEC	6	0	0	6	3
9	JBM1851	Comprehension and Technical Seminar	EEC	2	0	0	2	1
10	JBM1841	Project Work - Phase 2	EEC	18	0	0	18	9

## NON CREDIT MANDATORY COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1	JNC1261	Environmental Science	NCM	3	3	0	0	0
2	JNC1361	Essence of Indian Traditional Knowledge	NCM	2	2	0	0	0
3	-	Indian Constitution	NCM	3	3	0	0	0



## SEMESTER I

<b>JHS1121</b>	<b>COMMUNICATIVE ENGLISH &amp; SOFT SKILLS I</b> (Common to all B.E /B.Tech Programmes)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To enable the students of Engineering and Technology to develop their listening skill by learning the key techniques for comprehending information
- To facilitate the learners to speak effectively while exchanging ideas in academic and social domains
- To develop their skills in reading and understanding texts through practice
- To expose them to the correct usage of language to develop their writing skill
- To train the students to use appropriate vocabulary in academic and technical writings

### **UNIT I BASIC GRAMMAR I AND READING FOR INFORMATION 9**

Parts of speech - Sentence patterns – Tenses - Wh- questions - Yes/no questions - Countable and Uncountable nouns - Affixation – word formation; Reading short comprehension passages - practice in skimming and scanning for specific information and note-making, Critical reading - finding key information in a given text - shifting facts from opinions and paraphrasing

#### **SOFT SKILLS LAB 3**

Listening to documentaries, inspiring speeches of great leaders, news bulletins, Ted talks, telephonic conversations

### **UNIT II BASIC GRAMMAR I AND SHARING INFORMATION 9**

Pronouns - Adjectives - Adverbs - Imperatives - Direct and indirect questions - Compound words - Guessing meaning of words in contexts – one word substitutes; Autobiographical writing (writing about one's leisure time activities, hometown, favourite place and school life) – Biographical writing (place, people), Letter writing (informal letters)

#### **SOFT SKILLS LAB 3**

Self-introduction, peer introduction, picture description, JAM

### **UNIT III BASIC GRAMMAR III AND FREEWRITING I 9**

Conjunctions – Prepositions - Articles - Degrees of comparison – Discourse markers - Reference words; Process description, Coherence and cohesion in writing cause and effect / compare & contrast narrative / analytical paragraphs

#### **SOFT SKILLS LAB 9**

Language functions: Giving reasons, talking about future plans, comparing and contrasting, making suggestions

### **UNIT IV BASIC GRAMMAR IV AND LANGUAGE DEVELOPMENT 9**

Subject-verb agreement - Modal verbs - Phrasal verbs - Single word substitutes - Use of abbreviations & acronyms - Cloze reading - Interpreting visual material, Jumbled sentences

#### **SOFT SKILLS LAB 3**

Interpersonal Skills: role play, group discussion, debate, conduct of meeting

### **UNIT V BASIC GRAMMAR V AND FREE WRITING II 9**

Clause - Direct and indirect speech – Correction of errors - Word association (connotations) - Lexical items (fixed / semi fixed expressions) - Essay writing – different types of essays, dialogues writing

## **SOFT SKILLS LAB**

**3**

Creative writing and speaking skills: Poster making and description, project proposals

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Listen to different talks and lectures and understand them easily
- Communicate their thoughts confidently using communicative strategies
- Read and grasp different genres of texts effortlessly
- Write grammatically correct academic, business and technical texts
- Apply the language skills efficiently in all forms of communication

### **TEXT BOOKS:**

1. Board of Editors, Department of English, Anna University, Chennai. Using English: A Course Book for Undergraduate Engineers and Technologists, Orient Black Swan: Chennai, 2017.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.

### **REFERENCE BOOKS:**

1. Raman, Meenakshi & Sangeetha Sharma, Technical Communication: English Skills for Engineers. Oxford University Press, New Delhi, 2011.
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi, 2006
3. Rizvi M, Ashraf. Effective Technical Communication. Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
4. Rutherford, Andrea J. Basic Communication Skills for Technology. Pearson Edition (II Edition), New Delhi, 2001.

### **REFERENCE BOOKS FOR SOFT SKILLS LAB – I:**

1. Mandel, Steve. Effective Presentation Skills. New Delhi: Viva Books Pvt. Ltd., 2004.
2. Kilmet, Stephen. "The Resume and "The Computerized Resume." I Writing for Design Professionals.
3. Writing Cover Letters-Kilmet, Stephen. "Cover Letter," and "Enclosures and Attachments." In Writing for Design Professionals. New York
4. Writing a Proposal "Standard Proposal for Funding." in Writing in the Disciplines. Fort

### **WEBSITE REFERENCES:**

1. <https://www.perfect-english-grammar.com>
2. <https://edu.gcfglobal.org/en/grammar>
3. <https://www.talkenglish.com/grammar/grammar.aspx>
4. <https://learnenglish.britishcouncil.org/skills>
5. <https://www.myenglishlanguage.com>

### **EXTENSIVE READING:**

1. Kalam, Abdul. The Wings of Fire, Universities Press, Hyderabad. 1999

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	-	2
CO2	-	-	-	-	-	-	-	1	2	3	-	2
CO3	-	-	-	-	-	-	-	1	2	3	-	2
CO4	-	-	-	-	-	-	-	1	2	3	-	2
CO5	-	-	-	-	-	-	-	1	2	3	-	2

JMA1101	MATRICES AND CALCULUS (Common to all B.E /B.Tech Programmes)	L	T	P	C
		2	2	0	3

## COURSE OBJECTIVES:

- To equip students with the knowledge of matrices required for applications in engineering.
- To enable students to understand the concepts of multivariable functions and its calculus.
- To familiarize students on concepts of differential calculus and its applications.
- To introduce concepts of integral calculus as tools required for applications in engineering.
- To introduce ordinary differential equations which is widely used in problem solving and engineering applications.

### UNIT I MATRICES

12

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices by similarity and orthogonal transformations – Reduction of a quadratic form to canonical form- Nature of quadratic forms.

### UNIT II FUNCTIONS OF SEVERAL VARIABLES

12

Partial differentiation – Total derivative – Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

### UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS

12

Curvature and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

### UNIT IV APPLICATIONS OF INTEGRAL CALCULUS

12

Multiple integrals: Double integrals – Change of order of integration – Change of variables – Area enclosed by plane curves – Triple integrals – Volume of solids.

Improper integrals: Beta and Gamma Integrals – Definitions and properties – Simple problems.

### UNIT V ORDINARY DIFFERENTIAL EQUATIONS

12

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Method of undetermined coefficients - Homogeneous equation of Euler's and Legendre's type – System of simultaneous first order linear differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

## COURSE OUTCOMES:

**At the end of the course, students will be able**

- To understand applications of matrix theory in quadratic forms
- To use calculus for problems and applications dealing with functions of several variables

- To apply differential calculus in practical problem solving in the area of geometry
- To gain insight on the applications of multiple integrals in area and volume problems
- To solve ordinary differential equations that occur in many physical and engineering applications

### TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. P.Anuradha and V.Sudhakar, "Matrices and Calculus", Scitech Publications, 1st Edition, Chennai, 2019.

### REFERENCES

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
4. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

### WEBSITE REFERENCES:

1. <https://nptel.ac.in/courses/111/108/111108157/>
2. <https://nptel.ac.in/courses/111/107/111107108/>
3. <https://nptel.ac.in/courses/111/104/111104144/>
4. <https://nptel.ac.in/courses/111/105/111105122/>
5. <https://nptel.ac.in/courses/111/107/111107111/>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2

<b>JPH1101</b>	<b>ENGINEERING PHYSICS (Common to all B.E /B.Tech Programmes)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVES:

- To enable the students to understand the basics of the latest advancements in Physics
- To introduce the principles of quantum mechanics
- To impart knowledge of laser and fiber optic communication

## **UNIT I CRYSTAL PHYSICS 9**

Single crystal, Polycrystal and Amorphous materials – Single Crystals: Unit cell, Crystal systems, Bravais lattices, Directions and Planes in a crystal, Miller indices – Inter planar distances – Coordination number and Packing factor for SC, BCC, FCC, HCP and Diamond structures - Crystal imperfections: Point defects, Line defects – Burgers vector, Stacking faults

## **UNIT II PROPERTIES OF MATTER 9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic moduli and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - stress due to bending in beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment

## **UNIT III ULTRASONICS 9**

Production of ultrasound by Magnetostriction effect and Piezo electric effect Detection of ultrasonic wave – Properties of ultrasonic wave – Acoustic grating - Industrial applications – Drilling, Welding, Soldering and Cleaning – SONAR - Non Destructive Testing – Pulse echo system through Transmission and Reflection modes- A, B and C–scan displays.

## **UNIT IV PHOTONICS AND FIBRE OPTICS 9**

Spontaneous and stimulated emission-Population inversion -Einstein's A and B coefficients derivation – Laser Principle - Semiconductor lasers (homojunction & hetero junction)- Optical Fiber: types (material, refractive index, mode) - Propagation of light in optical fibers – Numerical aperture and Acceptance angle –attenuation, dispersion, bending -Fiber Optical Communication system (Block diagram) -Active and passive fiber sensors-Endoscope.

## **UNIT V QUANTUM PHYSICS 9**

Black body radiation –Planck's theory (derivation) –Deduction of Wien's displacement law and Rayleigh –Jeans' Law from Planck's theory –Compton effect-theory –Properties of Matter waves – G.P Thomson experiment -Schrödinger's wave equation –Time independent and time dependent equations –Physical significance of wave function –Particle in a one dimensional box -Scanning electron microscope -Transmission electron microscope

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

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

- To enhance knowledge on properties of matter
- To assess the properties of ultrasonics and imaging devices
- To understand and to compute problems in Quantum Physics.
- To learn the use of modern optical fiber communication systems and tools in real life applications.
- To gain more insight on the functioning of optical materials for optoelectronics.

### **TEXT BOOKS:**

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
4. Dr. Beula Shanthi John, Dr. P. Mani, "Engineering Physics", Dhanam Publications, First Edition, 2019.

## REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics".
4. W.H. Freeman, 2007
5. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
6. Arumugam M, "Materials Science", Anuradha Publications, 2015.
7. William F Smith, "Material Science and Engineering", Tata McGraw - Hill Publications, 2008.
8. John D. Cutnell, "Cutnell and Johnson Physics", Wiley Publications, 2018.

## WEB SITE REFERENCES:

1. <https://nptel.ac.in/courses/115/104/115104109/>
2. <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ce18/>
3. [https://onlinecourses.nptel.ac.in/noc21\\_bt50/preview](https://onlinecourses.nptel.ac.in/noc21_bt50/preview)
4. <https://nptel.ac.in/courses/115/104/115104096/>
5. <https://nptel.ac.in/courses/108/104/108104113/>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	1	-	-	1	-	1	-
CO2	2	1	1	-	-	1	-	-	1	-	1	-
CO3	2	1	1	-	-	1	-	-	1	-	1	-
CO4	2	1	1	-	-	1	-	-	1	-	1	-
CO5	2	1	1	-	-	1	-	-	1	-	1	-

JCY1101	ENGINEERING CHEMISTRY (Common to all B.E /B.Tech Programmes)	L	T	P	C
		3	0	0	3

## COURSE OBJECTIVE

- To acquaint the student with concepts of photochemistry and analytical techniques.
- To make the students conversant with boiler feed water and water treatment techniques.
- To make the students acquire sound knowledge in corrosion of materials.
- To understand polymer chemistry and the principle of energy in batteries.
- To impart knowledge on the basics of nano materials and engineering materials.

## UNIT I: PHOTOCHEMISTRY AND ANALYTICAL TECHNIQUES 9

Photochemistry- Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (problems). Photo processes - Internal Conversion, Inter-system crossing, Fluorescence and its applications in medicine - Phosphorescence-Chemiluminescence and Photo-sensitization Analytical Techniques - UV-visible spectroscopy - principles - instrumentation (block diagram only) - Colorimetry- Principle-Instrumentation, estimation of iron by colorimetry - Flame photometry - principle - Instrumentation - estimation of sodium by Flame photometry.



## **UNIT II WATER TECHNOLOGY**

**9**

Hardness-Units of Hardness- Temporary hardness-Permanent hardness- Estimation hardness by EDTA method- Alkalinity – Types- water quality parameters (pH, EC, TDS, DO, BOD, COD) – Boiler feed water-requirements- boiler troubles (scale and sludge- caustic embrittlement-boiler corrosion-priming and foaming) - softening of hard water -external treatment (zeolite and demineralization) - internal treatment (phosphate, calgon, carbonate, colloidal) -- desalination of brackish water –reverseosmosis.

## **UNIT III ELECTRO CHEMISTRY AND CORROSION**

**9**

Electrochemistry- Electrochemistry- Electrochemical cell - redoxreaction, electrode potential-oxidation potential- reduction potential, measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems).

Corrosion- causes- types-chemical, electrochemical corrosion- galvanic corrosion-differential aeration corrosion (pitting, waterline, wire fence, pipeline, crevice, stress corrosion), Factors influencing the rate of corrosion- corrosion control - material selection and design aspects – cathodic protection methods (sacrificial anode and impressed current cathodic methods)- Electroplating of Copper and electroless plating of nickel-corrosion inhibitors (anodic and cathodic inhibitors).

## **UNIT IV POLYMER, COMPOSITES AND ENERGY STORAGE DEVICES**

**9**

*Introduction-* Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization.. Bio degradable polymer- Types- synthetic methods – applications of biodegradable polymers. Polymer composites and its application.

*Energy Storage Devices* - Batteries and fuel cells: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, nickel-cadmium battery, lithium-ion-battery). Fuel cell – H<sub>2</sub>-O<sub>2</sub> fuel cell- solid oxide fuel cell - polymer electrolyte membrane fuel cell (PEMFC) applications.

## **UNIT V ENGINEERING MATERIALS AND NANOCHEMISTRY**

**9**

Engineering Materials- Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnesite and zirconia bricks. cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and whitecement–properties and uses.

*Nanotechnology* – Introduction – distinction between molecules, nanoparticles and bulk materials; Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications.

**TOTAL: 45 PERIODS**

## **COURSE OUTCOMES**

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

- Understand laws of photochemistry and principles of instrumentation and their applications in various fields.
- To understand the basic principle of water treatment and techniques involved in the purification process for future learning.
- Apply electrochemical reactions on the process of corrosion and its prevention methods.
- Gain knowledge on biodegradable polymers and understand the principle of batteries for development of new energy resources.

- Gain knowledge on engineering materials and understand the unique behavior of nanomaterials.

### TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.
2. R.Gopalan, D.Venkapayya, Sulochna Nagarajan, Text book of Engineering Chemistry, Vikas publishing pvt ltd, 4th edition, 2013.
3. Dr.N.John Jebarathinam Dr.R.Vaidyanathan Ms.A.U.Ajisha Dr.A.Ravikrishnan, Engineering Chemistry, Sri Krishna Publications, First edition 2019.

### REFERENCES:

1. O.G.Palanna, Engineering Chemistry, Mc Graw Hill, 2017
2. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2013.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
5. B.R.Puri, L.R.Sharma, Madan S.Pathana, Principle of physical chemistry, 47<sup>th</sup> edition, Vishal publishing Co, 2017

### WEBSITE REFERENCES:

1. <https://nptel.ac.in/content/storage2/courses/103108100/module2/module2.pf>
2. <https://www.samcotech.com/what-is-a-boiler-feed-water-treatment-system-how-does-it-work/>
3. <https://nptel.ac.in/courses/113/101/113101098/>
4. <https://nptel.ac.in/courses/112/107/112107221/>
5. <https://nptel.ac.in/courses/113/106/113106093>

### CO-PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	-	-	-	1	1
CO2	1	1	1	1	1	1	1	-	1	1	1	-
CO3	1	1	1	1	1	1	1	-	1	1	1	-
CO4	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	-	1	1	1	1

<b>JGE1101</b>	<b>ENGINEERING BASICS (Common to all B.E /B.Tech Programmes)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### COURSE OBJECTIVES

- To impart knowledge on the basics of Civil Engineering to the students.
- To impart knowledge on the basics of Mechanical Engineering to the students.

- To impart knowledge on the electric circuits and working principles of Electrical Machines.
- To impart knowledge on the Principles and characteristics of various electro devices.
- To impart knowledge on the basics of various measuring instruments.

## **UNIT I BASICS OF CIVIL ENGINEERING 11**

Introduction to Civil Engineering, Types of buildings, Components of a residential building, Building Materials, Types of slabs, beam, column, lintel, floor and foundation - Types of roofs. Surveying and Levelling - Linear and Angular Measurements - Introduction to transport system, role of transportation in society - Green Highway. Sources of water, Hydrological cycle, Irrigation Engineering, Rain water harvesting, Environmental pollution, Greenhouse gas emission, Ozone depletion, Global warming - Green building concepts.

## **UNIT II BASICS OF MECHANICAL ENGINEERING 11**

Introduction to the concepts of Mechanization and Automation, Robotics - Manufacturing methods - casting, machining, forming operations, Introduction to IC Engine - Working principles of four stroke petrol and diesel engines, Types of power plants - Hydel power plant and thermal power plant, Steam generators - Fire tube boiler and water tube boiler, Thermal systems - Heat exchangers, Radiator and oil cooler, Design of ingenious mechanisms - Parts feeding mechanism.

## **UNIT III ELECTRIC CIRCUITS AND ELECTRICAL MACHINES 7**

Basic circuit components - Ohms Law - Kirchoff's Law-Introduction to AC circuits - waveforms and RMS value - Power and power factor - Principles of operation and characteristics of DC machines - Transformers - Three phase and single - Phase induction motors.

## **UNIT IV ELECTRONIC DEVICES & CIRCUITS 7**

Types of Materials - Silicon & Germanium - N type and P type materials - Construction and Characteristics: PN Junction diode - Zener Diode - Bipolar Junction Transistor - Field effect Transistors - IGBT - Introduction to operational amplifier - Inverting Amplifier - Non-inverting Amplifier.

## **UNIT V MEASUREMENTS & INSTRUMENTATION 9**

Elements of generalized measurement system - Basic terminologies: Accuracy, precision, resolution, sensitivity, linearity, span and range - Errors in measurement - Standards of measurement - calibration - Operating forces: Deflection force, controlling force, damping force - Classification of instruments.

**TOTAL: 45 PERIODS**

## **COURSE OUTCOMES**

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

- Gain knowledge on the various fields of Civil Engineering.
- Know the fundamentals of Mechanical Engineering.
- Understand the basic concepts of electric circuits and working principles of electrical machines.
- Gain knowledge on the basics of electronics and apply them in practical situations.
- Choose appropriate instruments for electrical measurement for a specific application.

## TEXTBOOKS

1. Shanmugam G and Palanichamy MS, “ Basic Civil and Mechanical Engineering”, Tata McGraw Hill publishing Co.,2016
2. D P Kothari and I.J Nagarath, Electrical Machines - Basic Electrical and Electronics Engineering,McGrawHillEducation (India) PrivateLimited,Third Reprint,2016.

## REFERENCES:

1. Thereja .B.L., Fundamentals of Electrical Engineering and Electronics , S. Chand & Co. Ltd.,2008.
2. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi,2010.
3. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010.

## WEBSITE REFERENCES:

1. <https://www.eit.edu.au/>
2. <https://nptel.ac.in/courses/105/102/105102088/>
3. <https://nptel.ac.in/courses/108/105/108105155/>
4. <https://nptel.ac.in/courses/117/103/117103063/>
5. <https://nptel.ac.in/courses/108/105/108105153/>

## CO-PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	-	-
CO2	1	1	1	1	1	-	-	-	-	-	-	-
CO3	1	1	1	1	1	-	-	-	-	-	-	-
CO4	1	1	1	1	1	-	-	-	-	-	-	-
CO5	1	1	1	1	1	-	-	-	-	-	-	-

<b>JGE1102</b>	<b>PROGRAMMING IN C</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## COURSE OBJECTIVES

- To learn Fundamentals of computing
- To be able to use file operations in C
- To implement programs using basic features of C
- To learn to use C pointers and dynamically allocated memory techniques
- To learn advanced features of the C programming language

## UNIT I INTRODUCTION TO PROBLEM SOLVING

9

Simple model of a Computer – Hardware – Software – Data Representation, Problem Solving Techniques – Bottom up design and top down design - applications, Introduction to Algorithms and Flow Chart - Notion of memory, addresses, variables, instructions, execution of instruction- Operating system commands, file editing, compiling, linking, executing a program.

## **UNIT II C PROGRAMMING**

**9**

Introduction to 'C' programming – structure of a 'C' program – compilation and linking processes. Conversion of simple algorithm to program-Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problem

## **UNIT III ARRAYS AND STRINGS**

**9**

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - String- String operations –Arrays of strings.

## **UNIT IV FUNCTIONS AND USER DEFINED DATA TYPES**

**9**

Function – definition of function – Declaration of function – Pass by value - Pass by reference– Command Line Argument in C-- Recursion - Enumerators - Structures - Unions.

## **UNIT V POINTERS AND FILES**

**9**

Macros - storage classes - Pointers- Definition – Initialization – Pointers arithmetic – Double Pointers, Basic file operations-Example problems.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Design and represent solutions to problems as algorithm and flow chart
- Write simple C Programs using loops and conditional statements
- Write simple C Programs using arrays
- Write simple C Programs using function
- Write simple C codes using pointers, structures and union

### **TEXT BOOKS:**

1. Pradip Dey, ManasGhosh, "Programming in C", First Edition, Oxford University Press, 2018
2. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, McGraw-Hill,2010.
3. Brian W. Kernighan and Rob Pike, "The Practice of Programming" (Chap 1), Pearson Education, 2008.

### **REFERENCES:**

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education,2015.
2. Yashavant P. Kanetkar. "Let Us C", BPB Publications,2011.
3. Paul J Deitel,Dr.Harvey M.Deitel,"C How to Program", Seventh Edition, Pearson Education,2016.
4. E. Balagurusamy, "Computing Fundamentals and C Programming", McGraw-Hill Publishing Company Limited,(2008).

### **WEBSITE REFERENCES:**

1. <https://www.javatpoint.com/computer-fundamentals-tutorial>
2. <https://www.geeksforgeeks.org/basics-file-handling-c/>
3. <https://www.studytonight.com/c/string-and-character-array.php>
4. [https://www.tutorialspoint.com/cprogramming/c\\_functions.htm](https://www.tutorialspoint.com/cprogramming/c_functions.htm)
5. <https://www.guru99.com/c-pointers.html>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	3	3	3	-	3
CO2	3	3	3	-	-	-	-	3	3	3	-	3
CO3	3	3	3	-	-	-	-	3	3	3	-	3
CO4	3	3	3	-	-	-	-	3	3	3	-	3
CO5	3	3	3	-	-	-	-	3	3	3	-	3

JPC1111	<b>PHYSICS AND CHEMISTRY LABORATORY</b> (Common to all B.E /B.Tech Programmes)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

## COURSE OBJECTIVES:

- To be exposed to the syntax of C
- To be familiar with programming in C
- To learn to use arrays, strings, functions, pointers, structures and unions in C.
- To Learn the fundamentals of File Programming in C
- To solve simple problems using C

## LIST OF EXPERIMENTS:

### PHYSICS

1. Determination of Young's modulus for the given uniform bar by uniform bending method
2. Determination of wavelength of the diode laser and hence determine the size of the coated powder particle
3. Determination of velocity of Ultrasound using Ultrasonic interferometer and also find the compressibility of the given liquid
4. Determination of moment of inertia of the given circular disc and rigidity modulus of the metal wire using torsional pendulum
5. Determination of Planck' constant using different colorfilters
6. Determination of Wavelength of spectral lines in mercury spectrum using spectrometer
7. Analysis of I-V Characterization of Solarcell

**TOTAL: 15 PERIODS**

## LIST OF EXPERIMENTS

### CHEMISTRY

1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper in brass by Iodometry.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

**TOTAL:15 PERIODS**

## COURSE OUTCOMES:

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

1. Acquire experience in analyzing the elastic materials.
2. Understand the acoustic properties of various liquids.
3. Acquire knowledge in optical properties of solids.
4. Make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
5. Acquaint the students with the determination of molecular weight of a polymer by viscometry

## WEBSITE REFERENCES:

1. <http://www.digimat.in/nptel/courses/video/105107176/L31.html>
2. [https://www.canterbury.ac.nz/media/documents/science-outreach/chloride\\_mohr.pdf](https://www.canterbury.ac.nz/media/documents/science-outreach/chloride_mohr.pdf)
3. <http://www.mgcub.ac.in/pdf/material/20200428101433e562a8b8e8.pdf>
4. <http://depthome.brooklyn.cuny.edu/physics/lab/phy2/newlabs/Diffraction-grating-ver-2.pdf>
5. [http://web.physics.ucsb.edu/~phys128/experiments/interferometry/measuring\\_wavelength.pdf](http://web.physics.ucsb.edu/~phys128/experiments/interferometry/measuring_wavelength.pdf)

## REFERENCES:

1. Practical Fiber Optics, D. Bailey and E. Wright, 2003
2. J. Mendham, RC Denney, JD Barnes, MJK Thomas, Text book of quantitative chemical analysis, Vogel's, 2008

## CO-PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	1	1	-	-	1	-	1	1
CO2	2	1	1	-	1	1	-	-	1	-	1	1
CO3	2	1	1	-	1	1	-	-	1	-	1	1
CO4	2	1	1	-	1	1	-	-	1	-	1	1
CO5	2	1	1	-	1	1	-	-	1	-	1	1

JGE1112	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	4	2

## COURSE OBJECTIVES:

- To be exposed to the syntax of C
- To be familiar with programming in C
- To learn to use arrays, strings, functions, pointers, structures and unions in C.
- To Learn the fundamentals of File Programming in C
- To solve simple problems using C

## LIST OF PROGRAMS

1. Usage of Basic Linux commands
2. C Programming using Simple statements and expressions
3. Scientific problem solving using decision making and looping.

4. Simple programming for one dimensional and two dimensional arrays.
5. Solving problems using Strings
6. C Programming using Pointers
7. C Programming using user defined functions (Pass by value and Pass by reference)
8. C Programming using Recursion
9. C Programming using structures and union
10. C Programming using enumerated data types
11. C Programming using macros and storage classes
12. C Programming using Files

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES:**

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

- Write simple C Programs
- Able to solve scientific problems using C
- Gain knowledge on the use of functions and arrays
- Use structures, pointers and files in C Programs
- Develop modularized applications in C

**TEXT BOOKS:**

1. PradipDey, ManasGhosh, “Programming in C - As per the latest AICTE syllabus”, First Edition, Oxford University Press,2018
2. Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Third Edition, McGraw-Hill,2010

**WEBSITE REFERENCES:**

1. <https://www.javatpoint.com/first-c-program>
2. <https://www.w3resource.com/c-programming-exercises/>
3. <https://www.javatpoint.com/functions-in-c>
4. <https://www.programiz.com/c-programming/c-structures-pointers>
5. <https://www.sitesbay.com/cprogramming/c-applications>

**CO-PO MAPPING:**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	2	2	2	-	2
CO2	2	2	2	2	-	-	-	2	2	2	-	2
CO3	2	2	2	2	-	-	-	2	2	2	-	2
CO4	2	2	2	2	-	-	-	2	2	2	-	2
CO5	2	2	2	2	-	-	-	2	2	2	-	2

<b>JGE1111</b>	<b>DESIGN APPRECIATION LABORATORY (Common to all B.E /B.Tech Programmes)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVES**



- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To kindle own creativity, ideation and realize the importance of team working.
- To gain knowledge through experience in handling of engineering aggregates.
- To appreciate the use of various mechanisms involved in engineering products.
- To understand the interactions between its subsystems and their functionality.

## **GROUP A (CIVIL & MECHANICAL)**

### **I CIVIL ENGINEERING PRACTICE**

**13**

#### **Buildings:**

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

#### **PLUMBING WORKS:**

- Study of pipeline joints, its location and functions: valves, taps,
- couplings, unions, reducers, elbows in house hold fittings.
- Study of pipe connections requirements for pumps and turbines.
- Preparation of plumbing line sketches for water supply and sewage works.
- Hands-on-exercise: Basic pipe connections - Mixed pipe material
- connection Pipe connections with different joining components.
- Demonstration of plumbing requirements of high-rise buildings.

#### **CARPENTRY USING POWER TOOLS ONLY:**

- Study of the joints in roofs, doors, windows and furniture.
- Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

## **I MECHANICAL ENGINEERING PRACTICE**

**18**

#### **Welding:**

- Preparation of butt joints, lap joints and T- joints by Shielded metal
- arc welding.
- Gas welding practice

#### **Basic Machining:**

- Simple Turning and Taper turning
- Drilling Practice

#### **Sheet Metal Work:**

- Forming & Bending:
- Model making - Trays and funnels.
- Different type of joints.

#### **Machine Assembly Practice:**

- Study of centrifugal pump
- Study of air conditioner

#### **Demonstration on:**

- Smithy operations, upsetting, swaging, setting down and bending.
- Example – Exercise - Production of hexagonal headed bolt.
- Foundry operations like mould preparation for gear and step cone pulley.
- Fitting - Exercises - Preparation of square fitting and V – fitting models.

## **GROUP B (ELECTRICAL & ELECTRONICS)**

### **I ELECTRICAL ENGINEERING PRACTICE**

**13**

- Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- Fluorescent lamp wiring.

- c) Stair case wiring
- d) Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.
- e) Measurement of energy using single phase energy meter.
- f) Measurement of resistance to earth of electrical equipment.

## **II ELECTRONICS ENGINEERING PRACTICE**

**16**

- a) Study of Electronic components and equipments - Resistor, colour coding
- b) measurement of AC signal parameter (peak-peak, rms period, frequency)
- c) using CR.
- d) Study of logic gates AND, OR, EX - OR and NOT.
- e) Generation of Clock Signal.
- f) Soldering practice - Components Devices and Circuits - Using general purpose PCB.
- g) Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Fabricate carpentry components and pipe connections including plumbing works.
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings.
- Carry out basic home electrical works and appliances.
- Measure the electrical quantities.
- Elaborate on the components, gates, soldering practices.

### **LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

#### **CIVIL**

1. Assorted components for plumbing consisting of metallic pipes,
2. plastic pipes, flexible pipes, couplings, unions, elbows, plugs and
  - a. other fittings. 15 Sets
3. Carpentry vice (fitted to work bench) 15 Nos
4. Standard woodworking tools 15Sets
5. Models of industrial trusses, door joints, furniture joints 5 each
6. Power Tools:
  - i. Rotary Hammer 2 Nos
  - ii. Demolition Hammer 2 Nos
  - iii. Circular Saw 2 Nos
  - iv. Planer 2 Nos
  - v. Hand Drilling Machine 2Nos
  - vi. Jigsaw 2Nos

#### **MECHANICAL**

1. Arc welding transformer with cables and holders 5Nos
2. Welding booth with exhaust facility 5Nos
3. Welding accessories like welding shield, chipping hammer, wire Brushetc. 5Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2Nos

5. Centre lathe 2 Nos
6. Hearth furnace, anvil and smithy tools 2Sets
7. Moulding table, foundry tools 2Sets
8. Power Tool: Angle Grinder 2Nos
9. Study-purpose items: centrifugal pump, air-conditioner 1each

## **ELECTRICAL**

1. Assorted electrical components for house wiring 15Sets
2. Electrical measuring instruments 10Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1each
4. Megger (250V/500V) 1No
5. Power Tools:
  - a) Range Finder 2Nos
  - b) Digital Live-wire detector 2 Nos

## **ELECTRONICS**

1. Soldering guns 10Nos
2. Assorted electronic components for making circuits 50Nos
3. Small PCBs 10Nos
4. Multimeters 10Nos
5. Study purpose items: Telephone, FM radio, low-voltage powersupply

## **WEB SITE REFERENCES:**

1. [www.vikaspublishing.com/engineering-practices-lab](http://www.vikaspublishing.com/engineering-practices-lab)
2. <https://archive.org/mechanicalengineeringworkshoplaboratory>

## **CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	-	1	-	1	1
CO2	1	1	1	1	1	1	1	-	1	1	1	-
CO3	1	1	1	1	1	1	1	1	1	1	1	-
CO4	1	1	1	1	1	1	1	-	1	1	1	1
CO5	1	1	1	1	1	1	1	-	1	1	1	1



## **UNIT V TECHNICAL WRITING AND REPORT WRITING 9**

Degrees of comparison, editing, Email etiquette, Misspelled words -- Report writing: survey, feasibility, industrial visit, reporting various incidents and accidents, Minutes of meeting

## **SOFT SKILLS LAB 3**

Starting a Career – vision statement, preparing logo and tagline, making short term and long term goals, setting plans

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Read and understand general and technical texts
- Apply creative and critical thinking and communicate their ideas efficiently
- Participate in group discussions and deliver short speeches effectively
- Write effectively and persuasively in academic and workplace contexts
- Face the future challenges confidently and successfully

### **TEXTBOOKS:**

1. Department of English, Anna University, Chennai. Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.
3. Rizvi, M. Ashraf, “Effective Technical Communication”, Tata McGraw – Hill, 2006.

### **REFERENCE BOOKS:**

1. Ibbotson, Mark, “Cambridge English for Engineering”, Cambridge University Reference Press, 2008
2. English, Laura M & Sarah Lynn, “Business Across Cultures: Effective Communication Strategies”, Addison Wesley, 1995.
3. Richard Johnson-Sheehan, “Technical Communication Today” 4th Edition Books Longman Publishing Group, 2011.
4. Porter, Patricia A., and Margaret Grant, “Communicating Effectively in English: Oral Communication for Non-Native Speakers”, 2nd Edition, Wadsworth, 1992.
5. Gopaldaswamy, Ramesh & Ramesh Mahadevan. ACE of Soft Skills: Attitude, Communication and Etiquette for Success, New Delhi: Pearson, 2010.

### **WEBSITE REFERENCES:**

1. <https://learnenglish.britishcouncil.org/business-english>
2. <https://www.thebalancecareers.com>
3. <https://www.deakin.edu.au/students/studying/study-support/academic-skills/report-writing>
4. <https://www.englishclub.com>
5. <https://www.ielts.org>

### **EXTENSIVE READING:**

1. Wells, H.G. The Time Machine, Peacock, India,2008.

## CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	-	2
CO2	-	-	-	-	-	-	-	1	2	3	-	2
CO3	-	-	-	-	-	-	-	1	2	3	-	2
CO4	-	-	-	-	-	-	-	1	2	3	-	2
CO5	-	-	-	-	-	-	-	1	2	3	-	2

JMA1201	VECTOR CALCULUS AND COMPLEX ANALYSIS (Common to all B.E /B.Tech Programmes)	L	T	P	C
		2	2	0	3

## COURSE OBJECTIVES:

- To familiarize students with concepts of vector calculus and its applications.
- To help students understand theory of analytic functions and problem solving.
- To provide knowledge of complex integration, series expansions, residue theorem and its applications.
- To build concepts of Laplace transforms and its properties with problem solving.
- To enable students to use Laplace transforms and its inverse in solving differential equations.

## UNIT I VECTOR CALCULUS 12

Vector Differentiation: Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields Vector Integration: Line and surface integrals - Green's theorem – Gauss and Stoke's theorems – Verification and evaluation in simple problems.

## UNIT II ANALYTIC FUNCTIONS 12

Analytic functions – Zeros and Singularities - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (without proof) - Properties – Harmonic conjugates – Construction of analytic functions - Conformal mappings –  $w = z + i$ ,  $w = z^2$  Bilinear transformation  $\frac{w-i}{z}$ .

## UNIT III COMPLEX INTEGRATION 12

Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series - Types of Singularities and residues – Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals (Circular contour and semi-circular contour only).

## UNIT IV LAPLACE TRANSFORMS 12

Definition - Existence conditions – Transforms of elementary functions – Transforms of unit step function and unit impulse function – Properties with proof – Initial and final value theorems – Transform of periodic functions – Convolution theorem with proof – Problems.

## UNIT V INVERSE LAPLACE TRANSFORMS 12

Definition - Evaluation of Inverse Laplace transforms by using properties, partial fractions, residues

and convolution theorem - Applications to solution of linear second order ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, students will be able**

- To understand concepts of vector calculus and evaluate line and surface integrals
- To understand analyticity of complex valued functions, bilinear transformation and conformal mappings
- To evaluate complex integrals using Cauchy’s integral and Cauchy’s residue theorems
- To find Laplace transforms of functions using definition and properties
- To apply Laplace transform method in solving differential equations

**TEXT BOOKS:**

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. P.Anuradha and V.Sudhakar, "Vector Calculus and Complex Analysis" , Scitech Publications, 1<sup>st</sup> Edition, Chennai, 2019.

**REFERENCES:**

1. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O’Neil, P.V., “Advanced Engineering Mathematics”, Cengage Learning India Pvt Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**WEBSITE REFERENCES:**

1. <https://nptel.ac.in/courses/111/105/111105122/>
2. <https://nptel.ac.in/courses/111/106/111106141/>
3. <https://nptel.ac.in/courses/111/107/111107056/>
4. <https://nptel.ac.in/courses/111/106/111106139/>

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2

<b>JBE1221</b>	<b>APPLIED SCIENCE FOR BIOMEDICAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

## **COURSE OBJECTIVE**

- To understand the essential principles of conducting materials.
- To understand the essential principles of semiconducting materials.
- To understand the essential principles of new engineering materials.
- To Correlate Stereochemistry, conformation and reactivity. To know the importance of biomaterials.
- To understand about the principles in various analytical techniques.

### **UNIT I CONDUCTING MATERIALS**

**7**

Conductors –Classical Free Electron theory of metals–Electrical and thermal conductivity – Wiedemann –Franz law –Lorentz number –Draw backs of classical theory –Quantum theory –Fermi distribution function –Effect of temperature on Fermi Function –Density of energy states –Carrier concentration in metals.

### **UNIT II SEMI CONDUCTING MATERIALS**

**7**

Intrinsic semiconductor –Carrier concentration–Fermi level –Variation of Fermi level with temperature –Electrical conductivity –Band gap determination –Compound Semiconductors -Direct and Indirect band gap- Carrier concentration in N-type and P-type semiconductor –Variation of Fermi level with Temperature and Impurity concentration.

### **UNIT III ADVANCED ENGINEERING MATERIALS**

**7**

Metallic glasses: Preparation, Properties and Applications. Shape memory alloys (SMA): Characteristics, Properties of NiTi alloy, Application–Classification of Biomaterials and its applications

### **UNIT IV STEREO CHEMISTRY AND BIOMATERIALS**

**10**

Isomerism- structural isomerism, metamerism, tautomerism. Stereo isomerism (Geometrical and optical)–Diastereomers and -Enantiomers- Characteristics. E & Z and R & S system of nomenclature- sequence rules (illustration with simple examples). Molecular representation- Wedge and Dash projections, Fisher projections, Sawhorse projections and Newman projections. Biomaterials- definition, classification, defects, properties. Synthesis-(silicon, PMMA)- properties and applications. Biosensors-Types and applications.

### **UNIT V INSTRUMENTAL METHODS OF ANALYSIS**

**9**

Thermal analysis techniques- Thermo gravimetric analysis and Differential thermal analysis- Principle, instrumentation and applications: Concepts of chromatography – principle, instrumentation and applications of Paper chromatography, Column chromatography, Thin layer chromatography and Gas chromatography. Principle and applications of Conductometric titrations, Potentiometric titrations and pH-metry.



## **PHYSICS LABORATORY**

### **LIST OF EXPERIMENTS: (ANY FIVE)**

1. Determination of dispersive power of the given solid prism using spectrometer
2. Determination of thickness of the given thin material by forming interference fringes using air-wedge setup
3. Analysis of I-V Characterization of Solarcell
4. Determination of energy gap of the given semiconductor by plotting the graph between current and temperature
5. Determination of acceptance angle of the given fiber cable.
6. Determination of Young's modulus for the given uniform bar by nonuniform bending method

## **CHEMISTRY LABORATORY**

### **LIST OF EXPERIMENTS (ANY FIVE)**

1. Determination of strength of hydrochloric acid using pH meter.
2. Determination of strength of acids in a mixture of acids using conductivity meter.
3. Conductometric titration of strong acid vs strong base.
4. Estimation of iron content using potentiometer.
5. Estimation of iron content of the water sample using spectro photometer (thiocyanate method).
6. Estimation of sodium and potassium present in water using flame photometer.
7. Determination of SAP and FAV values of an oil.
8. Estimation of acetic acid adsorbed on charcoal

**TOTAL: 60 PERIODS**

## **COURSE OUTCOMES**

**At the end of the course, the students will able to**

- Gain knowledge on classical and quantum electron theories, and energy band structures.
- Acquire knowledge on basics of semiconductor physics and its applications in various devices.
- Apply the knowledge of advance engineering materials in day to daylife.
- Correlate Stereochemistry, conformation and reactivity.
- Infer about the principles and instrumentation involved in various analytical techniques.

## **TEXT BOOKS**

1. Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", PrenticeHall, 2009
3. Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
4. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.

## **REFERENCES**

1. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009
2. Gaur R.K. and Gupta S.L., Engineering Physics. Dhanpat Rai publishers, 2012.
3. K.SeshaMaheswaramma, MridulaChugh, Engineering chemistry, Pearson, 2016.

- O.G.Palanna, Engineering Chemistry, Mc Graw Hill, 2017
- Gurdeep R.Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House, 2007.
- TW Graham Solomons, Craig B.Fryhle, Organic Chemistry, John Wily & Sons.Inc.
- Buddy P.Ratner, Allan S.Hoffmann, Frederick J.Scjoen, Jack E.Lemons, Biomaterial Science, Elsevier Academic Press, 2004.
- Practical Fiber Optics, D. Bailey and E. Wright, 2003
- J.Mendham, RC Denney, JD Barnes, MJK Thomas, Text book of quantitative chemical analysis, Vogel's, 2008.

### WEBSITE REFERENCES:

- <https://nptel.ac.in/courses/115/102/115102025/>
- <https://www.youtube.com/watch?v=6QUFuZpCgGw>
- <http://tiny.cc/0vhjuz>
- <https://nptel.ac.in/content/storage2/courses/103108100/module7/module7.pdf>
- <https://nptel.ac.in/courses/108/108/108108122/>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	1	-	-	1	-	1	-
CO2	2	1	1	-	-	1	-	-	1	-	1	-
CO3	2	1	1	-	-	1	-	-	1	-	1	-
CO4	2	1	1	-	-	1	-	-	1	-	1	-
CO5	2	1	1	-	-	1	-	-	1	-	1	-

<b>JGE1203</b>	<b>ELECTRIC CIRCUITS AND ELECTRONIC DEVICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>2</b>	<b>0</b>	<b>3</b>

### COURSE OBJECTIVES:

- To Impart knowledge in basic circuits, circuit reduction techniques and analysis
- To explain the passive component characteristics for the ac and dc source of power in electric circuits
- To acquaint the students with the in-depth knowledge of characteristics of electronic devices.
- To introduce the advantages and characteristics of FET, MOSFET and different modes.
- To understand the special electronic devices such as UJT, Tunnel diode and power devices such as SCR, TRIAC etc.

### UNIT I BASIC CIRCUIT ANALYSIS

**12**

Passive and Active elements, Source transformation rules, Star-Delta conversion, Kirchhoff's laws, Mesh Analysis and Nodal Analysis, Introduction to coupled circuits, Resonance circuits.

## **UNIT II NETWORK THEOREMS&TRANSIENTS 12**

Network Theorems for AC and DC circuits: Super position Theorem, Thevenin and Norton Theorems –Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem. Transient Analysis-Series and parallel RL, RC and RLC Circuits.

## **UNIT III PN JUNCTION DIODE AND BJT 12**

PN junction diode-V-I Characteristics, Current equations, Diffusion and drift current densities, Transition and Diffusion Capacitances, Varactor diode, Switching Characteristics, Breakdown diodes, Applications. Bipolar Junction transistors- input and Output Characteristics, h-parameter model. CB,CE,CC configurations, Ebers-Moll Model.

## **UNIT IV FIELD EFFECT TRANSISTORS 12**

Classifications of FET, JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, Modes of MOSFET- V-I Characteristics and transfer characteristics

## **UNIT V SPECIAL SEMI CONDUCTOR DEVICES & POWER DEVICES 12**

Schottky barrier diode- Tunnel diode- Gallium Arsenide device, LASER diode, LDR. UJT, SCR, Diac, Triac, IGBT, MCT, LED, LCD, Photo transistor, Opto Coupler, Photo Voltaic Cells,CCD.

**TOTAL: 60 PERIODS**

### **OUTCOMES:**

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

- Analyze dc and ac circuits using mesh and nodal analysis.
- Apply circuit theorems to electronic circuits to obtain various parameters
- Explain the characteristics of semiconductor devices do small projects
- Explain the characteristics of special semiconductor devices and applications
- Understand the characteristics of various electronic components and power devices

### **TEXT BOOKS:**

1. Jacob Millman, Christos C. Halkias and Satyabrata Jit, Millmans Electronic Devices and Circuits, Fourth edition, McGraw Hill,2015
2. William H. Hayt, Jack Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill,2013.

### **REFERENCES:**

1. Salivahanan. S and Suresh Kumar S. N, —Electronic Devices and circuit, Fourth edition, Tata McGraw- Hill,2016.
2. R. S. Sedha, A Textbook of Electronic Devices and Circuits, Second Edition, S. Chand Publishing,2008.
3. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill,2015.

### **WEBSITE REFERENCE:**

1. [www.nptel.ac.in](http://www.nptel.ac.in)

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	2	-	-	-	-	3	3
CO2	3	3	3	3	2	2	-	-	-	-	3	3
CO3	3	3	3	3	2	1	-	-	-	-	2	3
CO4	3	3	3	3	2	1	-	-	-	-	3	3
CO5	3	3	3	3	2	1	-	-	-	-	3	3

JGE1201	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

## COURSE OBJECTIVES

- To provide an introduction to Python Programming Language.
- To understand the decision making and looping concepts.
- To understand functions, strings and list in Python.
- To understand tuples, dictionaries and files.
- To know the exception handling and 2D concepts.

### UNIT I INTRODUCTION TO PYTHON 9

History of Python, Features, Installing Python, Running Python Program, Interactive mode programming, Script Mode Programming, Identifiers, Reserved Words, Indentation, Comments, Variables, Data Types, Data Type Conversion

### UNIT II DECISION MAKING AND LOOPING 9

Python Operators, Operator Precedence, Decision Making: if Statement, if else Statement, if elif else Statement, nested if Statement, Loops: while loop, for loop, nested loops; Loop Control Statements: continue Statement, break Statement, pass Statement: Iterator and Generator

### UNIT III FUNCTIONS, STRING, LIST 9

Functions: Pre defined Functions, User defined Functions, Recursion, Lambda Function; String: Functions, methods, modules; Lists: Operations, pre-defined functions, advanced list processing; Packages

### UNIT IV TUPLES, DICTIONARY, FILES 9

Tuples: Tuple Operations and methods, Dictionary: Dictionary Operations and methods; Files: Text Files, Reading and writing Files; Format Operator, Command line argument

### UNIT V EXCEPTION HANDLING AND GRAPHICS 9

Date & Time Methods, Exception handling clauses, Raising an Exception, User Defined Exception; Simple graphics and image processing, simple 2d drawing - colors and shapes.

**TOTAL : 45 PERIODS**

## COURSE OUTCOMES :

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

- To understand the evolution of Python and run basic python programs.



<b>JGE1202</b>	<b>ENGINEERING GRAPHICS &amp; DESIGN (Common to all B.E /B.Tech Programmes)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>1</b>	<b>0</b>	<b>4</b>	<b>3</b>

## **COURSE OBJECTIVES**

- To understand the importance of graphics in engineering
- To develop skills in preparation of basic drawing
- To improve their technical communication skill in the form of communicative drawing
- To impart knowledge about standard principle of ortho graphic projection of objects.
- To improve their visualization skills for developing new products.

### **UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 15**

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Free hand sketching: 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 through free hand sketching of multiple views from pictorial views of objects.

### **UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

### **UNIT III PROJECTION OF SOLIDS 15**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

### **UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 15**

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts and square cutouts, perpendicular to the axis.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS** Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method

**TOTAL: 75 PERIODS**

## **COURSE OUTCOMES:**

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

- Familiarize with the fundamental and standards of engineering graphics.
- Perform free hand sketching of basic geometrical constructions and multiple views of object.
- Project orthographic projections of lines and plane surfaces.
- Draw projection of solids and development of surfaces.
- Interpret isometric and perspective view of objects.

## TEXT BOOKS:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai,
2. 2009.
3. Venugopal K and Prabhu Raja V., “Engineering Graphics”, New Age International (P)
4. Limited,2008.
5. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

## REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing
2. Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I & II combined), Subhas Stores,
4. Bangalore,2007.
5. Luzzader, Warren.J and Duff,John M., “Fundamentals of Engineering Drawing with an
6. introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
7. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
8. Shah M.B and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

## Publication of Bureau of Indian Standards:

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
3. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Methods.

## WEBSITE REFERENCES:

- [www.pdfdrive.com/engineering drawing-books.html](http://www.pdfdrive.com/engineering-drawing-books.html)
- <https://freevidelectures.com>
- <https://nptel.ac.in/courses>
- <https://nptel.ac.in/courses/105/104/105104148/>
- <https://nptel.ac.in/courses/112/103/112103019/>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	2	-	-	-	-	3	3
CO2	3	3	2	3	2	2	-	-	-	-	3	3
CO3	3	3	3	3	2	1	-	-	-	-	3	3
CO4	3	3	2	3	2	2	-	-	-	-	2	3
CO5	3	3	3	3	2	2	-	-	-	-	3	3

<b>JNC1261</b>	<b>ENVIRONMENTAL SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>

### **COURSE OBJECTIVES:**

- To study the interrelationship between living organism and environment.
- To find and implement scientific, technological and environmental problems due to pollution.
- To study the various natural resources and responsibility of the individual to conserve it.
- To study the social issues over environment.
- To get knowledge on population explosion, human rights and value education.

### **UNIT I ENVIRONMENT, ECOSYSTEMS AND BIO DIVERSITY 9**

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - value of biodiversity - threats to biodiversity - conservation of biodiversity: In- situ and ex-situ conservation of biodiversity.

### **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 (g) Nuclear hazards - Solid waste management: causes, effects and control measures of municipal solid wastes - Role of an individual in prevention of pollution.

### **UNIT III NATURAL RESOURCES 9**

Forest resources: Use and over-exploitation, deforestation, case studies - timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources- effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: renewable and non renewable energy sources, Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - role of an individual in conservation of natural resources.

### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9**

Water conservation- watershed management - resettlement and rehabilitation of policy. - consumerism and waste products - environment production act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - enforcement machinery involved in environmental legislation - central and state pollution control boards - Public awareness.

### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9**

Human population growth, variation among nations population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - women and child





<b>JGE1211</b>	<b>PYTHON PROGRAMMING LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### **COURSE OBJECTIVES**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- To implement basic 2 D diagrams.

### **LIST OF PROGRAMS**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Guess an integer number in a rang
6. Insert a card in a list of sorted cards.
7. Multiply matrices
8. Programs that take command line arguments (word count)
9. Find the most frequent words in a text read from afile
10. Create an User defined Exception
11. Draw a 2d circle and square

**TOTAL: 60 PERIODS**

### **PLATFORM NEEDED**

Python 3 interpreter for Windows/Linux

### **COURSE OUTCOMES :**

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

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Draw 2d graphic diagrams in Python

### **CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	-	3	-	-	3	3	3	-	3
<b>CO2</b>	3	3	3	-	3	-	-	3	3	3	-	3
<b>CO3</b>	3	3	3	-	3	-	-	3	3	3	-	3
<b>CO4</b>	3	3	3	-	3	-	-	3	3	3	-	3
<b>CO5</b>	3	3	3	-	3	-	-	3	3	3	-	3

<b>JGE1213</b>	<b>ELECTRIC CIRCUITS AND ELECTRONIC DEVICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b> <b>(Common to all B.E / ECE &amp; BME Programmes)</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### **COURSE OBJECTIVES:**

- To gain hand on experience in Thevenin & Norton theorem, KVL & KCL, and Super Position Theorems
- To understand the working of RL,RC and RLC circuits
- To learn the characteristics of basic electronic devices such as Diode, BJT,FET,SCR

### **LIST OF EXPERIMENTS:**

1. Verification of KVL & KCL
2. Verification of Thevenin & Norton theorems
3. Verification of Super Position Theorem
4. Verification of maximum power transfer & reciprocity theorems
5. Determination Of resonant frequency of series & parallel RLC Circuits
6. Study of Transient analysis of RL and RC circuits
7. Study of characteristics of PN Junction Diode and its application : clipper, clamper and Full Wave Rectifier
8. Study of characteristics of Zener diode and its application as voltage regulator
9. Study of input-output characteristics of BJT in Common Emitter Common Base Configuration
10. Study of Characteristics of FET
11. Study of Characteristics of UJT
12. Study of Characteristics of SCR

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Verify KVL & KCL, Theven in & Norton theorem and superposition Theorems
- Understand the behaviour of RL ,RC and RLC circuits
- Understand the characteristics of basic electronic devices

### **LABORATORY REQUIREMENTS:**

1. BC 107, BC 148,2N2646,BFW10 - 25 each
2. 1N4007, Zener diodes – 25 each
3. Resistors, Capacitors, Inductors – sufficient quantities
4. Bread Boards - 15 Nos
5. CRO (30MHz) – 10 Nos.
6. Function Generators (3 MHz) – 10 Nos.
7. Dual Regulated Power Supplies (0 – 30V) – 10 Nos.

### **WEBSITE REFERENCE:**

1. <https://nptel.ac.in/courses>
2. [www.electronicstheory.com](http://www.electronicstheory.com)

**CO-PO MAPPING:**

<b>CO\PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	3	3	1	2	-	-	-	-	2	3
<b>CO2</b>	3	3	2	3	1	2	-	-	-	-	2	3
<b>CO3</b>	3	3	3	3	3	1	-	-	-	-	1	3
<b>CO4</b>	3	3	3	3	1	1	-	-	-	-	2	3
<b>CO5</b>	3	3	3	3	3	1	-	-	-	-	3	3



- To use Z transforms as a tool for solving difference equations.
- To apply fundamentals concepts of advanced algebra in modern mathematics.
- To demonstrate efficient use of matrix representations and eigen value problems in linear transformations.
- To solve problems using orthogonalization process and use least square approximations in engineering applications. Approximations in engineering applications.

### TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Friedberg, A.H., Insel, A.J. and Spence, L., —Linear Algebra, Prentice Hall of India, New Delhi, 2004.

### REFERENCES:

1. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. James, G. —Advanced Modern Engineering Mathematics, Pearson Education, 2007.
3. Kolman, B. Hill, D.R., —Introductory Linear Algebra, Pearson Education, New Delhi, First Reprint, 2009.
4. Kumaresan, S., —Linear Algebra – A Geometric Approach, Prentice – Hall of India, New Delhi, Reprint, 2010.
5. Lay, D.C., —Linear Algebra and its Applications, 5th Edition, Pearson Education, 2015.
6. O’Neil, P.V., —Advanced Engineering Mathematics, Cengage Learning, 2007.
7. Strang, G., —Linear Algebra and its applications, Thomson (Brooks/Cole), New Delhi, 2005.
8. Sundarapandian, V. —Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.

### WEBSITE REFERENCES

1. <https://nptel.ac.in/courses/111/106/111106046/>
2. <https://nptel.ac.in/courses/111/102/111102129/>
3. <https://nptel.ac.in/courses/111/101/111101153/>
4. [https://nptel.ac.in/courses/111/105/111105093](https://nptel.ac.in/courses/111/105/111105093/)

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

JBM 1301	ELECTRONIC CIRCUITS FOR BIOMEDICAL ENGINEERS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand DC analysis and biasing methods of transistors
- To understand the design concepts of small and large signal amplifiers
- To understand the design of tuned amplifiers
- To understand the concepts for the design of feed back amplifiers and oscillators
- To know the applications of electronic circuits in biomedical field

**UNIT-I BIASING OF BJT AND FET 9**

Need for biasing – DC Load Line and Q Point – Various biasing methods of BJT – Bias Circuit Design – Thermal stability – Stability factors– Bias compensation techniques using Diode – JFET and MOSFET Biasing – MOSFET Handling Precautions.

**UNIT-II SMALL & LARGE SIGNAL AMPLIFIERS 9**

*h*-parameter model for BJT, Analysis of Small Signal CE amplifier at low and high Frequency, Short Circuit Current Gain. – Large Signal Amplifiers -Principles of Class A-Class B-Class AB , Efficiency of class A & B power amplifiers. Class C power amplifiers.

**UNIT-III TUNED AMPLIFIERS 9**

Coil losses, unloaded and loaded Q of tank circuits, Analysis of capacitor coupled single tuned amplifier – effect of cascading single tuned amplifiers on gain and bandwidth – Stagger tuned amplifiers - Stability of tuned amplifiers.

**UNIT-IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9**

Negative feedback: concept - effect on gain, stability, impedances and frequency Response- Types of Feedback topologies – Analysis of Current Series feedback in CE Amplifier Positive Feedback: Barkhausen's criterion for oscillation – RC Phase Shift, Wien bridge Oscillators – Hartley, Colpitt's and Crystal Oscillators.

**UNIT- V ELECTRONIC CIRCUITS FOR BIOMEDICAL APPLICATIONS 9**

Building a DC power supply unit for applications: Rectifiers -Filters– Series Voltage Regulator – SMPS, Amplification of Bio-signals: Need for Bio-amplifiers - Single ended and differential Bio-

amplifiers, Isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Analyze the various biasing methods of transistors
- Explain small signal amplifier design and power amplifiers
- Elaborate the working of tuned amplifiers
- Analyze feedback amplifiers and oscillators
- Apply the knowledge of electronic circuits in biomedical applications

**TEXT BOOKS:**

1. Donald. A. Neamen, “Electronic Circuits Analysis and Design”, 3rd Edition, McGraw Hill Education (India) Private Ltd.,2012.
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education, 2015.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd edition, Tata McGraw-Hill New Delhi, 2014.

**REFERENCES:**

1. Millman J, Halkias.C. and Sathyabrata Jit, “Electronic Devices and Circuits”, 4th Edition, McGraw Hill Education (India) Private Ltd., 2015.
2. David A. Bell, “Electronic Devices and Circuits”, Fifth Edition, Oxford University Press, 2008.
3. Salivahanan Sand Suresh N Kumar, “Electronic Devices and Circuits”, 4th Edition, McGraw Hill Education (India) Private Ltd., 2017.
4. Thomas L. Floyd, “Electronic Devices”, 9<sup>th</sup> Edition, Pearson Education, 2012.
5. Anwar A. Khan and Kanchan K. Dey, “A First Course on Electronics”, PHI, 2006.
6. Rashid M, “Microelectronics Circuits”, Thomson Learning, 2007.

**WEBSITE REFERENCES**

1. <https://nptel.ac.in/courses/108/102/108102095/>
2. <https://nptel.ac.in/courses/108/102/108102097/>
3. <https://www.youtube.com/watch?v=jZZni05GtwA>
4. [https://www.youtube.com/watch?v=0mgWEAEZ\\_88](https://www.youtube.com/watch?v=0mgWEAEZ_88)
5. <https://www.youtube.com/watch?v=tOAmzgzRkMQ>

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	2	2
CO2	3	3	3	2	2	1	-	-	-	-	2	2
CO3	3	3	3	2	2	1	-	-	-	-	2	2
CO4	3	3	3	2	2	1	-	-	-	-	2	2
CO5	3	3	3	2	2	1	-	-	-	-	2	2



## CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	2	1
CO2	1	2
CO3	2	1
CO4	2	1
CO5	1	1

JBM 1302	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES

- To identify all the organelles of cell, their functions and structure of the skin
- To understand structure and function of the musculo skeletal system and sense organs of the human body.
- To understand the importance of anatomical features and physiology of heart, lymphatic system, respiratory system
- To describe the structure, physiology, transmission processes, and reflex action of neurons.
- To explain digestion of food and absorption of nutrition by intestines.

### UNIT-I CELL STRUCTURE AND INTEGUMENTARY SYSTEM 9

Structure and functions of cells and cell organelles –Types of cells – Transport Across Membrane– Cellular processes – Cell Division – Types of Specialized tissues and their functions – Structure of skin – Interaction of nano particles with skin.

### UNIT-II MUSCULO SKELETAL SYSTEM AND SENSE ORGANS 9

Divisions of Skeletal system and functions – Physiology of Bone formation – Types of Joints and ligaments–structure and functions of tendons, Types of muscles – Sliding filament theory - Sense Organs: Physiology of vision and hearing.

### UNIT-III CARDIO VASCULAR, LYMPHATIC AND RESPIRATORY SYSTEMS 9

Cardiovascular: Anatomy of Heart, Conduction System of Heart - Cardiac Cycle – Regulation of Heart rate -Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels. Respiratory: Parts of Respiratory Systems – Types of respiration – Mechanism of respiration – Regulation of Respiration.

### UNIT-IV NERVOUS AND ENDOCRINE SYSTEMS 9

Nervous: Structure and functions of neurons – Types of Neurons – stages of action potential - neurotransmitters –Nerve impulse –Parts of Brain – structure and functions of Spinal Cord – Tract of Spinal cord – Reflex Mechanism–Endocrine-Pituitary and thyroid gland.

## UNIT-V DIGESTIVE AND URINARY SYSTEMS

9

Digestive System: Organs of Digestive system – Digestion and Absorption. Urinary System: Structure of Kidney and Nephron – Mechanisms of Urine formation– Regulation of Blood pressure by Urinary System – Urinary reflex.

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

At end of the course, student will be able to

- Explain the morphology and physiology of the fundamental unit of human body.
- Elaborate anatomy and physiology of bones, muscles and mechanism of breathing.
- Elucidate the structure of blood vessels and circulatory system.
- Describe the structure, physiology, transmission processes, and reflex action of neurons.
- Explain digestion of food and absorption of nutrition by intestines.

### TEXT BOOKS:

1. Guyton & Hall, “Medical Physiology” ,13<sup>th</sup> Edition, Elsevier Saunders, 2015.
2. Prabhjot Kaur, “Text Book of Anatomy and Physiology”, 2<sup>nd</sup> edition ,Lotus Publishers, 2014.
3. Elaine. N.Marieb, “Essential of Human Anatomy and Physiology ” , 8<sup>th</sup> Edition, Pearson Education, New Delhi,2007

### REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, “Fundamentals of Anatomy and Physiology”. 11<sup>th</sup>edition ,Pearson Publishers,2020
2. Gillian Pocock , Christopher D. Richards, “The Human Body – An introduction for Biomedical and Health Sciences” , Oxford University Press, USA,2013
3. William F.Ganong, “Review of Medical Physiology” ,22<sup>nd</sup> Edition,McGrawHill,New Delhi, 2010
4. Eldra Pearl Solomon ,“Introduction to Human Anatomy and Physiology ” 4<sup>th</sup> edition , W.B. Saunders Company,2014

### WEBSITE REFERENCES

1. <https://nptel.ac.in/courses/122103039/>
2. <https://www.edx.org/learn/human-anatomy>
3. <https://www.youtube.com/watch?v=Orumw-PyNjw>
4. <https://www.youtube.com/watch?v=URUJD5NEXC8>
5. <https://www.youtube.com/watch?v=gSW2ryFmihk>
6. <https://www.youtube.com/watch?v=28CYhgjrBLA>
7. <https://www.youtube.com/watch?v=48XO9iyZevs>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	1	1	1	-	-	1	2	1
CO2	2	1	1	-	1	1	1	-	-	1	2	1
CO3	2	1	1	-	1	1	1	-	-	1	2	1
CO4	2	1	1	-	1	1	1	-	-	1	2	1
CO5	2	1	1	-	1	1	1	-	-	1	2	1

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

JBM 1303	CLINICAL BIOCHEMISTRY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES**

- To understand properties of water, acids and buffers.
- To study structure, physical chemical and oxidative properties of carbohydrates.
- To understand classification and metabolic pathways of lipids.
- To understand the Structure and properties of RNA, DNA, proteins.
- To emphasize the classification and kinetics of enzymes.

**UNIT-I INTRODUCTION TO BIOCHEMISTRY****9**

Solvent properties of water, acids and bases, pH and buffers, Henderson - Hasselbalch equation, physiological buffers in living systems, Introduction to Biomolecules, significance and types of bio molecules.

**UNIT-II CARBOHYDRATES****9**

Classification of carbohydrates -Structure, physical and chemical properties of carbohydrates– Glycolysis, glycogenesis, glycogenolysis, gluconeogenesis, TCA cycle and electron transport chain, Oxidative phosphorylation - Disorders of carbohydrates metabolism.

**UNIT-III LIPIDS****9**

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

**UNIT-IV NUCLEIC ACIDS & PROTEIN****9**

Structure of purines and pyrimidines, DNA as a genetic material, Chargoff's rule. Watson and Crick model of DNA. Structure of RNA and its type, structure and properties of proteins, structural organization of proteins, separation of proteins - classification and properties of amino acids, Inborn Metabolic error of amino acid metabolism.

## UNIT-V ENZYMES

9

Classification of enzymes. Kinetics of enzymes – Michaelis-Menten equation. Factors affecting enzymatic activity. Inhibitors of enzyme action. Mode of action, regulation, Clinical enzymology, Measurement of enzyme activity.

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

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

- Explain the significance of water, its biological importance and the fitness of the aqueous environment.
- Elucidate the structure, physical chemical and oxidative properties, and metabolic pathways of carbohydrates.
- Explain the classification and metabolic pathways of lipids
- Explain the importance of genetic information carried in RNA, DNA, proteins and the process of gel filtration, electrophoresis and ultracentrifugation.
- Explain the enzymatic activity and its measurement.

### TEXT BOOKS:

1. Rafi MD, "Text book of Biochemistry for Medical Students" ,3rd Edition, University Press, 2017.
2. David. W. Martin, Peter. A. Mayes , Victor. W. Rodwell, "Harper's Review of Biochemistry", LANGE Medical Publications, 28<sup>th</sup> edition, 2009.

### REFERENCES:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", 5<sup>th</sup> edition Oxford University Press, 2009.
2. Pamela. C. Champe & Richard. A. Harvey, Lippincott , "Biochemistry Lippincott's Illustrated Reviews", 2<sup>nd</sup> Raven publishers, 1994.

### WEBSITE REFERENCES:

1. <https://nptel.ac.in/courses/102/105/102105034/>
2. [https://study.com/online\\_biochemistry\\_courses.html](https://study.com/online_biochemistry_courses.html)
3. <https://www.youtube.com/watch?v=jHLvveHmhWY>
4. <https://www.youtube.com/watch?v=F59RwK9hya8>
5. <https://www.youtube.com/watch?v=RoRLYmcbkTk>
6. <https://www.youtube.com/watch?v=-3TmDPzyBeY>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	1	1	1	-	-	1
CO2	2	1	3	2	-	-	1	1	1	-	-	1
CO3	3	2	1	2	-	-	1	1	1	-	-	1
CO4	2	3	3	3	-	-	1	1	2	-	-	2
CO5	1	1	2	2	-	-	1	1	3	-	-	3

## CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

<b>JBM 1304</b>	<b>BIO SENSORS AND MEASUREMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## COURSE OBJECTIVES

- To understand the methods and errors associated with measurements.
- To gain knowledge about the principle of transduction, classifications and characteristics of different transducers
- To understand the different bio potentials and biochemical sensors
- To gain knowledge on the different bridges used for measurement
- To be acquainted with the different recording devices and open source software for data analysis

### UNIT-I SCIENCE OF MEASUREMENT 9

Measurement System – Static and Dynamic characteristics- Errors in Measurements and their statistical analysis – Calibration - Standards- Classification and Characteristics of Transducers - Primary sensing elements

### UNIT-II TRANSDUCERS 9

Passive Transducers:-Resistance type : strain gauges - gauge factor - rosettes , RTD, Thermistor ; Inductive type: LVDT and Capacitive type ; Photoelectric ; Active Transducers :-Thermocouple, Piezoelectric, Photo Voltaic. Biomedical applications of Passive and Active Transducers.

### UNIT-III BIOPOTENTIAL AND BIOCHEMICAL SENSORS 9

Half cell potential (or) Electrode potential, Types of Electrodes - Micro electrodes, Depth and needle electrodes, Surface electrodes ; Biochemical sensors - pH, pO<sub>2</sub> and pCO<sub>2</sub>, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors

### UNIT-IV BIOSIGNAL CONDITIONING & ANALYSIS 9

AC and DC Bridges –wheat stone bridge, Maxwell, Hay, Schering bridges; Bio amplifier: Right leg driven ECG amplifier, Chopper amplifier. Power line interference – band pass filtering-Impedance matching networks - Bio-Analyzers: Blood gas analyzers, flame photometer, Spectrum analyzer, and auto analyzer.

## UNIT-V RECORDING DEVICES AND DATA ANALYSIS

9

DSO, Medical Oscilloscopes. PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Data Analysis using open source software

**TOTAL: 45 PERIODS**

### OUTCOMES:

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

- Explain the various methods and errors associated with measurement process.
- Identify and apply suitable transducers for measurement of a physical phenomenon.
- Demonstrate the concepts, types, working and practical applications of important biosensors.
- Organize the signal conditioning techniques and devices to be applied for specific measurement applications.
- Explain different types of recorders for data display and also assess the acquired data using relevant data analysis software.

### TEXT BOOKS:

1. Sawhney A.K, "A course in Electrical and Electronic Measurements and Instrumentation", Nineteenth Revised Edition ,Dhanpat Rai& Co, New Delhi, 2011.(Reprint 2014)
2. Kalsi H.S, "Electronic Instrumentation", 3rd Edition, Tata McGraw-Hill Education Pvt Ltd, 2010.
3. Geddes L.A and Baker L.E, "Principles of Applied Biomedical Instrumentation", 3rd Edition, Wiley India Pvt. Ltd, New Delhi, 2008.

### REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2nd edition, Prentice- Hall of India Pvt. Ltd, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Richard S.C. Cobbold, Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 2004.
4. Nandini K. Jog, Electronics in Medicine and Biomedical Instrumentation, PHI,2nd Edition 2013.
5. Harry N, Norton, Biomedical sensors – Fundamentals and Application, 2001. 7. Tatsuo Togawa, Toshiyo Tamma and P. AkeÖberg, Biomedical Transducers and Instruments, 2018.

### WEBSITE REFERENCES :

1. <https://nptel.ac.in/courses/108/105/108105064/>
2. <https://nptel.ac.in/courses/108/102/108102097/>
3. <https://www.youtube.com/watch?v=gJd0MeECLHA>
4. <https://www.youtube.com/watch?v=49CWbXNJ3WE>
5. <https://www.youtube.com/watch?v=WnKK11UEvVE>
6. <https://www.youtube.com/watch?v=D-malae4448>
7. <https://www.youtube.com/watch?v=VoX85L8zykE>
8. <https://www.youtube.com/watch?v=XWTw--FmumM>

### CO-PO MAPPING:

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	-	-	1	2	-	-	3	1

<b>CO2</b>	3	3	3	3	-	-	1	1	-	-	2	1
<b>CO3</b>	3	1	1	1	-	-	1	2	-	-	2	2
<b>CO4</b>	3	2	2	2	-	-	1	1	-	-	3	3
<b>CO5</b>	3	1	1	1	-	-	2	2	-	-	2	3

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
<b>CO1</b>	3	2
<b>CO2</b>	3	2
<b>CO3</b>	3	2
<b>CO4</b>	3	2
<b>CO5</b>	3	2

<b>JBM 1305</b>	<b>BIOMATERIALS FOR MEDICAL IMPLANTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### COURSE OBJECTIVES:

- To learn characteristics and classification of Biomaterials
- To understand different metals, ceramics and their characteristics as biomaterials.
- To learn polymeric materials and its combinations
- To demonstrate the use of sutures, adhesives, tapes and other materials for tissue replacement.
- To explain the design developments, manufacture and types of artificial organs.

### UNIT-I INTRODUCTION TO BIO-MATERIALS

**9**

Classification and requirements of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, blood compatibility, Nano scale phenomena.

### UNIT-II METALLIC AND CERAMIC MATERIALS FOR IMPLANTS

**9**

Metallic implant materials - Stainless steels, Co-based alloys, Ti-based alloys, shape memory alloy, nano structured metallic implants, degradation and corrosion, ceramic implant –bio inert, biodegradable or bio resorbable, bioactive ceramics, glass ceramics, nano structured bio ceramics.

### UNIT-III POLY MERIC IMPLANT MATERIALS

**9**

Polymerization, Factors influencing polymers properties, Polymers as biomaterials, Biodegradable polymers, Polyamides, PTFE, Biopolymers: Collagen, Elastin and Chitin, Medical Textiles, Membranes for plasma separation and Blood oxygenation, Materials for ophthalmology: contact lens, intraocular lens.

## **UNIT-IV ISSUE REPLACEMENT IMPLANTS**

**9**

ECM - Small intestinal sub mucosa and other Decellularization. Soft-tissue replacements: sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding.

## **UNIT-V TESTING AND STERILIZATION OF BIOMATERIALS**

**9**

Blood compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and In vivo testing; Sterilization of implants and devices: ETO, gamma radiation, autoclaving, Effects of sterilization.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Explain the manufacturing and properties of biomaterials such as tissue response, wound healing and blood compatibility.
- Record the characteristics of metals used to manufacture implants
- Identify the polymers used in the eye lenses and other implants and their durability.
- Demonstrate the use of sutures, adhesives, tapes and other materials for tissue replacement.
- To organize the design developments, manufacture and types of artificial organs.

### **TEXT BOOKS:**

1. Sujata V.Bhatt, “Biomaterials Second Edition”, Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, Murugan Ramalingam, Sampath Kumar T.S, and Winston O. Soboyejo, “Biomaterials: A Nano Approach”, CRC Press, 2010.

### **REFERENCES:**

1. MyerKutz, -“Standard Handbook of Biomedical Engineering & Design”, McGrawhill, 2003.
2. John Enderle, Joseph D. Bronzino, Susan M. Blanchard, “Introduction to Biomedical Engineering”, Elsevier, 2005.
3. Park J.B., “Biomaterials Science and Engineering”, Plenum Press, 1984.
4. Anand A.C, Kennedy JF, Mirafab.M, S.Rajendran,—Wood head, “Medical Textiles and Biomaterials for Healthcare”, Publishing Limited 2006.
5. Williams D F, “Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume”, VCH Publishers 1992.
6. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain. “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2015.

### **WEBSITE REFERENCES :**

1. <https://nptel.ac.in/courses/113104009/>
2. <https://www.youtube.com/watch?v=1oAbeWO3SvI>
3. <https://www.youtube.com/watch?v=8p2CYTPGiYE>
4. <https://www.youtube.com/watch?v=Ao2p19NkcQI>
5. <https://www.youtube.com/watch?v=ANHhZJguz3U>



**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	-	2	1	1	1	-	2	2	3
CO2	2	3	3	-	1	2	1	1	-	2	2	2
CO3	1	2	3	-	2	3	1	1	-	1	1	3
CO4	2	3	2	-	2	3	1	1	-	2	3	3
CO5	2	1	2	-	3	2	1	1	-	2	3	2

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	1	1
CO5	2	1

JPT1001	SOFT SKILLS AND APTITUDE -I	L	T	P	C
		0	0	2	*

**COURSE OBJECTIVES:**

- To help students groom their personality and develop their skill of building social relationships
- To improve the personality traits of students and their creativity
- To help students gain knowledge in rational thinking and aptitude
- To make students think logically and judiciously
- To help student acquire technical skills in C programming language

**UNIT-I SOFT SKILLS AND APTITUDE- I 9**

Self-Realization – Self Motivation – Relationship Building – Personality Enrichment – Personality Traits – Intra Personal Communication – Inter Personal Communication – Behavioural Based Perception – Attitude & Behaviour – SWOT Analysis

**UNIT-II SOFT SKILLS AND APTITUDE –II 9**

Dimensions of Personality – Self Confidence – Open Mindedness – Acceptance – Creativity - Strategies for developing creativity – Overcoming myths of creativity – Presence of Mind – Staying Focused – Self Acceptance – Self Growth

### **UNIT-III QUANTITATIVE APTITUDE**

**9**

Number system – Divisibility Rule – Simplification – Surds and Indices – Square root and Cube root – Averages – Percentage

### **UNIT-IV LOGICAL REASONING**

**9**

Number series – Alphabet series – Alphabet test – Word test – Letter Arrangement – Word Arrangement – Coding and Decoding – Analogy

### **UNIT-V TECHNICAL APTITUDE IN C-I**

**9**

Technical aptitude in C: Program Structure – Data types – Variables – Constants – Operators – Decision Making - Switch statement – Looping statements – Functions – Call by reference - Recursive Arrays, single dimensional, multi-dimensional.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Build better relationship with all in their social settings
- Engage in creative activities focusing on their career
- Solve the real time and complex problems in aptitude
- Solve critical reasoning and real time application problems
- Apply their knowledge in the basics of C programming

### **TEXT BOOKS:**

1. R.S Agrawal, “Quantitative Aptitude”.
2. R. S. Agrawal, “Verbal Reasoning”.
3. R.S. Agrawal “ Non Verbal reasoning.
4. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009
5. Yashavant P. Kanetkar. “ Let Us C”, BPB Publications, 2011.

### **WEBSITES REFERENCES :**

1. <https://www.indiabix.com/aptitude/questions-and-answers/>
2. <https://m4maths.com/placement-puzzles.php>
3. <https://www.youtube.com › watch/average>
4. <https://www.youtube.com › watch/coding and decoding>
5. <https://www.youtube.com › watch/c programs>
6. <https://www.youtube.com › watch/self confidence>
7. <https://www.youtube.com › watch/motivation>

### **CO - PO MAPPING**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	3	2	-	-	1	3	2	1	-	-
CO2	-	2	3	2	-	-	1	3	2	1	-	-
CO3	-	2	3	2	-	-	1	3	2	1	-	-
CO4	-	2	3	2	-	-	1	3	2	1	-	-
CO5	-	2	3	2	-	-	1	3	2	1	-	-

## CO -PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

<b>JBM1311</b>	<b>ELECTRONIC CIRCUITS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### COURSE OBJECTIVES

- To understand the biasing of BJT
- To design small signal amplifiers and analyze their frequency response
- To study the effect of negative feed back in amplifiers
- To analyze and design oscillators for various frequencies
- To understand the working power amplifiers and power supply units

### LIST OF EXPERIMENTS

1. Design of Voltage divider Biasing for BJT - CE amplifier
2. Frequency response of BJT – CE amplifier
3. Frequency response of Single Tuned amplifier
4. Frequency response of negative feedback amplifier – Current Series type.
5. Design of RC Phase shift Oscillator
6. Generation of sine wave using Hartley Oscillators
7. Generation of sine wave using Colpitts Oscillators
8. Construction and verification: Class-A power amplifier
9. Half Wave and Full Wave Rectifiers.
10. Construction of DC power supply unit for biomedical application.
11. Construction and verification of differential Amplifier
12. Study of Isolation amplifier

### COURSE OUTCOMES:

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

- Understand the design of biasing of BJT
- Design small signal amplifiers and analyze their frequency response
- Distinguish the effect of negative feedback in amplifiers
- Demonstrate analysis level design of oscillators for various frequencies
- Explain the working of power amplifiers and power supply units

**TOTAL: 60 PERIODS**

### WEBSITE REFERENCES :

1. <https://www.youtube.com/watch?v=5T84Jzcgj7M>
2. [https://www.youtube.com/watch?v=9all1Xz\\_lOw](https://www.youtube.com/watch?v=9all1Xz_lOw)
3. <https://www.youtube.com/watch?v=L6BZEJ4wH4I>
4. <https://www.youtube.com/watch?v=AQ9mbMGlvug>
5. <https://www.youtube.com/watch?v=iat53DqIOcU>

6. <https://www.youtube.com/watch?v=8rvwK8umNjk>
7. <https://www.youtube.com/watch?v=Xxftr1pymzg>
8. <https://www.youtube.com/watch?v=M3nMVORPWhY>
9. [https://www.youtube.com/watch?v=g1uRB\\_PRnTs](https://www.youtube.com/watch?v=g1uRB_PRnTs)
10. <https://www.youtube.com/watch?v=Jf1rprWfVsA>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	1	1	-	2	1	2	3
CO2	3	2	3	2	2	1	1	-	2	1	2	3
CO3	3	2	3	2	2	1	1	-	2	1	2	2
CO4	3	2	3	2	2	1	1	-	2	1	2	2
CO5	3	2	3	2	2	1	1	-	2	1	2	2

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

### LABORATORY REQUIREMENTS FOR 30 STUDENTS:

1	CRO(30Mhz)	15 Nos
2	Function generators (2 MHz)	15 Nos
3	Dual regulated power supplies (0-30 V)	15 Nos
4	Digital Multimeter	15 Nos
5	IC tester	15 Nos
6+	Transistors, Resistors, Capacitors, diodes, Zener diodes, Bread Boards, Transformers, wires	
7	BJT – BC547, 107, Diode -IN4001, Power transistor SL / CL100 – required Nos.	
8	Optical isolator -4N28	

<b>JBM1312</b>	<b>HUMAN PHYSIOLOGY AND BIOCHEMISTRY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### **COURSE OBJECTIVES:**

- To perform general test on carbohydrates proteins and lipids
- To perform estimation and quantification of blood glucose
- To identify blood group and count the blood cells
- To calculate the bleeding and clotting time of blood
- To perform experimentation to separate macromolecules.

### **LIST OF EXPERIMENTS:**

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of serum and plasma from blood.
3. Estimation of blood glucose.
4. Estimation of creatinine
5. Estimation of urea
6. Estimation of cholesterol
7. Assay of SGOT/SGPT
8. Blood grouping
9. Bleeding time and clotting time
10. ESR, PCV, MCH, MCV, MCHC,
11. Total count of RBC
12. Hemoglobin estimation

### **COURSE OUTCOMES:**

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

- Understand the general test on carbohydrates proteins and lipids
- Understand the estimation and quantification of blood glucose
- Expound on various qualitative tests of different types of biomolecules
- Identify blood group and count the blood cells
- Calculate the bleeding and clotting time of blood

**TOTAL: 60 PERIODS**

### **WEBSITE REFERENCES :**

1. <https://academic.oup.com/clinchem/article-abstract/20/4/470/5676927>
2. <https://physoc.onlinelibrary.wiley.com/doi/pdf/10.1113/jphysiol.1903.sp000949>
3. <https://www.healthline.com/health/sgot-test>
4. <https://www.nhs.uk/conditions/red-blood-count/>

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	2	1	1	3	1	3	3	1
CO2	2	1	3	2	2	1	2	3	1	3	3	1
CO3	3	2	1	2	2	1	3	2	1	3	3	1
CO4	2	3	3	3	2	2	3	3	2	2	1	2
CO5	1	1	2	2	3	3	2	2	3	1	2	3

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	3	3
CO2	2	2
CO3	3	2
CO4	2	2
CO5	3	2

<b>LABORATORY REQUIREMENTS FOR 30 STUDENTS:</b>		
1	Microscope	2
2	Centrifuge Normal	1
3	Wintrobe's tube	2
4	PCV tube	2
5	Neubaur's Chamber	2
6	Heparinized Syringe	1
7	Haemoglobinometer	1
8	Blood grouping kit	1
9	Capillary tubes	1
10	Ophthalmoscope	1
11	Tuning fork (256Hz to 512Hz)	5
12	Microslides (Packets)	2
13	Lancet (boxes)	5
14	Colorimeter	2
15	Spectrophotometer	1
16	Weighing balance	1
17	Refrigerator	1

## SEMESTER – 4

<b>JMA1401</b>	<b>APPLIED PROBABILITY AND NUMERICAL METHODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>2</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To provide basic concepts of one dimensional, two random variables, standard probability distributions and testing of hypothesis.
- To introduce numerical techniques for solving system of equations and interpolation problems that arise in engineering applications.
- To acquaint the students with the understanding of numerical differentiation and integration.

### **UNIT-I RANDOM VARIABLES 12**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Exponential and Normal distributions.

### **UNIT-II TWO - DIMENSIONAL RANDOM VARIABLES 12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

### **UNIT-III TESTING OF HYPOTHESIS 12**

Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table - Goodness of fit.

### **UNIT-IV SOLUTION OF EQUATIONS AND INTERPOLATION 12**

Solution of algebraic and transcendental equations – Fixed point iteration method and Newton Raphson method – Solution of linear system of equations – Direct methods of Gauss elimination and Gauss Jordan – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Interpolation with unequal intervals – Lagrange interpolation and Newton's divided difference interpolation – Interpolation with equal intervals – Newton's forward and backward difference formulae.

### **UNIT-V NUMERICAL DIFFERENTIATION AND INTEGRATION 12**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Understand random variables and use standard distributions in solving real time problems.
- Use joint density functions to perform correlation and regression analysis.
- Apply hypothesis testing for making statistical inferences in large and small sample real life problems.
- Demonstrate efficient use of numerical techniques in solving system of equations and interpolation problems.
- Solve problems of differentiation and integration through numerical methods.

**TEXT BOOKS:**

1. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", 1st Indian Reprint, Elsevier, 2007.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
4. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

**REFERENCES:**

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
3. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.
4. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
5. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.

**WEB REFERENCES:**

1. <https://nptel.ac.in/courses/111/104/111104032/>
2. <https://nptel.ac.in/courses/103/106/103106120>
3. <https://nptel.ac.in/courses/117/103/117103067>

**CO-PO MAPPING:**

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	-	-	-	-	2	-	-	2
CO2	3	3	2	2	-	-	-	-	2	-	-	2
CO3	3	3	2	2	-	-	-	-	2	-	-	2
CO4	3	3	2	2	-	-	-	-	2	-	-	2
CO5	3	3	2	2	-	-	-	-	2	-	-	2

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-



<b>JBM 1401</b>	<b>ANALOG &amp; DIGITAL INTEGRATED CIRCUITS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To design simple applications using logic gates and combinational circuits.
- To understand the design of sequential systems.
- To understand the operation of OPAMP and its applications
- To explain the concepts involved in filter design and waveform generators.
- To understand the operation and applications of functional circuits such as Timer, PLL and Data Converters.

### **UNIT-I NUMBER SYSTEMS AND LOGIC GATES 9**

Number systems—code conversion: BCD, Binary Gray Code - Boolean Laws and theorems – Solving Boolean expressions, Logic gates - Truth Tables and Logic circuits – The Karnaugh Map – half adder, full adder, Multiplexers and Demultiplexers - Decoders and encoders.

### **UNIT-II REGISTERS AND COUNTERS 9**

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

### **UNIT-III OPERATIONAL AMPLIFIERS 9**

The characteristics of Ideal Operation amplifier - Linear applications: inverting and non-inverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter – Difference amplifiers – Instrumentation amplifier-Differentiator and integrator. Nonlinear applications : Comparator - Schmitt Trigger.

### **UNIT-IV ACTIVE FILTERS AND SIGNAL GENERATORS 9**

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

### **UNIT-V TIMER, PLL, A/D AND D/A CONVERTERS 9**

555 Timer: monostable and astable modes. Phase locked Loop: Capture and lock in range .Voltage to frequency and frequency to voltage converters. DAC – Binary weighted DAC and R-2R DAC. ADC – single slope and dual slope ADCs, successive approximation ADC

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- To design simple digital applications using logic gates
- To understand the design of sequential digital systems.
- To explain the operation of OPAMP and its applications
- To analyze the design of filters and waveform generators.
- To explain the operation of functional circuits such as Timer, PLL, DAC and ADC.

**TEXT BOOKS:**

1. Morris Mano M, “Digital Logic and Computer design”, Published 2008 by Prentice Hall, Inc. Learning Pvt. Ltd
2. Ramakant A. Gayakwad, “OP-AMPS and Linear Integrated Circuits”, 4th Edition. Prentice Hall, 2000.

**REFERENCES:**

1. Robert B.Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, CRC Press,2004.
2. Sergio Franco, “Design with Operational Amplifiers and analog Integrated circuits”, Fourth Edition, Published by McGraw-Hill Education McGraw- Hills, 2003.
3. John. F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Published by Pearson Education, 2007.
4. Charles H. Roth, Larry L. Kinney, “Fundamentals of Logic Design”, Seventh Edition, Cengage Learning, 2013.

**WEBSITE REFERENCES:**

1. <https://nptel.ac.in/courses/108106068/>
2. <https://nptel.ac.in/courses/108/106/108106068/>
3. <https://www.youtube.com/watch?v=NqPhPiSer30&list=PLIY8eNdw5tW-yJHsxApeilNjX2Dkll-Ox>
4. <https://www.youtube.com/watch?v=8JMfp-y335s>
5. <https://www.youtube.com/watch?v=7FYHt5XviKc>
6. <https://www.youtube.com/watch?v=EGmreVQ-yNM>

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	1	-	-	1	1	1
CO2	3	3	3	3	3	-	1	-	-	1	1	1
CO3	3	3	3	3	3	-	-	-	-	1	1	1
CO4	3	3	3	3	3	1	-	1	-	1	1	1
CO5	3	3	3	3	3	-	-	-	-	2	2	2

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	3	3

<b>JBM1402</b>	<b>PATHOLOGY AND MICROBIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## **COURSE OBJECTIVES**

- To gain knowledge on the cellular degeneration and inflammation
- To know about the fluid and hemodynamic derangement
- To understand routes of infection due to viruses and bacteria
- To understand the science of microscopy and microbiological techniques in the study of micro organisms.
- To have a knowledge on immunology and simple immunological experiments.

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

Cell injury - Intracellular accumulation - Pathological calcification- cellular adaptations - Inflammation and Repair – Neoplasia and its types – carcinogenesis - spread of tumors - Autopsy biopsy and necropsy.

### **UNIT-II FLUID AND HEMO DYNAMIC DERANGEMENTS 9**

Accumulation of fluids - Edema, Hyperemia, Ischemia, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders- Bleeding disorders, Leukaemias, Lymphomas, Haemorrhage.

### **UNIT-III MICROBIOLOGY 9**

Structure of Bacteria and Virus. Routes of infection and spread, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture.

### **UNIT-IV MICROSCOPES 9**

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

### **UNIT-V IMMUNO PATHOLOGY 9**

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

**TOTAL : 45 PERIODS**

## **COURSE OUTCOMES:**

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

- Identify the general principles, terminology, and modes of spread of disease to the study of Systemic Pathology.
- Apply a basic understanding of histopathology and morbid anatomy to the examination of specimens, displaying pathological processes.
- Define the science of microscopy and microbiological techniques in the study of microorganisms.
- Explain about Genetic disorders, infection and immunity.
- Demonstrate knowledge of immunology and practical skills in undertaking simple immunological experiment.

## TEXT BOOKS:

1. Kumar, Abbas, Aster “ Robbins and Cotran Pathologic Basis of Disease and Robbins Basic Pathology”, 10<sup>th</sup> edition, 2014, Elsevier.
2. Dr Reba Kanungo, Ananthanarayanan & Panicker, “Microbiology”, 10<sup>th</sup>edition, 2017, Orient blackswan Publishers.
3. Ramnik Sood, “Concise Book of Medical Laboratory Technology Methods and Interpretations”, 2nd edition, Jaypee Publishers, 2015

## REFERENCES:

1. James C. E. Underwood & Simon S Cross, “General and Systematic Pathology”, 5th Edition, Churchill Living stone Elsevier , 2009.
2. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Derek Weber, Warner Bair, “Microbiology: An Introduction” , 13th Edition, 2018, Pearson.
3. Dubey RC and Maheswari K , “A Text Book of Microbiology”, 4<sup>th</sup>edition, S.Chand & Company Ltd., 2007
4. Joanne Willey ,Linda Sherwood, Christopher J. Woolverton “Microbiology” ,10<sup>th</sup>edition, 2017, McGrawHill.

## WEBSITE REFERENCES

1. <https://nptel.ac.in/courses/102/103/102103015/>
2. [https://swayam.gov.in/nd1\\_noc20\\_ce17/](https://swayam.gov.in/nd1_noc20_ce17/)
3. <https://www.youtube.com/watch?v=1vaEVcMfa1E>
4. [https://www.youtube.com/watch?v=AgHweEcj\\_p4](https://www.youtube.com/watch?v=AgHweEcj_p4)

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	1	1	1
CO2	2	2	1	-	-	-	-	-	-	2		2
CO3	3	2	2	-	-	-	-	-	-	2	1	1
CO4	3	1	1	-	-	-	-	-	-	1	1	3
CO5	2	3	2	-	-	-	-	-	-	2	2	2

## CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	2	1
CO4	3	1
CO5	3	1

<b>JBM1403</b>	<b>BIOMEDICAL INSTRUMENTATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To understand the origin of various biological signals, their characteristics and electrode configurations specific to bio-potential measurements.
- To understand the working of modules involved in monitoring and transmission of vital signs of human.
- To explain the different techniques used for measurement of non-electrical bio-parameters
- To explain the flow and sensory measurement techniques as applicable for diagnosis and treatment.
- To explain the standards and safety measures to be followed when using Biomedical Equipment.

### **UNIT-I ELECTRODE CONFIGURATIONS 9**

Biosignals 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 PATIENT MONITORING SYSTEMS AND BIOTELEMETRY 9**

Patient monitoring systems, ICU/CCU Equipment, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission, multiplexing of biosignals- FDM,TDM

### **UNIT-III MEASUREMENT OF NON-ELECTRICAL BIO-PARAMETERS 9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit, Sphygmomanometer.Pulse oximeter

### **UNIT-IV FLOW AND SENSORY MEASUREMENTS 9**

Blood flow and cardiac output measurement: Indicator dilution, thermal dilution, Psycho Physiological Measurements for testing and sensory Responses, Electro Oculograph (EOG), Electro Retinograph (ERG), Audiometer-Pure tone, Speech. EGG (Electrogastrograph), Galvanic Skin Resistance (GSR), Plethysmography -PPG

### **UNIT-V BIO AMLIFIERS & PATIENT SAFETY 9**

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards –Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Illustrate the origin of various biological signals and their characteristics.
- Gain knowledge on various modules involved in monitoring and transmission of vital signs of human.
- Explain the different measurement techniques for non-electrical bio-parameters

- Explain the flow and sensory measurement techniques as applicable for diagnosis and further treatment.
- Understand the standards and safety measures to be followed when using Biomedical Equipment.

### TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

### REFERENCE BOOKS

1. John Enderle, Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, second edition, Academic Press, 2005.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

### WEBSITE REFERENCES :

1. <https://nptel.ac.in/courses/108105101/>
2. <https://www.youtube.com/watch?v=49CWbXNJ3WE&t=35s>
3. [https://www.youtube.com/watch?v=NeiD87ZkJ8&list=PLXcK6l9b40r\\_WeJMfo7Wb5RYMdP6brgpj](https://www.youtube.com/watch?v=NeiD87ZkJ8&list=PLXcK6l9b40r_WeJMfo7Wb5RYMdP6brgpj)
4. <https://www.youtube.com/watch?v=zj1teWL9k7A>
5. <https://www.youtube.com/watch?v=xJkeLiRQBvU>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	3	-	-	2	2	3
CO2	3	3	3	3	3	-	3	-	-	2	2	3
CO3	3	3	3	3	3	-	3	-	-	2	2	3
CO4	3	3	3	3	3	-	3	-	-	2	2	3
CO5	3	3	3	3	3	-	3	-	-	2	2	3

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3

<b>JBM1404</b>	<b>BIO CONTROL SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## **COURSE OBJECTIVES**

- To understand the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems
- To analyze the time response of various systems and discuss the concept of system stability
- To analyze the frequency response characteristics of various systems using different charts
- To understand the concept of modeling basic physiological systems
- To comprehend the application aspects of feed back analysis in physiological control systems

### **UNIT-I INTRODUCTION 9**

Open and Closed loop Systems, Modeling and Block Diagrams, Block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control system.

### **UNIT-II TIME RESPONSE ANALYSIS 9**

Step and impulse responses of first order and second order systems, time domain specifications of first and second order systems, steady state error constants, Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability.

### **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 PHYSIOLOGICAL SYSTEM MODELS 9**

System properties- different configurations of tracheal network, static and dynamic resistance, Thermal resistance in human systems, System with volume storage capacity and its electrical analog , Simplified model of respiratory system , Simulation of aortic segments, Comparison of muscle model isotonic response, Step response of resistant / compliant systems –Dye dilution study of circulation, pulse response of first order system

### **UNIT-V FEEDBACK IN PHYSIOLOGICAL MODEL 9**

Characterization of Physiological Feedback systems - Hypophysis adrenal systems, pupillary hippus, Uses and Testing of System Stability, Simulation-Hodgkin-Huxley model, Model of cardiovascular variability.

**TOTAL: 45 PERIODS**

## **COURSE OUTCOMES:**

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

- Understand the basics of physical systems and mathematical model of electrical systems
- Acquire knowledge to process the physical systems using mathematical expressions, check stability and analyze the systems in time domain
- Apply the acquired knowledge to process the physical systems to check for stability of systems and analyze the response of systems frequency domain
- Develop the system to analyze the real time bio-signals in terms of their properties and apply the concept of modeling basic physiological systems
- Comprehend the application aspects of feedback analysis in physiological control systems.

**TEXT BOOKS:**

1. Nagrath J and Gopal M—"Control Systems Engineering", Fifth Edition, Anshan Publishers,2008. (UNIT - I to IV)
2. Michael C K Khoo, —Physiological Control Systems , IEEE Press, Prentice Hall of India, 2005 (UNIT - V)

**REFERENCES:**

1. Benjamin C.Kuo, "Automatic Control Systems ", Prentice Hall of India, 1995.
2. Richard C.Dorf, Robert H.Bishop,—Modern control systems, Pearson, 2004.
3. Gopal M., "Control Systems Principles and Design", Tata McGraw Hill, 2002.
4. Sinha N.K., Control Systems, 3rd Edition, New Age International Pvt. Ltd. Publishers, 2005. Nageswara Rao, Control Systems, 3rd Edition, A.R. Publications, 2003
5. Joseph Bronzino,, "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.

**WEBSITE REFERENCES :**

1. <https://nptel.ac.in/courses/107106081/>
2. <https://nptel.ac.in/courses/108/106/108106098/>
3. [https://www.youtube.com/watch?v=fHD\\_dexFmGA](https://www.youtube.com/watch?v=fHD_dexFmGA)
4. <https://www.youtube.com/watch?v=3cvV19nlNww>
5. <https://www.youtube.com/watch?v=T-wYZ9QyWhU>

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	1	-	-	-	1	3	1
CO2	3	1	1	-	-	1	-	-	-	1	3	1
CO3	3	1	1	-	-	1	-	-	-	1	3	1
CO4	3	1	1	-	-	1	-	-	-	1	3	1
CO5	3	1	1	-	-	1	-	-	-	1	3	1

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	2	1
CO2	1	1
CO3	1	-
CO4	1	-
CO5	1	-



<b>JPT1001</b>	<b>SOFT SKILLS AND APTITUDE- II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

- To help students learn various forms of writing and develop content
- To help students acquire time and stress management skills
- To facilitate students to gain required knowledge to understand practical concepts in aptitude
- To develop the thinking and analytical skills of students
- To gain knowledge in concepts of C programming language

**UNIT I SOFT SKILLS AND APTITUDE-III 9**

Communication – on Specific topics – both oral and written – Content development – various forms of writing and specific writing – Brainstorming – Individual – Concept focusing – Public Speaking – Analytical writing.

**UNIT-II SOFT SKILLS AND APTITUDE-IV 9**

Importance of Time – Time Management techniques – The art of prioritizing and scheduling – Stress – Positive and Negative Stress - Stress Management techniques – Concept of Goal setting – Importance of Goals – Dream vs Goal – Reasons for failure of Goals – SMART.

**UNIT-III QUANTITATIVE APTITUDE 9**

Ratio and Proportions – Allegations and Mixtures – Problem on Ages – Profit and Loss and Discount

**UNIT-IV LOGICAL REASONING 9**

Odd man out series – Blood Relation – Seating Arrangement – Number Ranking

**UNIT-V TECHNICAL APTITUDE IN C-II 9**

Strings - Storage Classes – Pointers – Preprocessor directives - Structures – Union. Typedef – Input/Output – File I/O - Header Files – Type casting – Error handling – Command Line Arguments – Variable Arguments – Memory Management - Bitwise operators.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

- Develop different types of content using the skills learnt
- Manage time and stress competently
- Find answers to real time application problems
- Use logical reasoning skills to solve problems differently
- Apply C programming concepts for coding

**TEXT BOOKS:**

1. R. S Agrawal, “Quantitative Aptitude”.
2. R. S. Agrawal, “Verbal Reasoning”.
3. R. S. Agrawal “Non Verbal reasoning.
4. PradipDey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009

5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

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1. <https://www.indiabix.com/aptitude/questions-and-answers/>
2. <https://m4maths.com/placement-puzzles.php>
3. [www.freshersworld.com](http://www.freshersworld.com)
4. [https://www.youtube.com > watch>problems on ages](https://www.youtube.com/watch>problems+on+ages)
5. [https://www.youtube.com > watch>blood relation](https://www.youtube.com/watch>blood+relation)
6. [https://www.youtube.com > watch>content](https://www.youtube.com/watch>content)

### CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	3	-	-	1	2	2	3
CO2	3	3	1	1	-	3	-	-	1	2	2	3
CO3	3	3	1	1	-	3	-	-	1	2	2	3
CO4	3	3	1	1	-	3	-	-	1	2	2	3
CO5	3	3	1	1	-	3	-	-	1	2	2	3

### CO - PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

<b>JBM1411</b>	<b>ANALOG &amp; DIGITAL INTEGRATED CIRCUITS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### COURSE OBJECTIVES:

- To design simple combinational logic circuits
- To demonstrate the working of sequential logic circuits -Shift registers and Counters
- To understand the applications of operation amplifier.
- To learn the working of multivibrators
- To study about analog to digital and digital to analog conversions

### LIST OF EXPERIMENTS

1. Study of logic gates
2. Half adder and Full adder
3. Encoder and BCD to 7 segment decoder
4. Multiplexer and demultiplexer using digital ICs
5. Universal shift register using flip flops
6. Design of mod-N counter
7. Inverting, non-inverting amplifier and comparator
8. Integrator and Differentiator

9. Current to Voltage convertor and Voltage to Current Convertor
10. Comparator, Schmitt trigger
11. Multivibrators using IC555 Timer
12. Study of A/D and D/A convertor

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

- Design simple digital circuits using logic gates
- Implement shift register and counters
- Demonstrate the circuits for different applications using OPAMP
- Explain the working of multivibrator circuits.
- Convert Analog Signals into Digital Signal

**WEBSITE REFERENCES :**

1. <https://www.youtube.com/watch?v=X7B8YwCUWpE>
2. <https://www.youtube.com/watch?v=smeUN1Bxj3M>
3. <https://www.youtube.com/watch?v=FKvnmxte98A>
4. <https://www.youtube.com/watch?v=AEGzpMIosvc>
5. [https://www.youtube.com/watch?v=Xulj0l\\_5b2k](https://www.youtube.com/watch?v=Xulj0l_5b2k)
6. <https://www.youtube.com/watch?v=OPvs7A554Rw>

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1	Digital Trainer Kit - (with 5 V, Variable and fixed frequency Clock, Bread Board, Four Seven Segment displays, LEDs for output display, Logic 1 and 0 Input switches)	15 Nos.
2	Logic ICs - (7400, 7402, 7404, 7408, 7410, 7420, 7432, 7447,7448, 7474, 7476, 7483,7485,7486,7490, 7495, 74151,Common Anode and cathode 7-segment displays, LEDs)	50 Nos each
3	NE 555	20 Nos.
4	IC741 – OPAMP	50 Nos.
5	A/D and D/A convertors	5 Nos.
6	Resistors	50 Nos.
7	Capacitors	50 Nos.
8	Regulated power supply-Dual 0 to 30V	5 Nos.
9	Regulated power supply-Single 0 to 30V	5 Nos.
10	Bread Boards	15 Nos.

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	1	-	2	1	2	3	1
CO2	3	3	3	3	2	1	-	1	1	1	2	1
CO3	3	1	1	1	1	1	-	2	1	1	2	2
CO4	3	2	3	2	3	1	-	-	1	3	3	3
CO5	3	1	1	1	3	1	-	2	1	2	2	3

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

<b>JBM1412</b>	<b>PATHOLOGY AND MICROBIOLOGY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVES:**

- To perform physical and chemical examination of urine
- To study the Usage of Compound microscope
- To perform Chemical examinations, Cryoprocessing, Histopathological examinations etc.
- To perform different types of staining
- To identify microfilaria and Leishmaniadonovani

**LIST OF EXPERIMENTS:**

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope
3. Histopathological slides of benign and malignant tumors
4. Manual paraffin tissue processing and section cutting (demonstration)
5. Basic staining
6. Special staining
7. Capsule staining
8. Simple staining

10. Gram staining
11. Abstaining
12. Slides of malarial parasites, micro filaria and Leishmaniadonovani.
13. Haematology slides of anemia and leukemia.
14. Study of bone marrow charts.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

- Experiment physical and chemical examination of urine
- Explain the Usage of Compound microscope
- Demonstrate practical experiments on Cryoprocessing, Histopathological examinations etc.
- Distinguish different types of staining
- Identify microfilaria and Leishmaniadonovani

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1.	Colorimeter	2
2.	Optical Microscope	1
3.	Cryosectioning	1
4.	Hot air oven	1
5.	Incubator	1
6.	Autoclave	1
7.	Fridge	1
8.	PH meter	1
9.	Vortex mixer	1
10.	Slide dispenser	1

**CO-PO MAPPING:**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	2	-	2	1	3	3	2	2
CO2	3	2	2	2	2	3	-	-	3	1	2	2
CO3	3	3	2	3	1	2	3	2	2	2	3	3
CO4	2	2	3	1	3	3	3	2	3	3	2	2
CO5	3	3	2	1	1	1	1	1	1	3	-	-

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	2	2
CO2	1	2
CO3	2	1
CO4	1	2
CO5	-	2

<b>JBM1413</b>	<b>BIOMEDICAL INSTRUMENTATION LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### COURSE OBJECTIVES:

- To design biological preamplifier
- To record and analyze biosignals
- To measure and record peripheral blood flow.
- To study the characteristics of isolation amplifier
- To record and analyze the non-electrical physiological measurements of the body

### LIST OF EXPERIMENTS:

1. Design and analysis of biological pre amplifiers
2. Recording of ECG signal and analysis
3. Recording of EMG-Signal
4. Recording of EEG-Signal
5. Recording of various physiological parameters using patient monitoring system
6. and telemetry units.
7. Measurement of pH and conductivity.
8. Measurement and recording of peripheral blood flow
9. Measurement of visually evoked potential.
10. Study of characteristics of optical Isolation amplifier
11. Measurement of blood pressure using sphygmomanometer.
12. Measurement of Respiratory parameters using spirometry.

**TOTAL: 60 PERIODS**

### COURSE OUTCOMES:

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

- Understand the basics of different types of electrodes in biological measurements
- Place the different electrodes using electrode configuration
- Record various biological signals
- Perform non-electrical physiological measurements
- Explain the bio chemical measurement devices
- Perform electrical physiological measurements

### WEBSITE REFERENCES

1. <https://medcraveonline.com/IJBSBE/design-of-an-ecg-sensor-circuitry-for-cardiovascular-disease-diagnosis.html>
2. [https://www.youtube.com/watch?v=tZcKT4l\\_JZk](https://www.youtube.com/watch?v=tZcKT4l_JZk)

3. [https://www.youtube.com/watch?v=8Q57q\\_kQPQY](https://www.youtube.com/watch?v=8Q57q_kQPQY)

4. <https://ieeexplore.ieee.org/document/6290719>

### LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

1.	Multiparameter patient monitoring system	1 No
2.	EEG recorder with accessories for evoked studies	1 No
3.	ECG recorder	1 No
4.	EMG recorder	1 No
5.	pH meter, conductivity meter	1 No
6.	Blood flow measurement system using ultrasound transducer	1 No
7.	GSR measurement setup.	1 No
8.	Spirometer	1 No
9.	Sphygmomanometer	1 No
10.	Function Generators	-
11.	DSOs	-
12.	Rugulated Power Supplies	-
13.	Breadboards	-
14.	IC 741	-

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	3	2	2	2	2	3
CO2	3	3	3	3	3	2	3	2	2	2	2	3
CO3	3	3	3	3	3	2	3	2	2	2	2	3
CO4	3	3	3	3	3	2	3	2	2	2	2	3
CO5	3	3	3	3	3	2	3	2	2	2	2	3

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3

## SEMESTER 5

<b>JEE1501</b>	<b>MICRO PROCESSORS AND MICRO CONTROLLERS (INTEGRATED COURSE)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To impart knowledge on architecture and interrupt structure of  $\mu$ P8085
- To impart knowledge on addressing modes and ALP of 8085
- To study the architecture and programming of 8051 microcontroller.
- To acquire knowledge about the features and functionalities of the peripheral devices and interfacing
- To understand the concepts of developing microcontroller based systems for various applications.

### **UNIT I THE 8085 MICRO PROCESSOR 6**

Hardware Architecture – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts

### **UNITII PROGRAMMING OF 8085 PROCESSOR 6**

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Subroutine instructions – stack- Introduction to 16-bit microprocessor

### **UNIT III 8051 MICRO CONTROLLERS 6**

Architecture of 8051 – Special Function Registers (SFRs) - Interrupts –Timer and counter - Instruction set - Addressing modes - Simple assembly language programming

### **UNITIV PERIPHERAL INTERFACING 6**

Programmable Peripheral Interface (8255) - Keyboard/Display Controller (8279) -Programmable Timer/ Counter (8254) - Programmable Interrupt Controller (8259) - DMA Controller (8257) - Serial Communication Interface (8251)

### **UNIT V MICRO CONTROLLER PROGRAMMING AND APPLICATIONS 6**

Simple programming exercises- key board and display interface –Control of servo motor-stepper motor control-Traffic Light control -ADC/DAC & Sensor Interfacing - Waveform generation.

**(TOTAL: 30 PERIODS)**

### **LIST OF EXPERIMENTS:**

#### **8085 PROGRAMS USING KITS**

1. Basic arithmetic and Logical operations
2. Move a data block
3. Programming with control instructions:
4. Ascending / Descending order, Maximum / Minimum of numbers.
5. Programs using Rotate instructions.
6. Code conversion, decimal arithmetic and matrix operations.
7. Floating point operations, string manipulations, sorting and searching



## **8051 EXPERIMENTS USING KITS**

1. Basic arithmetic and logical operations
2. conditional jumps & looping
3. Code conversion & calling subroutines

## **PERIPHERALS AND INTERFACING**

1. Traffic light control
2. Stepper motor control
3. Key board and Display
4. Serial interface and Parallel interface
5. A/D and D/A interface and Waveform Generation

## **8086 DEMONSTRATION USING SOFTWARE PACKAGE**

**(30 PERIODS)**

**(TOTAL - 60 PERIODS)**

### **COURSE OUTCOMES:**

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

- To understand about the architecture of 8085 microprocessor.
- To acquire knowledge in Addressing modes & instruction set of 8085 and write the assembly language programme.
- To realize the architecture and programming of 8051 microcontroller.
- To gain knowledge about the features and functionalities of the peripheral devices and interfacing
- To understand the concepts of developing microcontroller based systems for various applications.

### **TEXT BOOKS:**

1. Sunil Mathur & Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Krishna Kant, “Microprocessor and Microcontrollers, Architecture, Programming and System Design 8085, 8086, 8051”, Second Edition, PHI Learning Private Limited, 2014.
4. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
5. Rajkamal, “Microcontrollers - Architecture, Programming, Interfacing and System design, 2<sup>nd</sup> edition, Pearson, 2021.

### **REFERENCE:**

1. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM, “Computer Fundamentals Architecture and Organization” New age International Private Limited, Fifth edition, 2017.
3. DouglasV.Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,2016.
4. Kenneth J Ayala “The 8051 Microcontroller, Architecture, Programming and Applications” 2<sup>nd</sup> edition Penram International Publishing, 1996.
5. Muhammad H. Rashid, “The 8051 Microcontroller and Embedded Systems, Volume 1” Prentice Hall, 2000.
6. Barry B Brey, "The Intel Microprocessor Architecture Programming and Interfacing",

Pearson Education, 4th Edition, 2006.

7. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085, 8086, 8051, McGraw Hill Edu, 2013.

### WEBSITE REFERENCE:

1. <https://www.digimat.in/nptel/courses/video/108105102/L01.html>
2. <http://freevideolectures.com/courses/3018/microprocessors-and-microcontrollers>
3. <http://www.digimat.in/nptel/courses/video/108105102/L31.html>
4. <https://youtu.be/myw7ycAgJYM>
5. <https://nptel.ac.in/courses/108107029/>
6. <https://www.iitk.ac.in/new/microprocessor-and-microcontroller-laboratory>
7. <http://209.211.220.205/vlabiitkce/mi/labsMI.php>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	2	1	-	-	-	-	-	-	1
CO2	3	-	-	2	1	-	-	-	-	-	-	1
CO3	3	-	-	2	1	-	-	-	-	-	-	1
CO4	3	-	-	2	1	-	-	-	-	-	-	1
CO5	3	-	-	2	1	-	-	-	-	-	-	1

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	2	2
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

JEC 1304	SIGNALS AND SYSTEMS	L	T	P	C
		2	2	0	3

### OBJECTIVES:

- To understand the basic properties and classification of signals and systems.
- To analyze continuous time signals using Fourier and Laplace domain
- To analyze continuous time linear time invariant system in the Fourier and Laplace domain
- To analyze discrete time signals using Discrete time Fourier and Z transform domain
- To analyze discrete time linear time invariant system in Z domain.

### UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS

12

Standard signals-Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids- Classification of signals-operation on 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- Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

## **UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 12**

Fourier series of Periodic signals -Trigonometric, Cosine representation and exponential, Symmetry conditions-Fourier Transform and its properties -Laplace Transforms and its properties.

## **UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12**

Impulse response - convolution integrals-Differential equation- Fourier and Laplace Transforms in Analysis CT - LTI systems- CT Systems connected in series and parallel.

## **UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12**

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT- Z Transform and its properties-.

## **UNIT V LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS 12**

Impulse response -Convolution sum- Difference equations- discrete time Fourier Transform and Z Transform -Analysis of Recursive & Non-Recursive systems – DT Systems connected in series and parallel.

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Analyze the characteristics of signals and systems.
- Analyze and characterize CT signals using Fourier transform and Laplace transform.
- Investigate and characterize CT LTI systems using Fourier transform and Laplace transform.
- Analyze and characterize DT signals using Discrete Time Fourier transform and Z Transform.
- Investigate and characterize DT LTI systems using Discrete time Fourier transform and Z Transform

### **TEXT BOOKS:**

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, 2<sup>nd</sup> Edn., Pearson, 2015.
2. P.Ramesh Babu and R.AnandaNatarajan,“Signals and Systems”, 5<sup>th</sup> EdnScitech 2017

### **REFERENCES:**

1. H. P. Hsu, “Signals and Systems” Schaum’sOutline Series, McGraw Hill Professional, 3rd Edition, 2013.
2. A.Anandkumar,“Signals and Systems”, 2<sup>nd</sup> Edn, PHI Learning 2012
3. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
4. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
5. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
6. Simon Haykin and Barry Van Veen “Signals and Systems”,Wiley& Sons, 3<sup>rd</sup>Edition, 2012.
7. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson Education, 4th Edition, 2014.

### **WEBSITE REFERENCES:**

1. <https://nptel.ac.in/courses>

2. [https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ\\_9kfoqZyx](https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyx) Prof. K.S. Venkatesh, Department of Electrical Engineering, IIT Kanpur
3. [https://www.academia.edu/34693866/Continuous\\_and\\_Discrete\\_Time\\_Signals and Systems](https://www.academia.edu/34693866/Continuous_and_Discrete_Time_Signals_and_Systems)
4. <https://web.stanford.edu/~boyd/ee102/laplace.pdf>
5. [https://www.youtube.com/watch?v=WXwQ\\_fb7NEk-](https://www.youtube.com/watch?v=WXwQ_fb7NEk-) V.G.K.Murti, Department of Electrical Engineering, IIT Madras.
6. <https://www.youtube.com/watch?v=IanYg7ujpo0> - Prof.S. C Dutta Roy, Department of Electrical Engineering, IIT Delhi

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	2	2
CO2	3	3	3	2	2	1	-	-	-	-	2	2
CO3	3	3	3	2	2	1	-	-	-	-	2	2
CO4	3	3	3	2	2	1	-	-	-	-	2	2
CO5	3	3	3	2	2	1	-	-	-	-	2	2

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	2	3
CO2	1	2
CO3	2	2
CO4	2	2
CO5	1	3

JBM 1501	RADIOLOGICAL EQUIPMENT	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To understand the generation of X-ray and its uses in imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging
- To discuss the radiation therapy techniques and radiation safety.

### UNIT I MEDICAL X-RAY EQUIPMENT

9

X-rays: Discovery of X-rays, production of X-rays, X-Ray tubes, X-Ray generator circuits, quality and intensity of X-rays. Interaction of X and Gamma rays with matter- Photoelectric absorption, Compton scattering, Pair production. Radiation units-Curie-Roentgen-Gray-Sievert. Computed

radiography: photo stimulable phosphor, Charge coupled devices. Digital radiography-flat pane detectors. Mammography. Fluoroscopy-digital fluoroscopy-angiography.

## **UNIT II COMPUTED TOMOGRAPHY 9**

Tomography principle. CT Generations. CT Equipment: X-ray tubes-X-ray detectors- Helical CT. Image reconstruction -iterative method, back projection, filtered back projection. Hounsfield units and grey scale. Image display. Data acquisition methods. Image quality and artifacts. Radiation dose-CT dose index(CTDI)

## **UNIT III MAGNETIC RESONANCEIMAGING 9**

Physics of magnetic resonance imaging (MRI)- Resonance and radiofrequency. Relaxation times,T1 and T2 and T2\*. MRI equipment- gradient coils, radio frequency coils, shim coils. Image sequences-spin echo, gradient recalled echo, inversion recovery. Special sequences, MR angiography, spectroscopy, perfusion imaging, diffusion weighted imaging. MRI image quality, artifacts and bio-safety

## **UNIT IV NUCLEAR MEDICINE SYSTEM 9**

Radioactivity-nuclear transformation- isotope production, radiopharmaceuticals. Radiation detectors –gas filled ionization chambers, proportional counter, GM counter -scintillation detector. Imaging equipment-Gamma camera-single photon emission computed tomography (SPECT), Positron emission tomography (PET), PET-CT, PET-MRI

## **UNIT V RADIATION THERAPY AND RADIATION QUANTITIES 9**

Radiation therapy equipment – linear accelerator-tele-Cobalt unit-CT stimulator. External beam characteristics-.principle of treatment planning. Advanced therapy techniques: IMRT – IGRT-SRS/SRT– Tomotherapy -Cyber knife- proton therapy. Brachytherapy. Radiation safety- TLD dosimeter – site planning-radiation survey-annual dose limits-regulations

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Describe the working principle of X-ray machine and its application.
- Illustrate the principle computed tomography.
- Interpret the technique used for
- visualizing various sections of the body using magnetic resonance imaging
- Explain the applications of radio nuclide imaging.
- Outline the methods of radiation safety.

### **TEXT BOOKS:**

1. Steve Webb, “The Physics of Medical Imaging”, Adam Hilger, Philadelphia, 1988 (Units I, II, III & IV).
2. R.Hendee and Russell Ritenour, “Medical Imaging Physics”, Fourth Edition William, WileyLiss, 2002.
3. Thayalan K ,Basic radiological Physics (2017),2<sup>nd</sup>Ed:Jaypee brothers medical Publisheres (P) Ltd.,New Delhi

### **REFERENCES:**

1. Thayalan K, The physics of radiology and imaging (2014):Jaypee brothers medical Publisheres (P) Ltd,New Delhi

2. GopalB. Saha, “Physics and Radiobiology of Nuclear Medicine” - Third edition Springer, 2006.
3. B.H.Brown, PVLawford, R H Small wood, DRHose, DC Barber, “Medical physics and Biomedical Engineering”, - CRC Press,1999.
4. P.Ragunathan, “Magnetic Resonance Imaging and Spectroscopy in Medicine ConceptsandTechniques”, Paperback – Import, 2007.
5. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

### WEBSITE REFERENCES:

1. [https://en.wikipedia.org/wiki/Instruments\\_used\\_in\\_radiology](https://en.wikipedia.org/wiki/Instruments_used_in_radiology)
2. <http://blog.medicomart.in/2016/07/25/list-commonly-used-radiology-instruments-uses/>
3. <https://www.medicalexpo.com/cat/radiology-AJ.html>
4. <https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy>
5. <https://www.radiologyinfo.org/en/info/gennuclear>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	-	-	-	-	1	3	2
CO2	3	3	3	2	3	-	-	-	-	1	3	3
CO3	3	3	3	3	3	-	-	-	-	1	3	3
CO4	3	3	3	2	2	-	-	-	-	1	2	2
CO5	3	3	3	2	3	-	-	-	-	1	2	2

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	3	-
CO2	2	1
CO3	2	1
CO4	2	1
CO5	3	-

JNC1361	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		2	0	0	0

### UNIT I INTRODUCTION TO TRADITIONAL KNOWLEDGE 6

Define traditional knowledge (TK), nature and characteristics, scope and importance, kinds of

traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

## **UNIT II PROTECTION OF TRADITIONAL KNOWLEDGE 6**

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

## **UNIT III LEGAL FRAME WORK AND TK 6**

A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

## **UNIT IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 6**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

## **UNIT V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 6**

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

**TOTAL: 30 PERIODS**

### **COURSE OUTCOMES:**

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

- To understand the concept of Traditional knowledge and its importance
- To know the need and importance of protecting traditional knowledge.
- To know the various enactments related to the protection of traditional knowledge.
- To understand the concepts of Intellectual property to protect the traditional knowledge.
- To know the applications of traditional knowledge in various fields.

### **REFERENCE BOOKS:**

1. Amit Jha, "Traditional Knowledge System in India", 2009.
2. Basanta Kumar Mohanta and Vipin Kumar Singh, "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.
3. Amit Jha, "Traditional Knowledge System in India", Atlantic publishers, 2002
4. Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India"

### **WEBSITE REFERENCES:**

1. <https://www.youtube.com/watch?v=LZP1StpYEPM>
2. <http://nptel.ac.in/courses/121106003/>

### **CO - PO MAPPINGS**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	1	1	1	1	-	-	-	-	-
CO2	-	-	1	1	1	1	1	-	-	-	-	-
CO3	-	-	1	1	1	1	1	-	-	-	-	-
CO4	-	-	1	1	1	1	1	-	-	-	-	-
CO5	-	-	1	1	1	1	1	-	-	-	-	-

## CO -PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1



<b>JPT1002</b>	<b>TECHNICAL SKILLS AND APTITUDE I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>*</b>

### **COURSE OBJECTIVES:**

- To make students analyze and solve problems in technical as well as quantitative aptitude.
- To enhance the technical skills and basics of programming language
- To make students understand how to apply the practical knowledge with real time applications.
- To make students think and draw a conclusion from different scenarios.
- To help students understand python programming concepts

### **UNIT I OOPS CONCEPTS 6**

What is objectoriented programming? Const and classes -Arrays and string arrays fundamentals. Arrays of object, string, the standard C++ String class - Operator overloading: Overloading unary operations. Concept of inheritance. Derived class and based class. Derived class constructors, member function, Virtual Function

### **UNIT II PYTHON I 6**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, modules and functions.

### **UNIT III PYTHON II 6**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, list parameters; Tuples: tuple assignment, Dictionaries: operations and methods; advanced list processing – list comprehension

### **UNIT IV QUANTITATIVE APTITUDE 6**

Boats and streams – Time and work – Pipes and Cistern – Time and Distance – Problems on Trains

### **UNIT V LOGICAL REASONING 6**

Syllogism – Statement and Conclusion – Inequalities – Non Verbal Reasoning – Figure Analogy – Mirror and Water images – Paper cutting and Folding – Cubes and Dices – Pattern completion.

**TOTAL: 30 PERIODS**

### **COURSE OUTCOMES:**

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

- Apply OOPS concepts in applications
- To enhance knowledge in python programming.
- Gain knowledge in coding using the python programming.
- Solve complex arithmetic problems practically with real time applications.

- Think logically in solving problems, enhance decision making, for difficult situations.

### TEXTBOOKS:

1. Dr.E. Balagurusamy, “Programming in C++” complete reference 8<sup>th</sup> Edition.
2. “THE COMPLETE REFERENCE PYTHON”, Herbert schildt., McGraw Hill Education, 2011.
3. Python: The Complete Reference by Martin Brown and Martin C.Brown Published in 2014.
4. Python in a nutshell by Alex Martelli Revised in March 2013.
5. Dr. R.S Agrawal, “Quantitative Aptitude” and Non Verbal Reasoning published in 2000.

### WEBSITE REFERENCES:

1. <https://www.indiabix.com/aptitude/questions-and-answers/>
2. <https://m4maths.com/placement-puzzles.php>
3. [www.freshersworld.com](http://www.freshersworld.com)
4. [www.careerride.com](http://www.careerride.com)
5. [www.youtube.com/watch/python](http://www.youtube.com/watch/python)
6. [www.youtube.com/watch/concepts of python](http://www.youtube.com/watch/concepts%20of%20python)
7. <https://stackoverflow.com/>
8. <https://www.w3schools.com/>
9. <https://www.geeksforgeeks.org/>

### CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	1	-	-	1	-	1
CO2	-	-	-	-	1	-	1	-	-	1	-	1
CO3	-	-	-	-	1	-	1	-	-	1	-	1
CO4	-	-	-	-	1	-	1	-	-	1	-	1
CO5	-	-	-	-	1	-	1	-	-	1	-	1

### CO - PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

<b>JHS1511</b>	<b>PROFESSIONAL COMMUNICATION</b> (Common to all B.E/ B.Tech Programmes)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### COURSE OBJECTIVES:

- To enable students to acquire aspecialized knowledge of the essential professional skills
- To train them to make effective presentationson a variety of topics

- To help them participate in group discussions displaying teamwork skills
- To build their confidence and help them attend interviews winningly
- To groom them to become successful professionals

## **UNIT I EXPOSURE TO PROFESSIONAL SKILLS 6**

Introduction to Skills: hard skills and soft skills–communication skills–interpersonal skills–employability and career skills–planning and prioritizing work–time management–stress management–emotional intelligence–SWOT analysis

## **UNIT II PREPARING AND PRESENTING INSPIRING TALKS 6**

Key elements of effective presentation–non verbal communication–impressive self-introduction and short individual presentation – preparing outline – structuring and organising content – presenting – introducing topic– developing points– concluding–answering questions

## **UNIT III MEASURES TO CRACK GROUP DISCUSSION 6**

Group discussion skills–team building–using key strategies–etiquette–content preparation–brain storming– out of box thinking–mind mapping– turn taking and turn giving–speaking persuasively–questioning and clarifying

## **UNIT IV INTERVIEW SKILL TO GET HIRED 6**

Interview skills–etiquette–body language– confidence–preparedness–types of interview–Frequently Asked Questions(FAQs)– mock interview– job application and resume writing

## **UNIT V LANGUAGE SKILLS AND CAREER MAPPING 6**

Listening skills – understanding different accents – reading skills – verbal ability – email writing – professional grooming – leadership qualities – fundamentals of entrepreneurship – career planning – goal setting– future challenges

**TOTAL:30 PERIODS**

### **COURSE OUTCOMES:**

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

- Have sufficient knowledge of the skills required for professional development
- Give form a land effective presentations
- Participate actively in group discussions
- Attend job interviews and answer questions confidently and effortlessly
- Emerge as professionals ready for placement

### **RECOMMENDED SOFTWARE:**

1. Globe arena
2. Win English

### **TEXTBOOKS:**

1. Interact English Lab Manual for Undergraduate Students, 2016, Hyderabad: Orient Black Swan.

### **REFERENCES:**

2. Alex, K, 2019, Soft Skills: Know Yourself and Know the World, New Delhi: S. Chand & Company Limited.
3. Butterfield, Jeff, 2015, Soft Skills for Everyone. New Delhi: Cengage Learning.

4. Kumar, Suresh E et al, 2015, Communication for Professional Success, Hyderabad: OrientBlackSwan.
5. Mitra, Barun K, 2016, Personality Development and Soft Skills, New Delhi: OxfordUniversityPress.
6. Raman, Meenakshi and Sangeeta Sharma, 2014, Professional Communication, Oxford: OxfordUniversityPress.
7. Rizvi, Ashraf, M, 2018, Effective Technical Communication, Chennai: McGraw-HillEducation.

### WEBSITE REFERENCES:

1. <https://www.britishcouncil.in/english/online/resources-websites/moocs>
2. <https://alison.com/courses/communications>
3. <https://in.topresume.com/career-advice/15-free-resources-to-improve-your-presentation-and-speaking-skills>
4. [http://www.washington.edu/doing/TeamN/present\\_tips.html](http://www.washington.edu/doing/TeamN/present_tips.html)
5. <https://www.softwaretestinghelp.com/how-to-crack-the-gd/>
6. <http://www.oxforddictionaries.com/words/writing-job-applications>
7. [http://www.mindtools.com/pages/article/newCDV\\_34.htm](http://www.mindtools.com/pages/article/newCDV_34.htm)
8. <https://myinterviewpractice.com/>

### CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	1	-	-	1	-	1
CO2	-	-	-	-	1	-	1	-	-	1	-	1
CO3	-	-	-	-	1	-	1	-	-	1	-	1
CO4	-	-	-	-	1	-	1	-	-	1	-	1
CO5	-	-	-	-	1	-	1	-	-	1	-	1

### CO - PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

JBM 1511	PROGRAMMING TOOLS FOR BIOMEDICAL ENGINEERS	L	T	P	C
		0	0	2	1

### COURSE OBJECTIVES:

- To practice in MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files and basic programming.
- To impart knowledge on generation and analysis of signals

- To make them understand basic R programming
- To Prepare and visualize data using R programming
- To elucidate the data statistics in R programming

### EXPERIMENTS USING MATLAB

1. Basic commands Assigning variables Operations with variables
2. Operations on matrix
3. 2D and 3D plot
4. Loops and Conditional Statements
5. Writing functions
6. Generation of signals

### EXPERIMENTS USING R PROGRAMMING

1. Basic language elements and datatypes
2. R -data structures
3. Data input/output
4. Control structures and Functions
5. Data preparation
6. Data visualization
7. Data statistics

**TOTAL: 30 PERIODS**

### COURSE OUTCOMES:

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

- Execute Basic arithmetic operations, Boolean operations in MATLAB
- Demonstrate signal generation and analyze the signal generated .
- Execute programs on control structures and function in R programming
- Prepare missing data and data visualization using R programming
- Perform data statistics in R programming

### WEBSITE REFERENCES:

1. [https://nptel.ac.in/content/storage2/courses/103106118/Week%20%201/1\\_MATLAB\\_Basics.pdf](https://nptel.ac.in/content/storage2/courses/103106118/Week%20%201/1_MATLAB_Basics.pdf)
2. <https://nptel.ac.in/courses/108/102/108102044/>
3. <https://nptel.ac.in/courses/111/104/111104100/>
4. <https://nptel.ac.in/courses/111/104/111104120/>
5. [https://onlinecourses.nptel.ac.in/noc21\\_ma37/preview](https://onlinecourses.nptel.ac.in/noc21_ma37/preview)

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	-	-	3	2	3	3	2	1
CO2	3	2	2	-	-	-	3	2	3	3	2	1
CO3	3	2	2	-	1	-	3	2	3	3	2	1
CO4	3	2	2	2	1	-	3	2	3	3	2	1
CO5	3	2	2	-	1	-	3	2	3	3	2	1

### CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	2	-

### EQUIPMENT LIST:

SL.NO	EQUIPMENT & SOFTWARE	NO REQUIRED
1	PCs with related accessories	15
2	Matlab software	10
3	Open source programming – R software	10

JBM 1521	MINI PROJECT	L	T	P	C
		0	0	2	1

### COURSE OBJECTIVES

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

### COURSE GUIDELINES

- The students are required to search / gather the material / information on a specific a topic comprehend it and present via ppt, prototype model, video etc., to the panel for further discussion and approval.
- The students in a group of 3 to 4 works on the approved topic should make a hardware/software model which shall be a working model or simulated output. The progress of the project should be presented and get evaluated by a reviewer committee constituted by the head of the department.
- The student's batch should prepare a comprehensive mini project report after completing the work to the satisfaction of the reviewer committee. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 30 PERIODS**

## **COURSE OUTCOMES:**

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

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Express the technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present the oral demonstrations.

## **CO - PO MAPPING**

<b>CO/PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	1	3	3	1	2	-	-	-	2	1	2
<b>CO2</b>	3	3	3	3	3	2	-	-	-	1	2	3
<b>CO3</b>	3	2	3	1	3	3	-	-	-	2	2	3
<b>CO4</b>	3	3	3	3	3	3	-	-	-	1	2	3
<b>CO5</b>	3	2	3	3	2	3	-	-	-	3	2	2

## **CO - PSO MAPPING**

<b>CO\PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	1	3	2
<b>CO2</b>	2	2	1
<b>CO3</b>	2	2	3
<b>CO4</b>	1	2	2
<b>CO5</b>	2	3	3





## COURSE OUTCOMES:

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

- Explain the medical devices used diagnostic and therapeutic applications related to cardiac equipments
- Describe the medical devices used in diagnostic techniques and therapeutic applications related to neurological equipment.
- Explain various equipments relevant to muscular and biomechanical diagnostic procedures.
- Explain different types of diathermy equipment and discuss on usefulness of ultrasound in diagnosis.
- Describe the techniques involved in various extracorporeal medical devices and special diagnostic and therapeutic equipments

## TEXTBOOKS :

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt. Ltd, New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology, Pearson Education, 2004.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

## REFERENCE BOOKS :

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. Anthony Y.K. Chan, "Biomedical Device Technology – Principles and Design", Charles C Thomas Publisher Ltd., 2008.
3. Joseph D. Bronzino, "The Biomedical Engineering Handbook", Third Edition: Three Volume Set, CRC Press, 2006
4. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merrill Publishing Company., 2006
5. Albert M. Cook and Webster J.G, "Therapeutic Medical devices", Prentice Hall Inc., New Jersey, 1982.

## WEBSITE REFERENCES :

1. [https://www.who.int/medical\\_devices/priority/core\\_equipment](https://www.who.int/medical_devices/priority/core_equipment)
2. <https://gpcmedicalequipment.wordpress.com>
3. <https://www.dicardiology.com>
4. <https://www.youtube.com/watch?v=kwLbSx9BNbU>
5. <https://geekymedics.com/record-ecg/>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	3	-	-	2	2	3
CO2	3	3	3	3	3	-	3	-	-	2	2	3
CO3	3	3	3	3	3	-	3	-	-	2	2	3
CO4	3	3	3	3	3	-	3	-	-	2	2	3
CO5	3	3	3	3	3	-	3	-	-	2	2	3

**CO-PSO MAPPING:**

CO\PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3

JEC 1501	DISCRETE TIME SIGNAL PROCESSING	L	T	P	C
		2	2	0	3

**COURSE OBJECTIVES:**

- To learn discrete Fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand and design FIR filters and apply these filters to filter undesirable signals in various frequency bands.
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi rate signal processing and its applications communication and biomedical engineering

**UNIT I INTRODUCTION TO DISCRETE FOURIER TRANSFORM 12**

Introduction to Discrete Fourier transform (DFT) - Computation of DFT - Properties of DFT - Linear filtering using DFT- Filtering long data sequences - overlap save and overlap add method- Fast Fourier transform (FFT Radix-2) - Decimation-in-time and Decimation-in-frequency.

**UNIT II INFINITE IMPULSE RESPONSE FILTERS 12**

Design of analog filters - Butterworth filter -Design of digital IIR filters from analog filters (LPF, HPF, BPF) - Impulse invariance method, Bilinear transformation- Introduction to Chebyshev Filters - Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

**UNIT III FINITE IMPULSE RESPONSE FILTERS 12**

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming, Hanning and Blackmann window),Frequency sampling method-FIR filter structures - Direct form and cascade realizations, Linear phase structure.

**UNIT IV FINITE WORD LENGTH EFFECTS 12**

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise – input quantization error - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations – signal scaling.

## UNIT V MULTIRATE SIGNAL PROCESSING

12

Introduction to Multirate signal processing- Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor - Sampling rate conversion by a rational factor - Multistage implementation of sampling rate conversion - Applications of Multirate signal processing and adaptive filtering - narrowband filtering of fetal ECG.

**TOTAL: 60 PERIODS**

### COURSE OUTCOMES:

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

- Apply DFT for the analysis of digital signals and systems
- Design IIR and FIR filters
- Design FIR filters
- Characterize the effects of finite precision representation on digital filters
- Design multirate filters and apply adaptive filters appropriately for communication and biomedical systems

### TEXT BOOKS:

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. V. Oppenheim, R.W. Schaffer and J.R. Buck, "Discrete-Time Signal Processing", 8<sup>th</sup> Indian Reprint, Pearson, 2010.

### REFERENCES

1. Emmanuel C. Ifeakor & Barrie W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, Reprint, 2011.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Fourth Edition, Tata McGraw Hill, 2013.
3. Andreas Antoniou, "Digital Signal Processing", Second Edition, Tata McGraw Hill, 2009.
4. M.H. Hayes, "Digital Signal Processing, Schaum's Outline Series", Second Edition McGraw-Hill, New York, 2011.

### WEBSITE REFERENCES:

1. <https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/>
2. [https://onlinecourses.nptel.ac.in/noc20\\_ee31/preview](https://onlinecourses.nptel.ac.in/noc20_ee31/preview)
3. <https://nptel.ac.in/courses/117/105/117105134/>, Prof. Mrityunjay Chakraborty, IIT Kharagpur.
4. <https://nptel.ac.in/courses/108/105/108105055/>, Prof. T. K. Basu, IIT Kharagpur.
5. <https://nptel.ac.in/courses/117/102/117102060/>, Prof. S. C. Dutta Roy, IIT Delhi.

### CO - PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	-	-	-	-	3	2
CO2	3	3	3	3	3	1	-	-	-	-	2	3
CO3	3	3	3	3	3	1	-	-	-	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	2	3
CO5	3	3	3	3	3	1	-	-	-	-	3	2

## CO - PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	2	3
CO4	3	3
CO5	3	3

JPT1002	TECHNICAL SKILLS AND APTITUDE-II	L	T	P	C
		0	0	2	1

### COURSE OBJECTIVES

- To make students analyze and solve problems in technical as well as quantitative aptitude. Enhance the technical skills and basics of programming language
- To make the students understand how to apply the practical knowledge in real time applications.
- To make the students think and draw conclusions from different scenarios.
- To help the students understand JAVA programming concepts
- To help the students understand concepts and develop new applications in JAVA

#### **UNIT I JAVA FUNDAMENTALS 6**

OOP in Java – Characteristics of Java – Java Source-File -Structure – Compilation. Fundamental Programming Structures in Java.

#### **UNIT II ADVANCED JAVA PROGRAMMING 6**

Defining classes in Java – constructors, methods -access specifiers – static members - Data Types, Variables, Operators, Control Flow, Arrays, Inheritance – Super classes- sub classes – Protected members – constructors in sub classes- Interfaces –Strings.

#### **UNIT III MATHEMATICAL AND ARITHMETIC PROBLEM SOLVING 6**

Crptoarithmic Problem Solving, Logarithms, Trigonometry, Mensuration, Probability, Permutations and Combinations.

#### **UNIT IV LOGICAL REASONING - COGNITIVE THINKING 6**

Numerical Ability, English Ability, Gaming, Arrangements, Visual Reasoning, Flowcharts – Visual Reasoning – DI.

#### **UNIT V LOGICAL REASONING - CRITICAL THINKING 6**

Logical Sequence, Inferred Meaning, Agree Disagree Psychometric, Statement & Conclusions, Cubes and Cuboids.

**TOTAL: 30 PERIODS**

## COURSE OUTCOMES:

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

- Enhance their knowledge in JAVA concepts and Java Programming.
- Gain knowledge in coding using JAVA programming.
- Solve complex arithmetic problems practically with real time applications.
- Think logically in solving problems, enhance decision making, for difficult situations

## TEXT BOOKS:

1. Herbert Schildt, “Java The complete reference”, 8<sup>th</sup> Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9<sup>th</sup> Edition, Prentice Hall, 2013.
3. Dr. R.S Agrawal, “Quantitative Aptitude” and Non Verbal Reasoning published in 2000.
4. S.Chand – A Modern Approach to Logical Reasoning Published in 2000.

## WEBSITE REFERENCES:

1. <https://www.indiabix.com/aptitude/questions-and-answers/>
2. <https://m4maths.com/placement-puzzles.php>
3. [www.freshersworld.com](http://www.freshersworld.com)
4. [www.careerride.com](http://www.careerride.com)
5. [www.youtube.com/watch/python](http://www.youtube.com/watch/python)
6. [www.youtube.com/watch/concepts of python](http://www.youtube.com/watch/concepts%20of%20python)
7. <https://stackoverflow.com/>
8. <https://www.w3schools.com/>
9. <https://www.geeksforgeeks.org/>

## CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	-	1	-	-	1	-	1
CO2	-	-	-	-	1	-	1	-	-	1	-	1
CO3	-	-	-	-	1	-	1	-	-	1	-	1
CO4	-	-	-	-	1	-	1	-	-	1	-	1
CO5	-	-	-	-	1	-	1	-	-	1	-	1

<b>JBM1611</b>	<b>DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

## COURSE OBJECTIVES:

- To study the equipments used for biosignal acquisition .
- To understand the working of different therapeutic equipments.
- To use simulation tool for acquisition and analysis of Biosignals.
- To provide knowledge on diagnostic imaging modality.
- To learn the concepts of transmission of biosignals over a distance.

## LIST OF EXPERIMENTS:

1. Simulation of ECG – detection of QRS complex and heart rate

2. Shortwave diathermy - Measurement of application parameters
3. Ultrasonic diathermy - Measurement of energy and study of its applications
4. Study of Medical Stimulator.
5. Cutting and Coagulation operations using Electrosurgical Unit.
6. Recording of Audiogram
7. Fibrillation correction using Defibrillator.
8. Correction of abnormal pacing using Pacemaker model
9. Design of ECG and EMG amplifier, recording and analysis using simulation tools.
10. Study of Ultrasound scanner
11. Transmission of biosignals using Biotelemetry
12. Analysis of electrical safety in equipments using Electrical Safety Analyzer

### **LAB REQUIREMENTS FOR 30 STUDENTS**

1. Multioutput 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 Analyser 1 No.
6. Medical simulator 1 No
7. Defibrillator 1 No.
8. Pacemaker 1 No.
9. Surgical diathermy with analyzer 1 No
10. Audiometer 1No
11. Software to Analyze ECG,EEG and EMG: 1 No.
12. Ultrasound scanner - Hospital visit

### **TOTAL 60 PERIODS**

### **COURSE OUTCOMES:**

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

- Demonstrate acquisition and measurement of different biosignals using various equipments.
- Explain the working of different therapeutic equipments.
- Analyze bio signals using simulation software.
- Explain the use of imaging modality for diagnostic application using Ultrasound scanner
- Demonstrate the transmission of biosignals using Biotelemetry

### **WEBSITE LINKS:**

1. [https://www.youtube.com/watch?v=iUW\\_15YAEEM](https://www.youtube.com/watch?v=iUW_15YAEEM)
2. <https://www.youtube.com/watch?v=Q03SbmORSbY>
3. <https://www.youtube.com/watch?v=UTtCfvIQRBs>
4. <https://www.youtube.com/watch?v=7USeIrVW320>
5. [https://www.youtube.com/watch?v=FHpuzI\\_zYKU](https://www.youtube.com/watch?v=FHpuzI_zYKU)
6. <https://www.youtube.com/watch?v=tZhHy2GAjRs>
7. <https://www.youtube.com/watch?v=2fiqhpnrjQI>
8. <https://www.youtube.com/watch?v=ajGH5s93D7Q>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	3	-	-	2	2	3
CO2	3	3	3	3	3	-	3	-	-	2	2	3
CO3	3	3	3	3	3	-	3	-	-	2	2	3
CO4	3	3	3	3	3	-	3	-	-	2	2	3
CO5	3	3	3	3	3	-	3	-	-	2	2	3

## CO-PSO MAPPING:

CO\PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3

<b>JEC 1511</b>	<b>DISCRETE TIME SIGNAL PROCESSING LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

## COURSE OBJECTIVES:

- To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB
- To perform MATLAB based implementation of various DSP systems
- To implement FIR and IIR filters in MATLAB and DSP Processor
- To study the architecture of DSP processor
- To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts.

## LIST OF EXPERIMENTS:

### MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Basic operations on signals
3. Linear and Circular convolutions
4. Auto correlation and Cross Correlation
5. Sampling and effect of aliasing
6. Frequency Analysis using DFT

7. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
8. Design of Butterworth IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations

## **DSP PROCESSOR BASED IMPLEMENTATION**

1. Study of architecture of Digital Signal Processor
2. Perform MAC operation using various addressing modes
3. Generation of various signals(sawtooth, square, triangular waveforms)
4. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
5. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
7. Implement an Up-sampling and Down-sampling operation in DSP Processor

**TOTAL: 60 PERIODS**

## **COURSE OUTCOMES:**

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

- Carryout basic signal processing operations
- Demonstrate their abilities towards MATLAB based implementation of various DSP systems
- Analyze the architecture of a DSP Processor
- Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals
- Design a DSP system for various applications of DSP

## **LAB Requirements for a Batch of 30 students (3 students per experiment):**

1. MATLAB software package for simulation experiments
2. PCs - 15 Nos
3. Kits - DSP Processor/ADC Kit-15 Nos.
4. CROs - 15 Nos,
5. Function Generators – 15 Nos.

## **WEBSITE REFERENCES:**

1. <https://www.vlab.co.in/participating-institute-iit-kharagpur>, Prof. C.S. Kumar, IIT Kharagpur
2. <http://vlabs.iitkgp.ernet.in> > dsp
3. <https://www.iitk.ac.in> > new > digital-signal-processing

## **CO - PO MAPPING**

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	3	2
CO2	3	3	3	3	3	1	-	-	-	-	2	3
CO3	2	3	3	3	3	1	-	-	-	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	2	3
CO5	3	3	3	2	3	1	-	-	-	-	3	2



## CO - PSO MAPPING

CO\PSO	PSO1	PSO3
CO1	2	1
CO2	2	1
CO3	1	1
CO4	2	1
CO5	1	1

## SEMESTER VII

<b>JBM 1701</b>	<b>DIGITAL IMAGE PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

### **UNIT I DIGITAL IMAGE FUNDAMENTALS 9**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2Dtransforms - DFT, DCT.

### **UNIT II IMAGE ENHANCEMENT 9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Spatial operations – directional smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

### **UNIT III IMAGE RESTORATION 9**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

### **UNIT IV IMAGE SEGMENTATION 9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

### **UNIT V IMAGE COMPRESSION AND RECOGNITION 9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

**TOTAL PERIODS :45**

## COURSE OUTCOMES:

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

- Apply the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms on images
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Discuss the restoration concepts and filtering techniques.
- Apply the basics of segmentation in a digital
- Use different compression method in a digital image

## TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson Fourth Edition
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson,2015.

## REFERENCES:

1. Kenneth R.Castleman, “Digital Image Processing” ,Pearson,2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, \_Digital Image Processing using MATLAB’, Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, \_Multi dimensional Digital Signal Processing’, Prentice
4. Hall Professional Technical Reference, 1990.
5. J. Michael Fitzpatrick and Milan Sonka, “Handbook of Medical Imaging, Vol. 2, SPIE Press, 2000
6. Milan Sonka et al \_Image processing, analysis and machine vision’, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

## WEBSITE REFERENCES :

1. <https://nptel.ac.in/courses/117105135>
2. <https://nptel.ac.in/courses/117105079>
3. <https://nptel.ac.in/courses/117104069>
4. <https://www.youtube.com/watch?v=7xKhYfPel9w>
5. <https://www.youtube.com/watch?v=5qxrzD6ODHc>

## CO - PO MAPPING

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	1	2	-	1
CO2	3	1	1	-	-	-	-	-	1	2	-	2
CO3	3	2	1	-	-	-	-	-	1	2	-	2
CO4	3	3	1	-	-	-	-	-	1	2	-	2
CO5	3	3	1	-	-	-	-	-	1	2	-	2

## CO - PSO MAPPING

CO\PSO	PSO1	PSO2	PSO3
CO1	2	-	2
CO2	2	-	2
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

<b>JBA1711</b>	<b>ENTREPRENEURSHIP FOR ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### COURSE OBJECTIVES:

- To provide exposure on insight of entrepreneurship
- To investigate the feasibility study for the new venture.
- To identify the right process for successful business plan

Sl.No	LIST OF ACTIVITIES	No. of Periods
1	Insight of Entrepreneurship	1
2	Business Idea	1
3	Business sources	1
4	Business Plan	1
5	Financial Plan	1
6	Market Survey	2
7	Feasibility report	2
8	Case study	3
9	Entrepreneurship Que Card	2
10	Prevention of Sickness & Measures	1

**TOTAL: 20 PERIODS**

### COURSE OUTCOMES:

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

- Procure knowledge on setting up of new venture
- Draft and approval of financial plan and appraisal of new project
- Impart the knowledge of effectiveness of innovation in entrepreneurship

## REFERENCES

1. Hisrich, Robert D., Michael Peters and Dean Shepherded, Entrepreneurship, Tata McGraw Hill, 2014.
2. SS. Khanka, Entrepreneurial Development, Third Edition, S.Chand & company, New Delhi 2001.
3. Srinivasan, Case Studies in marketing Indian context, sixth edition PHI learning private Limited 2014.
4. Lall, Madhurima and Shikha Sahai, Entrepreneurship, Excel Book, New Delhi. 2008.

## WEBSITE REFERENCES:

- <https://ideadrop.co/innovation-management/top-five-favourite-idea-generation-techniques/>
- <https://www.bajajfinserv.in/what-are-the-sources-of-finance-for-entrepreneurs>
- <https://www.babson.edu/academics/undergraduate-school/core-experiences/foundations-of-management-and-entrepreneurship/>
- <https://www.businessgig.com/business-plan-preparation>
- <https://www.financierworldwide.com/the-impact-of-social-entrepreneurship-on-economic-growth>.

<b>JBM 1711</b>	<b>DIGITAL IMAGE PROCESSING LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

## COURSE OBJECTIVES:

- To practice the basic image processing techniques to use arithmetic operations and analyse the resolution of an image
- To apply various intensity transformations on images .
- To understand and apply the concepts of image enhancement
- To perform image segmentation.
- To implement image compression technique

## LIST OF EXPERIMENTS

### Simulation using MATLAB

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. Display of bit planes of an Image
5. DFT analysis of images
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Region based Segmentation
12. Analysis of images with different color models.
13. Image compression techniques

**TOTAL : 60 PERIODS**

## **COURSE OUTCOMES**

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

- Implement basic arithmetic operations ,identify the resolution of an image
- Use transforms and analyze the characteristics of the image.
- Perform enhancing operations on the image using spatial filters and frequency domain filters.
- Perform segmentation operations in the images.
- Apply image compression techniques to solve real healthcare problems.

## **WEBSITE REFERENCES:**

1. <https://in.mathworks.com/matlabcentral/fileexchange/28445-image-processing-laboratory>
2. <https://cse19-iiith.vlabs.ac.in/exp/image-arithmetic/objective.html>
3. <https://www.electronicsforu.com/electronics-projects/lossless-image-compression-using-matlab>
4. <http://vlabs.iitb.ac.in/utsp/exp11/index.html#>
5. <https://sites.google.com/site/ipcvmit/home>

## **CO - PO MAPPING**

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	1	2	-	1
CO2	3	1	1	-	-	-	-	-	1	2	-	2
CO3	3	2	1	-	-	-	-	-	1	2	-	2
CO4	3	3	1	-	-	-	-	-	1	2	-	2
CO5	3	3	1	-	-	-	-	-	1	2	-	2

## **CO - PSO MAPPING**

CO\PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	3	-
CO4	3	-
CO5	3	-

JBM 1712	HOSPITAL TRAINING	L	T	P	C
		0	0	2	1

## **COURSE OBJECTIVES:**

- To Observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- To Provide access to healthcare Professionals to get a better understanding of their work;

- To Demonstrate patient-care in a hospital setting.
- To prepare and present technical report on devices of various department

### 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 for visit
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopaedic and Physiotherapy
5	ICU/CCU
6	Operation Theatre
7	Neurology
8	Nephrology
9	Radiology
10	Nuclear Medicine
11	Pulmonology
12	Urology
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**

### COURSE OUTCOMES:

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

- Advocate a patient-centered approach in healthcare
- Communicate with other health professionals in a respectful and responsible manner
- Recognize the importance of inter-professional collaboration in healthcare.
- Propose a patient-centered inter-professional health improvement plan based upon the patient's

perceived needs

- Address the healthcare needs of populations and patients

### CO - PO MAPPING

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	2	2	2	1	2	1	2
CO2	3	1	1	2	1	2	1	2	1	2	1	2
CO3	2	2	1	2	1	1	2	2	1	2	2	2
CO4	2	2	1	2	1	2	1	1	1	1	1	1
CO5	2	2	1	2	1	2	2	2	1	1	1	1

### CO - PSO MAPPING

CO\PSO	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1

<b>JBM 1731</b>	<b>PROJECT PHASE-I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>6</b>	<b>3</b>

### COURSE OBJECTIVES:

- To identify a specific problem for the present need of the society and collecting information related to the same through detailed literature survey.
- To develop the methodology to solve the identified problem.
- To design, analyze and simulate the chosen problem using the software package.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**TOTAL: 90 PERIODS**

### COURSE OUTCOMES:

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

- Analyze and formulate the problem
- Identify the methodology needed to solve the problem.
- Identify the tools and techniques required to solve the problem.
- Work with team mates to acquire the required material needed to find solutions to the chosen problem.
- Effectively communicate the outcomes of the findings.



**CO-PO MAPPING:**

<b>CO\PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	2	2	2	3	3	3	3	3	3	3
<b>CO2</b>	3	3	2	2	2	3	3	3	3	3	3	3
<b>CO3</b>	3	3	2	2	2	3	3	3	3	3	3	3
<b>CO4</b>	3	3	2	2	2	3	3	3	3	3	3	3
<b>CO5</b>	3	3	2	2	2	3	3	3	3	3	3	3

**CO-PSO MAPPING:**

<b>CO\PO</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	3	2
<b>CO2</b>	3	2
<b>CO3</b>	3	2
<b>CO4</b>	3	2
<b>CO5</b>	3	2

## SEMESTER VIII

<b>JNC 1861</b>	<b>INDIAN CONSTITUTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>

### **COURSE OBJECTIVES:**

- To understand the importance of Indian constitution, Administration, Concept and Development of Human Rights, election commission.

**UNIT I INTRODUCTION TO INDIAN CONSTITUTION 6**  
Constitution' meaning of the term, Indian Constitution- Sources and constitutional history, Features- Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

**UNIT II UNION GOVERNMENT AND ITS ADMINISTRATION 6**  
Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;  
**State Government and its Administration** Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

**UNIT III LOCAL ADMINISTRATION 6**  
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

**Pachayati raj:** Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

**UNIT IV CONCEPT AND DEVELOPMENT OF HUMAN RIGHTS 6**

Meaning Scope and Development of Human Rights, United Nations and Human Rights – UNHCR, UDHR 1948, ICCPR 1996 and ICESCR 1966, Human Rights in India: Protection of Human Rights Act,1993 (NHRC and SHRC), First, Second and Third Generation Human Rights, Judicial Activism and Human Rights.

**UNIT V ELECTION COMMISSION 6**

Election Commission- Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

**TOTAL : 30 PERIODS**

### **COURSE OUTCOME:**

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

- To know the sources, features and principles of Indian Constitution.
- To learn about Union Government, State government and its administration.

- To get acquainted with Local administration and Pachayati Raj.
- To be aware of basic concepts and developments of Human Rights.
- To gain knowledge on roles and functioning of Election Commission

**REFERENCES:**

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd. NewDelhi
2. Subash Kashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)

**WEBSITE LINKS:**

1. [nptel.ac.in/courses/109104074/8](http://nptel.ac.in/courses/109104074/8)
2. [nptel.ac.in/courses/109104045/](http://nptel.ac.in/courses/109104045/)
3. [nptel.ac.in/courses/101104065/](http://nptel.ac.in/courses/101104065/)
4. [www.hss.iitb.ac.in/en/lecture-details](http://www.hss.iitb.ac.in/en/lecture-details)
5. [www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution](http://www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution)

<b>JBM 1811</b>	<b>COMPREHENSION &amp; TECHNICAL SEMINAR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

- To revamp the knowledge gained in the semester and prepare the students to face interview both at the academic and the Industrial Sector
- To encourage the students to study about the recent developments in the field
- To prepare and present technical reports
- To encourage the students to use various teaching aids such as Power point presentation and Demonstrative models

**COMPREHENSION:**

One period is allotted for comprehension. During this period, a test with objective type questions from competitive exams is conducted in identified technical courses. The evaluation is purely internal. Average of all the test marks shall be calculated , a weightage of 50 marks is awarded to the comprehension component.

**TECHNICAL SEMINAR:**

Three periods are allotted for the technical seminar. During the seminar session each student is expected to prepare and present a technical topic for duration of 10 minutes. Each student is expected to make presentation at least twice during the semester and the student is evaluated based on various parameters such as topic chosen, content delivery, communication skills and presentation. A faculty guide is allotted who shall guide and monitor the progress and attendance of all the students. Equal weightage is considered for the two seminar sessions for a total weightage of 50 marks.

The total mark awarded for the course shall be the sum of marks scored out of 50 each for the two components. Evaluation is purely internal.

**TOTAL : 30 PERIODS**

## COURSE OUTCOMES:

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

- Consolidate all the engineering concepts acquired in the course of study.
- Enrich their technical knowledge.
- Prepare and present technological developments.
- Communicate effectively the concepts related to the various topics.
- Face the interviews with confidence during the placement

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	3	3	3	3	3
CO2	3	3	2	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	2	2	3	3	3	3	3	3	3
CO5	3	3	2	2	2	3	3	3	3	3	3	3

## CO-PSO MAPPING:

CO\PO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

JBM 1832	PROJECT PHASE-II	L	T	P	C
		0	0	18	9

## COURSE OBJECTIVES:

- To develop the ability to solve a specific problem related to their subject expertise.
- To develop the methodology to solve the identified problem.
- To design, analyze and implement the chosen problem using the hardware components.
- To validate the simulation, hardware results with the theoretical results.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**TOTAL: 270 PERIODS**

## COURSE OUTCOME:

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

- Apply the technical knowledge acquired for solving real world problems.

- Develop skills such as self learning, critical thinking, problem solving, project management and finance.
- Apply modern tools and techniques.
- Work with team mates and collectively work towards the success of the project.
- Communicate effectively to present the outcomes of the project both in written and oral forms.

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	3	3	3	3	3
CO2	3	3	2	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	2	2	3	3	3	3	3	3	3
CO5	3	3	2	2	2	3	3	3	3	3	3	3

### CO-PSO MAPPING:

CO\PO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

**JERUSALEM COLLEGE OF ENGINEERING**

*(An Autonomous Institution, affiliated to Anna University & Accredited by NAAC 'A' Grade)*

**DEPARTMENT OF BIOMEDICAL ENGINEERING**

*(Accredited by NBA)*

**PROFESSIONAL ELECTIVES (VERTICALS) R-21**

<b>VERTICAL I HEALTHCARE MANAGEMENT</b>	<b>VERTICAL II BIOSIGNAL &amp; IMAGE PROCESSING</b>	<b>VERTICAL III DESIGN OF MEDICAL DEVICES</b>	<b>VERTICAL IV BIO- ENGINEERING</b>	<b>VERTICAL V COMMUNICATION SYSTEMS</b>	<b>VERTICAL VI REHABILITATION ENGINEERING</b>
JBM1029 Hospital Planning and Management	JBM1034 Radiographic Imaging Systems	JBM1038 Biomedical Entrepreneurship	JBM1002 Bio Transport Phenomena	JBM1016 Principles of Communication for Biomedical Engineers	JBM1004 Biomechanics
JBM1030 Computers in Medicine	JBM1021 Medical Imaging Techniques	JBM1039 Medical Device Design	JBM1043 Bioprinting	JBM1011 Telehealth Technology	JBM1007 Biofluids and Dynamics
JBM1031 Healthcare Technology	JBM1035 Biomedical Ultrasonics	JBM1040 Critical Care Equipment	JBM1001 BioMEMS	JBM1025 Body Area Network and Healthcare	JBM1012 Physiological Modelling
JBM1032 Quality Control for Medical Devices	JBM1036 Biometric Systems	JBM1006 Medical Optics	JBM1009 Nanotechnology and Applications	JBM1008 Pattern Recognition and Neural Network	JBM1026 Rehabilitation Engineering
JBM1015 Medical Informatics	JBM1005 Virtual Instrumentation for Biomedical Engineers	JBM1024 Human Assist Devices	JBM1044 Medical Implants	JBM1027 Cognitive Neuroscience	JBM1020 Ergonomics
JBM1033 Medical Ethics	JBM1037 Soft Computing Techniques	JBM1041 Medical Device Standards, Regulation & Ethics	JBM1045 Artificial Organs	JBM1018 Robotics in Medicine	JBM1048 Neuromechanics of Human Movement
JBM1014 Healthcare Informatics	JBM1023 Brain Computer Interface Techniques	JBM1042 Clinical Research Methodology	JBM1046 Next gen Sequencing Technology	JBM1047 Virtual Reality in Medicine	JBM1049 Medical Haptics

## VERTICAL I - HEALTHCARE MANAGEMENT

<b>JBM1029</b>	<b>HOSPITAL PLANNING AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To understand the importance of hospital planning
- To elucidate planning of radiological and laboratory services
- To explain operation theatre and sterilization process planning
- To describe the challenges in hospital management and administration
- To explicate organizing and delegating the hospital administration

### **UNIT I - HOSPITAL PLANNING**

**9**

Types of Hospital, Hospital as a System, need of hospital planning, hospital planning team, hospital planning process, bed planning, site selection, size of the hospital, circulation of routes, equipping hospital, steps in equipment planning and procurement, Construction and Commissioning.

### **UNIT II - CLINICAL AND SUPPORTIVE SERVICES**

**9**

Radiology and imaging services: Classification of radiological work, Space Requirement, different layouts of radiology department, Laboratory Services: Function Planning of laboratory service, Sitting and space requirement, Layout Design of Radiation Facility, Laboratory equipment placing, policies and laboratory procedure.

### **UNIT III - OPERATION THEATRE STERILIZATION**

**9**

OT circulation pattern, location of OT, number of OTs, Time utilization planning, zoning, lighting, Electrical and Air - Conditioning, Function of CSSD, Location and space requirement, Policies and procedure of CSSD.

### **UNIT IV - HOSPITAL ADMINISTRATION**

**9**

Challenges in Hospital Management, roles and functions of hospital administration, administration skills of Hospital managers, planning and forecasting Strategic planning: Systems Engineering in Strategic Planning.

### **UNIT V - ORGANIZING AND DELEGATION**

**9**

Realities of Hospital Organization, Authority Relationships, Delegation: Principles of Delegation, Steps in Delegation, Organization chart of Hospital administration, Characteristics of Static vs Dynamic organization.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES (CO):**

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

- Select the site for the hospital and plan equipment purchase of the hospital
- Design the functional planning of radiological, laboratory services.
- Utilize the process and procedures of the sterilization units of hospital.
- Demonstrate skills in solving challenges faced in hospital management and administration
- Apply effective methods in organizing and delegation of the hospital administration.

**TEXT BOOKS:**

1. Dinesh Bhatia, Prabhat Kumar Chaudhari, Bhupinder Chaudhary, "A Guide to Hospital Administration and Planning", Singapore: Springer Nature Singapore, 2023.
2. BM Sakharkar, "Principles of Hospital Administration and Planning", 2<sup>nd</sup> Edition Jaypee Brothers Medical Publishers, 2015.

**REFERENCE BOOKS:**

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI, 4<sup>th</sup> Edition, 2006
2. Joshi, M, "Hospital Administration", Jaypee Brothers Medical Publishers, 2022.

**WEBSITE LINKS:**

1. <https://www.coursera.org/learn/eu-law-doing-business/lecture/K83OQ/fundamental-company-law-concepts>
2. [https://books.google.co.in/books/about/Hospitals.html?id=N\\_mvAAAACAAJandredir\\_esc=y](https://books.google.co.in/books/about/Hospitals.html?id=N_mvAAAACAAJandredir_esc=y)
3. <https://www.kobo.com/us/en/ebooks/hospital-administration-care>
4. <https://www.slideshare.net/jenishaadhikari/disaster-management-in-hospital-setting-126372414>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	1	1	1	2	1	3	1	-	2	2	2	1	1	-
CO-2	2	1	1	2	1	2	1	-	2	2	2	1	1	1
CO-3	1	1	1	1	2	2	-	1	2	2	1	1	-	2
CO-4	1	1	1	3	3	3	-	1	2	2	1	1	1	2
CO-5	2	1	1	2	2	2	-	-	3	3	1	1	1	2
AVG	1.4	1	1	2	1.8	2.4	0.4	0.4	2.2	2.2	1.4	1	0.8	1.4



<b>JBM1030</b>	<b>COMPUTERS IN MEDICINE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To realize the 8086 architectures, instruction sets and various units of PC-AT.
- To Study the technique of data acquisition, storage, retrieval and transmission of bioinformation.
- To apply tools of informatics in patient monitoring.
- To understand the application of computers in system modelling
- To elucidate pattern recognition, medical imaging and development of expert systems.

**UNIT I – BASIC COMPUTER HARDWARE 9**

8086 architecture, system connections, Instruction set and programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.

**UNIT II - SYSTEM DESIGN 9**

Multichannel computerized ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.

**UNIT III - COMPUTERS IN PATIENT MONITORING 9**

Physiological monitoring, automated ICU, computerized arrhythmia monitoring, information flow in a clinical lab, computerized concepts, interfacing to HIS.

**UNIT IV - MEDICAL SYSTEMS MODELLING 9**

Radiotherapy, drug design, drug delivery system, physiological system modeling and simulation.

**UNIT V - COMPUTERS IN MEDICAL RESEARCH 9**

Role of expert systems, pattern recognition techniques in medical image classification, ANN concepts.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (CO):**

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

- Utilize the 8086 architectures, instruction sets and various units of PC-AT in medical device design
- Enumerate technique of data communication of bioinformation transfer
- Define the application of computers in patient monitoring.
- Apply the modern tools in system modelling
- Recognize different pattern and apply the same in medical imaging and development of expert systems.

**TEXT BOOKS:**

1. R.D.Lee, “Computers in Medicine”, Tata McGraw-Hill, New Delhi, 1999.
2. Douglas V.Hall, “Microprocessors and Interfacing: Programming and hardware”, McGraw-Hill, Singapore, 2019.

**REFERENCE BOOKS:**

1. Atul Khate, “Cryptography and network security”, Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. B.Govindarajalu, “IBM PC and Clones: Hardware, Trouble shooting and Maintenance”, Tata McGraw Hill Publishing Company, New Delhi, 2005.
3. H M Dietel, “Internet and World Wide Web”, AB Goldberg publishers, New Delhi, 2007.
4. N.Mathivanan, “PC Based Instrumentation: Concepts and Practice”, Prentice Hall of India, New Delhi 2007.

**WEBSITE LINKS:**

1. <https://www.javatpoint.com/uses-of-computer-in-hospitals>
2. <https://www.online-sciences.com/computer/computers-in-medicine-uses-advantages-and-disadvantages/>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	3	2	3	1	2	1	1	-	1	1	1	1	2	2
CO-2	2	3	3	1	1	1	1	-	1	1	1	1	2	1
CO-3	3	2	2	1	2	1	1	-	1	1	1	1	2	2
CO-4	2	3	2	1	2	1	1	-	1	1	1	1	2	1
CO-5	3	3	3	1	1	1	1	-	1	1	1	1	2	1
AVG	2.6	2.6	2.6	1	1.6	2.2	2	1.6	1	1	1	1	2	1.4

<b>JBM1031</b>	<b>HEALTHCARE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To apply the m-health technology in health care application
- To mitigate various attack through internet of medical things devices
- To apply different data mining in healthcare data
- To utilize smart decision-making tools in health care
- To detail out different information security mechanism

**UNIT I – M-HEALTH 9**

e-health to m-health, m-health regulation and legislation, smart m-health sensing, wearable sensors for m- health monitoring, m-health models and applications.

**UNIT II - INTERNET OF MEDICAL THINGS 9**

IoMT System Architecture, IoMT Devices, Attacks in IoMT, Security Plans for IoMT.

**UNIT III – DATA STORAGE 9**

Rise of big Data, Medical Data as Big data-data mining process-techniques, data mining tool, usage of cloud computing in healthcare, Application of data mining in medical fields.

**UNIT IV - SMART DECISION MAKING 9**

Precision medicine, Artificial intelligence and medical visualization, Intelligent personal health records, Applications: AI in cancer diagnosis, drug delivery, medical imaging.

**UNIT V - HEALTH INFORMATION SECURITY 9**

Data backups-Encryption: Cryptography, Encrypting patient Data in Storage, Remote Authentication Dial in User Service authentication of medical devices, Remote Access, VPN, PPTP, Secure disposal of medical records.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (CO):**

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

- Apply principles m-health technology in health care applications
- Mitigate various internet attack to the security of hospital information systems
- Apply different big data mining techniques in healthcare data
- Apply the artificial intelligence concepts in health care application
- Elucidate encryption, decryption mechanism for securing medical records

**TEXT BOOKS:**

1. Adam Bohr, Kaveh Memarzadeh, “Artificial Intelligence in Healthcare”, Elsevier Science, 2020.
2. Ciampa Mark, and Revels Mark, “Internet of Medical Things: Remote Healthcare Systems and Applications”, Springer International Publishing, 2021.

**REFERENCE BOOKS:**

1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra, “Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications”, CRC Press, 2018.

**WEBSITE LINKS:**

1. <https://nptel.ac.in/courses/106105166>
2. <https://nptel.ac.in/courses/106106129>
3. <https://csrc.nist.gov/glossary/term/infosec>
4. <https://www.osplabs.com/insights/what-is-mhealth/>
5. <https://www.upgrad.com/blog/data-mining-vs-data-analytics/>

**CO-PO/PSO MAPPING:**

<b>CO\PO, PSO</b>	<b>PO- 1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO- 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO-1</b>	2	1	-	-	2	1	1	-	2	2	1	1	2	2
<b>CO-2</b>	1	1	1	1	1	1	-	-	2	2	1	1	1	2
<b>CO-3</b>	2	1	1	1	2	2	-	-	1	2	1	1	2	2
<b>CO-4</b>	1	1	1	1	1	2	1	-	2	1	1	1	1	1
<b>CO-5</b>	1	1	-	-	1	1	1	-	3	3	1	1	2	1
<b>AVG</b>	<b>1.4</b>	<b>1</b>	<b>0.6</b>	<b>0.6</b>	<b>1.4</b>	<b>1.4</b>	<b>0.6</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1.6</b>	<b>1.6</b>

<b>JBM1032</b>	<b>QUALITY CONTROL FOR MEDICAL DEVICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To identify the Medical Device Regulatory Framework.
- To utilize different medical device standards
- To employ six sigma process and improvement in medical device manufacturing
- To identify and incorporate basic risk management concepts into Quality Management System
- To familiarize and utilize the different product development life cycle.

**UNIT I - MEDICAL DEVICES 9**

Definition, Differences between Medical Device and Drug development, Classification of medical device, Major Steps in the Design and Development of Medical Device, Medical device life cycle.

**UNIT II - MEDICAL DEVICES STANDARDS 9**

Basics of the different systems for the Medical Device regulations - FDA, AERB Regulation, The ISO 13485 Standard - ISO 9000.

**UNIT III - SIX SIGMA PROCESS 9**

Six Sigma Fundamentals, Process Modeling, Process Mapping, Value Stream Mapping, Business Process Management, Six Sigma Improvement, Phases of Six sigma improvement.

**UNIT IV - QUALITY MANAGEMENT SYSTEM 9**

Design Control, Core Components of QMS, Software Development, Risk Management, Risk Management Procedures, Risk Management Roles and Responsibilities, Biocompatibility, Electromagnetic compatibility testing, Electrical Safety Testing.

**UNIT V - PRODUCT DEVELOPMENT PROCESS 9**

Waterfall Model, Iterative Model, Stage, Gate PDP, Agile Methodologies in MedDev PDP, Clinical trial design considerations, Technology readiness levels.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (CO):**

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

- Utilize the regulatory differences in Medical Devices and Regulatory Framework.
- Assess the function of device regulatory standards.
- Analyze and apply six sigma process in the design improvement of medical device.
- Analyze the basic risk management concepts into the Quality Management System.
- Utilize different product development life cycle in medical device manufacturing.

**TEXT BOOKS:**

1. DeMarco, C. T “Medical Device Design and Regulation”, ASQ Quality Press, 2011.
2. Mekki, K. S., El-Haik, B. “Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness” Germany: Wiley, 2011.

**REFERENCE BOOKS:**

1. Saiko, G. “Bringing a Medical Device to the Market: A Scientist’s Perspective” Jenny Stanford Publishing Singapore, 2022.

**WEBSITE LINKS:**

1. <https://www.cfpie.com/the-importance-of-quality-control-in-the-manufacturing-of-medical-devices>
2. <https://www.fda.gov/medical-devices/postmarket-requirements-devices/quality-system-qs-regulationmedical-device-good-manufacturing-practices>
3. <https://www.mastercontrol.com/quality/quality-control/medical-device/>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	1	1	1	-	2	-	1	-	-	1	2	1	1	2
CO-2	2	1	1	1	2	1	1	-	1	1	2	1	1	1
CO-3	1	1	1	1	2	1	1	-	1	2	1	1	1	2
CO-4	1	1	1	2	3	2	2	-	1	2	1	1	1	2
CO-5	2	1	1	3	2	3	1	-	2	1	1	1	1	2
<b>AVG</b>	<b>1.4</b>	<b>1</b>	<b>1</b>	<b>1.4</b>	<b>2.2</b>	<b>1.4</b>	<b>1.2</b>	<b>-</b>	<b>1</b>	<b>1.4</b>	<b>1.4</b>	<b>1</b>	<b>1</b>	<b>1.8</b>

<b>JBM1015</b>	<b>MEDICAL INFORMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To apply ICT tools in medicine with an introduction to health informatics.
- To access the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in HIS.
- To manage the data storage and automation of the hospital modules in informatics.
- To estimate the different approach of health Informatics.
- To evaluate recent trends in medical informatics.

**UNIT I - INFORMATICS SYSTEM IN MEDICINE 9**

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

**UNIT II - MEDICAL STANDARDS 9**

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

**UNIT III - DATA ACQUISITION AND STORAGE 9**

Representation of Data, Data modeling Techniques, Relational Hierarchical and network Approach, Normalization techniques for Data handling, Factors to be considered in acquiring Data, Fundamentals of data acquisition system, acquiring sensor data, Plug-in Data Acquisition and Control Boards, Data Acquisition using Serial Interface, Medical Data formats, signal, Image and Video Formats, Data protection and security.

**UNIT IV - HEALTH INFORMATICS 9**

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training, Aarogya setu app, Coronavrius contact tracing app, Education and Training.

**UNIT V - RECENT TRENDS 9**

Medical Expert Systems, Virtual Environment, Surgical simulation, Radiation therapy and planning, Telemedicine, virtual hospitals, Smart Medical Homes, Personalized e-health services, Biometrics, GRID and Cloud Computing in Medicine, Nanomedicine, 3D Bioprinting.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (CO):**

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

- Discuss about health informatics and different ICT applications in medicine.
- Explain the function of Hospital Information Systems
- Analyse medical standards
- Explain concept of health informatics
- Have knowledge on recent trends on medical informatics

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press,2007.
2. Yi Ping Phoebe Chen, "Bioinformatics Technologies", Springer International Edition, New Delhi, 2007.
3. Richard S. Dick "The Computer-based Patient Record: An Essential Technology for Health Care" Institute of medicine, 1997.
4. Khandpur R S, "Telemedicine - Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.
5. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York 2002.

**WEBSITE LINKS:**

1. <https://healthinformatics.uic.edu/blog/what-is-medical-informatics/>
2. <https://www.youtube.com/watch?v=fdLP99Kxbck>
3. <https://www.youtube.com/watch?v=pzS--PaGC9o>
4. <https://jech.bmj.com/content/56/11/808>
5. <https://link.springer.com/article/10.1007/s41666-018-0040-y?shared-article-renderer>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	3	3	3	-	1	2	-	-	3	-	1	1	2	1
CO-2	3	3	3	2	1	2	-	-	3	1	1	1	2	1
CO-3	3	3	3	2	2	2	-	-	3	2	1	1	2	1
CO-4	3	3	2	2	3	2	2	-	2	3	1	1	2	1
CO-5	3	3	3	3	2	1	1	-	1	2	1	1	2	1
AVG	3	3	2.8	1.8	1.8	1.8	0.6	-	2.4	1.6	1	1	2	1



<b>JBM1033</b>	<b>MEDICAL ETHICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To investigate on human values and ethical consideration
- To understand and apply medical ethics to be practiced by healthcare workers
- To review and apply safety measures in designing and using medical devices
- To review on the accreditation standards in hospital
- To discuss on different safety aspects to be followed in hospital

**UNIT I - HUMAN VALUES**

**9**

Morals, Values and Ethics, Integrity, Work Ethics, Service Learning, Respect for Other, Living Peacefully, caring, commitment, Empathy, Self-Confidence.

**UNIT II - MEDICAL ETHICS**

**9**

Definition of Medical ethics, Scope of ethics in medicine, international code of ethics for occupational health professionals, Role of ethics in healthcare workplace, Decision Model for Healthcare Dilemmas.

**UNIT III - MEDICAL DEVICES SAFETY**

**9**

Shared Responsibility for Medical device safety, WHO, International Health Regulations, Stages of regulatory control of medical devices, Ethics committee - its members and functions, Global Harmonization Task Force.

**UNIT IV - HOSPITAL ACCREDITATION**

**9**

Accreditation, Benefits of Accreditation, JCI accreditation, NABH and NABL, Joint Commission on Accreditation of Healthcare Organizations.

**UNIT V - SAFETY IN HOSPITAL**

**9**

Alara principal Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety, Disposal of Biological waste - Electrical and Fire safety.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (CO):**

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

- Apply human values and ethical consideration in delivery of health care
- Apply medical ethics to be practiced by healthcare workers
- Seek and apply safety measures in designing and using medical devices
- Review on the accreditation standards in hospital
- Consider different safety aspects to be followed in hospital

**TEXT BOOKS:**

1. B.M.Sakharkar, Principles of Hospital administration and Planning, Jaypee Brothers, Medical Publishers, 2015.
2. Joseph F Dyro, "Clinical Engineering Handbook", Elsevier Publishers, 2004.

**REFERENCE BOOKS:**

1. Karen Parsley, Karen Parsley Philomena Corrigan, “Quality improvement in Healthcare”, 2nd edition, Nelson Thrones Pub, 2012.
2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House, 2010.

**WEBSITE LINKS:**

1. <https://www.nspe.org/resources/ethics>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	1	2	1	2	1	-	-	1	2	2	1	1	-	2
CO-2	1	2	1	2	1	-	-	1	2	-	1	1	1	1
CO-3	-	1	1	2	1	-	-	1	2	2	1	1	-	2
CO-4	1	2	1	1	1	-	-	1	2	2	1	1	1	1
CO-5	3	3	3	2	1	-	-	-	1	2	1	1	1	1
<b>AVG</b>	<b>1.2</b>	<b>2</b>	<b>1.4</b>	<b>1.8</b>	<b>1</b>	-	-	<b>0.8</b>	<b>1.6</b>	<b>1.8</b>	<b>1</b>	<b>1</b>	<b>0.6</b>	<b>1.4</b>

<b>JBM1014</b>	<b>HEALTHCARE INFORMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand fundamental characteristics of data, information, and knowledge in the Health Informatics domain.
- To illustrate the conceptual framework for handling the collection, storage and the optimal use of biomedical data.
- To understand basic principles of imaging systems in clinical laboratory.
- To develop understanding of computers in decision making.
- To explore emerging trends in health informatics.

**UNIT I - INTRODUCTION TO HEALTHCARE INFORMATICS 9**

Role of the health care worker, Impact of informatics on professional practice, Components of hardware and software, Theoretical Issues for Health Care Informatics, Theories, Standardized languages

**UNIT II - PATIENT CARE INFORMATICS 9**

Informatics in Patient Care Settings, The EMR and the EHR, HHS meaningful use criteria, Next generation nursing systems, Health data storage and exchange, Automated staffing and workload systems, Quality assurance, Social, ethical and legal Issues, Informatics in Health Care Research, Data collection, Data analysis, Data Presentation.

**UNIT III - COMPUTERS IN CLINICAL LABORATORY 9**

Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance

**UNIT IV - COMPUTER ASSISTED MEDICAL DECISION-MAKING 9**

Neuro computers and Artificial Neural Networks application, Expert system - General model of CMD, Computer –assisted decision support system-production rule system, cognitive model, semester networks, decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing

**UNIT V - RECENT TRENDS IN HEALTH INFORMATICS 9**

Virtual reality applications in medicine, The role of Internet of Things in Biomedicine-Application Design and Case Study, Computer assisted surgery , Computer assisted patient education and health -Medical education and health care information. Trends and directions for the future.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (CO):**

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

- Identify and describe various information technologies and standards in healthcare.
- Elucidate the methods of storing health records and patient data.
- Explain the procedure of computer operation in Medical Imaging equipment.
- Describe the application of computer techniques in decision making.
- Describe the latest developments in health informatics.

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Ramachandra Lele, “Computers in Medicine Progress in Medical Informatics”, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. Orpita Bosu, “Bioinformatics – Databases, Tools and Algorithms”, Oxford University Press, 2007.
3. Lukas K Baehler, “Bioinformatics – Basics, Applications in Biological Sciences and Medicine”, Taylor and Francis, London, 2005.
4. Sundeep Sahay and Sundararaman T, “Public Health Informatics: Designing for change a developing country perspective”, ISBN: 978-0198758778, OUP-Oxford publishers,2017.
5. Edward H. Shortliffe (Editor), James J. Cimino (Edito Biomedical Informatics: Computer Applications in Health Care and Biomedicine ISBN-101447144732, 2014.

**WEBSITE LINKS:**

1. <http://nhsrindia.org/health-informatics>
2. <https://www.philips.co.in/healthcare/medical-specialties/healthcare-informatics>
3. <https://www.classcentral.com/course/edx-health-informatics-and-technology-in-decision-making-11546>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	3	2	1	-
CO2	3	3	3	-	-	-	-	-	-	-	3	3	1	-
CO3	3	3	3	-	-	-	-	-	-	-	3	3	1	-
CO4	3	3	2	-	-	-	-	-	-	-	2	2	1	-
CO5	3	3	3	-	-	-	-	-	-	-	2	2	1	-
AVG	3	3	2.8	-	-	-	-	-	-	-	2.6	2.4	1	-

**\*\*\* END OF VERTICAL 1 \*\*\***

## **VERTICAL II - BIOSIGNAL & IMAGE PROCESSING**

<b>JBM1034</b>	<b>RADIOGRAPHIC IMAGING SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To study the production of x-rays and its application in medical imaging.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections
- To understand the fundamentals of medical image processing techniques.
- To develop computational methods and algorithms to quantify biomedical data

### **UNIT I - ESSENTIAL CONCEPTS OF MEDICAL IMAGING 9**

Interaction of Tissue with radiation, Physical processes and signals underlying imaging, Planes and modalities of imaging, image quality quantifiers, artifacts, signals and systems approaches applied to imaging, computer hardware and software in imaging.

### **UNIT II - RADIOGRAPHIC IMAGING CONCEPTS 9**

Physics of radiography – Ionization and excitation, radiation interactions, Attenuation of radiation, beam strength, radiation dosimetry, Luxel technology and TLDs (thermoluminescent dosimeters), Dosimetry Methods and Tools - Computational and Physical Human Phantoms, Monte Carlo Simulation Methods, Uncertainties in Doses, Diagnostic radiation dose, Therapeutic procedure radiation dose and occupational radiation dose.

### **UNIT III - PROJECTION RADIOGRAPHY 9**

X-ray Generator - Components and Image formation technique, Factors Affecting X-ray Emission, X-ray Exposure Rating Charts, quantum efficiency, Scan equalization digital radiography (SEDR), slot-scan digital radiography, and full-field digital radiography systems for phantom imaging, X-ray phase radiography and tomography with grating interferometry and the reverse projection technique.

### **UNIT IV - COMPUTED TOMOGRAPHY 9**

Basic Principles of Tomographic Acquisition and Tomographic Reconstruction, Computed Tomography Instrumentation – Geometry, source, collimation, detectors, Tomographic image formation – CT numbers, reconstruction methods, Artifacts, Image quality.

### **UNIT V - ADJUNCTIVE IMAGING MODALITIES 9**

Mammography, Fluoroscopy, Computed Radiography, Digital Radiography, Geometric Tomography, Digital Tomosynthesis, Temporal Subtraction, Dual-Energy Subtraction. Medical applications and case studies.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Explain the production of x-rays and its application in medical imaging.
- Elaborate the different types of Radio diagnostic techniques.
- Apply the special imaging techniques used for visualizing the cross sections
- Explain the fundamentals of medical image processing techniques.
- Apply computational methods and algorithms to analyze and quantify biomedical data.

**TEXT BOOKS:**

1. Jerry L. Prince, Jonathan M. Links, “Medical Imaging Signals and Systems”, Second Edition, Pearson Prentice Hall, 2015.
2. Jerrold T. Bushberg, J. Anthony Seibert, Edwin Marion Leidholdt, John M. Boone, “The Essential Physics of Medical Imaging”, Wolters Kluwer Health Publisher, 2020.

**REFERENCE BOOKS:**

1. Masao Takano, Takeshi Iinuma, Yukio Tateno, “Computed Radiography”, Springer Japan, 2012.
2. Andreas Maier, Stefan Steidl, Vincent Christlein, Joachim Hornegger, “Medical Imaging Systems - An Introductory Guide”, Creative Media Partners, LLC, 2020.
3. Kris Iniewski, Troy Farncombe, “Medical Imaging Technology and Applications”, CRC Press, 2017.
4. Arnulf Oppelt, “Imaging Systems for Medical Diagnostics”, Wiley, 2006.
5. Cornelius T Leondes, “Medical Imaging Systems Technology”, World Scientific Publishing Company, 2005.

**WEBSITE LINKS:**

1. <https://www.fda.gov/radiation-emitting-products/medical-imaging/medical-x-ray-imaging>
2. <https://www.msmanuals.com/en-in/professional/special-subjects/principles-of-radiologic-imaging/conventional-radiography>
3. <https://radiologykey.com/projection-x-ray-imaging/>
4. <https://www.fda.gov/radiation-emitting-products/medical-x-ray-imaging/what-computed-tomography>
5. <https://www.breastcancer.org/screening-testing/digital-tomosynthesis>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	2	2	3	2	1	-	-	2	3	2	3
CO2	3	3	2	1	2	3	2	1	-	-	2	3	2	3
CO3	3	3	2	2	3	3	2	1	-	-	2	2	2	3
CO4	3	3	2	1	3	3	2	1	-	-	2	3	2	3
CO5	3	3	2	1	3	3	2	1	-	-	2	3	2	3
<b>AVG</b>	<b>3</b>	<b>3</b>	<b>2.5</b>	<b>1.5</b>	<b>2.5</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>

<b>JBM1021</b>	<b>MEDICAL IMAGING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To study the nuclear magnetic resonance imaging techniques.
- To study the advanced Magnetic resonance techniques that estimates the axonal organization and neural tracts.
- To get accustomed with technique of planar scintigraphy.
- To study the technique of emission computed tomography.
- To study the ultrasonic imaging technique for diagnosis.

**UNIT I - MAGNETIC RESONANCE IMAGING 9**

Nuclear Magnetic Resonance (NMR) - Review of generation and detection of the Magnetic Resonance Signal, Spatial encoding, slice selection, k-space, Pulse Sequences, spin Echo, Perfusion and Diffusion Contrast, k-space Data Acquisition and Image Reconstruction, Three-Dimensional Fourier Transform Image Acquisition, Image Characteristics, Artifacts.

**UNIT II - DIFFUSION WEIGHTED IMAGING 9**

Physics of Diffusion Weighted (DW) Imaging technique, representation of DW images, mechanisms, diffusion model, Measures of anisotropy and diffusivity, Diffusion Tensor Imaging (DTI), Diffusion Basis Spectrum Imaging, Fiber tractography, Quantitative analysis methods, Clinical applications.

**UNIT III - PLANAR SCINTIGRAPHY 9**

Physics of Nuclear Medicine, Radiotracers, Instrumentation of scintigraphy, image formation – acquisition modes, angle camera equations, image quality, PET-MRI technique, electronic brachytherapy, thermal brachytherapy, phantoms - materials, phantoms with integrated radiation dosimeters, virtual/computational phantoms, patient-specific phantoms.

**UNIT IV - EMISSION COMPUTED TOMOGRAPHY 9**

SPECT – Instrumentation, Image formation, Image quality; PET - Instrumentation, Image formation, Image quality.

**UNIT V - ULTRASOUND IMAGING 9**

Physics of Ultrasound – wave equation, propagation, beam formation, instrumentation, scanning modes, steering and focusing, image characteristics and quality, multi-dimensional ultrasound image formation - 2D, 3D, 4D and 5D ultrasound techniques, fetal ultrasound monitoring, doppler ultrasound.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Gain knowledge on the nuclear magnetic resonance imaging techniques.
- Explain the advanced Magnetic resonance techniques to estimate the axonal organization
- Explain planar scintigraphy technique for visualizing the tissue cross sections.
- Explain the technique emission computed tomography.
- Explain the ultrasonic imaging technique for diagnosis.

**TEXT BOOKS:**

1. Jerry L. Prince, Jonathan M. Links, “Medical Imaging Signals and Systems”, Second Edition, Pearson Prentice Hall, 2015.
2. Jerrold T. Bushberg, J. Anthony Seibert, Edwin Marion Leidholdt, John M. Boone, “The Essential Physics of Medical Imaging”, Wolters Kluwer Health Publisher, 2020.

**REFERENCE BOOKS:**

1. Masao Takano, Takeshi Iinuma, Yukio Tateno, “Computed Radiography”, Springer Japan, 2012.
2. Andreas Maier, Stefan Steidl, Vincent Christlein, Joachim Hornegger, “Medical Imaging Systems An Introductory Guide”, Creative Media Partners, LLC, 2020.
3. Kris Iniewski, Troy Farncombe, “Medical Imaging Technology and Applications”, CRC Press, 2017.
4. Arnulf Oppelt, “Imaging Systems for Medical Diagnostics”, Wiley, 2006.
5. Cornelius T Leondes, “Medical Imaging Systems Technology”, World Scientific Publishing Company, 2005.

**WEBSITE LINKS**

1. <https://www.microscopemaster.com/microscopy-imaging-techniques.html>
2. <https://www.radiologyinfo.org/en/info/bodymr>
3. <https://www.radiologycafe.com/frcr-physics-notes/molecular-imaging/planar-imaging/>
4. <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/positron-emission-tomography-pet>
5. <https://www.urologyhealth.org/urology-a-z/u/ultrasound-imaging>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	3	2	1	-	-	2	3	2	3
CO2	3	3	2	1	2	3	2	1	-	-	2	3	2	3
CO3	3	3	2	2	3	3	2	1	-	-	2	2	2	3
CO4	3	3	2	1	3	3	2	1	-	-	2	3	2	3
CO5	3	3	2	1	3	3	2	1	-	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	3	2	1	-	-	2	3	2	3



<b>JBM1035</b>	<b>BIOMEDICAL ULTRASONICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To familiarize with basics of ultrasound.
- To introduce and learn the different modes of ultrasound imaging technique
- To explain the various diagnostic applications of ultrasonography
- To explain the various therapeutic applications of ultrasonography
- To impart knowledge on few advanced ultrasound imaging techniques.

**UNIT I - BASICS OF ULTRASOUND 9**

Acoustic waves – wave equation, propagation, ultrasound source and field calculations, wave interactions with tissue, generation of ultrasound, selection of ultrasound probes, ultrasound imaging arrays and basics of beamforming, beam steering, echo-pulse technique for imaging applications.

**UNIT II - SCANNING MODES OF ULTRASOUND 9**

Conventional ultrasound imaging modes - A, B, C, M, Doppler, and color flow, adaptive beamforming, imaging sequences, Applications.

**UNIT III - DIAGNOSTIC APPLICATIONS 9**

Scattering from tissue and tissue characterization, Ultrasonic Elastography, blood flow imaging techniques – ultrafast Doppler, functional ultrasound, vector flow, speckle tracking, super-resolution microvascular imaging, blood pressure measurements, Imaging in gynecology and obstetrics for fetal monitoring.

**UNIT IV - THERAPEUTIC ULTRASOUND 9**

Ultrasound contrast agents, ultrasound induced bioeffects, ultrasound physiotherapy, lithotripsy, High intensity focused ultrasound, Histotripsy and Hemostasis, cavitation enhanced HIFU, Transcranial ultrasound, sonothrombolysis, ultrasound mediated drug delivery and gene therapy, ultrasound induced neurostimulation.

**UNIT V - ADVANCED ULTRASOUND TECHNIQUES 9**

3D imaging, molecular imaging, photoacoustic imaging, Quantitative ultrasound and ultrasound tomography with Applications.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain the basics of ultrasound.
- Apply different scanning modes of ultrasound imaging technique
- Explain the various diagnostic applications of ultrasonography
- Explain the various therapeutic applications of ultrasonography
- Gain knowledge on few advanced ultrasound imaging techniques.

**TEXTBOOKS:**

1. Richard S.C. Cobbold, “Foundations of Biomedical Ultrasound”, Oxford University Press, USA, 2007.
2. Thomas Szabo, “Diagnostic Ultrasound Imaging: Inside Out”, 2nd edition, Elsevier Science, 2013.

**REFERENCE BOOKS:**

1. Haim Azhari, “Basics of Biomedical Ultrasound for Engineers”, Wiley Publishing, 2010.
2. Da Xing, Sihua Yang, “Biomedical Photoacoustics”, Jenny Stanford Publishing, 2020.
3. Andrew Webb, “Introduction to Biomedical Imaging”, Second edition, Wiley publishing, 2023.
4. Yufeng Zhou, “Principles and Applications of Therapeutic Ultrasound in Healthcare”, CRC Press, 2021.

**WEBSITE LINKS:**

1. [www.nature.com/articles/s41551-018-0287-x](http://www.nature.com/articles/s41551-018-0287-x)
2. <https://iopscience.iop.org/article/10.1088/0034-4885/33/1/302/meta>
3. [www.bibliomed.org/mnsfulltext/6/6-1316978067.pdf?1681200349](http://www.bibliomed.org/mnsfulltext/6/6-1316978067.pdf?1681200349)
4. [www.researchgate.net/publication/231081825](http://www.researchgate.net/publication/231081825)
5. [www.fda.gov/radiation-emitting-products/medical-imaging/ultrasound-imaging](http://www.fda.gov/radiation-emitting-products/medical-imaging/ultrasound-imaging)

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	1	-	-	2	3	2	3
CO2	3	3	2	1	2	-	-	2	-	-	2	3	2	3
CO3	3	3	2	2	3	-	-	2	-	-	2	2	2	3
CO4	3	3	2	1	3	-	-	2	-	-	2	3	2	3
CO5	3	3	2	1	3	-	-	2	-	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	-	-	1.5	-	-	2	3	2	3

<b>JBM1036</b>	<b>BIOMETRIC SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To describe the principles of biometric modalities and know how to deploy them in authentication scenarios;
- To organize and conduct biometric data collections, and apply for finger print
- To apply different models for face Recognition and hand geometry in biometric application
- To deploy statistical methods in Iris and retinal biometrics
- To itemize the most up-to-date examples of real biometric applications in human Authentication

**UNIT I - THE BASICS OF BIOMETRICS 9**

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

**UNIT II - FINGER PRINT RECOGNITION 9**

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

**UNIT III - FACE RECOGNITION AND HAND GEOMETRY 9**

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

**UNIT IV - IRIS AND RETINAL BIOMETRICS 9**

Principles of iris image capture, iris sensors. Iris image preprocessing, segmentation, formatting and filtering. Daugman’s method, iris code, statistical properties of the iris code. Other iris coding methods, wavelet analysis. Retina scanning: Technical description, Characteristics, Strengths – Weaknesses, Deployment. Retina vascular pattern.

**UNIT V - BIOMETRIC AUTHENTICATION 9**

Introduction to Biometric Authentication Methods - Biometric Authentication Systems - Biometric authentication by fingerprint - Biometric Authentication by Face Recognition - Support Vector Machines - Biometric authentication by fingerprint - Multi-biometrics and Two-Factor Authentication.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Explain the basic principles of biometric modalities
- Collect the finger print data collections, and apply for finger print recognition technique.
- Apply different models for face Recognition and hand geometry in biometric application
- Deploy statistical methods in Iris and retinal biometrics.
- Demonstrate real-time biometric applications for human authentication.

## TEXT BOOKS:

1. Anil K jain, Patrick Flynn, Arun A. (Eds.), Handbook of Biometrics, Springer, 2008
2. S.Y. Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach” Prentice Hall, 2005

## REFERENCE BOOKS:

1. K. Jain, A. Ross, K. Nandakumar, Introduction to Biometrics: A Textbook, (2011), Springer Publishers, 2011.
2. Guide to Biometrics, By: Ruud M. Bolle, SharathPankanti, Nalini K. Ratha, Andrew W.Senior, Jonathan H. Connell, Springer 2009
3. Julian Ashbourn “Biometrics: Advanced Identify Verification: The Complete Guide”, Springer-Verlag, 2000.
4. Derbel, Nabil & Kanoun, Olfa. “Advanced Methods for Human Biometrics”- springer,2021.
5. Paul Reid, “Biometrics for Network Security”, Pearson Education, 2004.

## WEBSITE LINKS:

1. <https://www.techtargget.com/searchsecurity/definition/biometrics>
2. <https://www.digimat.in/nptel/courses/video/106104119/L08.html>
3. <https://www.digimat.in/nptel/courses/video/106104119/L05.html>

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	2	-	-	2	3	2	3
CO2	3	3	2	1	2	-	-	2	-	-	2	3	2	3
CO3	3	3	2	2	3	-	-	2	-	-	2	2	2	3
CO4	3	3	2	1	3	-	-	2	-	-	2	3	2	3
CO5	3	3	2	1	3	-	-	2	-	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	-	-	2	-	-	2	3	2	3

<b>JBM1005</b>	<b>VIRTUAL INSTRUMENTATION FOR BIOMEDICAL ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To enlighten the student on the basic concepts of Virtual instrumentation
- To inculcate knowledge on programming concepts of Virtual instrumentation.
- To know about data acquisition system used with Virtual instrumentation
- To provide an insight to various instrument interface
- To impart knowledge on various analysis tool and its applications

**UNIT I - INTRODUCTION TO VIRTUAL INSTRUMENTATION 9**

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

**UNIT II - VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES 9**

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

**UNIT III - DATA ACQUISITION 9**

Introduction to PC based data acquisition-typical plug-in data acquisition board-multiplexing of analog inputs-single ended and differential inputs-different strategy for sampling of multi-channel analog inputs. Concept of universal data acquisition card-use of timers/counters

**UNIT IV - INSTRUMENT INTERFACES 9**

Current loop, RS 232C/RS 485, General Purpose Interface Bus, System basics, interface basics networking basics for office & industrial application, Virtual Instrument Software Architecture & Interchangeable Virtual Instrument, image acquisition & processing, Motion Control. Analog to digital conversion, digital to analog conversion, Digital input and output, Digital multi meter, waveform generator.

**UNIT V - ANALYSIS TOOLS AND APPLICATION 9**

Fourier Transforms, Power spectrum, Correlation methods, Major equipment - Oscilloscope, Digital Multimeter, temperature data acquisition system, Multi-channel data acquisition using LABVIEW, ECG acquisition, Electrodes and sensor for ECG signal acquisition, Denoising ECG signal, effect of oversampling and under sampling, windowing, heart rate calculation using VI

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Explain the basic concepts of VI and its difference with conventional programming
- Elucidate the programming concepts of VI.
- Explain the different data acquisition hardware.
- Describe various instrument interface.
- Describe designing a biomedical based real time applications using LabVIEW

## TEXT BOOKS:

1. Gary Johnson, LABVIEW Graphical Programming, 2nd Edition, McGraw Hill, 1997.
2. Lisa K. Wells and Jeffrey Travis, LABVIEW for Everyone, PHI, 1997.
3. Skolkoff, Basic concepts of LABVIEW 4, PHI, 1998.

## REFERENCE BOOKS:

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
2. S. Gupta, J.P. Gupta, PC Interfacing for Data Acquisition and Process Control, ISA, 2nd Edition, 1994.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.
4. Jerome, Virtual Instrumentation Using LabView, PHI, 2010.
5. Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW BY Jon B. Olansen, Eric Rosow, 2001

## WEBSITE LINKS:

1. [https://www.halvorsen.blog/documents/teaching/courses/labview\\_automation/labview\\_basic.php](https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_basic.php)
2. [https://wwwusers.ts.infn.it/~rui/univ/Acquisizione\\_Dati/Lezioni/VIII%20-%20Labview%20-%20Introduction/LabVIEW%20Introduction-SixHour.pdf](https://wwwusers.ts.infn.it/~rui/univ/Acquisizione_Dati/Lezioni/VIII%20-%20Labview%20-%20Introduction/LabVIEW%20Introduction-SixHour.pdf)
3. <https://nptel.ac.in/courses/111/104/111104100/>
4. [https://onlinecourses.nptel.ac.in/noc21\\_ma37/preview](https://onlinecourses.nptel.ac.in/noc21_ma37/preview)

## CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	1	3	2	3	1
CO2	3	2	2	2	-	-	-	-	-	1	2	2	2	1
CO3	2	3	3	2	-	-	-	-	-	-	3	3	2	1
CO4	3	2	2	2	-	-	-	-	-	1	2	2	2	1
CO5	3	3	3	3	-	-	-	-	-	1	2	2	3	1
AVG	2.8	2.6	2.6	2.4	-	-	-	-	-	0.8	2.4	2.2	2.4	1

<b>JBM1037</b>	<b>SOFT COMPUTING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To familiarize with concepts of Artificial Intelligence.
- To introduce and use the idea of Neural networks for pattern classification.
- To explain the algorithm and techniques of Pattern association and competition based neural networks.
- To demonstrate the implementation of fuzzy systems.
- To impart knowledge on the various supervised and unsupervised techniques for pattern classification and clustering.

**UNIT I - ARTIFICIAL INTELLIGENCE 9**

Introduction to Artificial Intelligence (AI), Various types and characteristics of production systems, AI Search algorithm-breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A\* algorithm, AO\* Algorithms and various types of control strategies. Knowledge representation issues, Semantic networks-frames, Propositional and predicate logic, monotonic and non-monotonic reasoning, forward Reasoning, backward reasoning.

**UNIT II - NEURAL NETWORK FOR PATTERN CLASSIFICATION 9**

Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, characteristic and applications of ANN, single layer network, Multilayer network, Hebb Net, Perceptron, Adaline, Madaline nets.

**UNIT III - PATTERN ASSOCIATION AND NEURAL NETWORKS 9**

Fixed weight Competitive nets, Kohonen Self-organizing maps, Counter propagation network, LVQ, Back Propagation network.

**UNIT IV - FUZZY LOGIC AND SYSTEMS 9**

Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions. Fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic, Adaptive networks based Fuzzy interfaces-Classification and Representation trees.

**UNIT V - PATTERN RECOGNITION AND CLUSTERING TECHNIQUES 9**

Overview of Pattern recognition, Types of Pattern recognition, Parametric and Nonparametric approach, Bayesian classifier, Discriminant function, non parametric density estimation, histograms, kernels, window estimators, k- nearest neighbor classifier, estimation of error rates. Unsupervised learning- Hierarchical clustering- Similarity measures, Single-linkage Algorithm, Complete - linkage Algorithm, Average-linkage algorithm and Ward's method. Partitional clustering, Forgy's Algorithm, k-means algorithm.

**TOTAL:45 PERIODS**

## COURSE OUTCOMES:

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

- Explain and implement the concepts of Artificial Intelligence.
- Apply the idea of Neural networks for pattern classification.
- Explain and implement the algorithm and techniques of Pattern association and competition based neural networks.
- Demonstrate the implementation of fuzzy systems.
- Apply various supervised and unsupervised techniques for pattern classification and clustering.

## TEXT BOOKS:

1. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012.
2. S.N.Sivanandam, “Introduction to Artificial Neural Networks using MATLAB 6.0”, Tata McGraw hill Publication, 2016.
3. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”, Pearson India Education, 2015.

## REFERENCE BOOKS:

1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2<sup>nd</sup> Edition, 2011.
2. S. Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.
3. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009.

## WEBSITE LINKS:

1. <https://www.coursera.org/learn/neural-networks-deep-learning>
2. <https://www.classcentral.com/course/neuralnets-398>
3. <http://neuralnetworksanddeeplearning.com/chap1.html>
4. <https://online-learning.harvard.edu/subject/neural-networks>

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
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CO4	3	3	2	1	3	3	-	-	-	-	2	3	2	3
CO5	3	3	2	1	3	3	-	-	-	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	3	-	-	-	-	2	3	2	3



<b>JBM1023</b>	<b>BRAIN COMPUTER INTERFACE TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the theories behind brain computer interaction.
- To introduce the basic concepts of brain computer interface system
- To study the various approaches and models in structure of BCI.
- To study the signal processing and classification methods used in BCI.
- To gain knowledge on various BCI technology applications in medicine.

**UNIT I - HUMAN COMPUTER INTERACTION 9**

Theories within cognitive and perceptual psychology, human decision making and actions in computer supported situations, Interaction between human and computerized technical systems, Concept of Brain Computer Interface (BCI),

**UNIT II - STRUCTURE OF BCI 9**

Design and construction of Brain Computer Interface system, Invasive and Non-invasive Types of BCI, EEG Standards, Signal Features, Spectral Components, EEG Data Acquisition, Pre-processing, Hardware and Software, Artifacts, Methods to Remove artifacts, Near Infrared BCI.

**UNIT III - BCI APPROACHES AND MODELS 9**

Movement Related EEG Potentials, Mental States, Visual Evoked Potential. P300 virtual platform, EEG Feature Extraction Methods - Time/Space Methods, Fourier Transform, Wavelets, AR models, Band pass filtering, PCA, Laplacian Filters, Linear and Non-linear Features, EEG Feature Translation Methods- LDA, Regression, Memory Based Vector Quantization, Gaussian Mixture Modeling, Hidden Markov Modeling.

**UNIT IV - BCI DATA ANALYSIS AND CLASSIFICATION 9**

Classification techniques–Binary classification, Ensemble classification, Multiclass Classification, Regression - Linear, Polynomial, Multilayer neural networks, Support vector machine.

**UNIT V - BCI CONTROLLED APPLICATIONS 9**

Brain Computer Interface for Motor rehabilitation, Neuro-prosthetics, Mediating interaction in Virtual reality and augmented reality, Haptics, BCI Controlled Robots, Brain Actuated Control applications, Therapeutic applications of BCI technologies, Ethical issues in BCI research.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain the theories behind brain computer interaction.
- Apply the basic concepts of brain computer interface system
- Demonstrate the various approaches and models in structure of BCI.
- Elaborate the signal processing and classification methods used in BCI.
- Analyse and apply the various BCI technology applications for use at clinical side.

**TEXT BOOKS:**

1. Rajesh P. N. Rao, “Brain-Computer Interfacing: An Introduction”, First Edition, Cambridge University Press, 2019.
2. Fabien Lotte, Chang S. Nam, Anton Nijholt, “Brain–Computer Interfaces Handbook: Technological and Theoretical Advances”, CRC Press, UK. 2018.

**REFERENCE BOOKS:**

1. Elizabeth Winter Wolpaw, Jonathan Wolpaw, “Brain Computer Interfaces: Principles and Practices”, First Edition, Oxford University Press, 2014.
2. Ella Hassanien, Ahmad Taher Azar, “Brain-Computer Interfaces: Current Trends and Applications”, Springer International Publishing, 2016.
3. Christoph Guger, Brendan Allison, Gernot Müller-Putz, “Brain-Computer Interface Research A State-of-the-Art Summary”, Springer International Publishing, 2015.
4. Dennis J. McFarland, Guido Dornhege, Jose del R. Millan, Klaus-Robert Müller, Thilo Hinterberger, “Toward Brain-computer Interfacing”, MIT Press, 2007.

**WEBSITE LINKS:**

1. <http://learn.neurotechedu.com/>
2. <https://www.geeksforgeeks.org/brain-machine-interface-bmi/>
3. <https://www.frontiersin.org/articles/10.3389/fnsys.2021.578875/full>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3497935/>
5. <https://www.techtarget.com/whatis/definition/brain-computer-interface-BCI>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	2	-	-	2	3	2	3
CO2	3	3	2	1	2	-	-	2	-	-	2	3	2	3
CO3	3	3	2	2	3	-	-	2	-	-	2	2	2	3
CO4	3	3	2	1	3	-	-	2	-	-	2	3	2	3
CO5	3	3	2	1	3	-	-	2	-	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	-	-	2	-	-	2	3	2	3

\*\*\* END OF VERTICAL 2 \*\*\*

## **VERTICAL III - DESIGN OF MEDICAL DEVICES**

<b>JBM1038</b>	<b>BIOMEDICAL ENTREPRENEURSHIP</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To learn fundamentals of entrepreneurship and its scope in Biomedical field.
- To learn the theories of entrepreneurial motivation for startup.
- To learn about the assistance and support available for Entrepreneurship.
- To gain knowledge on the regulatory and legislations in Entrepreneurship.
- To learn to assess the venture and globalization strategies.

### **UNIT I - SCOPE FOR ENTREPRENEURSHIP 9**

Introduction to Entrepreneurship, Factors influencing entrepreneurship, Characteristics of an entrepreneur, Types of entrepreneurs - According to Type of Business, According to Use of Technology, According to Motivation, According to Growth, According to Stages. Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.

### **UNIT II - ENTREPRENEURIAL MOTIVATION 9**

Motivation - Maslow's theory, Herzberg's theory, McGregor's Theory, McClelland's Need – Achievement Theory, Culture and Society, Values / Ethics. Risk taking behaviour, Creativity in Entrepreneurship, Innovation and inventions, Legal Protection of innovation, Skills of an Entrepreneur for Decision making and Problem Solving.

### **UNIT III - ORGANISATION ASSISTANCE 9**

Identify and organize support for product development, funding agencies, collaborative initiatives, and angel investors. New Ventures, MSME Act Small Scale Industries, Carry on Business license, Environmental Clearance, National Small Industries Corporation, Government Stores Purchase scheme (e-tender process), Excise exemptions and concession, Quality Standards with special reference to ISO, The Small Industries Development Bank of India, The State Small Industries Development Corporation, Export oriented units, Incentives and facilities to exports entrepreneurs.

### **UNIT IV - RULES, REGULATIONS AND LEGISLATION 9**

Applicability of Legislation, Industries Development Act, 1951, Factories Act, 1948, The Industrial Employment Act, 1946, Suspension, Stoppage of work, Termination of employment, Environment Act, 1986, The sale of Goods Act, 1950, Industrial Dispute Act 1947, Directorate General of Supplies and Disposals, Certification, ISI, CE, UL, NABL and FDA regulations, ISO:13485, ISO:14791, risk management, Environmental regulation. Case study on risk management.

### **UNIT V - VENTURE AND IMPACT OF GLOBALIZATION 9**

Assessing the venture, establish venture invention, market research, presenting the business plan, medical product manufacturing and marketing, leadership, quality management, safety, safe disposal, preventing pollution and health hazards. Case study.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Describe the role of Biomedical Engineers in entrepreneurship
- Interpret the background for biomedical engineers in entrepreneurship
- Acquire the skills and techniques required towards innovation
- Categorize the resources and funding agencies
- Judge the right product based on market needs, Compile and quantify the opportunities and challenges

## TEXT BOOKS:

1. O.P. Gupta, “Fundamentals of Entrepreneurship”, Reprint Edition, SBPD Publishing House, 2021.
2. Jen-Shih Lee “Biomedical Engineering Entrepreneurship”, World Scientific Publishing, USA. 2010.

## REFERENCE BOOKS:

1. S. Anil Kumar, “Entrepreneurship Development”, New Age International Publishers, 2008.
2. Brant Cooper, Patrick Vlaskovits, “The Lean Entrepreneur”, Wiley, 2nd edition, New Jersey, 2016.
3. Nathan Furr, Jeff Dyer, “The Innovator's Method: Bringing the Lean Start-up into Your Organization”, Harvard Business Press, Boston, 2014.

## WEBSITE LINKS:

1. <https://msme.gov.in>
2. [www.gktoday.in/topic/national-policy-guidelines-on-bio-medical-innovation-and-entrepreneurship/](http://www.gktoday.in/topic/national-policy-guidelines-on-bio-medical-innovation-and-entrepreneurship/)
3. [www.worldscientific.com/doi/10.1142/9789813270435\\_0008](http://www.worldscientific.com/doi/10.1142/9789813270435_0008)
4. [www.coursera.org/specializations/wharton-entrepreneurship](http://www.coursera.org/specializations/wharton-entrepreneurship)
5. <https://swayam.gov.in/explorer?searchText=entrepreneurship>

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
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CO3	3	3	2	2	3	3	3	3	3	2	2	2	3	3
CO4	3	3	2	1	3	3	3	3	3	2	2	3	3	3
CO5	3	3	2	1	3	3	3	3	3	2	2	3	3	3
AVG	3	3	2.5	1.5	2.5	3	3	3	3	2	2	3	3	3

<b>JBM1039</b>	<b>MEDICAL DEVICE DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand about need and scope in areas of medical device design.
- To understand the standards and regulatory requirements in developing a medical device.
- To introduce the basics processes of design, construction and development of medical device.
- To learn the technology of inclusion of hardware and software technology in medical device design.
- To understand the procedures involved in patenting the developed medical device design.

**UNIT I - SCOPE OF MEDICAL DEVICE DESIGN 9**

Need for innovation in medical device design, Strategy for device design-problem identification, prior art searches, strategy planning and concept generation; estimation, sketching, sketch modelling, design elements, testing and prototyping.

**UNIT II – REGULATORY REQUIREMENTS 9**

Medical device classification, bioethics, bio-compatibility and privacy issues in conceptualization, design of clinical trials, Specifications, control and regulatory requirements of design of : medical diagnostics (In-vitro, in-vivo diagnostics and Imaging), minimally invasive devices, surgical tools and implants.

**UNIT III - DEVELOPMENT STRATEGY AND PLANNING 9**

Intellectual property strategy – research and development strategy – clinical strategy – regulatory strategy – quality and process management – reimbursement strategy – marketing and stakeholder strategy – sales and distribution strategy – competitive advantage and business strategy.

**UNIT IV - HARDWARE AND SOFTWARE DESIGN 9**

Hardware risk analysis, Design and project merits, Design for six sigma, software risk analysis, licensing; Medical Device Rules, 2017: Implications on medical devices. Labelling, Inspection and IVD establishments, Clinical investigation; ISO 14971 (Medical devices: Application of risk management to medical devices). Regulatory requirements of biocompatibility of medical devices and ISO 10993; regulation of investigational medical devices.

**UNIT V - DESIGN TRANSFER AND IPR 9**

Transfer to manufacturing, documents and deliverables. Standard-ISO, Intellectual Property – Indian Economic Services, Patents, Copy rights, Trademarks, Trade secrets; Regulations and standards involved in the design – CE mark and FDA, Regulatory bodies in India, ISO 14155 standards for clinical investigations, Steps for getting FDA approval, Function and role of ethical committee, Medical ethics proposed by ICMR.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Understand about need and scope in areas of medical device design.
- Gain knowledge on the standards and regulatory requirements in developing a medical device.
- Explain the basics processes of design, construction and development of medical device.
- Understand the technology of inclusion of hardware and software technology in medical device design.
- Explain the procedures involved in patenting the developed medical device design.

## TEXT BOOKS:

1. Vikki Hazelwood, “Foundations and Strategies for Medical Device Design”, e-book, McGraw Hill LLC, 2021.
2. Jose Justiniano and Venky Gopaldaswamy, “Six Sigma for Medical Device Design”, First Edition, CRC Press, 2004.

## REFERENCE BOOKS:

1. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau ‘Handbook of Human Factors in Medical Device Design’, CRC press, 2010.
2. Peter J. Ogrodnik, “Medical Device Design: Innovation from Concept to Market”, Academic Press Inc; 1st Edition, 2012.
3. Paul H. King, Richard C. Fries, Arthur T. Johnson, “Design of Biomedical Devices and Systems”, Third Edition, 2014.
4. Stefanos Zenios, Josh Makower, Paul Yock, Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel, “Biodesign: The Process of Innovating Medical Technologies”, Cambridge University Press; 1 edition, 2009.

## WEBSITE LINKS:

1. [www.sciencedirect.com/science/article/pii/S0921344917302094](http://www.sciencedirect.com/science/article/pii/S0921344917302094)
2. <https://www.researchgate.net/publication/319445657>
3. <https://www.strategy2market.com/>
4. [www.jabil.com/blog/medical-device-industry.html](http://www.jabil.com/blog/medical-device-industry.html)
5. [www.insightregulatory.com/design-and-development](http://www.insightregulatory.com/design-and-development)

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	2	2	3	2	1	1	-	3	3	3	3
CO2	3	3	2	1	2	3	2	2	2	-	3	3	3	3
CO3	3	3	2	2	3	3	1	1	1	-	2	2	3	3
CO4	3	3	2	1	3	3	2	2	1	-	3	3	3	3
CO5	3	3	2	1	3	3	1	1	1	-	2	3	3	3
AVG	3	3	2.5	1.5	2.5	3	1.5	1.5	1	-	2.5	3	2.5	3

<b>JBM1040</b>	<b>CRITICAL CARE EQUIPMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To study the role and importance of machines that are used for diagnosis in ICUs
- To study various imaging and intervening devices used in ICU
- To learn the various feeding, suction equipment and their accessories used in Intensive care unit.
- To understand the operational procedure of various therapeutic, life-saving equipment and accessories of a critical care unit.
- To learn the role and importance of machines that are used in neonatal, pediatric Critical care units.

**UNIT I - MONITORING EQUIPMENT AND ACCESORIES 9**

Intensive care unit – Overview and Importance, Classification, ICU Bed, Medical Stretcher, Patient Monitoring systems, continuous vital sign monitoring – Oscillometric blood pressure, capnometer, temperature, SpO<sub>2</sub>, Holter monitor; Video laryngoscopes, Endoscopes, Glucometer, uric acid meter, pressure gauge, pressure monitoring line, monitoring lamps, Retractor set.

**UNIT II - CRITICAL CARE IMAGING AND INTERVENTION 9**

Ultrasound Machine, Endoscopic imaging, laparoscopic imaging, laparoscopic clip applicator, electronic morcellator, laparoscopic endo-trainer set, electro-surgical unit vessel sealing system, stainless steel surgical instruments.

**UNIT III – FEEDING AND SUCTION EQUIPMENT 9**

Syringe Pump, Infusion Pump, Enteral Feeding Pumps, Lines - Arterial line, central line, vascath, Peripherally Inserted Central Catheter (PICC), Breathing tubes - Endotracheal (ET) tube, laryngectomy tube, intubation tube, Tracheostomy tube; tracheostomy mask, endotracheal tube holder, Inhalers; Suction catheters and machine.

**UNIT IV – LIFE SAVING EQUIPMENT 9**

Oxygen supply – central line, portable oxygen cylinders; Sequential Compression Device, Ventilator – CPAP, BiPAP machine: mask, headgear, tube and filters, HME filter, nebulizer kit, Bains circuit, respiratory humidifier, Resuscitators, Blood warmer, Defibrillator, oxygen concentrator – Nasal cannula, oxygen mask, Dialysis machine, Anaesthesia machine, vaporiser, alarms.

**UNIT V – NEONATAL AND PAEDIATRIC EQUIPMENT 9**

Baby Warmer, Neonatal Ventilator, Baby Incubator, Pediatric Laryngoscope, Mucus Extractor, Baby Resuscitation Unit, Enteral Feeding Pump, Baby Thermometer, Pediatric Suction Machine, Baby Measuring Mat, lumbar puncture set, breast pump electric, Refrigerator for feed and medicine, Neonatal Monitors, Arterial blood gas analyzers, Neonatal echocardiogram.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain the role and importance of machines that are used for diagnosis in Intensive Care Unit of a Hospital.
- Interpret various imaging and intervening devices used in Intensive Care Unit of a Hospital.
- Explain the various feeding, suction equipment and their accessories used in Intensive care unit.
- Describe operational procedure of various therapeutic, life-saving equipment and accessories of a critical care unit.
- Explain role and importance of machines that are used in neonatal, paediatric Critical care units.

**TEXT BOOKS:**

1. R.K.V. Murugan, “Hospital Medical Equipment Made Easy-Intensive care and Pediatric Intensive Care”, First Edition, Notion Press publication, January 2020.
2. Yatin Mehta, “Textbook of Critical Care”, Second Edition, Jaypee Brothers Medical Publishers, 2022.

**REFERENCE BOOKS:**

1. Bikram Kumar Gupta, “Critical Care Medicine Bench to Bedside”, First Edition, Jaypee Brothers Medical Publishers, 2022.
2. Kler Neelam, “Handbook on Neonatal ICU”, First Edition, Jaypee Brothers Medical Publishers, 2020.
3. C. William Hanson, “Procedures in Critical Care”, McGraw Hill LLC Publishers, 2008.
4. Daniel Aston, Angus Rivers and Asela Dharmadasa, “Equipment in Anesthesia and Critical Care”, Scion Publishing, 2013.

**WEBSITE LINKS:**

1. <https://aci.health.nsw.gov.au/>
2. <https://www.narang.com/>
3. <https://intensivecarehotline.com/>
4. <https://patient.uwhealth.org/>
5. <https://www.kogland.com/>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
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CO4	3	1	2	1	3	3	-	2	2	-	2	3	2	3
CO5	3	1	2	1	3	3	-	1	1	-	2	3	2	3
AVG	3	1	2.5	1.5	2.5	3	-	1	1	-	2	3	2	3



<b>JBM1006</b>	<b>MEDICAL OPTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To obtain knowledge about optical properties of the tissues and its utilization on medical photonic diagnostic and therapeutic procedures.
- To understand the principle of Laser technology and other Instrumentation in medical photonics used in diagnosis and therapy.
- To understand the various medical applications of laser.
- To understand the principle of various diagnostic imaging modalities and monitoring equipment using photonics.
- To understand the various photonic intervention and treatment techniques

**UNIT I - LIGHT - TISSUE INTERACTIONS 9**

Fundamental Properties of light, Optical properties of tissues, Photobiology: Light induced cellular processes, Light induced processes in tissues: Radiative - Photo emission (Fluorescence and speckles), Non-Radiative - Photo chemical, Photo thermal and Photo disruption, Photo ablation, In-vivo Photoexcitation of tissues - Optical Biopsy.

**UNIT II - INSTRUMENTATION APPLIED IN MEDICAL PHOTONICS 9**

Instrumentation for absorption, Scattering and emission measurements, Principle of Optical Biosensing, Optical Biosensors, Excitation light sources, Optical Waveguides, coupling devices and tips, Optical filters, polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection techniques, Image intensifiers.

**UNIT III - LASERS IN THERAPEUTIC MEDICINE 9**

Laser Characteristics as applied to medicine, Lasers for therapeutic applications in the field of Ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Gastroenterology, Neurology, Laser Safety Procedures.

**UNIT IV - PHOTONIC DETECTION AND IMAGING TECHNIQUES 9**

Wave fronts, interference patterns, Principle of Hologram and its applications, Optical Coherence Tomography, Optical Elastography, Laser Induced Fluorescence Imaging (FLIM) Laser Doppler Perfusion Monitoring and Imaging, Flow Cytometry, Near field imaging of biological structures, Multispectral Imaging.

**UNIT V - PHOTONIC INTERVENTION AND TREATMENT TECHNIQUES 9**

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT – Bio-stimulation effect, Tissue Engineering with light, Overview of Bio-nano photonics.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Explain about Optical properties of the tissues and their light interaction mechanisms.
- Elaborate on the Principle of Laser technology and other Instrumentation in medical photonics used in diagnosis and therapy.
- Explain the various medical applications of laser.
- Explain the principle of various Diagnostic photonic Imaging modalities.
- Describe the Therapeutic applications of photonics

## TEXT BOOKS:

1. Tuan Vo Dirh, “Biomedical Photonics – Handbook”, CRC Press, BocaRaton,2003
2. Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and Sons, Inc. Publications, 2003.

## REFERENCE BOOKS:

1. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic Press Edition,1998.
2. Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007
3. David A. Boas, Constantinos Pitris, Nimmi Ramanujam, "Handbook of Biomedical Optics", CRC Press, Taylor and Francis Group, 2011.
4. R. Splinter, B.A. Cooper, "An Introduction to Biomedical optics", Taylor and Francis, 2007.

## WEBSITE LINKS:

1. <https://www.vumc.org/periop-services/laser-tissue-interaction>
2. <https://www.ipen.br/biblioteca/2007/eventos/14658.pdf>
3. <https://www.cancer.gov/about-cancer/treatment/types/photodynamic-therapy>
4. <https://www.fda.gov/radiation-emitting-products/surgical-and-therapeutic-products/medical-lasers>

## CO-PO/PSO MAPPING:

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CO4	3	3	2	1	3	-	-	2	-	2	2	3	2	3
CO5	3	3	2	1	3	-	-	1	-	2	2	3	2	3
AVG	3	3	2.5	1.5	2.5	-	-	1.5	-	2	2	3	2	3

<b>JBM1024</b>	<b>HUMAN ASSIST DEVICE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To study the role and importance of machines that takes over the functions of the heart.
- To study the role and importance of machines that takes over the functions of the lungs.
- To learn the functioning of the artificial unit which does the clearance function of kidney.
- To understand the devices developed for orthopedic assistance.
- To learn the assistive devices that augments and alternates sensory responses.

**UNIT I - CARDIAC ASSIST DEVICES 9**

Cardiac cycle, cardiac output, Principle of External counter pulsation techniques, left ventricular assist device, a right ventricular assist device, biventricular assist device, Muscle-powered VADs, intra-aortic balloon pump, Auxiliary ventricle, Short-term Circulatory Support Extracorporeal membrane oxygenation, prosthetic cardio valves, Artificial Heart, Pacemakers, case study.

**UNIT II - RESPIRATORY ASSIST DEVICES 9**

Respiratory function, lungs gaseous exchange/transport, Ventilators, Non-invasive positive pressure respiratory assistance, PAP, Continuous Positive Airway Pressure Device, CPAP-machine, Bi-Level Positive Airway Pressure Device machine, Electronic IPPB unit with monitoring for all respiratory parameters, Phrenic nerve stimulator, vertical expandable prosthetic titanium rib, High frequency chest wall oscillation – Smart vest, Heart Lung machine, oxygenators, blood pumps. Case study.

**UNIT III - RENAL ASSIST DEVICES 9**

Peritoneal dialysis, Artificial kidney, Dialysis principle, Hemodialysis Machine, Portable kidney machine, Dialyzers, functional parameters of hemodialyzer, Material and maintenance of dialyzers, Pelvic nerve stimulator, Case study.

**UNIT IV - ORTHOPAEDIC ASSIST DEVICES 9**

Classification of amputation types, Upper limb orthotics: different types of models, externally powered limb, myoelectric systems, Lower limb orthotics: Foot Orthoses (FO), Ankle Knee Foot Orthoses (AFO), Knee Ankle Foot Orthoses (KAFO), Spinal Orthoses, Crutches and Calipers, Design considerations of Wheelchairs, Case study.

**UNIT V - SENSORY ASSIST DEVICES 9**

Types of deafness, Auditory augmentation and substitution - hearing aids, Cochlear implants, Voice synthesizer, Speech trainer, Speech synthesizer, mobility aids for visually impaired - Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers, Case study.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Explain the principles and construction of artificial heart and associated assistive methods.
- Understand various devices and techniques that enable oxygenation and ventilation.
- Apply the technique of the extracorporeal machine that cleanses the blood.
- Describe development and utility of assist devices for orthopedic applications.
- Explain various sensory augmentation and assisting devices.

## TEXT BOOKS:

1. Dr. S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2019.
2. Albert M. Cook, Janice Miller Polgar, “Essentials of Assistive Technologies”, Elsevier Health Sciences, 2014.
3. Rory A, Cooper, Hisaichi Ohnabe, Douglas A, Hodson, “An Introduction to Rehabilitation Engineering”, CRC Press, First edition, 2006.

## REFERENCE BOOKS:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006.
2. Suzanne Robitaille, “The illustrated guide to Assistive technology and devices–Tools and gadgets for living independently”, Demos Health New York, First edition, 2010.
3. Michael Lysaght and Thomas Webster, “Biomaterials for artificial Organs”, Wood head Publishing series in biomaterials, 2010.
4. John B. Park Joseph D. Bronzino, “Biomaterials - Principles and Applications” CRC Press, 4th edition, 2003.
5. Design of Artificial Human Joints and Organs, Subrata Pal, Springer New York, 2016.

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3. <https://www.who.int/news-room/fact-sheets/detail/assistive-technology>
4. <https://www.thenationaltrust.gov.in/content/innerpage/aids-and-assistive-devices>

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	3	-	1	1	-	2	3	2	3
CO2	3	3	2	1	2	3	-	1	1	-	2	3	2	3
CO3	3	3	2	2	3	3	-	1	1	-	2	2	2	3
CO4	3	3	2	1	3	3	-	1	1	-	2	3	2	3
CO5	3	3	2	1	3	3	-	1	1	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	3	-	1	1	-	2	3	2	3

<b>JBM1041</b>	<b>MEDICAL DEVICE STANDARDS, REGULATION AND ETHICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand hazards and safety aspects of medical devices and hospital environment.
- To understand the need for quality management in hospital sector.
- To describe the Hospital safety and accreditation standards.
- To describe medical equipment safety standards.
- To explain the medical ethics.

**UNIT I - HAZARDS IN HEALTHCARE SERVICES 9**

Physiological effects of electrical current/shock, leakage current, electrical and chemical causes of fire, smoke and explosion, Occupational hazards - *hazardous agents*, ergonomic hazards, physical hazards and psychological hazards, Effects of radiation Exposure.

**UNIT II - STANDARDIZATION AND QUALITY MANAGEMENT 9**

Need for Standardization, Quality Management, QM in Healthcare Organization-Quality assurance methods, Quality management system for medical devices (ISO 9001 and ISO13485), safety and standardization for risk management (ISO 14971), FDA guidelines for medical devices approval and classification based on risk assessment, measures for Quality Control, Safety and Testing of Medical devices.

**UNIT III - HOSPITAL SAFETY AND ACCREDITATION STANDARDS 9**

Life Safety Standards- Protecting Occupants, Protecting the Hospital and individual from Fire, Smoke, and Heat, Systems for Extinguishing Fires, Managing Hazardous Material and Waste, Testing, Maintaining, and Inspecting Medical Equipment. Accreditation- JCI Accreditation and its Policies, Patient Organization management standards, NABH, NABL standards.

**UNIT IV - MEDICAL EQUIPMENT STANDARDS 9**

General requirements for basic safety and essential performance of medical equipment, IEC 60601 standards, Electrical Safety of Medical Equipment and Patient, classification of medical devices and their safety standards, Bioeffects of Radiation, Safety Codes for Electromedical Equipment, Electrical Safety Analyser, Radiation Safety Instruments, Radiation Monitoring Instruments, radiation protection.

**UNIT V - MEDICAL ETHICS 9**

Introduction to medical law and ethics, Consent to Treatment, Confidentiality and Clinical Negligence, Types of mental health, ethics of abortion, Reproductive Technology and surrogacy, The law in relation to end of life issues and Research. Maintaining standards and regulation, Presenting evidence and reports, The Coroner's court, The General Medical Council, Doctors rights: Employment and other rights of doctors.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Describe the Social responsibility in healthcare systems to avoid hazards.
- Comprehend the medical equipment safety standards and medical device maintenance.
- Apply Legal and professional guidelines for the hospital accreditation and understand hospital safety aspects
- Understand and apply medical device standards.
- Discuss the Bioethics and its role in healthcare services.

## TEXT BOOKS:

1. Olinda Timms, “Biomedical Ethics”, First Edition, Reed Elsevier India Pvt. Ltd., 2016.
2. Marcia A. Lewis and Carol D. Tampo, “Medical Law, Ethics, and Bioethics for the Health Professions”, F. A. Davis Company, 6<sup>TH</sup> Edition, 2007.

## REFERENCE BOOKS:

1. Domiel A Vallero, Biomedical Ethics for Engineers, Elsevier Pub.1st edition, 2007
2. C.M. Baxter, “The practical guide to Medical ethics and Law”, Second Edition. Pastest Publisher, 2005.
3. Johnna Fisher, Biomedical Ethics: A Canadian Focus, Oxford University Press, 2009.
4. Robert M Veatch, The Basics of Bio Ethics, 3rd Edition. Routledge, 2011.
5. Joint Commission Accreditation Standards for Hospitals, 6th Edition 2018.
6. Ben Mepham, Bioethics-An Introduction for the biosciences, 2nd Edition, Oxford University Press, 2008.
7. Nils Hoppe, Jose Miola, “Medical law and Medical Ethics”, Cambridge University Press, 2014.

## WEBSITE LINKS:

1. <https://vtethicsnetwork.org/>
2. [www.intechopen.com/chapters/74571](http://www.intechopen.com/chapters/74571)
3. [www.karger.com/Article/FullText/509119](http://www.karger.com/Article/FullText/509119)
4. [www.themedicportal.com/application-guide/medical-school-interview/medical-ethics/](http://www.themedicportal.com/application-guide/medical-school-interview/medical-ethics/)
5. [www.ohchr.org/en/instruments-mechanisms/instruments/principles-medical-ethics-relevant-role-health-personnel](http://www.ohchr.org/en/instruments-mechanisms/instruments/principles-medical-ethics-relevant-role-health-personnel)

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	3	2	2	2	-	2	3	3	3
CO2	3	3	2	1	2	3	1	1	1	-	2	3	3	3
CO3	3	3	2	2	3	3	2	1	2	-	2	2	3	3
CO4	3	3	2	1	3	3	1	1	1	-	2	3	3	3
CO5	3	3	2	1	3	3	2	2	2	-	2	3	3	3
AVG	3	3	2.5	1.5	2.5	3	2	2	2	-	2	3	3	3

<b>JBM1042</b>	<b>CLINICAL RESEARCH METHODOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To learn the various study designs and team formation in clinical research work.
- To gain knowledge on clinical research planning strategy and documentation works.
- To describe the quality control and assurance measures of research.
- To learn about data management in clinical research.
- To describe the data analytics and reporting of clinical research work.

**UNIT I - STUDY DESIGNS AND TEAMS 9**

Clinical research methods - Controlling Method, Randomization techniques, Time Sequences, Sampling methods, Health outcome measures: Clinical and Physiological, Humanistic and economic. Designing the methodology, Sample size determination and outcome of a study. Study team - Roles and responsibilities of: Investigator, Study Coordinator, Sponsor, Monitor, Contract Research Organization, Site management Organizations.

**UNIT II - EXECUTION AND DOCUMENTATION 9**

Good clinical practice (ICH GCP E6), Clinical trial materials (Documentation, Investigational drugs, devices, logistical materials). Review of source documents, CRF, ICF, IP storage, accountability and reconciliation, Study Procedure, Safety reporting, Monitoring visit reporting and follow-up, Guidelines to the preparation of following documents: Protocols, Investigator's Brochure, Informed Consent Form, Case report forms, Contracts and agreements, Trial Master File preparation and maintenance, Investigator Site File, Pharmacy File, Study related documents collection, Archival requirement.

**UNIT III - QUALITY CONTROL AND ASSURANCE 9**

Audit criteria, Audit process, Responsibilities of stakeholders in audit process, Audit follow-up and documentation, Audit resolution and preparing for FDA inspections, Fraud and misconduct management. Clinical Research regulations in India – CDSCO guidelines, ICMR guidelines, Clinical trial application requirements in India- IND, ANDA, AADA and NDA. USFDA regulations to conduct drug studies.

**UNIT IV - RESEARCH DATA MANAGEMENT 9**

Infrastructure and System Requirement for Data Management: Electronic data capture systems, System validation and test procedures, Coding dictionaries, Data migration and archival, Standard Operating Procedures, Data management plan, Case Report Forms and Database design considerations, Data cleaning, Adverse Drug Reaction data, Data transfer and database lock, Quality Control and Assurance in CDM, Data mining and warehousing.

**UNIT V - DATA ANALYTICS AND REPORT WRITING 9**

Clinical research data distribution, Measures describing the central tendency distributions-average, median, mode, Construction and labeling of data plots. Measurement of the spread of data-range, variation of mean, standard deviation, variance, coefficient of variation, standard error of mean. Incidence and prevalence, relative risk, attributable risk, Basics of testing hypothesis - Null hypothesis, level of significance, power of test, P value, statistical estimation of confidence intervals. Basics of statistical software: Excel, R-Programming, SAS. Report writing and presentation of data.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Explain the various study designs and team formation in clinical research work.
- Apply the principles of planning strategy and related documentation works for clinical research.
- Explain the various measures of quality control and assurance of research.
- Record and ensure data management obtained out of clinical research.
- Perform data analytics on data collected and report publishing of clinical research work done.

## TEXT BOOKS:

1. Frederick P Ognibene, John I. Gallin, Laura Lee Johnson, “Principles and Practice of Clinical Research”, Fourth Edition, Elsevier Science, 2017.
2. Richard Chin, Bruce Y Lee, “Principles and Practice of Clinical Trial Medicine”, Elsevier Science Publishing, 2008.

## REFERENCE BOOKS:

1. Duolao Wang, Ameet Bakhai, “Clinical Trials - A Practical Guide to Design, Analysis, and Reporting”, Remedica Publishing, 2006.
2. Ben M. W. Illigens, Felipe Fregni, “Critical Thinking in Clinical Research Applied Theory and Practice Using Case Studies”, Oxford University Press, 2018.

## WEBSITE LINKS:

1. <https://onlinelibrary.wiley.com/doi/full/10.1002/ped4.12166>
2. <https://clinicaltrials.gov/ct2/about-studies/learn>
3. [www.nia.nih.gov/health/what-are-clinical-trials-and-studies](http://www.nia.nih.gov/health/what-are-clinical-trials-and-studies)
4. <https://www.ern-eye.eu/clinical-research/sturz>

## CO-PO/PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	3	-	2	-	-	2	3	2	3
CO2	3	3	2	1	2	3	-	2	-	-	2	3	2	3
CO3	3	3	2	2	3	3	-	2	-	-	2	2	2	3
CO4	3	3	2	1	3	3	-	2	-	-	2	3	2	3
CO5	3	3	2	1	3	3	-	2	-	-	2	3	2	3
AVG	3	3	2.5	1.5	2.5	3	-	2	-	-	2	3	2	3

\*\*\* END OF VERTICAL 3 \*\*\*



## VERTICAL IV - BIO-ENGINEERING

<b>JBM1002</b>	<b>BIO TRANSPORT PHENOMENA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To provide a broad view of transport process in biological system
- To explore models of heat transfer system in the body
- To apply mass transport principles to biological systems
- To introduce the applications of mass transfer principles
- To impart knowledge on pharmacokinetic modelling

### **UNIT I - BASIC CONCEPTS OF TRANSPORT PROCESSES 9**

Relationship between flow and effort variables. Chemical balances, force balances, general flow balances, Kirchhoff's laws, Conservation of mass, conservation of energy, momentum balance.

### **UNIT II - HEAT TRANSFER SYSTEMS 9**

Modes of heat transfer, conduction, convection and radiation. Heat production, heat loss to the environment, role of blood circulation in internal heat transfer, models for heat transfer within the body.

### **UNIT III - MASS AND FLUID TRANSFER PRINCIPLES 9**

Mass balance, molecular diffusion, Transport through cell membranes. Mass transfer in kidneys, models of nephron function, gas transport mechanisms in the lungs and blood. Modelling of oxygen and inert gas uptake in the lungs.

### **UNIT IV - MASS TRANSFER IN ASSISTIVE DEVICES 9**

Modelling of patient-artificial kidney system. Comparison of natural and artificial lungs. Models for blood oxygenation, analysis of gas transport in membrane oxygenators.

### **UNIT V - COMPARTMENTAL MODELS 9**

Approaches to pharmacokinetic modelling and drug delivery, one and two compartmental models. Physiological applications-intravenous injection, constant intravenous infusion, determination of regional blood flow volumes and blood flow rates. Microscale Transport Phenomena in Bio-Engineering Applications.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Explain different balances of bio transport process
- Elucidate the models of heat transfer system in the body.
- Elucidate the models of mass transfer principles
- Explain the application of mass transfer principles in artificial kidney
- Elucidate different compartmental models of drug delivery and blood flow

**TEXT BOOKS:**

1. Ronald L, “Fourier Bio Transport phenomena in Biomedical Engineering”, 3rd Edition, CRC Press 2012.
2. Robert J. Roselli, R. Diller, “Bio transport principles and application”, Springer, London 2011

**REFERENCE BOOKS:**

1. George A Truskey, Fan yuan, “Transport phenomena in biological system”, CRC press 2009.
2. G. Astarita, R. Ocone, “Special Topics in Transport Phenomena”, Elsevier science, 2001.
3. Mark Johnson and C. Ross Ethier, “Problems for Biomedical fluid Mechanics”, CRC press 2009.
4. Kal Renganathan Sharma, “Transport phenomena in Biomedical Engineering”, Tata McGraw Hill, 2010
5. Umesh K.Mishra and Jasprit singh, “Semiconductor Device physics and Design”, Springer 2008.

**WEBSITE LINKS:**

1. <https://bme.osu.edu/research/biotransport>
2. <https://link.springer.com/article/10.1007/BF02647343>
3. [https://en.wikipedia.org/wiki/Compartmental\\_models\\_in\\_epidemiology](https://en.wikipedia.org/wiki/Compartmental_models_in_epidemiology)

**CO-PO/PSO MAPPING:**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO1</b>	3	2	3	3	2	3	-	-	-	-	3	3	2	-
<b>CO2</b>	3	3	3	2	2	3	-	-	-	-	3	3	2	-
<b>CO3</b>	2	3	2	3	3	3	-	-	-	-	3	2	2	-
<b>CO4</b>	3	3	3	2	3	3	-	-	-	-	2	3	2	-
<b>CO5</b>	3	3	3	2	3	3	-	-	-	-	2	2	2	-
<b>AVG</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>2.4</b>	<b>2.6</b>	<b>3</b>	-	-	-	-	<b>2.6</b>	<b>2.6</b>	<b>2</b>	-

<b>JBM1043</b>	<b>BIOPRINTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To create organs and transplantable tissues that can be safely placed in humans.
- To understand the basic concepts of 3D Printing technology.
- To create problem solving ability among students for creating 3D Printing solutions.
- To design novel 3D Printing approaches for different CAD Models.
- To prepare students for Entrepreneurship in the field of 3D Printing technology.

**UNIT I - DESIGN PROCESS OVERVIEW 9**

Fusion 360, CAD environment, CAD - best practices, common files types, cad libraries, a short history of digital manufacturing: design for 3D print, fusion 360 modeling, sketching, extruding, collaborating on files, process flow: fusion 360 sculpting, moving between environments, matching imported geometry.

**UNIT II - 3D PRINTING AND ITS PROCESS 9**

3D printing Business Case: working with Meshes, Scanning Tools, Editing Scanned Files, Fixing Scan Bugs, Printing in Plastic: Optimizing for Print, Printing, Stanford Print, De-Bugging, Printing in Metal: making assemblies, moving and aligning, Parts Joints.

**UNIT III - BIOPRINTING APPROACHES 9**

Printing in glass, wood, concrete: Prototype II, fasteners, finishes, advanced modeling tools, bioprinting: Working with Service Providers, Optimizing Files for different methods, debugging prints, ethics: CAD Rendering, Mechanical Drawings, Photographing Parts.

**UNIT IV - 3D BIOPRINTING AND BIOFABRICATION 9**

Problem identification, Applications in Lab-on-chip and Organ-on-chip (Brain-on-chip, Artery-on-a-chip, Lung-on-a-chip, Bone-on-a-chip, Liver-on-a-chip, Gut-on-a-Chip, etc.), Applications in prosthetics (Robohand) – implants - innovative bioactive research - regenerative medicine.

**UNIT V - DEVELOPMENTS IN BIOPRINTING 9**

Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Digital Light Process (DLP), Multi Jet Fusion (MJF), Polyjet. Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM).

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Identify the four major steps in bioprinting a 3D structure and explain how bioprinting can be used to address medical needs.
- Differentiate the advantages and limitations of 3D modelling software for bioprinting
- Identify the ethical and regulatory issues involved in new medical treatments and the future of 3D bioprinting.
- Evaluate the nature and variation of materials for prosthetics and structural supports used in 3D bioprinting.
- Apply the 3D printing process to case studies of biomaterials enhancing lives.

**TEXT BOOKS:**

1. Atala et al., Essentials of 3D Biofabrication and Translation, 1st edition, ISBN-13: 978-0128009727.
2. Zhang et al., 3D Bioprinting and Nanotechnology in Tissue Engineering and Regenerative Medicine. 1st edition, ISBN 9780128005477.
3. Forgacs et al., Biofabrication - Micro- and Nano-fabrication, Printing, Patterning and Assemblies, 1st Edition, ISBN 9781455728527,

**REFERENCE BOOKS:**

1. Hod Lipson, Melba Kurman., M, “Fabricated: The new world of 3D printing”. John Wiley and Sons, 2013.
2. France, A. K, “Make: 3D printing: the essential guide to 3D printers”, Maker Media, Inc., 2013.

**WEBSITE LINKS:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_bt61/preview](https://onlinecourses.nptel.ac.in/noc22_bt61/preview)
2. <https://www.coursera.org/lecture/3d-printing-applications/bioprinting-V6WNO>
3. <https://www.sciencedirect.com/journal/bioprinting>

**CO-PO/PSO MAPPING:**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO-1</b>	1	2	-	2	3	2	3	2	1	1	2	2	3	3
<b>CO-2</b>	1	1	2	1	2	1	-	1	1	2	2	2	3	1
<b>CO-3</b>	1	3	2	2	2	3	1	3	1	2	2	1	3	2
<b>CO-4</b>	1	3	1	1	3	3	2	1	-	3	2	2	3	3
<b>CO-5</b>	1	2	1	3	1	2	1	1	3	3	2	2	2	3
<b>AVG</b>	<b>1</b>	<b>2.2</b>	<b>1.2</b>	<b>1.8</b>	<b>2.2</b>	<b>2.2</b>	<b>1.4</b>	<b>1.6</b>	<b>1.2</b>	<b>2.2</b>	<b>2</b>	<b>1.8</b>	<b>2.8</b>	<b>2.4</b>

<b>JBM1001</b>	<b>BioMEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To aware the students about the fundamental principles of microsystems
- To provide the concepts essential for designing lab-on-a-chip and Point-of-care devices
- To provide the concept of Biosensors, uses, design, and development for advanced research level so that students would be comfortable in higher studies.
- To Hands-on experience in in-house microfabrication and Hands-on experience in fabricating simple microfluidic devices.
- To learn and design about various biosensors and its applications.

**UNIT I - MICROSYSTEMS 9**

Overview of MEMS and BioMEMS, Silicon microfabrication: materials for MEMS, Emergence, device and applications, Scaling issues.

**UNIT II - MICROFABRICATION TECHNOLOGY 9**

Microfabrication concept, types of microfabrication: Thin film deposition, Lithography, E-Beam Lithography, X-ray Lithography, Photolithography, Soft lithography Etching, Wafer Bonding, Bulk Micromachining, Surface Micromachining, and LIGA process.

**UNIT II – MICROFLUIDICS 9**

Basic principles in microfluidics, design principles for microfluidic devices, device fabrication procedures, components of microfluidic devices utility of microfluidic devices in various biological, chemical, and optical sensing applications, opto-fluidics, Inertial-microfluidics, droplet-microfluidics, microfluidics based-flow cytometry.

**UNIT IV - LAB-ON-A-CHIP DEVICES 9**

Concept of ‘Lab on a chip’, Components of lab-on-a chip: micropump, microvalve, micromixer, microsensor, lenses, heaters, sensors, etc. Field flow fractionation (FFF), Microfluidic PCR, Microfluidic cell sorter, Lab-on-chip array for biomolecules, Minimally invasive biomedical microdevices, and Microfluidics Future prospects.

**UNIT V - BIOSENSORS AND ITS TYPES 9**

Introduction to Overview of Biosensors, components of a biosensor, design considerations. Biosensors for Health: Biosensors for diabetes, cardiovascular diseases, and cancer applications. Ion exchange membrane electrodes, enzyme electrodes, glucose sensors, immunosensors, Basic principles of MOSFET biosensors.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Know the various MEMS design and fabrication techniques for Biosensors. Explore the concepts of BioMEMS and its application in healthcare.–
- Ability to identify basic requirements for a design application related to microfabrication and its techniques for biomedical systems.
- Develop the skill to realize, build, and get hands-on experience fabricating simple microfluidic devices.

- Analyse the performance and merit of different lab-on-a-chip concepts, designs, and modes of work.
- Know the different biosensors for biomedical applications, analyze, compare and appreciate the performance and merit of different and point-of-care devices' concepts, importance, design.

#### TEXT BOOKS:

1. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2001.
2. Wanjun Wang, Stephen A.Soper, “BioMEMs: Technologies and Applications”, CRC Press, 2006.
3. Mohamed Gad-el-Hale, “MEMS Applications”, CRC Press, 2006.

#### REFERENCE BOOKS:

1. Madou, M. J., “Fundamentals of microfabrication and nanotechnology”, three-volume set. CRC Press, 2018
2. Gerald A. Urban, “BioMEMS”, Springer, 2010.
3. Steven S Saliterman, “Fundamentals of BioMEMS and Medical Microdevices”, SPIE, 2008.

#### WEBSITE LINKS:

1. <https://archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-me01/>
2. <https://pll.harvard.edu/course/introduction-mems-and-biomems>
3. <https://link.springer.com/book/10.1007/978-1-4757-3534-5>

#### CO-PO/PSO MAPPING:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO-1</b>	3	2	3	2	3	2	3	2	1	2	3	1	1	1
<b>CO-2</b>	2	1	2	1	-	1	-	1	1	2	2	2	2	1
<b>CO-3</b>	3	2	2	2	2	-	-	3	1	2	3	1	2	2
<b>CO-4</b>	1	3	3	2	3	3	2	1	-	1	3	1	3	3
<b>CO-5</b>	3	2	1	3	1	1	1	2	3	3	2	3	2	1
<b>AVG</b>	<b>2.4</b>	<b>2</b>	<b>2.2</b>	<b>2</b>	<b>1.8</b>	<b>1.4</b>	<b>1.2</b>	<b>1.8</b>	<b>1.2</b>	<b>2</b>	<b>2.6</b>	<b>1.4</b>	<b>2</b>	<b>1.6</b>

<b>JBM1009</b>	<b>NANOTECHNOLOGY AND APPLICATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates
- To make them acquaint with the fabrication and characteristics of nanomaterials
- To make them learn the methods and techniques for analysis and synthesis of nanoparticles
- To make them learn about the shapes, structure and properties of nanoparticles
- To make them understand various applications of nanoparticles in different sectors

**UNIT I - INTRODUCTION TO NANOTECHNOLOGY 9**

Basic Structure of Nanoparticles, History of Nanotechnology-Opportunity at the nano scale-length and time scale in structures-energy landscapes-Inter dynamic aspects of inter molecular forces nanoclusters of metals and semiconductors.

**UNIT II - FABRICATION OF NANOMATERIALS 9**

Physical Vapor Deposition (PVD), pulsed laser deposition, Magnetron sputtering, Multi Beam Epitaxy, Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), Microlithography, Dip-pen and Electron beam lithography, thin film deposition; Electrospinning; Bio-synthesis of nanomaterials

**UNIT III - PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9**

Influence of Nano structuring on Mechanical, optical, electronic, magnetic and chemical properties, Electronic and optoelectronic properties of molecular materials, Microscopy measurements: Scanning electron microscopy, transmission electron microscopy, Atomic force microscopy, scanning tunnelling microscopy.

**UNIT IV - NANOSTRUCTURES 9**

Nanocrystals, Dendrimers, Buckyballs, Carbon Nanotubes, Fullerenes, Nanowires, Micelles, Quantum Dots, Giant magnetoresistance Applications of nanostructures- Reinforcement in Ceramics, Drug delivery.

**UNIT V - BIONANOPHOTONICS 9**

Semiconductor (metal) nanoparticles, nucleic acid and protein-based recognition groups– Application in optical detection methods – Nanoparticles as carrier for genetic material–. Designer proteins, Peptide nucleic acids, Nanomedicine, DNA computing, Molecular design using biological selection, Hybrid materials, Biosensors. Other general applications- Nanotechnology in agriculture – Fertilizer and pesticides

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Understand the basic of nanomedicine and analyze the key properties of nanomaterial in contrast biological relevance.
- Determine the potential advantages of nanostructure materials as drug carriers
- Apply their learned knowledge to develop Nanocarriers.
- Quantify surface area and volume in nanosystems in comparison with microsystems
- Infer the nanocarriers in various drug delivery systems

## TEXT BOOKS:

1. Vladimir P.T., “Nanoparticulates as Drug Carriers”, Imperial College Press, 2006.
2. Christ of M. Niemeyer, “Nano bio-technology: Concepts, Applications and Perspectives”, Wiley, 2014.
3. Dong Kee Yi, Georgia C. Papaefthymiou, “Nanobiomaterials: Development and Applications”, CRC Press, 2013.

## REFERENCE BOOKS:

1. Reza.A., Kentus. L., “Smart Nanoparticles in Nanomedicine”, Kentus Books, 2015.
2. Robert.W.Kelsall, Ian.W.Hamley, Mark Geoghegan, “Nano Scale Science And Technology”, John Wiley and son, ltd., 2011.
3. Mick Wilson Kamali Kannangara Geoff Smith Michelle, Simmons Urkhard Raguse, “Nano Technology”, Overseas India private Ltd., 2005.
4. S. M Lindsay, “Introduction to Nanoscience”, Oxford (2010).
5. Parag D., and Ashish., “Nano Medicines”, Pentagon Press, 2006.
6. K.K.Jain, “Nano Biotechnology”, Horizons Biosciences, 2008.

## WEBSITE LINKS:

1. <https://nptel.ac.in/courses/115/106/115106066/>
2. <https://nptel.ac.in/courses/122/106/122106034/>
3. <https://nptel.ac.in/courses/112/105/112105123/>
4. <https://nptel.ac.in/courses/115/105/115105099/>

## CO-PO/PSO MAPPING:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	3	2	2	3	2	3	-	-	1	1	3	2	3	1
CO-2	3	3	3	2	3	3	-	2	2	1	3	3	3	2
CO-3	-	-	3	3	3	3	-	1	1	1	3	3	2	1
CO-4	2	3	2	2	2	-	2	1	1	1	-	2	2	1
CO-5	3	3	3	2	3	3	1	1	1	1	2	2	3	1
AVG	2.2	2.2	2.6	2.4	2.6	2.4	0.6	1	1.2	1	2.2	2.4	2.6	1.2



<b>JBM1044</b>	<b>MEDICAL IMPLANTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To describe the principles of implant design with a case study.
- To study the implant design parameters and various blood interfacing implants.
- To study about soft tissue replacement and hard tissue replacement.
- To learn about the different kinds of implant materials and its uses.
- To understand the implants in patients and its ethical principles.

**UNIT I - PRINCIPLES OF IMPLANT DESIGN 9**

Clinical Problems Requiring Implants for Solution, Principles of Implant Design/Design Parameters: Permanent versus Absorbable Devices, The Missing Organ and its Replacement, Criteria for Materials Selection, Tissue Engineering-Scaffolds and Cells and Regulators.

**UNIT II - DESIGN PARAMETERS 9**

Design Specifications, Biocompatibility: Local and Systemic Effects, Tissue Bonding and Modulus Matching, Degradation of Devices: Natural and Synthetic Polymers, Corrosion and Wear, Biocompatibility: Scar Formation and Contraction, Federal Regulation of Devices.

**UNIT III - DESIGN SOLUTIONS 9**

Scaffolds for Cartilage Repair, Implants for Bone, Implants for Plastic Surgery, Cardiovascular Prostheses: Heart Valves and Blood Vessels, Devices for Nerve Regeneration, Musculoskeletal Soft Tissues: Meniscus, Intervertebral Disk, Dental and Otologic Implants.

**UNIT IV - IMPLANT MATERIALS 9**

Implant Materials: Metallic implant materials, Stainless steels, Co based alloys, Ti-based alloys, Ceramic implant materials, Aluminium oxides, Hydroxyapatite, Glass ceramics, Carbons, nanocomposites in healing abutment and anti-microbial activity.

**UNIT V - IMPLANTS PRACTICAL ASPECTS 9**

Case studies – bone, cartilage, joints (knee and hip joints) and neural tissue regenerative devices, Ethical and Safety Issues, Implant and Device Failure, Implant Retrieval and Evaluation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Have an idea about implant design and its parameters
- Decide the testing procedure for specific biomaterial/implant and evaluate the response of biomaterial/Implant to Human body
- Analyse and characterize physiological signals and systems.
- Classify the types of materials used during implantation.
- Gain knowledge about medical device classification, regulatory requirements, and principles of bioethics.

**TEXT BOOKS:**

1. Paul H. King, Richard C. Fries, Arthur T. Johnson, “Design of Biomedical Devices and Systems”, Third Edition, ISBN 9781466569133, 2018.
2. Peter J. Ogrodnik, “Medical Device Design: Innovation from Concept to Market”, Academic Press Inc, 1st edition, ISBN-10: 0123919428, 2012.
3. Stefanos Zenios, Josh Makower, Paul Yock, Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel, Biodesign: “The Process of Innovating Medical Technologies”, Cambridge University Press, 1st edition, ISBN-10: 0521517427, 2009.

**REFERENCE BOOKS:**

1. Martin Culjat, Rahul Singh, Hua Lee, “Medical Devices: Surgical and Image-Guided Technologies”, 2012
2. Reinaldo perez, “Design of medical electronic device”, Elsevier science, 2002.
3. Theodore R, Kucklick, “The Medical Device Ramp-D Handbook”, Taylor and Francis Group LLC”, 3rd edition 2013.
4. David Prutchi, Michael Norris, “Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design, construction and test of medical devices”, John Wiley and Sons, 2005.
5. J. E. Ellingsen, S. Petter Lyngstadaas, “Bio-Implant Interface: Improving Biomaterials and Tissue Reactions”, CRC Press, 2003.

**WEBSITE LINKS:**

1. <https://www.mayoclinic.org/patient-care-and-health-information>
2. <https://biodesign.stanford.edu/>
3. <https://pib.gov.in/newsite/printrelease.aspx?relid=157955>

**CO-PO/PSO MAPPING:**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO-1</b>	3	2	2	2	3	1	3	1	3	2	1	1	3	1
<b>CO-2</b>	2	2	2	3	3	3	2	1	2	1	1	2	2	2
<b>CO-3</b>	2	3	1	3	2	1	3	1	3	2	1	3	2	1
<b>CO-4</b>	3	3	2	2	2	2	2	2	3	3	2	2	2	1
<b>CO-5</b>	2	2	3	3	-	3	3	3	2	3	3	1	3	1
<b>AVG</b>	<b>2.4</b>	<b>2.4</b>	<b>2</b>	<b>2.6</b>	<b>2</b>	<b>2</b>	<b>2.6</b>	<b>1.6</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1.8</b>	<b>2.4</b>	<b>1.2</b>

<b>JBM1045</b>	<b>ARTIFICIAL ORGANS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To have an overview of artificial organs and transplants
- To describe the principles of cardiac implants and its design.
- To study about implants of blood and cochlea.
- To describe about artificial skin and its substitutes.
- To study about physical parameters for concept design of artificial pancreas and lungs.

**UNIT I - ARTIFICIAL ORGANS AND TRANSPLANTS 9**

**Artificial Organs:** Basic physiology of human organs, Introduction, outlook for organ replacements, design consideration, evaluation process, Biomaterials used in artificial organs and prostheses. **Transplants:** Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

**UNIT II - CIRCULATORY ASSIST DEVICES 9**

Engineering Design of artificial Heart and Circulatory Assist Devices, Detailed Design to execute the plant, Heart Assist Technology, Blood Pumps, Prosthetic Heart Valves.

**UNIT III - ARTIFICIAL BLOOD AND COCHLEAR IMPLANTS 9**

Blood components and characteristics, Oxygen carrying plasma expanders, Blood substitutes, Crystalloid and colloidal solutions as volume expanders, Artificial oxygen carriers, Fluorocarbons, Hemoglobin based artificial blood. **Cochlear Implant:** Introduction, candidates for implant, the auditory system, the auditory periphery, theory of operation, evaluation of cochlear prosthesis, benefits and risks of implantation, the cost of implantation, the future of cochlear prosthesis.

**UNIT IV - ARTIFICIAL SKIN 9**

Structure and functions of skin, Characteristics and clinical use of skin substitutes, two conceptual stages in the treatment of massive skin loss, Skin substitutes: characteristics and uses, types of skin substitutes.

**UNIT V - ARTIFICIAL PANCREAS AND ARTIFICIAL LUNGS 9**

Parenteral Structure and function of Pancreas, Endocrine pancreas and insulin secretion, Diabetes, Insulin therapy, Insulin administration systems, Insulin production systems. Artificial Lungs: Gas exchange systems, Cardiopulmonary Bypass, Oxygen and CO<sub>2</sub> transport, coupling of oxygen and CO<sub>2</sub> exchange, Shear-Induced Transport Augmentation and Devices for Improved Gas Transport.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Elaborate the principle and biology underlying the design of implants and artificial organs.
- Differentiate classes of materials used in medicine.
- Discuss the application of cardiac assist devices.
- Discuss concept of biocompatibility and the design of artificial skin.
- Discuss the design process in artificial pancreas and lungs.

**TEXT BOOKS:**

1. Bronzino, J. D, “The Biomedical Engineering Handbook”, Germany: CRC Press, 2000.
2. Gerardo Catapano and Gijsbertus Jacob Verkerke, “Artificial Organs”, IGI Global Publishers, 2012.

**REFERENCE BOOKS:**

1. Miller, G. E., “Artificial Organs”, United States: Morgan and Claypool Publishers, 2006.
2. Schoen, F. J., Ratner, B. D., Hoffman, A. S., Lemons, J. E., “Biomaterials Science: An Introduction to Materials in Medicine”, Elsevier, 2003.
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, “Clinical Engineering”, CRC Press, 1st edition, 2010.
4. Yannas, I. V, “Tissue and Organ Regeneration in Adults”, New York, NY: Springer, ISBN:9780387952147, 2001.

**WEBSITE LINKS:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_bt12/preview](https://onlinecourses.nptel.ac.in/noc20_bt12/preview)
2. <https://aabme.asme.org/posts/innovations-in-artificial-organs>
3. <https://onlinelibrary.wiley.com/journal/15251594>

**CO-PO/PSO MAPPING:**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO-1</b>	1	1	2	2	2	2	3	2	1	1	1	1	2	2
<b>CO-2</b>	1	2	3	3	3	1	2	1	1	2	2	2	2	2
<b>CO-3</b>	-	-	-	1	1	1	1	3	1	2	3	1	2	2
<b>CO-4</b>	1	3	1	1	3	3	2	1	-	3	3	1	3	3
<b>CO-5</b>	3	2	1	3	1	2	1	1	-	3	2	3	2	3
<b>AVG</b>	<b>1.2</b>	<b>1.6</b>	<b>1.4</b>	<b>2</b>	<b>2</b>	<b>1.8</b>	<b>1.8</b>	<b>1.6</b>	<b>0.6</b>	<b>2.2</b>	<b>2.2</b>	<b>1.6</b>	<b>2.2</b>	<b>2.4</b>

<b>JBM1046</b>	<b>NEXT GEN SEQUENCING TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the principles and technologies of Next Generation Sequencing
- To acquire problem-solving skills for NGS experimental design, sample preparation and data generation for analysis and interpretation
- To develop proficiency in NGS data analysis, including quality control, alignment, variant calling and annotation
- To gain familiarity with commonly used NGS tools, databases and resources
- To explore applications of NGS in genomics research

**UNIT I - NGS DESIGN AND SAMPLE PREPARATION 9**

Historical overview of sequencing technologies, Principles and advantages of NGS, Overview of NGS platforms and technologies, Experimental design considerations, Sample collection, DNA/RNA extraction, and quality control, Library preparation methods.

**UNIT II - NGS DATA GENERATION AND ANALYSIS 9**

Sequencing platforms and protocols, Sequencing data quality control and assessment, Read preprocessing and quality control, Read alignment and mapping to reference genomes, Introduction to file formats (FASTQ, BAM, etc.).

**UNIT III - NGS DATA INTERPRETATION AND VISUALIZATION 9**

Single nucleotide variant (SNV) and insertion/deletion (Indel) calling, Quality filtering and variant annotation, Variant calling pipelines and tools, Interpretation of NGS results, Visualization techniques and tools,

**UNIT IV - NGS TOOLS, DATABASES AND RESOURCES 9**

Overview of commonly used NGS analysis tools, Public databases and resources for NGS data analysis, Integration of NGS data with other omics data, Advanced topics in NGS research (e.g., epigenetics, single-cell sequencing).

**UNIT V - NGS APPLICATIONS IN GENOMICS RESEARCH 9**

Gene expression analysis (RNA-Seq), Whole genome sequencing (WGS), Exome sequencing and variant discovery, Metagenomics and microbiome analysis, Sources of error and biases in NGS data, Limitations and considerations for data interpretation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Demonstrate knowledge of various NGS platforms, their advantages, and limitations.
- Design NGS experiments, including sample collection, library preparation, and quality control.
- Analyze NGS data using appropriate bioinformatics tools and pipelines.
- Communicate effectively about NGS technology and its applications in genomics research.
- Apply NGS techniques to specific genomics research applications such as gene expression analysis, variant discovery, and metagenomics.

**TEXT BOOKS:**

1. High-Throughput Next Generation Sequencing, Methods and Applications.

- (Springer). Editors: Kwon, Young Min, Ricke, Steven C. (Eds.)
- Next Generation Sequencing, Methods and Protocols, 2018, Volume 1712, Steven R. Head, Phillip Ordoukhanian, Daniel R. Salomon (Eds), Humana Press. ISBN : 978-1-4939-7512-9

**REFERENCE BOOKS:**

- Next Generation Sequencing and Data Analysis 2021, Melanie Kappelmann-Fenzl, Springer. ISBN : 978-3-030-62489-7

**WEBSITE LINKS:**

- [https://onlinecourses.nptel.ac.in/noc23\\_bt34/preview](https://onlinecourses.nptel.ac.in/noc23_bt34/preview)
- [https://www.hindawi.com/journals/tswj/2014/802437/?utm\\_source=google&utm\\_medium=cpc&utm\\_campaign=HDW\\_MRKT\\_GBL\\_SUB\\_ADWO\\_PAI\\_DYNA\\_JOUR\\_X\\_PCUPS\\_Cambridge&gclid=CjwKCAjwhJukBhBPEiwAniIcNWYQ5vKbnzA53Lm2Ce5z2bUjmb-ityBcytWw2Up7neRMJDJBA1pVBoC4WIQAvD\\_BwE](https://www.hindawi.com/journals/tswj/2014/802437/?utm_source=google&utm_medium=cpc&utm_campaign=HDW_MRKT_GBL_SUB_ADWO_PAI_DYNA_JOUR_X_PCUPS_Cambridge&gclid=CjwKCAjwhJukBhBPEiwAniIcNWYQ5vKbnzA53Lm2Ce5z2bUjmb-ityBcytWw2Up7neRMJDJBA1pVBoC4WIQAvD_BwE)
- <https://pubmed.ncbi.nlm.nih.gov/24995601/>

**CO-PO/PSO MAPPING:**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO-1</b>	3	1	1	2	-	2	-	-	1	2	3	1	2	1
<b>CO-2</b>	3	1	1	2	-	3	-	-	1	2	-	2	2	1
<b>CO-3</b>	3	2	1	2	-	2	1	2	1	2	1	2	3	2
<b>CO-4</b>	3	3	1	3	-	1	1	2	1	2	2	2	3	2
<b>CO-5</b>	3	3	1	-	1	-	2	3	1	2	-	2	3	2
<b>AVG</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1.8</b>	<b>0.2</b>	<b>1.6</b>	<b>0.8</b>	<b>1.4</b>	<b>1</b>	<b>2</b>	<b>1.2</b>	<b>1.8</b>	<b>2.6</b>	<b>1.6</b>

**\*\*\* END OF VERTICAL 4 \*\*\***

## VERTICAL V – HEALTHCARE NETWORKS

<b>JBM1016</b>	<b>PRINCIPLES OF COMMUNICATION FOR BIOMEDICAL ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To know about analog communication and its types
- To learn data and pulse communication techniques.
- To gain knowledge on digital communication techniques
- To know the different types of bio-telemetry system
- To know the fundamental concepts of picture archiving and communication system

### **UNIT I - ANALOG COMMUNICATION 9**

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

### **UNIT II - PULSE AND DATA COMMUNICATION 9**

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

### **UNIT III - DIGITAL COMMUNICATION 9**

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

### **UNIT IV – BIO-TELEMETRY SYSTEM 9**

Components of telemetry system, Bio-telemetry and its importance, Single and multi-channel biotelemetry, ECG telemetry system, Temperature telemetry system, Telemetry of ECG and Respiration, Sports telemetry, Multi-patient telemetry, Ambulatory patient monitoring, Implantable telemetry systems.

### **UNIT V - PICTURE ARCHIVING AND COMMUNICATION SYSTEMS 9**

History of Picture archiving and communication system (PACS): Computer network development and data storage technology history - Establishment of standards for image exchange in medicine - PACS server, Benefits of a PACS Server, Cloud-based PACS, PACS With Radiology Information Systems (RIS) - Applications of PACS, PACS software, implementation of a picture archiving and communication system in a prototype application.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- List and explain Different Digital Communication Technique
- Elucidate on biotelemetry system and its components
- Describe the applications of PACS in hospital communication

## TEXT BOOKS:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6<sup>th</sup> Edition, Pearson Education, 2009.
2. R S Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2003.
3. Yu Liu, Jihong Wang, "PACS and Digital Medicine: Essential Principles and Modern Practice", CRC Press, 2010.

## REFERENCE BOOKS:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007.
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.

## WEBSITE LINKS:

1. <https://electronicspost.com/explain-the-need-for-modulation-in-a-communication-system/>
2. <https://www.postdicom.com/en/blog/cloud-based-pacs>
3. <https://science.jrank.org/pages/6722/Telemetry-System-components.html>
4. <https://blog.peekmed.com/pacs-systems/>

## CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	2	2	2	1	1	1	1	2	2
CO2	3	3	3	3	1	3	3	3	1	1	1	1	1	2
CO3	3	3	3	3	1	2	2	3	1	1	1	1	2	2
CO4	3	3	3	3	1	3	3	3	1	1	1	2	2	1
CO5	3	3	3	3	2	3	2	3	2	2	2	2	1	1
AVG	3	3	3	2.8	1.2	2.6	2.6	2.8	1.2	1.2	1.2	1.4	1.6	1.6



<b>JBM1011</b>	<b>TELEHEALTH TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the key principles for telemedicine in health
- To apply multimedia technologies in medicine
- To understand legal issues and legal aspects of telemedicine
- To know about various telemedical standards
- To know about mobile telemedicine and its application.

**UNIT I - FUNDAMENTALS OF TELEMEDICINE 9**

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, tele medicine systems, benefits and limitations of telemedicine.

**UNIT II - TELEMEDICINE TECHNOLOGIES 9**

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

**UNIT III - ETHICAL AND LEGAL ASPECTS 9**

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection and security, jurisdictional issues, intellectual property rights. constraints for the wide spread use of telemedicine, social acceptance

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

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

**UNIT V - APPLICATIONS OF TELEMEDICINE 9**

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

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- To study about the basic concepts and benefits of telemedicine
- Detail on information and communication
- Apply multimedia technologies in telemedicine
- Explain legal issue in telemedicine
- Apply telehealth in healthcare

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Jung Hee Seo, Vijay Vedula, Theodore Abraham and ajat Mittal, “Multiphysics Computational models for cardiac low and virtual cardiography”, Int.J.Numer. Meth. Biomed. Engg. Published online in Wiley Online Library, 2013.
2. Lee Waite, Jerry Fine, “Applied Biofluid Mechanics”, McGraw Hill, 2007.
3. John K-J Li, “Dynamics of Vascular System”, World Scientific, 2004.
4. C.Ross Ethier, Craig A Simmons, “Introduction to Biomechanics - From Cells to Organisms”, Cambridge Texts in Biomedical Engineering, 2007.

**WEBSITE LINKS:**

1. [https://www.physio-pedia.com/Fundamentals\\_of\\_Telehealth\\_Technology](https://www.physio-pedia.com/Fundamentals_of_Telehealth_Technology)
2. <https://catalyst.nejm.org/doi/full/10.1056/CAT.18.0268>
3. <https://www.healthit.gov/faq/what-telehealth-how-telehealth-different-telemedicine>

**CO-PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	3	3	2	2	1	1	1	1	1	1	1	1
<b>CO2</b>	3	3	3	2	2	1	1	1	1	1	1	1	1	1
<b>CO3</b>	3	3	3	3	3	2	1	1	1	2	1	1	1	1
<b>CO4</b>	3	3	2	2	3	1	1	1	1	2	1	1	1	1
<b>CO5</b>	3	3	3	2	3	1	1	1	1	2	1	1	1	1
<b>AVG</b>	<b>3</b>	<b>3</b>	<b>2.9</b>	<b>2.4</b>	<b>2.4</b>	<b>1.4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1.6</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>

<b>JBM1025</b>	<b>BODY AREA NETWORK</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To study about working of Body Area Network
- To learn about body area networks and different hardware related to it
- To understand the healthcare devices of BAN
- To describe the need and methods of communication network
- To provide knowledge in the applications of Body area Network

**UNIT I - BODY AREA NETWORKS 9**

Need for wireless monitoring, Body area networks and Healthcare, Technical Challenges - Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture - Introduction.

**UNIT II - HARDWARE FOR BAN 9**

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

**UNIT III - HEALTHCARE DEVICES 9**

Wearable system for ECG monitoring, Evaluation of night time performance, smart phone-based healthcare monitoring system, Phone based fall risk prediction, RFID based personal mobile medical assistance.

**UNIT IV - WEARABLE SENSORS IN COMMUNICATION 9**

Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE 802.15.3, IEEE 802.15.4, Zigbee.

**UNIT V - BAN APPLICATIONS AND CHALLENGES 9**

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics, Electronic pill, Hardware centric and human centric challenges.

**TOTAL: 45 PERIODS**

**COURSE COUTCOMES:**

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

- Explain about the working of Body area network
- Understand the mobile based healthcare devices
- Perform body area network in wireless health systems
- Use different sensors and communication techniques in BAN
- Discuss the applications of BAN

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Hang, Yuan Ting, “Wearable medical sensors and systems”, Springer-2013
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation and Applications”, Pan Stanford Publishing Pvt. Ltd, Singapore, 2012
3. Guang-Zhong Yang (Ed.), “Body Sensor Networks”, Springer, 2017
4. Nilanjan Dey, Amira S. Ashour, Simon James Fong, “U-Healthcare Monitoring Systems: Volume 1: Design and Applications”, United Kingdom, Elsevier Science, 2018.

**WEBSITE LINKS:**

1. <https://www.nist.gov/publications/application-link-adaptation-body-area-networks>
2. <https://www.sciencedirect.com/science/article/pii/S187705091630299X>
3. <https://www.lairdconnect.com/resources/white-papers/overview-of-medical-body-area-networks>

**CO-PO MAPPING:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	3	2	1	1	-	1	2	1	2	1	1	2	3	2
<b>CO2</b>	3	2	1	1	2	1	2	1	1	2	1	2	3	2
<b>CO3</b>	3	2	1	1	2	2	2	1	1	2	1	2	3	2
<b>CO4</b>	3	3	1	1	2	2	2	1	1	2	2	2	3	2
<b>CO5</b>	3	2	3	1	-	3	3	2	3	2	3	2	3	2
<b>AVG</b>	<b>3</b>	<b>2.4</b>	<b>1.4</b>	<b>1</b>	<b>1.2</b>	<b>1.8</b>	<b>2.4</b>	<b>1.2</b>	<b>1.6</b>	<b>1.8</b>	<b>1.6</b>	<b>2</b>	<b>3</b>	<b>2</b>

<b>JBM1008</b>	<b>PATTERN RECOGNITION AND NEURAL NETWORK</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the fundamentals of pattern recognition and its types.
- To understand the principles of unsupervised algorithms and Clustering approaches to Pattern Recognition.
- To emphasize basic neural network architectures and learning algorithms.
- To understand how ANNs can be designed and trained using special neural nets.
- To illustrate the recent trends in pattern recognition and machine learning theories

**UNIT I INTRODUCTION AND SUPERVISED LEARNING 9**

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

**UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS 9**

Unsupervised learning- Hierarchical clustering- Similarity measures, Single-linkage Algorithm, Complete - linkage Algorithm, Average-linkage algorithm and Ward's method. Partitional clustering- Forgy's Algorithm, k-means algorithm.

**UNIT III SIMPLE NEURAL NETWORKS 9**

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

**UNIT IV SPECIAL NEURAL NETWORKS 9**

Back propagation network, Bidirectional Associative memory, Hopfield Network, Kohonen Self organizing map, Counter Propagation network

**UNIT V ADVANCEMENTS AND APPLICATIONS IN NEURAL NETWORKS 9**

Introduction to SVM and CNN, Neuro-fuzzy Systems, Application of ANN in Medical Diagnostics, Introduction to Machine Learning- Tensor Flow.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain the fundamentals of pattern recognition and supervised learning
- Demonstrate unsupervised classification using clustering techniques.
- Explain the basic concepts in Simple Neural Networks
- Acquire the basic concepts of competition-based neural nets.
- Analyze the application of ANN, fuzzy logic and machine learning to real time systems

**TEXT BOOKS:**

1. Freeman J.A., and Skapura B.M, " Neural networks, algorithms, applications and programming techniques", Addison – Wesley,2003.
2. S.N.Sivanandam, “ Introduction to Artificial Neural Networks using MATLAB 6.0”, Tata McGrawhill Publication,2016.

**REFERENCE BOOKS:**

1. Robert Schalkoff, “Pattern recognition, Statistical, Structural and neural approaches” John Wiley and Sons (Asia) Pte. Ltd., Singapore, 2005.
2. Laurene Fausett “Fundamentals of neural networks – Architectures, algorithms and applications”, Prentice Hall, 1994.
3. S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press, 2009.
4. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
5. S. Haykin, “Neural Networks and Learning Machines”, Prentice Hall of India, 2010.
6. D. E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, 1stEdn, Pearson, 2016.

**WEBSITE LINKS:**

1. <https://www.coursera.org/learn/neural-networks-deep-learning>
2. <https://www.classcentral.com/course/neuralnets-398>
3. <http://neuralnetworksanddeeplearning.com/chap1.html>
4. <http://www.deeplearningbook.org/>
5. <https://online-learning.harvard.edu/subject/neural-networks>

**CO-PO MAPPING:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	2	1	1	1	-	-	-	-	-	-	2	1	3	3
<b>CO2</b>	2	2	3	3	-	-	-	-	-	-	1	2	3	3
<b>CO3</b>	1	3	1	3	-	-	-	-	-	-	1	1	3	3
<b>CO4</b>	2	1	2	3	-	-	-	-	-	-	1	1	3	3
<b>CO5</b>	3	1	2	3	-	-	-	-	-	-	1	1	3	3
<b>AVG</b>	<b>2</b>	<b>1.6</b>	<b>1.8</b>	<b>2.6</b>	-	-	-	-	-	-	<b>1.2</b>	<b>1</b>	<b>3</b>	<b>3</b>

<b>JBM1027</b>	<b>COGNITIVE NEUROSCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To impart knowledge on basics of cognitive science and findings of cognitive psychology.
- To explore the ways in which psychologists go about studying these questions.
- To understand the human memory systems
- To explore the relationship between theories of cognition and empirical research
- To detail out the Cognitive neuroscience of consciousness

**UNIT I - BASICS OF COGNITIVE PSYCHOLOGY 9**

The Science of the Mind - scope of cognitive psychology, A Brief History, the emergence of modern cognitive psychology. Research in cognitive psychology. The neural basis of cognition -the Principal Structures of the Brain – neurons, communication of neurons, structure of functions of brain.

**UNIT II - ATTENTION AND PERCEPTION 9**

Selective attention, divided attention, models of attention – filter model and attenuation model. Bottom up and top-down processing in perception, Object Recognition – template matching, interactive activation model, feature integration theory, recognition by components theory. Gestalt laws of perceptual organization. Face perception, Speech perception.

**UNIT III - HUMAN MEMORY SYSTEMS 9**

Types of memory, working memory, long term memory. Memory Acquisition; Retrieval; Encoding Specificity; Implicit Memory; Theoretical Treatments of Implicit Memory; Amnesia; Memory Errors and Memory Gaps; Autobiographical Memory. Mnemonic systems.

**UNIT IV - LANGUAGE AND THINKING 9**

Concepts: Definitions and Prototypes; Organization of Language, Phonology, Words, Syntax, Sentence Parsing, Language and Thought, Judgment Heuristics, Anchoring; Reasoning: Confirmation and Disconfirmation, Logic, Decision-Making; Problem Solving: General Problem-Solving Methods, Relying on Past Knowledge. Defining the Problem.

**UNIT V - CONSCIOUSNESS 9**

Consciousness and cognitive psychology. Modern theories of consciousness – DICE, Global Works place. The functions of Consciousness – cognitive neuroscience of consciousness, the function of neuronal workspace, consciousness as justification for action.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain the neural basis of brain
- Perform the different attention model
- List the different memory system
- Explain the linguistic ability and decision-making system
- Elucidate consciousness state of brain

**TEXT BOOKS:**

1. Reisberg, Daniel (2009). “Cognition: Exploring the science of the mind”, (4th Edition). New York: Norton. Goldstein, E. Bruce (2007).
2. Wadsworth. Matlin, M W (2009), “Cognitive Psychology: connecting mind, research and everyday experience” (2nd Edition).

**REFERENCE BOOKS:**

1. Mathews G.G. “Neurobiology”, 2nd edition, Blackwell Science, UK, 2000
2. Eric R.Kandel et al., “Principles of Neural science”, McGraw-Hill, New York, 2012
3. R.Cooper, et.al, “Techniques in clinical Neurophysiology: A Practical manual”, Elsevier, Amsterdam, The Netherlands, 2005.

**WEBSITE LINKS:**

1. <https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-10-cognitive-neuroscience-spring-2016/study-materials/>
2. <https://oxford.universitypressscholarship.com/view/10.1093/acprof:oso/9780195141740.001.0001/acprof-9780195141740>
3. <https://www.emotiv.com/glossary/cognitive-neuroscience/>
4. <https://pubmed.ncbi.nlm.nih.gov/9496622/>
5. <https://www.tandfonline.com/doi/full/10.1080/17588928.2010.503602>

**CO-PO/PSO MAPPING:**

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	1	-	3	1	-	-	-	-	-	2	2	1
CO2	2	3	1	-	3	2	-	-	-	-	-	2	2	1
CO3	2	3	-	1	3	1	-	-	-	-	-	2	2	1
CO4	2	2	1	-	3	1	-	-	-	-	-	2	2	1
CO5	2	3	-	1	3	1	-	-	-	-	-	2	2	1
AVG	2	2.6	0.6	0.4	3	1.2	-	-	-	-	-	2	2	1



<b>JBM1018</b>	<b>ROBOTICS IN MEDICINE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand concepts of robots and types of robots, manipulators, actuators and grippers.
- To understand the basics of Inverse Kinematics.
- To explore various kinematic motion planning solutions for Robotic configurations.
- To design techniques used for planning and decision-making in robotics and examine casestudies.
- To explore various applications of Robots in Medicine

**UNIT I - MEDICAL ROBOTICS 9**

Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation - 5-axis robot, 4-axis robot, 6-axis robot, Dynamic stabilization.

**UNIT II – KINEMATICS 9**

General properties of solutions tool configuration, Workspace analysis and trajectory planning work envelope, workspace fixtures, Pick and place operations, Continuous path and Interpolated motion, Straight-line motion.

**UNIT III - ROBOT VISION 9**

Robot Vision Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation - Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

**UNIT IV - PLANNING 9**

Task Planning, Task level programming, Planning Representations: Symbolic Representation Uncertainty, Configuration, Space, Gross motion, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation. Case-Study: Planning for Mobile Manipulators and Legged Robots, Minimax Formulation, Partially-Observable Markov Decision Processes.

**UNIT V – APPLICATIONS 9**

Bio Engineering Biologically Inspired Robots - Rehabilitation - Interactive Therapy, Bionic Arm, Clinical and Surgical Gynecology, Orthopedics, Neurosurgery, Cardiac, Pediatric, abdominal, and urologic procedures with teleoperated robots - Prostate interventions with manual robots, Image guided robotic systems for focal ultrasound based surgical applications.

**TOTAL: 45 PERIODS**

**COURSE COUTCOMES:**

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

- Explain the basics of robotic systems.
- Design basic robotics system and formulate kinematics.
- Gain knowledge on robot vision on image
- Construct inverse kinematic motion planning solutions for various robotic configurations.
- Design robotic systems for medical application.

**TEXT BOOKS:**

1. J.J.Craig, "Introduction to Robotics", Pearson Education, 2014.
2. Achim Schweikard, Floris Ernst, "Medical Robotics", 2015.
3. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, First edition, 2003.
4. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008.

**REFERENCE BOOKS:**

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modeling and Control", Wiley Publishers, 2020.
2. Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.
3. Daniel Faust, "Medical Robots", Rosen Publishers, 2016.
4. K.S.Fu, R.C. Gonzales and C. S.G. Lee, "Robotics", McGrawHill, 2008.
5. Mikell P Groover and Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012

**WEBSITE LINKS:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6625162/>

**CO-PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	2	3	2	3	-	-	1	1	3	2	3	1
<b>CO2</b>	3	3	3	2	3	3	-	2	2	1	3	3	3	2
<b>CO3</b>	-	-	3	3	3	3	-	1	1	1	3	3	2	1
<b>CO4</b>	2	3	2	2	2	-	2	1	1	1	-	2	2	1
<b>CO5</b>	3	3	3	2	3	3	1	1	1	1	2	2	3	1
<b>AVG</b>	<b>2.2</b>	<b>2.2</b>	<b>2.6</b>	<b>2.4</b>	<b>2.6</b>	<b>2.4</b>	<b>0.6</b>	<b>1</b>	<b>1.2</b>	<b>1</b>	<b>1.6</b>	<b>2.4</b>	<b>2.6</b>	<b>1.2</b>

<b>JBM1047</b>	<b>VIRTUAL REALITY IN MEDICINE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To get knowledge about the various component and benefits of virtual reality
- To introduce the relevance to the existing technology through I/O devices
- To implement case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality

**UNIT I - COMPONENTS OF VR 9**

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system – real time computer graphics, virtual environment requirement, benefits of virtual reality, historical development of VR, scientific landmark.

**UNIT II - INPUT AND OUTPUT DEVICES 9**

Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays and haptic feedback.

**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 AND 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 – robotics applications – Advanced Real time tracking other applications, games, movies, simulations, therapy, case studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- To understand various components of VR
- Analyse and design a system or process to meet given specifications with realistic engineering constraints.
- Identify problem statements and function as a member of an engineering design team.
- Utilize technical resources
- Propose technical documents and give technical oral presentations related to design mini project results.

**TEXT BOOKS:**

1. John Vince, “Introduction to Virtual Reality”, Springer -Verlag Ltd., 2004.
2. William R.Sherman, Alan B.Craig, “Understanding Virtual Reality – Interface, Application, Design”, The Morgan Kaufmann Series, 2003.
3. C.Burdea and Philippe Coiffet, “Virtual Reality Technology”, Second Edition, Gregory, John Wiley and Sons, Inc., 2008.
4. Jason Jerald, “The VR Book: Human-Centered Design for Virtual Reality”, Association for Computing Machinery and Morgan and Claypool, 2015.

**REFERENCE BOOKS:**

1. Steve Aukstakalnis, “Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)”, Addison-Wesley Professional; first edition, 2016.
2. Tony Parisi, O’Reilly Media, “Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile”, first edition, 2015.

**WEBSITE LINKS:**

1. <https://archive.nptel.ac.in/courses/106/106/106106138/>
2. <https://vrvisiongroup.com/virtual-reality-development/apps/>
3. <https://www.smashingmagazine.com/2017/09/guide-virtual-reality-web-developers/>

**CO-PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
<b>CO1</b>	3	2	2	1	-	2	1	1	1	3	1	2	3	2
<b>CO2</b>	3	2	2	1	2	2	2	1	2	1	2	2	3	2
<b>CO3</b>	3	2	2	1	2	2	2	1	2	2	2	2	3	2
<b>CO4</b>	3	3	2	1	2	2	1	1	1	2	1	2	3	2
<b>CO5</b>	3	2	2	1	-	2	1	2	1	1	1	2	3	2
<b>AVG</b>	<b>3</b>	<b>2.2</b>	<b>2</b>	<b>1</b>	<b>1.2</b>	<b>2</b>	<b>1.4</b>	<b>1.2</b>	<b>1.4</b>	<b>1.8</b>	<b>1.4</b>	<b>2</b>	<b>3</b>	<b>2</b>

**\*\*\* END OF VERTICAL 5 \*\*\***

## VERTICAL VI – REHABILITATION ENGINEERING

<b>JBM1004</b>	<b>BIOMECHANICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- To expose to basic principles of mechanics, fluid and solid mechanics and their property.
- To give knowledge on basic principles of bio fluid mechanics, to learn artificial heart valves types and testing and blood vessel material property for modelling.
- To understand the properties, models, material property for modelling of soft tissues for orthopaedic applications.
- To learn orthopaedic implant design, prosthetic joint, biomaterials characteristics and biocompatibility for design.
- To understand human locomotion, biomechanical analysis using FEA, Gait analysis for modelling and designing.

### **UNIT I – BASIC MECHANICS**

**9**

Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus, Bio fluid mechanics, flow properties of blood, free body diagram, Dynamics – Newton’s law of motion, Mechanics of motion, Anthropometry.

### **UNIT II - BIOFLUID MECHANICS**

**9**

Fluid mechanics - Euler equations, Bernoulli’s equation and Navier - Stoke’s equations, Hagen-Poiseuille Flow in a Circular Tube, Rheological properties of blood, Viscoelasticity and its models, Bio-viscoelastic fluids, shear stresses in extra-corporeal circuits, material properties and modelling of Blood vessels.

### **UNIT III - BIOSOLID MECHANICS**

**9**

**Hard Tissues:** Bone structure and composition, viscoelasticity and strength of bones, functional adaptation, bone fracture mechanics, Maxwell and Voight models, Kinetics and Kinematics of bones. **Soft Tissues:** Material properties and Modelling of Soft Tissues, Muscle action, Hills models.

### **UNIT IV - BIOMECHANICS OF JOINTS**

**9**

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, pulse wave velocities in arteries, biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Design of orthopaedic implant, specifications for a prosthetic joint.

### **UNIT V - MODELLING AND ERGONOMICS**

**9**

Introduction to Finite Element Analysis, occupant response to vehicular vibration, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Mechanics of knee joint during standing and walking.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES (CO):

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

- Apply the laws of motion and energy function.
- Study the behaviour of fluids inside the body and its simulation.
- Differentiate and explain the material properties and composition of the tissues.
- Differentiate between the rigid bodies and free body and to characterize biomaterials.
- Design the work station depending upon the ergonomics using finite element analysis

## TEXT BOOKS:

1. Duane Knudson, “Fundamentals of Biomechanics”, Second Edition, Springer Science and Business Media, 2007.
2. Cees Oomens, Marcel Brekelmans, Sandra Loerakker, Frank Baaijens, “Biomechanics: Concepts and Computation”, Cambridge University Press, second edition, 2018.
3. Y.C. Fung, “Bio-Mechanics - Mechanical Properties of Tissues”, Springer-Verlag, 1998.

## REFERENCE BOOKS:

1. Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, Springer Science Business Media, 2004.
2. Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press, 2007.
3. Bruce M. Koeppen and Bruce A. Stanton, “Berne and Levy Physiology”, Mosby, 6th Updated Edition, 2009.
4. Robert L.Huston, “Principles of Biomechanics”, CRC Press, 2008.

## WEBSITE LINKS:

1. <https://www.sciencedirect.com/topics/engineering/biofluid-mechanics>
2. <https://ep.jhu.edu/courses/535663-biosolid-mechanics/>
3. <https://www.frontiersin.org/articles/10.3389/frobt.2020.00013/full>
4. <https://ptsmc.com/healthy-workplace-ergonomics>
5. <https://www.sciencedirect.com/topics/neuroscience/gait-analysis>

## CO-PO/PSO MAPPING:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	3	-	3	3	3	1	-	-	1	1	1	2	1	1
CO-2	3	1	2	2	2	1	-	-	-	1	1	3	2	1
CO-3	2	2	2	2	2	2	-	-	1	2	1	2	2	2
CO-4	3	2	1	1	3	2	-	-	1	1	3	2	3	3
CO-5	2	1	2	1	1	1	-	-	2	-	2	2	2	1
AVG	2.6	1.2	2	1.8	2.2	1.4	-	-	1	1	1.6	2.2	2	1.6

<b>JBM1007</b>	<b>BIOFLUIDS AND DYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To expose the students to the characteristics of motion of biological fluid
- To make the students learn the viscoelastic properties of the biological fluid
- To learn about the function and metabolism of heart tissues
- To give knowledge on basic concepts of material models from nonlinear elasticity and viscoelasticity
- To help in discovering and potentially optimizing the mechanical stresses experienced by normal, diseased, injured, or surgically treated bones.

**UNIT I - BIO-FLUID MECHANICS 9**

Newton's laws, derivation of pipe flow, Sheer stress and viscosity Bernoulli equation, Reynolds number, Poiseuille's law, Flow Rate, Womersley number, Relationship between diameter, velocity and pressure of blood flow, Resistance against flow, classification of fluids, Bio-viscoelastic fluid, Response to Harmonic variation, viscoelastic models.

**UNIT II - FLOW PROPERTIES OF BLOOD 9**

Rheological properties of blood, Apparent and relative viscosity, types of flow, transition from laminar to turbulent flow, laminar flow annulus, Blood viscosity variation: Effects of shear rate, Casson's equation, Rheology of Blood in Micro-vessels: Fahraeus - Lindquist effect and inverse effect.

**UNIT III - CARDIAC MECHANICS 9**

cardiovascular system, Ventricular performance, Pulsality index, Physics of valvular diseases, mechanical properties of blood vessels, Blood flow types, control theory and system analysis, mechanical analysis of circulatory systems, Physics of cardiovascular diseases, myocardial mechanics, fluid dynamics of aortic and mitral valves, index of contractibility.

**UNIT IV - SOFT TISSUE MECHANICS 9**

Pseudo elasticity, non-linear stress-strain relationship, Mechanical properties of soft biological tissues, Entropic elasticity-stretching, bending and twisting, persistence length, function and mechanical properties of skin, ligaments and tendons, Finite elasticity, hyperelasticity, poroelasticity, biphasic, Tissue Remodeling

**UNIT V - ORTHOPEDIC MECHANICS 9**

Mechanical properties of cartilage, diffusion properties of Articular cartilage, Bone mechanics - mechanical characterisation, fracture mechanics, degeneration, Whole bone biomechanics, adaptive nature of bone, kinetics and kinematics of joints, lubrication of joints.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Analyse how fluid mechanics principles can be applied to blood circulation
- Derive the principles of Blood flow in living body and analyse if the flow is steady or pulsatile
- Analyse the heart pumping functions through various involuntary movements that can be used for diagnosis
- Design and analyse the non-linear stress-strain relationship among various soft tissues
- Apply knowledge on how to potentially optimize the mechanical stresses experienced by normal, diseased, injured, or surgically treated bones and joints

## TEXT BOOK:

1. David Rubenstein, Wei Yin, Mary Frame, “Biofluid Mechanics: An introduction to Fluid Mechanics, Macro circulation and Microcirculation”, 2nd edition, Academic press series in biomedical engineering, 2015.
2. JiyuanTu, Kiao Inthavong and Goodarz Ahmadi, “Computational Fluid and Particle Dynamics in the Human Respiratory System”, Springer, 1st edition, 2013.

## REFERENCE BOOKS:

1. Silver Frederick H. “Biomaterials, Medical Devices and Tissue Engineering”, Chapman and Hall publishers, 1994.
2. Nihanth ozkai, Mc Donald, “Biomechanics, Blood flow in arteries”, Edward Arnold, 1998.
3. Philip J Pritchard and John W Mitchell, “Fox and McDonald’s Introduction to fluid Mechanics”, John Wiley, 9<sup>th</sup> edition, 2012.

## WEBSITE LINKS:

1. <https://www.frontiersin.org/articles/10.3389/fphys.2019.01329/full>
2. <https://www.sciencedirect.com/topics/engineering/biofluid-mechanics>

## CO-PO/PSO MAPPING:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
CO-1	1	1	3	3	3	1	2	-	1	1	3	2	1	1
CO-2	2	1	2	2	2	-	2	-	3	1	3	3	1	-
CO-3	1	1	2	2	2	-	1	-	3	2	2	-	2	2
CO-4	2	2	1	1	3	2	2	-	3	1	-	2	2	1
CO-5	2	1	2	1	1	1	1	-	2	-	2	2	-	3
AVG	1.6	1.2	2	1.8	2.2	1.4	1.6	-	2.4	1	2	1.8	0.8	1.4



<b>JBM1012</b>	<b>PHYSIOLOGICAL MODELLING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To make the students to understand the system concepts of Physiological models and Vital organs.
- To make them acquaint with couple systems and applications of transfer functions.
- To make them learn methods and techniques for analysis/synthesis of dynamic models.
- To make them learn about the mechanics of internal system that trips away from homeostasis with the help of modelling.
- To make them describe the dynamic models, simulate and visualize, dynamic responses of physiological models.

**UNIT I – MATHEMATICAL MODELLING 9**

Physiological system modelling basics, generalized system properties, models with combination of system elements, linear models of physiological systems, linear system and superposition principle, impulse response and linear convolution, state space analysis.

**UNIT II – IDENTIFICATION OF PHYSIOLOGICAL SYSTEMS 9**

Basic Problems in Physiological System Analysis, nonparametric and Parametric Identification methods, Problems in Parameter Estimation: Identifiability and Input design, Identification of Closed-Loop Systems.

**UNIT III – ANALYSIS OF PHYSIOLOGICAL SYSTEMS 9**

Cardiovascular models and controls, respiratory models and controls, neural network for physiological control, methods and tools for identifying physiological system, saccadic eye movement systems, Regulation of Glucose, Hodgkin-Huxley Model.

**UNIT IV – TIME DOMAIN ANALYSIS 9**

Linearized Respiratory Mechanics, Open-Loop and Closed-Loop Transient Responses – first order model, Open-Loop versus Closed-Loop Transient Responses, second order model, Dynamic model of neuromuscular reflex motion, model of Cheyne-Stoke's breathing, Physical Significance of under damped responses of post systolic operations in aortic arch.

**UNIT V – FREQUENCY DOMAIN ANALYSIS 9**

Steady-State Responses to Sinusoidal Inputs, Graphical Representations of Frequency Response, Frequency Response of a Model of Circulatory control, Frequency Response of a Model of Circulatory system, Review of transient and stability analysis, Analysis of Instrumentation to measure air flow system, Evaluation of Transfer function from frequency response for muscle response modes.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Analyse the applications of Physiological models.
- Develop the organ model and to determine impedance model and transfer function
- Determine the transfer function from frequency response for various organs
- Test the system stability and model variability of organs
- View functioning of receptors and simulate the physiological systems

**TEXT BOOKS:**

1. John D. Enderle, “Model of Horizontal eye movements: Early models of saccades and smooth pursuit”, Morgan and Claypool Publishers, 2010.
2. Micheal C.K.Khoo, “Physiological Control System – Analysis, Simulation and Estimation”, Prentice Hall of India, New Delhi, 2001.
3. Claudio Cobelli Ewart Carson, “Introduction to Modelling in Physiology and Medicine”, second edition, Academic Press, 2019.

**REFERENCE BOOKS:**

1. Willian B. Blesser, “A System Approach to Biomedicine”, Mc Graw Hill Book Co., 1969.
2. Richard Skalak and Shu Chien, “Hand Book of Biomedical Engineering”, McGraw Hill and Co., 1987.
3. Joseph D, Bronzino, “The Biomedical Engineering Handbook”, CRC Press, 3<sup>rd</sup> edition, 2006.

**WEBSITE LINKS:**

1. <https://pubmed.ncbi.nlm.nih.gov/2092991/>
2. <https://www.nature.com/articles/ncb3510>
3. [https://www.cds.caltech.edu/~murray/courses/cds101/fa04/caltech/am04\\_ch6-3nov04.pdf](https://www.cds.caltech.edu/~murray/courses/cds101/fa04/caltech/am04_ch6-3nov04.pdf)
4. <https://nsec.lab.uconn.edu/home/courses-2/bme-3100-physiological-modeling/>
5. <https://www.sciencedirect.com/science/article/abs/pii/S0045794902004819>

**CO-PO/PSO MAPPING:**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO1	PSO2
<b>CO-1</b>	2	1	2	3	2	1	2	-	2	3	1	2	1	2
<b>CO-2</b>	2	1	1	1	2	3	3	-	3	2	1	2	1	3
<b>CO-3</b>	1	1	1	1	2	3	2	-	2	2	1	2	1	2
<b>CO-4</b>	2	1	1	2	2	3	2	-	2	3	3	3	2	2
<b>CO-5</b>	1	2	3	3	3	3	2	-	1	1	2	1	1	1
<b>AVG</b>	<b>1.6</b>	<b>1.2</b>	<b>1.6</b>	<b>2</b>	<b>2.2</b>	<b>2.6</b>	<b>2.2</b>	<b>-</b>	<b>2</b>	<b>2.2</b>	<b>1.6</b>	<b>2</b>	<b>1.2</b>	<b>2</b>

<b>JBM1026</b>	<b>REHABILITATION ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand and analyse the importance and role of Rehabilitation techniques
- To describe the design specifications, operation and indications of Orthotic and Prosthetic devices.
- To understand the different methods and devices concerned with sensory augmentation and substitution.
- To describe the various Therapeutic Exercises and assistive technology devices that help to restore and strengthen the neuromuscular functional activity.
- To have an overview of physiological, psychological and legal aspects involved in rehabilitation service rendered for the benefit of the impaired population

**UNIT I - NEED FOR REHABILITATION 9**

Types of disabilities, Activities of daily living, Appropriate Technology, Residual function, Levels of Prevention, Rehabilitation team, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering, Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

**UNIT II - OCCUPATIONAL REHABILITATION 9**

Motor rehabilitation, different types of models for limb prosthetics, Artificial limbs - body powered, externally powered and controlled prosthetics, restoration of standing and walking, Hybrid Assistive Systems (HAS), Bionic arm, Wireless robotic arm, assessment of mobility rehabilitation, Functional Electrical Stimulus for mobility.

**UNIT III - AUDITORY AND SPEECH REHABILITATION 9**

Types of deafness, hearing aids, application of DSP in hearing aids, Tactual augmentation and Tactual substitution, Cochlear implants, Voice synthesizer, speech trainer. Brain plasticity, Sensory Substitution systems for auditory and speech impairment.

**UNIT IV - COGNITIVE REHABILITATION 9**

Memory aids, Electronic reminder systems, adaptive technology, sensory stimulation tools, neurofeedback training, voice-to-text software, sensory stimulation, AR and VR in cognitive rehabilitation.

**UNIT V - REHABILITATION MEDICINE 9**

Architectural design features for motor and visual disability for day-to-day life, Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspects of rehabilitation – Disability evaluation, provision available in education.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Analyse the role of Rehabilitation techniques by describing the Principle and Practice of Rehabilitation and Assistive Technology focussed toward the welfare of the disabled.
- Apply the acquired knowledge on the design specifications, operation and indications of Orthotic and Prosthetic devices.
- Learn and understand the different methods and devices concerned with sensory augmentation and substitution.
- Create various Therapeutic Exercises and assistive technology devices that help to restore and strengthen the neuromuscular functional activity.
- Analyse the physiological, psychological and legal aspects involved in rehabilitation service rendered for the benefit of the impaired population.

## TEXT BOOKS:

1. Dr.S.Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publications, New Delhi. 2010
2. Joseph D.Bronzino, “The Biomedical Engineering Handbook”, Third Edition: Three Volume Set, CRC Press, 2006

## REFERENCE BOOKS:

1. Rory A Cooper, “An Introduction to Rehabilitation Engineering”, CRC press, 2006
2. Christian Buhler, Harry Knops, “Assistive Technology on the threshold of the New Millennium”, IOS Press, 2019.
3. Margaret J.Giannini, “Choosing a wheelchair system”, Diane Publishing Co., 1992.

## WEBSITE LINKS:

1. <https://cmasuki.org/introduction-to-movement-analysis/>
2. <https://www.mobility-aids.com/advancements-in-mobility-aids.html>

## CO-PO/PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	-	2	2	2	-	-	2	3	2	-	1	1
CO2	3	3	3	3	2	3	2	-	2	3	2	3	2	1
CO3	3	3	3	3	2	3	2	-	2	2	1	3	2	2
CO4	3	3	3	2	2	2	1	-	2	1	2	3	3	3
CO5	1	-	2	-	2	3	2	-	2	2	3	2	2	1
AVG	2.4	2.4	2.2	2	2	2.6	1.4	-	2	2.2	2	2.2	2	1.6

<b>JBM1020</b>	<b>ERGONOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE 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 be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

**UNIT I - ERGONOMICS 9**

Objectives and scope of ergonomics, role of an ergonomist, human characteristics and capabilities, human error, team work and ageing, interfaces between job, person and environment, musculoskeletal and nervous – body systems, static and dynamic postures, work physiology, risk to health.

**UNIT II – METHODS AND TECHNIQUES 9**

Work place layout and equipment design, ergonomic risk assessment, developing ergonomic strategy at work, perception of risk, signal detection theory and vigilance, work stress – causes, prevention and protective measures, human error, human computer interaction, measurement and information gathering.

**UNIT III - VISUAL AND AUDITORY ERGONOMICS 9**

Visual display unit, 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 and mitigation, noise induced hearing loss.

**UNIT IV - MUSCLE PHYSIOLOGY 9**

Muscle physiology – muscle metabolism – joint motion study – measure of physiological inefficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH), Bio-mechanical recommended limits of MMH, work related upper limb disorders (WRULD).

**UNIT IV – DESIGN PRINCIPLES AND STANDARDS 9**

Anthropometry, anthropometric design principles, Physical work load and energy expenditure, ergonomic implications, thermal environment, reducing accidents by altering behaviour, ISO standards, selection and training, supervision and record, measuring health and illness.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Derive the principles of ergonomic auditory monitors and measure the factors that effects mitigation
- Understand the significance of posture and to measure of physiological in-efficiency and energy consumption during every activity
- Analyse movement relationships control orders and responses along with human limitations in the tracking task
- Design the control panel to reduce the causes of accident and to develop work space envelope
- Perform case studies on handling electronic instruments and medical equipment.

## TEXT BOOKS:

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.

## REFERENCE BOOKS:

1. George Kanawaty, “Introduction to work study”, ILO, 3rd edition, Oxford and IBH publishing, 2001.
2. Stephen Pheasant, Christine M. Haslegrave, “Bodyspace: Anthropometry, Ergonomics and the Design of Work”, CRC Press, 2005.
3. Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press, 2007.
4. Francesca Tosi, “Design for ergonomics”, First edition, Springer International Publishing, 2019.

## WEBSITE LINKS:

1. <https://www.hsph.harvard.edu/ecpe/programs/ergonomics-and-human-factors/>
2. <https://archive.nptel.ac.in/courses/109/103/109103101/>
3. <https://ehs.unc.edu/workplace-safety/ergonomics/>

## CO-PO/PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	2	3	2	3	-	1	1	-	1	2	3
CO2	2	1	2	1	-	1	-	-	1	2	2	2	2	2
CO3	2	2	2	2	2	-	-	-	1	2	3	1	1	2
CO4	1	3	1	2	3	-	2	-	-	1	3	1	1	1
CO5	3	2	1	3	1	2	1	-	3	3	2	3	2	3
AVG	1.8	2	1.2	2	1.8	1	1.2	-	1.2	1.8	2	1.6	1.6	2.2

<b>JBM1048</b>	<b>NEUROMECHANICS OF HUMAN MOVEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the basic principles of neuromechanics and how they apply to human movement.
- To describe the physiological processes involved in muscle contraction and relaxation
- To understand neural control of movement, including the role of reflexes and higher-level control centres.
- To understand the principles of motor learning and development, and how they apply to skill acquisition.
- To apply neuromechanics principles to rehabilitation and sport science contexts

**UNIT I – REVIEW OF NERVOUS SYSTEM 9**

General organization of the nervous system, neurons and glial cells, action potential, synaptic transmission, significance of sensory systems – vision, hearing, taste, smell and proprioception, motor systems, homeostasis, neuroplasticity.

**UNIT II – MUSCLE PHYSIOLOGY 9**

Muscle moment arms and lever systems, Muscle work, power, and efficiency, Muscle tissue properties, strengthening muscle, injury to skeletal muscle, combined movement characteristics of muscle, Muscle injury and repair, Muscle weakness and atrophy, Muscle function in athletic performance, Muscle adaptation to training.

**UNIT III – NEURAL CONTROL OF MOVEMENT 9**

Forms of motion, joint movement terminology, spatial reference systems, structure of the motoneuron, neural control of force output, sensory receptors and reflexes, effect of training and exercise, Qualitative analysis of human movement, neural communication, Synaptic transmission, Somatic and autonomic nervous systems, Motor pathways and control, Reflexes and movements.

**UNIT IV – MOTOR LEARNING AND DEVELOPMENT 9**

Basic principles of motor control, Historical and current theories of motor learning, Stages of Motor Development, Types of feedback and their effects on learning, Use of technology in feedback delivery, Types of practice and their effects on learning, Transfer of learning, Factors that influence practice effectiveness, Factors that influence practice effectiveness, Applications of motor learning in different types of rehabilitation.

**UNIT V – APPLICATIONS 9**

Historical and current theories of neuromechanics in sports medicine, Techniques for reducing injury risk through neuromechanical approaches, Neuromechanical approaches to injury prevention in different types of sports, Neuromechanical approaches to improving injury diagnosis in sports medicine, Ethical considerations in neuromechanics research in sports medicine.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Deliver basic principles of neuromechanics, including the interaction between the nervous system and musculoskeletal system in generating and controlling movement.
- Identify different types of muscle contractions and analyze different components of human movement, including muscle activation patterns, and forces acting on the body.
- Understand the role of feedback and feedforward mechanisms in movement control and how they are used to optimize performance.
- Analyze and interpret human movement data and to understand the role of feedback and feedforward mechanisms in movement control
- Acquaint the knowledge of the practical applications of neuromechanics in sports training and rehabilitation.

## TEXT BOOKS:

1. Enoka, Roger M, “Neuromechanics of human movement”, United States: Human Kinetics, 2015.
2. Joseph Hamill, Kathleen M. Knutzen, “Biomechanical Basis of Human Movement”, Lippincott Williams and Wilkins, 2006.

## REFERENCE BOOKS:

1. Paavo V. Komi, “The Encyclopaedia of Sports Medicine, Neuromuscular Aspects of Sports Performance”, John Wiley and Sons, 2011.
2. Susan J. Hall, “Basic biomechanics”, sixth edition, McGraw Hill publishers, 2007.

## WEBSITE LINKS:

1. <https://www.frontiersin.org/research-topics/18381/neuromechanics-in-movement-and-disease-with-physiological-and-pathophysiological-implications-from-fundamental-experiments-to-bio-inspired-technologies>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4392340/>

## CO-PO/PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	2	3	2	3	-	1	1	-	1	2	3
CO2	2	1	2	1	2	1	-	-	1	2	2	2	2	2
CO3	2	2	2	2	2	3	1	-	1	2	3	1	1	2
CO4	1	3	1	2	3	1	2	-	2	1	3	1	1	1
CO5	3	2	1	3	1	2	1	-	1	3	2	3	2	3
AVG	1.8	2	1.2	2	2.2	1.8	1.4	-	1.2	1.8	2	1.6	1.6	2.2



<b>JBM1049</b>	<b>MEDICAL HAPTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the basic principles, theories, and concepts of haptics.
- To know different types of haptic feedback, including force feedback, tactile feedback, and thermal feedback.
- To learn current trends and challenges in haptic rendering research, including the development of new haptic devices, new haptic rendering algorithms, and new applications.
- To adapt to current trends and challenges in haptic rendering research, including the development of new haptic devices and haptic rendering algorithms.
- To understand critical thinking and problem-solving skills related to haptic interaction research and its applications.

**UNIT I – MECHANICS OF TOUCH 9**

The sense of touch and its receptors, Anatomy of the skin and other tactile organs, Types of touch and their neural pathways – sensory processing, Overview of haptics, Types of receptors and their functions, Haptic perception and the brain, sensing and actuation.

**UNIT II – HAPTIC RENDERING 9**

Types of haptic feedback - vibrotactile, force feedback, thermal feedback; Human subjects experiments and statistics, Kinematics of haptic devices, Virtual coupling, Proxy-based haptic rendering, Texture and surface rendering, Multi-finger haptic rendering, Haptic rendering in teleoperation and remote manipulation.

**UNIT III – HAPTIC DESIGN PRINCIPLES 9**

PHANToM, Human factors considerations in haptic design, Design principles for effective haptic interfaces, Human haptic perception, Surface haptic devices, Tactile displays, design of Motion simulators, Haptics in human-machine interactions, Haptic design principles and guidelines. Haptic interfaces in medicine.

**UNIT IV – HAPTIC INTERACTIONS 9**

Human haptic sensing, Haptic interaction techniques, Haptic communication, Perception of haptic feedback, Evaluation of haptic devices and interfaces, Psychophysics of wearable haptic and tactile perception in a multisensory context.

**UNIT V – HEALTHCARE APPLICATIONS 9**

Surgical training, robotic surgery, haptics in rehabilitation and prosthetics, training and education of haptic technology, pain management and therapy using haptic devices, telemedicine and remote healthcare, haptic enabled models in medical education.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

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

- Apply fundamental concepts of physiology of touch, haptic perception, and haptic feedback in various applications.
- Develop different types of haptic feedback devices, including grounded and ungrounded force feedback devices, tactile feedback devices, and hybrid devices
- Experiment rendering algorithms, including point-based and model-based rendering into virtual environments
- Solve the challenges and analyse limitations of haptic technology, including device resolution, latency, and stability and how to overcome issues.
- Analyse and evaluate the effectiveness of haptic technology in different applications, using metrics such as user performance, user satisfaction, and usability.

## TEXT BOOKS:

1. Lynette A. Jones, “Haptics”, The MIT press essential knowledge series, 2018.
2. Mark Paterson, “The senses of touch –haptics, affects and technologies”, Bloomsbury Publishing, 2007.

## REFERENCE BOOKS:

1. Troy McDaniel and Sethuraman Panchanathan, “Haptics interfaces for accessibility, health, and enhanced quality of life”, Springer Publications, 2019.
2. Christian Hatzfeld, Thorsten A. Kern, “Engineering Haptic Devices A Beginner's Guide”, Springer London, 2014.

## WEBSITE LINKS:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4003673/>
2. <https://healthcare-in-europe.com/en/news/haptic-technology-will-change-healthcare.html>
3. <https://www.frontiersin.org/articles/10.3389/frobt.2021.612949/full>

## CO-PO/PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	1	1	1	1	-	2	2	1	1	1	1
CO2	2	2	2	1	1	1	1	-	2	1	1	1	1	1
CO3	2	2	1	2	1	2	1	-	2	1	2	2	1	1
CO4	1	2	1	3	1	2	2	-	1	2	3	2	2	2
CO5	1	1	2	2	2	3	3	-	2	3	2	1	3	2
AVG	1.4	1.8	1.8	1.8	1.2	1.8	1.6	-	1.8	1.8	1.8	1.4	1.6	1.4

\*\*\* END OF VERTICAL 6 \*\*\*

## OPEN ELECTIVES OFFERED BY BIOMEDICAL ENGINEERING

### SEMESTER - IV

<b>JBM9001</b>	<b>HUMAN BIOLOGY FOR ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES**

- To understand the basic structures of Cells and sub organelles
- To study about blood and its composition.
- To study the structure and function of the heart & respiratory system
- To gain knowledge on digestive and excretory system
- To understand different bio inspired technologies

### **UNIT-I CELL STRUCTURE AND TISSUES 9**

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport across Cell Membrane - Action Potential –Cell Division. Types of Specialized tissues –Functions

### **UNIT-II BLOOD AND ITS COMPONENTS 9**

Components of Blood and its functions- Blood Groups and importance- Types of blood vessels – common blood tests and its clinical significance

### **UNIT-III CARDIOVASCULAR AND RESPIRATORY SYSTEM 9**

Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure.

Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration

### **UNIT-IV DIGESTIVE AND URINARY SYSTEMS 9**

Digestive System: Organs of Digestive system – Digestion and Absorption. Urinary System: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System

### **UNIT-V BIO-INSPIRED TECHNOLOGIES 9**

Elementary neurophysiology and biological neural network- Artificial neural network-Architecture, biases and thresholds, Perceptron, Adaline and Madaline Networks.DNA as a genetic material-Genetic Algorithms: Introduction to Genetic Algorithms (GA) as optimization tool.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

At end of the course the students will be able to

- Explain the structure and function of the cell



<b>JBM9002</b>	<b>INTRODUCTION TO MEDICAL INSTRUMENTATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## **COURSE OBJECTIVES**

- To Understand the origin and propagation of biopotential
- To gain knowledge on the measurement of electrical activity of the heart
- To study the electrical activity of the brain
- To understand the respiratory measurement
- To know about the measurement of chemical components in blood

### **UNIT-I ELECTRODES FOR BIOSIGNAL ACQUISITION 9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half-cell potential- Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half-cell potential

### **UNIT-II CARDIAC MEASUREMENTS 9**

Bio signals characteristics – frequency and amplitude ranges- anatomy and physiology of heart - ECG – Einthoven’s triangle, standard 12 lead system-

### **UNIT-III EEG MEASUREMENT 9**

Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain EEG – 10-20 electrode system, unipolar, bipolar and average mode

### **UNIT-IV BLOOD PRESSURE AND RESPIRATORY MEASUREMENT 9**

Blood Pressure: indirect methods , direct methods, Respiratory Measurement –Spirometer-Pneumograph.

### **UNIT-V BIOCHEMICAL MEASUREMENT 9**

Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyzer, spectrophotometer, blood cell counter, auto analyzer

**TOTAL: 45 PERIODS**

## **COURSE OUTCOMES:**

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

- Explain the origin and propagation of Biopotential
- Describe the measurement of electrical activity of the heart
- Elucidate on the electrical activity of the brain
- Describe the measurement of respiratory parameters
- Explain about the measurement of chemical components in blood

## **TEXT BOOK:**

1. Leslie Cromwell, —Biomedical Instrumentation and measurement, 2<sup>nd</sup> edition, Prentice hall of India, New Delhi, 2015.

## REFERENCES:

1. JohnG.Webster,—MedicalInstrumentationApplicationandDesign, 4<sup>th</sup>edition,Wiley India PvtLtd,New Delhi, 2015.
2. JosephJ.CarrandJohnM.Brown,—IntroductiontoBiomedicalEquipmentTechnologyl, Pearson Education,2004.
3. MyerKutz,—Standard Handbook ofBiomedical Engineering and Design , McGraw-Hill Publisher,2003.
4. KhandpurR.S,—Handbook ofBiomedicalInstrumentation, 3<sup>rd</sup>edition,TataMcGraw-Hill New Delhi,2014

## WEBSITE REFERENCES:

1. <https://nptel.ac.in/courses/108105101/>
2. <https://www.youtube.com/watch?v=49CWbXNJ3WE&t=35s>
3. [https://www.youtube.com/watch?v=NeiD87ZkJ8&list=PLXcK6l9b40r\\_WeJMfo7Wb5RYMdP6brgpj](https://www.youtube.com/watch?v=NeiD87ZkJ8&list=PLXcK6l9b40r_WeJMfo7Wb5RYMdP6brgpj)
4. <https://www.youtube.com/watch?v=zj1teWL9k7A>
5. <https://www.youtube.com/watch?v=xJkeLiRQBVU>
6. <https://www.youtube.com/watch?v=PPXcsZ6hh6g>

## CO-PO MAPPING:

CO\PO	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	3	2	-	-	-	-	-	-	-	1	2
CO2	3	3	3	-	-	-	-	-	-	-	1	3
CO3	3	3	3	-	-	-	-	-	-	-	1	3
CO4	3	3	3	-	-	-	-	-	-	-	1	2
CO5	3	3	3	-	-	-	-	-	-	-	1	2

<b>JBM9003</b>	<b>INTRODUCTION TO BIO SENSORS AND ITS APPLICATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## COURSE OBJECTIVES:

- To know the principle of transduction for measuring pressure and its biomedical applications.
- To understand the characteristics of different temperature sensors
- To understand the principles of photo electric measurement
- To understand sound, ultrasound and its biomedical applications.
- To gain
- knowledge on biochemical sensors

## UNIT-I DISPLACEMENT AND PRESSURE SENSORS

9

Sensors and transducer - Classification and Characteristics of Transducers- Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gage, biomedical applications; strain gauge as displacement & pressure transducers: Capacitive transducer, Inductive transducer, LVDT,

Biomedical application of Displacement and pressure sensors

**UNIT-II TEMPERATURE SENSORS 9**

RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, biomedical applications of Temperature sensors. Active type: Thermocouple – characteristics.

**UNIT-III PHOTOELECTRIC SENSORS 9**

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, Spectro photometric applications of photo electric transducers.

**UNIT-IV SOUND AND ITS BIOMEDICAL APPLICATIONS 9**

Physics of sound and its characteristics –Simple and complex sound –Frequency spectra of repetitive and non repetitive sounds – Doppler effect – Ultrasound instrumentation – Ultra sound imaging- Application in blood flow measurement-Sound therapy- Infrasonics - Sonic waves induced stress.

**UNIT-V BIOCHEMICAL SENSORS 9**

pH, pO<sub>2</sub> and pCO<sub>2</sub>, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET)

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain the principle of transduction for measuring pressure and its biomedical applications.
- Explain the characteristics of different temperature sensors
- Elucidate the principles of photo electric measurement
- Explain the sound,ultrasound,its sensors and its biomedical application
- Explain about biochemical sensors and their applications

**TEXT BOOK:**

1. A.K.Sawhney, —Electrical & Electronics Measurement and Instrumentation,10thedition, DhanpatRai& Co, New Delhi, 19th Revised edition 2011, Reprint 2014.
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995
3. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

**REFERENCES:**

1. Leslie Cromwell, —Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, —Medical Instrumentation Application and Design, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015.
3. Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technology, Pearson Education, 2004.

**WEBSITE REFERENCES :**

1. <https://nptel.ac.in/courses/108/105/108105064/>
2. <https://nptel.ac.in/courses/108/102/108102097/>

3. <https://www.youtube.com/watch?v=XWTw--FmumM>
4. <https://www.youtube.com/watch?v=49CWbXNJ3WE>
5. <https://www.youtube.com/watch?v=WnKK11UEvVE>
6. <https://www.youtube.com/watch?v=D-malae4448>

### CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	-	-	1	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1
CO3	2	2	2	2	2	1	-	-	-	-	1	1
CO4	3	3	2	2	2	1	-	-	-	-	1	1
CO5	2	3	2	2	2	1	-	-	-	-	1	1

### SEMESTER V

<b>JBM 9004</b>	<b>BIOMEDICAL EQUIPMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### COURSE OBJECTIVES:

- To understand the origin of various biological signals, their characteristics and electrode configurations specific to bio-potential measurements and study the technique of acquisition of various biopotentials.
- To understand the techniques of measurement of various Biochemical and Non-electrical parameter of the physiological system.
- To obtain knowledge on the principle of various Imaging modalities.
- To familiarize with various equipments that are used in therapy and rehabilitative medicine.
- To obtain knowledge on various specialized medical equipments that are used in medical care.

### UNIT - I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDERS 9

Sources of Bio-potentials - Its propagation, typical waveforms and signal characteristics, biopotential electrodes, biological amplifiers. Electrocardiography, Electroencephalography, Electromyography, Electroretinography, Electrooculography.

### UNIT - II NON-ELECTRICAL PARAMETER MEASUREMENT DEVICES 9

Blood flow meter - Electromagnetic and Ultrasonic method, cardiac output measurement - Dye dilution technique, Phonocardiography, Temperature - thermistor probe and Infrared thermometer, pulse oximeter, Patient Monitoring systems



**UNIT - III IMAGING DEVICES****9**

Principles and block diagram of X-Ray, CT, MRI, Nuclear Medicine, Ultrasound scanner, Optical Imaging - Optical Coherence tomography.

**UNIT - IV THERAPEUTIC AND ASSISTIVE DEVICES****9**

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Lithotripsy, Neuromuscular stimulators.

DC Defibrillator, Hemodialyser, Heart lung machine, Cardiac pacemakers

**UNIT - V SPECIALIZED MEDICAL EQUIPMENTS****9**

Thermography, Endoscopy and Laparoscopy unit, Lasers in medicine, Cryogenic Surgery, Biofeedback Instrumentation , Biotelemetry and Telemedicine.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

- Illustrate the origin of various biological signals and their characteristics and also elaborate on various electrodes and amplifiers used for such measurements. Also be able to explain the technique of recording of various biopotentials.
- Explain the measurement of various Biochemical and Non-electrical parameter of the physiological system.
- Explain the principle of various imaging modalities.
- Explain the various equipments that are used in therapy and rehabilitative medicine.
- Elaborate on various specialized medical equipments that are used in medical care.

**TEXTBOOKS :**

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

**REFERENCE BOOKS :**

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology, Pearson Education, 2004.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt. Ltd, New Delhi, 2015.
3. Anthony Y.K. Chan, "Biomedical Device Technology – Principles and Design", Charles C Thomas Publisher Ltd., 2008.
4. Joseph D.Bronzino, "The Biomedical Engineering Handbook", Third Edition: Three Volume Set, CRC Press, 2006
5. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merrill Publishing Company., 2006
6. Albert M.Cook and Webster J.G, "Therapeutic Medical devices", Prentice Hall Inc., New Jersey, 1982.

## WEBSITE REFERENCES :

1. [https://www.who.int/medical\\_devices/priority/core\\_equipment](https://www.who.int/medical_devices/priority/core_equipment)
2. <https://gpcmedicalequipment.wordpress.com>
3. <https://www.dicardiology.com>
4. <https://www.youtube.com/watch?v=kWLbSx9BNbU>
5. <https://geekymedics.com/record-ecg/>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	3	3

<b>JBM9005</b>	<b>HOSPITAL PLANNING AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## COURSE OBJECTIVES:

- To understand the fundamentals of hospital administration and hospital planning
- To elucidate planning medical and ancillary services in hospital
- To know the purchase and procurement process in a hospital
- To explain the equipment planning in a hospital
- To elucidate the quality of hospital and recent trends in hospital planning

### **UNIT I OVERVIEW OF HOSPITAL PLANNING 9**

Challenges in Hospital Administration – Types of hospitals, - a, formation of hospital planning team, market survey, feasibility study, selection of location, Financial planning of hospitals, Macro level planning

### **UNIT II PLANNING FOR MEDICAL AND SUPPORTIVE SERVICES 9**

Out-patient services, Emergency services, Intensive Care Units (ICU), Physical Therapy department. Medical Records department, Laboratory services, blood banking -Radiological services, Pharmacy, CSSD

### **UNIT III PURCHASE MANAGEMENT 9**

Objectives and elements of good purchasing system, Procurement procedure, Tending system, modes of tenders, Purchase order and its types, types of purchasing systems.

### **UNIT IV EQUIPMENT MANAGEMENT 9**

Classification of Hospital equipments, Planning and selection of equipments, factors affecting utilization of equipments, equipment failure, training & development, documentation, equipment maintenance and its types and Equipment audit.



<b>JBM 9006</b>	<b>INTRODUCTION TO BIOMETRIC SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To familiarize students with basic knowledge about the introduction of biometric systems and its types
- To understand the general principles and design of fingerprint recognition biometric systems
- To know the general principles of design of face and hand geometry recognition systems and pattern classification algorithms
- To recognize personal privacy and security implications of biometrics based identification technology
- To identify issues in the realistic evaluation of biometrics based authentication systems

**UNIT I INTRODUCTION TO BIOMETRIC SYSTEMS 9**

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

**UNIT II FINGERPRINT TECHNOLOGY 9**

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

**UNIT III FACE RECOGNITION AND HAND GEOMETRY 9**

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

**UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION 9**

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

**UNIT V BIOMETRIC AUTHENTICATION 9**

Introduction - Biometric Authentication Methods - Biometric Authentication Systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- Describe the various biometric technologies, characteristics, need for strong authentication and its applications



**OPEN ELECTIVES  
SEMESTER VI**

<b>JBM9007</b>	<b>BASICS OF IMAGE PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To describe and explain basic principles of digital image processing.
- To illustrate types of image enhancement.
- To learn concepts of image restoration techniques.
- To explain different image segmentation techniques.
- To design and implement algorithms that perform basic image processing such as feature extraction and classification.

**UNIT I DIGITAL IMAGE FUNDAMENTALS 9**

Components of digital image processing system, elements of visual perception, Image sensing and acquisition, Sampling and quantization of images, 2-D sampling theory, representation of digital image.

**UNIT II IMAGE ENHANCEMENT 9**

Spatial Domain: Gray level transformations – Histogram processing – Smoothing and Sharpening, Spatial Filtering, Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters, Homomorphic filtering.

**UNIT III IMAGE RESTORATION 9**

Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

**UNIT IV IMAGE SEGMENTATION 9**

Point, line and edge detection, Thresholding, Region Based segmentation, Edge linking and boundary detection, Hough transform, Watershed segmentation algorithm.

**UNIT V IMAGE CLASSIFICATION 9**

Classification Overview, Pixel Based Classification-Unsupervised and Supervised Classification; Object or Feature Based Classification, Object recognition, template matching.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

- Explain general terminology of digital image processing.
- Describe image enhancement techniques in spatial and frequency domain.
- Elucidate the mathematical modelling of image restoration.
- Describe the concept of image segmentation.
- Explain the methodologies for image classification.

**TEXT BOOKS:**

1. R.C.Gonzalez, R.E.Woods, " Digital Image processing", Pearson edition, Inc3/e,2008.

2. A.K.Jain,” Fundamentals of Digital Image Processing”, PHI,2003.

## REFERENCES :

1. J.C. Russ,” The Image Processing Handbook”, (5/e), CRC, 2006
2. R.C.Gonzalez& R.E. Woods; “Digital Image Processing with MATLAB”, Prentice Hall, 2003.  
S.Jayaraman,S.Esakkirajan,T.Veerakumar, “Digital image processing”, McGraw Hill  
1. Education Publication,2017.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic  
3. Press,2008.

## WEBSITE REFERENCES :

- <http://www.imageprocessingplace.com/>
- [https://onlinecourses.nptel.ac.in/noc19\\_ee55/preview](https://onlinecourses.nptel.ac.in/noc19_ee55/preview)
- <https://online.stanford.edu/courses/ee368-digital-image-processing>
- <https://www.coursera.org/courses?query=image%20processing>
- <https://www.edx.org/learn/image-processing>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	2	2	1	2	2	2	3
CO2	2	1	2	2	3	1	2	2	3	3	1	3
CO3	1	2	3	3	3	3	3	2	3	2	1	1
CO4	2	1	3	2	3	1	3	2	2	3	3	1
CO5	1	3	1	3	3	1	2	3	3	3	1	1

<b>JBM9008</b>	<b>COMPUTERS IN MEDICINE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## COURSE OBJECTIVES:

- To understand the computer revolution and Informatics
- To describe the principle of automated laboratories.
- To know the services used in Hospital information system.
- To understand the concept of computerized patient record.
- To discuss the applications of computers used in medicine.

## UNIT I COMPUTERS AND INFORMATICS

9

Computers in Data processing, Computer Revolution and medicine, The structure of medical informatics, use of internet in medicine – online and off line services.

## **UNIT II COMPUTERS IN LABORATORIES 9**

Database approach to laboratory Computerization, Automated clinical Laboratories, Automated methods in Hematology, Intelligent laboratory system (IILS), Computerized Electrocardiography-computer aided analysis of Electrocardiograms.

## **UNIT III HOSPITAL INFORMATION SYSTEM 9**

Introduction– Functional capabilities of a computerized hospital information system –Need for computerization in hospitals –security of computer records.

## **UNIT IV CLINICAL INFORMATION SYSTEM 9**

Introduction – computerized patient record (CPR) – Dialogue with the computer-clinical information system (CIS) – modes of decision output to physician – clinical Decision support- CIS in obstetrics – Gynecology,

## **UNIT V COMPUTER APPLICATIONS IN MEDICINE 9**

Computerized prescriptions for patient - Patient online ,Health online, Automated computer assisted fluid and metabolic balance – EMG controlled limbs – Applications of Telemedicine.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Describe the concept of computer evolution and informatics.
- Illustrate the principle of automated laboratories
- Interpret the services used for Hospital information system
- Demonstrate the concept of Computerized patient record
- Outline the application of computers in medicine

### **TEXT BOOKS:**

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

### **REFERENCES:**

1. Richard S. Dick “The Computer-based Patient Record: An Essential Technology for Health Care” Institute of medicine, 1997.
2. OrpitaBosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press,2007.
3. Yi Ping Phoebe Chen, “Bioinformatics Technologies”, Springer International Edition, New Delhi, 2007.

### **WEBSITE REFERENCES:**

1. [https://en.wikipedia.org/wiki/Hospital\\_information\\_system](https://en.wikipedia.org/wiki/Hospital_information_system)
2. <https://www.techwalla.com/articles/10-ways-computers-are-used-in-medicine>
3. [https://www.google.co.in/books/edition/Computers\\_In\\_Medicine\\_Progress\\_In\\_Medica/P59A\\_mgibb-4C?hl=en&gbpv=1&dq=R.D.lele+-computers+in+medicine&pg=PR7&printsec=frontcover](https://www.google.co.in/books/edition/Computers_In_Medicine_Progress_In_Medica/P59A_mgibb-4C?hl=en&gbpv=1&dq=R.D.lele+-computers+in+medicine&pg=PR7&printsec=frontcover)



4. <https://www.covetus.com/blog/what-is-cpr-computer-based-patient-record-and-its-use-in-healthcare-it>
5. <https://www.ncbi.nlm.nih.gov/books/NBK233055>

### CO-PO MAPPING :

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	1	2
CO2	3	3	3	-	-	-	-	-	-	-	1	3
CO3	3	3	3	-	-	-	-	-	-	-	1	3
CO4	3	3	3	-	-	-	-	-	-	-	1	2
CO5	3	3	3	-	-	-	-	-	-	-	1	2

<b>JBM 9009</b>	<b>NANOTECHNOLOGY IN MEDICINE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVES:

- To know how molecules are deposited in micron spatial level and analyse physical and chemical properties of liquids and gases at a microscale.
- To study the fundamentals of nanorobots, that switches between different molecular conformations and to study its applications in sensing, computing, actuating and therapeutic nanodevices.
- To learn about how the nanoparticles can be engineered to carry the drugs as conjugates.
- To study how the patient therapy is tailored by the patient's individual genetic and disease profile.
- To get acquainted with the revolutionizing technology in cancer application .

### UNIT I NANOMOLECULAR DIAGNOSTICS - ARRAY AND CHIPS 9

Introduction - Rationale of Nanotechnology for Molecular Diagnostics - Nanoarrays for Molecular Diagnostics - Self-Assembling Protein - Nanoarrays - Fullerene Photodetectors for Chemiluminescence Detection on Microfluidic chips.

### UNIT II NANOMACHINES AND NANOBARCODES, NANOBIOSENSOR 9

DNA Nanomachines - Nanobarcode Particle Technology for SNP Genotyping - Bio-barcode Assay for Proteins, Based DNA Nanosensors, Ion Channel Switch Biosensor Technology - Microneedle Mounted Biosensors Optical Biosensors - Nanowire (NW) Biosensors.

### UNIT III NANOPHARMACEUTICALS 9

Introduction - Gold Nanoparticles and quantum dots for drug delivery - Nanotechnology Enables Drug Design at Cellular Level Nanobiotechnology - Dendrimers and Fullerenes - Self-Assembling Nanoparticles for Intracellular Drug Delivery - Nanomotors for Drug Delivery.

## **UNIT IV ROLE OF NANOTECHNOLOGY IN BIOLOGICAL THERAPIES 9**

Introduction - Nanoparticle drug system for oral administration – Drug system for nasal administration – Drug system for ocular administration - Nanotechnology for Point-of-Care Diagnostics - Nanodiagnosics for the Battle Field.

## **UNIT V APPLICATION IN CANCER THERAPY & NANOMEDICINE 9**

Introduction and Rationale for Nanotechnology in Cancer Therapy - Multifunctional Nanoparticles for Cancer Therapy - Neutron Capture Therapy of Cancer: Nanoparticles and High Molecular Weight Boron Delivery Agents.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES :**

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

- Explain the characteristics of physical and chemical properties of liquids and gases at microscale.
- Explain the behaviour of nanorobots in computing and sensing applications.
- Detail the types of conjugate nanoparticles and its characteristics.
- Differentiate between the genetic and disease profiles to analyse the type of therapy to be provided to the patient.
- Explain various applications and the nature of nanoparticles under various domain.

### **TEXT BOOKS:**

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

### **REFERENCES:**

1. Robert. A, Freitas Jr., “Nanomedicine Volume IIA: Biocompatibility”, Landes Bioscience Publishers, 2003.
2. Richard S. Dick “The Computer-based Patient Record: An Essential Technology for Health Care” Institute of medicine, 1997.
3. OrpitaBosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press,2007.
4. Khandpur R S, “Telemedicine – Technology and Applications”, PHI Learnig Pvt Ltd., New Delhi, 2017.
5. Norris A C, “Essentials of Telemedicine and Telecare”, John Wiley, New York 2002.

### **WEBSITE REFENCES:**

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4. <https://www.intechopen.com/books/applications-of-nanobiotechnology/role-of-nanobiotechnology-in-drug-discovery-development-and-molecular-diagnostic>
5. <https://www.cancer.gov/nano/cancer-nanotechnology/treatment>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	2	1
CO2	2	2	2	-	-	-	-	-	-	-	1	2
CO3	2	2	3	-	-	-	-	-	-	-	2	1
CO4	1	1	1	-	-	-	-	-	-	-	1	2
CO5	2	1	2	-	-	-	-	-	-	-	2	2

## OPEN ELECTIVES SEMESTER VII

JBM 9010	TELEMEDICINE AND ITS APPLICATION	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES :

- To learn the key principles for telemedicine and scope of Tele healthcare services.
- To acquire knowledge on the technology and devices useful in telemedicine.
- To understand the concepts of various standards that are involved in medical data transmission.
- To gain knowledge on the ethical and legal aspects involved in telemedicine.
- To understand the various applications of telemedicine

### UNIT I FUNDAMENTALS OF TELEMEDICINE 9

Introduction to telemedicine, Telemedicine system - Evolution, scope and components, delivery modes. Benefits & challenges of implementing telemedicine - emerging recent advancements of telemedicine in healthcare services.

### UNIT II TELEMEDICAL DATA AND COMMUNICATION STANDARDS 9

Information sources and transmission of different data types in medicine, Evolution of Medical data content and transport standards, Medical data content standards - HL7, C-CDA, USCDI, Medical data transport standards - DICOM, FHIR, SCRIPT, CDISC, LOINC, Medical data security standards - HIPAA, GDPR. Types of telecommunication technologies for telemedicine - POTS, DDS, ISDN, LAN and WAN technology, GSM- Mobile health systems, satellite communication systems

### UNIT III TELEMEDICINE WORKSTATION - NETWORKING , WIRELESS TECHNOLOGIES 9

Network configurations, Communications in network, Wireless Technologies in telemedicine - Bluetooth, Zigbee, mHealth, Ubiquitous Healthcare, Challenges in wireless transmission of medical data, e health, cyber medicine.

## **UNIT IV ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9**

Autonomy & Confidentiality issues in Telemedicine, patient rights and consent, the patient-doctor relationship, data protection & security, licensing, maintenance and access of medical records, continuity of care, jurisdictional issues.

## **UNIT V APPLICATIONS OF TELEMEDICINE 9**

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e-Health and Cyber Medicine, Telerehabilitation, Tele-education, video conferencing.

**TOTAL : 45 PERIODS**

### **COURSE OUTCOMES:**

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

- Explain the scope and emerging trends in telemedicine.
- Elaborate on the different technologies involved in telemedicine.
- Understand the need for standardization and various formats in medical data handling for transmission.
- Analyze the ethical and legal aspects involved in telehealth technology.
- Understand the various domains of medicine where telemedicine plays a vital role.

### **TEXTBOOKS:**

1. R.S. Khandpur, "Telemedicine - Technology and Applications", PHI Learning Pvt. Ltd., Eastern Economy Edition, 2017.
2. Shashi Gogia, "Fundamentals of Telemedicine and Telehealth", American Press, Elsevier, 2020.

### **REFERENCES:**

1. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
2. H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications", Wiley, New Jersey, 2010.
3. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
4. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006
5. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.
6. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill, 2004

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2. <https://chironhealth.com/telemedicine/telehealth-technology>
3. [https://www.physio-pedia.com/Fundamentals\\_of\\_Telehealth\\_Technology](https://www.physio-pedia.com/Fundamentals_of_Telehealth_Technology)
4. <https://telehealth.hhs.gov/providers/getting-started>
5. <https://www.healthit.gov>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	2	2	-	-	2	3	-	-
CO2	3	3	-	3	2	3	-	-	2	3	-	3
CO3	3	3	-	3	2	3	-	-	2	3	-	3
CO4	-	-	-	-	2	2	-	3	2	-	-	3
CO5	3	3	-	-	2	3	3	-	2	3	-	2

<b>JBM 9011</b>	<b>MATERIAL SCIENCE FOR BIOIMPLANTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## COURSE OBJECTIVES

- To learn characteristics and classification of Biomaterials
- To understand different metals, ceramics utility as biomaterials
- To identify significant gap required to overcome challenges and further development in polymeric materials
- To elucidate and learn polymeric materials and its combinations that could be used as a tissue replacement implants
- To understand the concept of biocompatibility and the methods for biomaterials testing and sterilization

### UNIT I INTRODUCTION TO BIO-MATERIALS

9

Definition and classification of bio-materials, mechanical properties, surface chemistry of materials, surface modification, Wound Kinetics, Material-tissue response.

### UNIT II METALLIC AND CERAMIC MATERIALS

9

Metallic implants - Stainless steels, Co-based alloys, Ti-based alloys, Shape memory alloy, types and factors inducing corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics.

### UNIT III POLYMERIC IMPLANT MATERIALS

9

Polymerization, factors influencing the properties of polymers, types of polymerization method, biodegradable polymers, Bio polymers: Collagen, Elastin and Chitin, polymeric materials for

ophthalmology: contact lens, intraocular lens, failure mechanisms, Composite materials in medical field.

#### **UNIT IV HARD & SOFT TISSUE REPLACEMENTS 9**

Biomaterials for tissue repair, Soft Tissue replacements: materials and types of sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts.

Hard tissue replacement Implants: joint replacements and tissue scaffolding.

#### **UNIT V TESTING & STERILIZATION OF BIOMATERIALS 9**

Tests: Biocompatibility, blood compatibility, tissue compatibility, Toxicity, sensitization, carcinogenicity, mutagenicity and special tests. Invitro and Invivo testing. Sterilization of implants and devices: process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization.

**TOTAL: 45 PERIODS**

#### **COURSE OUTCOMES:**

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

- widen design approaches to biomaterials engineering
- explain the impact and identify significant gap required to overcome challenges and further development in technology
- describe the development of polymeric biomaterials.
- create combinations of materials that could be used as a tissue replacement implant.
- analyze and apply the testing standards applied for biomaterials.

#### **TEXT BOOKS:**

1. Jonathan Black, "Biological Performance of Materials - Fundamentals of biocompatibility", 4th Edition, CRC Press 2005.
2. Joseph D.Bronzino, "The Biomedical Engineering Handbook", Third Edition, CRC Press, 2006
3. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain, "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.

#### **REFERENCE BOOKS :**

1. Larry L. Hench and Julian R.Jones, "Biomaterials, Artificial organs and Tissue Engineering", 2005.
2. Buddy D.Ratner, Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, "Biomaterial Science - An Introduction to Materials in Medicine", 2nd Edition, Elsevier Academic Press, San Diego, 2004.
3. Park J.B, "Biomaterials Science and Engineering", Plenum Press, 1984.

#### **WEBSITE LINK :**

1. <https://pubs.acs.org/journal/abseba>
2. <https://www.frontiersin.org/journals/biomaterials-science>
3. <https://www.intechopen.com/chapters/56243>

## CO-PO MAPPING:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	3	1	2	-	1	2	1	2
CO2	2	3	1	1	3	2	2	-	1	1	-	2
CO3	2	3	1	1	3	1	2	-	1	2	-	2
CO4	2	3	2	-	3	1	1	-	2	3	-	2
CO5	2	3	3	-	3	1	1	-	2	2	2	2

JBM9012	HUMAN ASSISTIVE TECHNOLOGY	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To explain Cardiac assistive technologies in practice .
- To learn the functioning of the unit that assist kidney
- To explain different respiratory devices .
- To Study various assistive devices for deaf and blind
- To Elucidate the prosthetics devices for limb replacement

#### UNIT I CARDIAC ASSIST DEVICES

9

Principle of External counter pulsation techniques, Ventricular Bypass Pump, Auxiliary ventricle, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves,

#### UNIT II ARTIFICIAL KIDNEY

9

Indication and Principle of Hemodialysis, Membrane, Dialysate, types of hemodialyzer, Monitoring Systems, Peritoneal dialysis, Wearable Artificial Kidney

#### UNIT III RESPIRATORY DEVICES HEARING AIDS

9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters..

#### UNIT IV SENSORY ASSIST DEVICES

9

Types of Deafness, Hearing Aids, Cochlear implant , Electronic braille -haptics as a substitution of vision -Guide dogs

#### UNIT -V PROSTHETIC DEVICES

9

Hand and arm replacement – different types of models, externally powered limb prosthesis, myo electric powered limb prosthesis

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:

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

- explain Cardiac assistive technology .
- describe Artificial kidney and peritoneal dialysis
- explain different respiratory devices.
- describe various assistive devices for deaf and blind
- Elucidate the prosthetics devices for limb replacement

