JERUSALEM COLLEGE OF ENGINEERING
(An Autonomous Institution Affiliated to Anna University, Chennai)

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

JERUSALEM COLLEGE OF ENGINEERING
(An Autonomous Institution Affiliated to Anna University, Chennai)
DEPARTMENT OF BIOMEDICAL ENGINEERING

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

- Providing technical knowledge through skilled innovative practices and experiments in ethical learning environment.

- 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.

- Providing quality education and design activities in developing entrepreneurship

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able 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.

PO4: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 chang

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- The Graduates will excel in application of mathematics, basic sciences, and Biosciences to multidisciplinary projects.

- The Graduates will adapt to the contemporary technologies and support health care providers at various levels with effective communication and team work.

- The Graduates will develop optimum Biomedical Engineering solution with ethical commitment.

- The Graduates will excel themselves to work as an Entrepreneur in Biomedical field.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- Development of innovative tools: an ability to design innovative tools to analyze and diagnose various pathological disorders.
- 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
	TOTAL	23	22	22	22	18	21	22	10	160

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
THEORY								
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
PRACTICALS								
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
TOTAL				30	16	2	12	23

SEMESTER - II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
TOTAL				**35**	**15**	**4**	**16**	**22**

SEMESTER – III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
TOTAL				**29**	**17**	**2**	10	**22**

*Only Internal Assessment

SEMESTER – IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
TOTAL				30	14	02	14	22

SEMESTER – V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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 Elective1	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
PRACTICALS								
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
TOTAL				**27**	**17**	**0**	**10**	**18**

*Only Internal Assessment

SEMESTER – VI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
TOTAL				**25**	**15**	**0**	**12**	**21**

*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
THEORY								
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
PRACTICALS								
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
TOTAL				30	15	0	14	22

SEMESTER - VIII

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

PROFESSIONAL ELECTIVE – 1 (V SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	JBM1001	Bio Mems	PE	3	3	0	0	3
2	JBM1002	Bio Transport Phenomena	PE	3	3	0	0	3
3	JBM1003	Immuno Technology	PE	3	3	0	0	3
4	JBM1004	Bio Mechanics	PE	3	3	0	0	3
5	JBM1005	Virtual Instrumentation for Biomedical Engineers	PE	3	3	0	0	3
6	JBM1006	Medical Optics	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE- 2 (VI SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	JBM1007	Bio Fluids and Dynamics	PE	3	3	0	0	3
2	JBM1008	Pattern Recognition and Neural network	PE	3	3	0	0	3
3	JBM1009	Nanotechnology and Applications	PE	3	3	0	0	3
4	JBM1010	Psychotherapeutic Techniques	PE	3	3	0	0	3
5	JBM1011	Tele-health Technology	PE	3	3	0	0	3
6.	JBM1012	Physiological Modeling	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - 3 (VI SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	JBM1013	Hospital Management	PE	3	3	0	0	3
2	JGE1004	Intellectual Property Rights	PE	3	3	0	0	3
3	JBM1014	Health Care Informatics	PE	3	3	0	0	3
4	JBM1015	Medical Informatics	PE	3	3	0	0	3
5	JGE1001	Professional Ethics in Engineering	PE	3	3	0	0	3
6	JBM1016	Principles of Communication for Biomedical Engineers	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE 4 (VII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	JBM 1017	Biometric Systems	PE	3	3	0	0	3
2	JBM 1018	Robotics in Medicine	PE	3	3	0	0	3
3	JBM 1019	Neural Engineering	PE	3	3	0	0	3
4	JBM 1020	Ergonomics	PE	3	3	0	0	3
5	JBM 1021	Medical Imaging Techniques	PE	3	3	0	0	3
6	JBM 1022	Fuzzy Logic and Optimization Techniques	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE 5 (VII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	JBM 1023	Brain Computer Interface Techniques	PE	3	3	0	0	3
2	JBM 1024	Human Assist Devices	PE	3	3	0	0	3
3	JBM 1025	Body Area Network and Healthcare	PE	3	3	0	0	3
4	JBM 1026	Rehabilitation Engineering	PE	3	3	0	0	3
5	JBM 1027	Cognitive Neuroscience	PE	3	3	0	0	3
6.	JBM 1028	Modern Techniques For Cancer Therapy	PE	3	3	0	0	3

OPEN ELECTIVES TO BE OFFERED BY OTHER DEPARTMENTS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
IV SEM								
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
V SEM								
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
VI SEM								
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
VII SEM								
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
THEORY								
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
THEORY								
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
THEORY								
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
THEORY								
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
THEORY
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
THEORY
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

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

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 app ropriate 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 (informalletters)

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, dialoguewriting

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 technicaltexts
- 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. NewYork
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

		L	T	P	C
JMA1101	MATRICES AND CALCULUS (Common to all B.E /B.Tech Programmes)	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, 43rd 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.

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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

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

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 – Co ordination 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 Magneto striction 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 ultra sonics and imagingdevices
- To understand and to compute problems in QuantumPhysics.
- 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 opto electronics.

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,FirstEdition,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. Willam F Smith, "Material Science and Engineering", Tata McGraw - Hill Publications,2008.
8. John D.Cutnell, "Cutnell and Johnson Physics", Willey Publications,2018.

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2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ce18/
3. 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	-

	ENGINEERING CHEMISTRY	L	T	P	C
JCY1101	**(Common to all B.E /B.Tech Programmes)**	**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 ofmaterials.
- To understand polymer chemistry and the principle of energy inbatteries.
- 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 CHEMISTRYAND CORROSION   9
Electrochemistry- Electrochemistry- Electrochemical cell - redoxreaction, electrode potential-oxidation potential- reduction potential, measurement and applications - electrochemical series and its

significance - Nernst equation (derivation andproblems).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 curren tcathodic methods)- Electroplating of Copper and electroless plating of nickel-corrosion inhibitors (anodic and cathodic inhibitors).

UNIT IV POLYMER, COMPOSITES AND ENERGY STORAGE DEVICES
<div align="right">9</div>

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_2-O_2 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 anduses.
Nanochemistry – Introduction – distinction between molecules, nanoparticles and bulk materials; Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications.

<div align="right">**TOTAL: 45 PERIODS**</div>

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 Chemsitry, 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 edition2019.

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, 47th edition, Vishal publishing Co, 2017

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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

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

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 - Kirchhoff'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.

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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	-	-	-	-	-	-	-

JGE1102	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

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).

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

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 Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTAmethod.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argento metric method.
5. Estimation of copper in brass by Iodometry.
6. Determination of molecular weight of polyvinyl alcohol using Ostwaldvisco meter.

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

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

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3. http://www.mgcub.ac.in/pdf/material/20200428101433e562a8b8e8.pd
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

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

		L	**T**	**P**	**C**
JGE1112	**PROGRAMMING IN C LABORATORY**	**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 usingRecursion
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

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

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:

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

CARPENTRY USING POWER TOOLS ONLY:

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

I MECHANICAL ENGINEERING PRACTICE   18

Welding:

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

Basic Machining:

   a) Simple Turning and Taper turning
   b) Drilling Practice

Sheet Metal Work:

   a) Forming &Bending:
   b) Model making - Trays and funnels.
   c) Different type of joints.

Machine Assembly Practice:
 a) Study of centrifugal pump
 b) Study of air conditioner
Demonstration on:
 a) Smithy operations, upsetting, swaging, setting down and bending.
 b) Example – Exercise - Production of hexagonal headed bolt.
 c) Foundry operations like mould preparation for gear and step conepulley.
 d) Fitting - Exercises - Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)
I ELECTRICAL ENGINEERING PRACTICE   13
 a) Residential house wiring using switches, fuse, indicator, lamp and energy meter.
 b) 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
2. https://archieve.org/mechanicalengineeeringworkshoplaboratory

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

JHS1221	TECHNICAL ENGLISH & SOFT SKILLS II (Common to all B.E /B.Tech Programmes)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To make the students of engineering and technology enhance their ability to read and comprehend different texts
- To improve their creative and critical thinking so as to use in demanding contexts
- To equip the learners with the skills of writing convincing job applications and effective reports
- To develop their speaking skills to make technical presentations and participate in group discussions
- To facilitate them to hone their soft skills

UNIT I   TECHNICAL WRITING AND VISUAL CONVERSION   9

Definitions, Purpose statements, Technical vocabulary, regular and irregular verbs - Process Description and Interpretation of Graphs and Charts

SOFT SKILLS LAB   3

Skimming and scanning, understanding logic and sequencing in reading, inferring the exact meaning of text, making out meaning of pictorial and graphical representations

UNIT II   TECHNICAL WRITING AND GUIDELINES PREPARATION 9

Conditional clauses, Numerical adjectives, Collocation, verbal analogies –Instructions, Recommendations, Checklist

SOFT SKILLS LAB   3

Comprehensive listening: Listening to telephonic conversations, listening to native accents, short and long conversations from different domains, listening to various pre-recorded conversations and speeches

UNIT III   12
SOFT SKILLS LAB

Listening and speaking practice based on BEC, IELTS and TOEFL

UNIT IV   TECHNICAL WRITING AND BUSINESS LETTERS   9

Cause and effect, impersonal passive voice, idioms and phrases, words used as nouns and verbs - Letter writing – job application, business correspondence (letters) – callingfor quotations, placing order, complaint letters, preparing a memo, notice and e-mail – itinerary

SOFT SKILLS LAB   3

Group Discussions - Process, Skills, Guidelines, Evaluation, Oral Presentation – Planning, Preparing, Organizing, Presenting

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

<div align="right">

TOTAL: 60 PERIODS

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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. Gopalaswamy,Ramesh & RameshMahadevan. 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

		L	T	P	C
JMA1201	**VECTOR CALCULUS AND COMPLEX ANALYSIS (Common to all B.E /B.Tech Programmes)**	**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 $- = + , \neg w = \neg z$ Bilinear transformation $\frac{1}{z}$.

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 contouronly).

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 INVERSELAPLACE 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 surf aceintegrals
- To understand analyticity of complex valued functions, bilinear transformation and conformalmappings
- 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 differentialequations

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.

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

JBE1221	APPLIED SCIENCE FOR BIOMEDICAL ENGINEERING	L	T	P	C
		2	0	2	3

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

Isomerisam- structural isomerism, metamerism, tautomerism. Stereo isomerism (Geometrical and optical)–Diasteromers 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 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
2. 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.
4. O.G.Palanna, Engineering Chemistry, Mc Graw Hill,2017
5. Gurdeep R.Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House, 2007.
6. TW Graham Solomons, Craig B.Fryhle, Organic Chemistry, John Wily & Sons.Inc.
7. Buddy P.Ratner, Allan S.Hoffmann, Frederick J.Scjoen, Jack E.Lemons, Biomaterial Science, Elsevier Academic Press, 2004.
8. Practical Fiber Optics, D. Bailey and E. Wright,2003
9. J.Mendham, RC Denney, JD Barnes, MJK Thomas, Text book of quantitative chemical analysis, Vogel's,2008.

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/115/102/115102025/
2. https://www.youtube.com/watch?v=6QUFuZpCgGw
3. http://tiny.cc/0vhjuz
4. https://nptel.ac.in/content/storage2/courses/103108100/module7/module7.pdf
5. 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	-

JGE1203	ELECTRIC CIRCUITS AND ELECTRONIC DEVICES	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To Impart knowledge in basic circuits, circuit reduction techniques andanalysis
- To explain the passive component characteristics for the ac and dc source of power in electric scircuits
- 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, TRIACetc.

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, The venins 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

COURSE OUTCOMES:

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

- Analyze dc and ac circuits using mesh and nodalanalysis.
- Apply circuit theorems to electronic circuits to obtain various parameters
- Explain the characteristics of semiconductor devices do smallprojects
- Explain the characteristics of special semiconductor devices andapplications
- Understand the characteristics of various electronic components and powerdevices

TEXT BOOKS:

1. Jacob Millman, Christos C. Halkias and SatyabrataJit, 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 ti on, 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

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
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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 inPython.
- To understand tuples, dictionaries and files.
- To know the exception handling and 2Dconcepts.

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 LOOPI.NG   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.
- To structure simple python programs for solvingprograms.
- To Decompose larger programs intofunctions.
- To Understand compound structures like list, tuple,dictionary.
- To Learn basic 2d graphics concepts inPython.

TEXTBOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016(http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert,―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

WEBSITE REFERENCES:

1. https://www.w3schools.com/python/python_reference.asp
2. https://www.pythonforbeginners.com/basics/python-websites-tutorials
3. https://www.programiz.com/python-programming/methods/built-in/list
4. https://www.geeksforgeeks.org/python-convert-dictionary-to-list-of-tuples/
5. https://www.javatpoint.com/python-exception-handling

CO-PO MAPPING:

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

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

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 squad 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 PRESPECTIVE 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
- https://freevideolectures.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

JNC1261	ENVIRONMENTAL SCIENCE	L	T	P	C
		3	0	0	0

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 welfare - role of information technology in environment and human health.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of course completion, students will be able to
- Explain about ecosystem, their structure and function to conserve biodiversity.
- Recognize the level of environmental pollution and their control measures.
- Explain about the various types of natural resources and role of a human being in maintaining a clean sustainable environment for the future generations.
- Identify the social problems in the environment to reduce social issues.
- Understand environment and human health - human rights - value education, and the role of information technology in environment and human health.

TEXT BOOKS:
1. Erach Bharucha, - Textbook of Environmental Studies, Universities Press PVT, LTD, Hydrabad,2015.
2. Benny Joseph, Environmental Science and Engineering', Tata McGraw-New Delhi, 2006.

REFERENCES:
1. Dharmendra S.Sengar, Environmental law', Prentice hall of India PVT LTD, NewDelhi, 2007.
2. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
3. Gilbert M. Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. G. Tyler Miller and Scott E. Spoolman, - Environmental Science, Cengage Learning India PVT, LTD, Delhi,2014.

WEB SITE REFERENCES:
1. https://moef.gov.in/e-books/
2. https://www.csindia.org/understanding-eia-383
3. https://nptel.ac.in/courses/120108004

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	1	-
CO3	1	-	1	1	-	-	1	1	1	1	1	1
CO4	-	1	1	-	1	1	1	1	1	1	-	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1

JGE1211	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

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
CO1	3	3	3	-	3	-	-	3	3	3	-	3
CO2	3	3	3	-	3	-	-	3	3	3	-	3
CO3	3	3	3	-	3	-	-	3	3	3	-	3
CO4	3	3	3	-	3	-	-	3	3	3	-	3
CO5	3	3	3	-	3	-	-	3	3	3	-	3

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

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.electronicsforyou.com

CO-PO MAPPING:

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

JMA1301	TRANSFORMS AND LINEAR ALGEBRA	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To equip students with the knowledge of Fourier transforms which is used in signals and systems.
- To enable students to understand Z transforms and its applications in solving Difference equations.
- To familiarize students in the concepts of vector spaces, bases and dimension.
- To help understand concepts of linear transformation, Eigen values, Eigen vectors and Diagonalizability.
- To introduce inner product spaces, orthogonalization and least square approximations

UNIT - I   FOURIER TRANSFORMS   12

Statement of Fourier integral theorem – Complex form of the Fourier integral - Fourier transform pair – Fourier sine and cosine transforms –Properties - Transforms of simple functions – Convolution theorem – Parseval's identity

UNIT - II   Z - TRANSFORMS AND DIFFERENCE EQUATIONS   12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

UNIT - III   VECTOR SPACES   12

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT - IV   LINEAR TRANSFORMATION AND DIAGONALIZATION   12

Linear transformation – Properties - Kernel and Image – One-to-One and Onto transformations - Dimension theorem - Matrix representations of linear transformations - Eigen values and eigenvectors – Diagonalizability

UNIT - V   INNER PRODUCT SPACES   12

Inner products and norms – Gram Schmidt orthogonalization process -Adjoint of a linear operator – Least square approximation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able

- To understand problem solving in Fourier transforms and Fourier integral representations.
- 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.

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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

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
- Analyzefeedback 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. andSathyabrataJit, "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. SalivahananSand Suresh N Kumar,"Electronic Devices and Circuits", 4th Edition, McGraw Hill Education (India) Private Ltd., 2017.
4. Thomas L. Floyd, "Electronic Devices", 9th 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.

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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
5. https://www.youtube.com/watch?v=tOAmmzgRkMQ

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 ANDURINARY 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" ,13th Edition, Elsevier Saunders, 2015.
2. Prabhjot Kaur, "Text Book of Anatomy and Physiology", 2nd edition ,Lotus Publishers, 2014.
3. Elaine. N.Marieb, "Essential of Human Anatomy and Physiology " , 8th Edition, Pearson Education, New Delhi,2007

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1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology". 11thedition ,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" ,2m2nd Edition,McGrawHill,New Delhi, 2010
4. Eldra Pearl Solomon ,"Introduction to Human Anatomy and Physiology " 4th edition , W.B. Saunders Company,2014

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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-Mentenequation. 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, 28th edition, 2009.

REFERENCES:

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

WEBSITE REFERENCES:

1. https://nptel.ac.in/courses/102/105/102105034/
2. 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

JBM 1304	BIO SENSORS AND MEASUREMENTS	L	T	P	C
		3	0	0	3

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_2 and pCO_2, 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.

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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:

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

JBM 1305	BIOMATERIALS FOR MEDICAL IMPLANTS	L	T	P	C
		3	0	0	3

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, muta genicity 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.
- Recosrd the characteristics of metals used to manufacture implants
- Identify the polymers used in the eye lenses and other implants and their durability.
- Demonstrate theuse 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" ,CRCPress, 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. ParkJ.B., "Biomaterials Science and Engineering", Plenum Press, 1984.
4. Anand A.C, Kennedy JF, Miraftab.M, S.Rajendran,-Wood head, "Medical Textiles and Biomaterials for Healthcare", Publishing Limited2006.
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 KratiJain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.

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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

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

QUANTITATIVE APTITUDE   9
UNIT-III
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.

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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

JBM1311	ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

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 feedbackin 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
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
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

JBM1312	HUMAN PHYSIOLOGY AND BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

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/

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	

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

LABORATORY REQUIREMENTS FOR 30 STUDENTS:		
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

JMA1401	APPLIED PROBABILITY AND NUMERICAL METHODS	L	T	P	C
		2	2	0	3

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", KhannaPublishers, 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.

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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	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 1401	ANALOG & DIGITAL INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

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 ANDSIGNALGENERATORS   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 ANDD/ACONVERTERS   9
555 Timer: monostable and astablemodes. 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.

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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

JBM1402	PATHOLOGY AND MICROBIOLOGY	L	T	P	C
		3	0	0	3

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", 10th edition, 2014, Elsevier.
2. Dr Reba Kanungo, Ananthanarayanan & Panicker, "Microbiology", 10th edition, 2017,
3. Orient blackswan Publishers.
4. Ramnik Sood, "Concise Book of Medical Laboratory Technology
5. 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", 4th edition, S.Chand & Company Ltd., 2007
4. Joanne Willey ,Linda Sherwood, Christopher J. Woolverton "Microbiology" ,10th edition, 2017, McGrawHill.

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1. https://nptel.ac.in/courses/102/103/102103015/
2. https://swayam.gov.in/nd1_noc20_ce17/
3. https://www.youtube.com/watch?v=1vaEVcMfa1E
4. 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

JBM1403	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

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 Occulograph (EOG), Electro Retinograph (ERG), Audiometer-Pure tone, Speech. EGG (Electrogastrograph), Galvanic Skin Resistance (GSR), Plethysmoghraphy -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.

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2. https://www.youtube.com/watch?v=49CWbXNJ3WE&t=35s
3. https://www.youtube.com/watch?v=NeiD87Z kJ8&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

JBM1404	BIO CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

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)

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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.

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2. https://nptel.ac.in/courses/108/106/108106098/
3. https://www.youtube.com/watch?v=fHD_dexFmGA
4. https://www.youtube.com/watch?v=3cvVl9nlNww
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	-

JPT1001	SOFT SKILLS AND APTITUDE- II	L	T	P	C
		0	0	2	1

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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2. https://m4maths.com/placement-puzzles.php
3. www.freshers world.com
4. https://www.youtube.com › watch>problems on ages
5. https://www.youtube.com › watch>blood relation
6. 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

JBM1411	ANALOG & DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

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, Schimtt 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=AEGzpMlOsvc
5. 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

JBM1412	PATHOLOGY AND MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:
- To perform physical and chemical examination of urine
- To study the Usage of Compound microscope
- To peform 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,
2. bilirubin and blood)
3. Study of parts of compound microscope
4. Histopathological slides of benign and malignant tumors
5. Manual paraffin tissue processing and section cutting (demonstration)
6. Basic staining
7. Special staining
8. Capsule staining
9. 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

JBM1413	BIOMEDICAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:
- To design biological preamplifer
- 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
3. 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

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

COURSE OBJECTIVES:

- To impart knowledge on architecture and interrupt structure of µP8085
- 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 INTERFAPCING
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, 2nd 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. DoughlasV.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2016.
4. Kenneth J Ayala "The 8051 Microcontroller, Architecture, Programming and Applications" 2nd 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.

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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/vlabiitece/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 CONTINOUS 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", 2nd Edn., Pearson, 2015.
  2. P.Ramesh Babu and R.AnandaNatarajan,"Signals and Systems", 5th 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", 2nd 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, 3rdEdition, 2012.
  7. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, 4th Edition, 2014.

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1. https://nptel.ac.in/courses
2. https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyxProf. K.S. Venktesh, Department of Electrical Engineering , IIT Kanpur
3. 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- 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. Hounds field 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, Philadelpia, 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),2ndEd:Jaypee brothers medical Publisheres (P) Ltd.,New Delhi

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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.

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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   6
 PROPERTY
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 SECTORS6
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, MichelDanino, "Knowledge Traditions and Practices of India"

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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

		L	T	P	C
JPT1002	**TECHNICAL SKILLS AND APTITUDE I**	**0**	**0**	**2**	*****

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 8th 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 Reasoningpublishedin 2000.

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2. https://m4maths.com/placement-puzzles.php
3. www.freshers world.com
4. www.careerride.com
5. www.youtube.com/watch/python
6. www.youtube.com/watch/concepts of python
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

JHS1511	PROFESSIONALCOMMUNICATION (Common to all B.E/ B.TechProgrammes)	L	T	P	C
		0	0	2	1

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
- Tohelpthemparticipate ingroupdiscussionsdisplayingteamworkskills
- To build theirconfidenceand help them attend interviewswinningly
- Togroomthem tobecomesuccessfulprofessionals

UNIT I   EXPOSURE TO PROFESSIONAL SKILLS   6
Introduction to Skills: hard skills and soft skills–communication skills–interpersonal skills–employability and careerskills–planning and prioritizing work–timemanagement–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 TOCRACKGROUP DISCUSSION   6
Group discussion skills–team building–using key strategies–etiquette–content preparation–brain storming– outof box thinking–mind mapping– turn taking and turn giving–speaking persuasively–questioning andclarifying

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 – goalsetting– futurechallenges

                                                        TOTAL:30PERIODS

COURSEOUTCOMES:
At the endof the course,students will beableto:
- 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. Globearena
2. Win English

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

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2. Alex, K, 2019, Soft Skills: Know Yourself and Know the World, New Delhi: S. Chand &CompanyLimited.
3. Butterfield,Jeff,2015, SoftSkillsforEveryone.NewDelhi: CengageLearning.
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.

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2. https://alison.com/courses/communications
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4. http://www.washington.edu/doit/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
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

		L	T	P	C
JBM 1511	**PROGRAMMING TOOLS FOR BIOMEDICAL ENGINEERS**	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 studentswill be able to:
- Execute Basic arithmetic operations, Boolean operations in MATLAB
- Demonstrate signal genenation 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 REFERNCES:
1. 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

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

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

CO - PSO MAPPING

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

JBM 1601	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To understand the working of devices and therapeutic procedures related tocardiology.
- To study the working of equipments used in the domain of Neurology and their applications.
- To studythe concepts involved in various equipments relevant to muscular and biomechanical diagnostic procedures.
- To familiarize with the diagnostic and therapeuticuses of ultrasonic and diathermy equipments.
- To understand the various clinical procedures involved in extracorporeal circulation and recent medical procedures.

UNIT I   CARDIAC EQUIPMENT   9
ECG – Einthoven's triangle, standard 12 lead system, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Echocardiography, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemakers, AC and DC Defibrillators- ECG telemetry , Application of cardiac equipment -CathLab

UNIT II   NEUROLOGICAL EQUIPMENT   9
Clinical significance of EEG- 10 -20 electrode system ,Multi-channel EEG recording system, Epilepsy, Evoked Potential–BERA, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation- .EEG system maintenance and troubleshooting.Application of neurological equipment for - treatment of epilepsy, Sleep analysis, and neurofeedback training.

UNIT III   MUSCULAR AND RESPIRATORY EQUIPMENT   9
Recording and analysis of EMG waveforms, fatigue characteristics, Nerve conduction velocity measurement,Pressure myography,EMG Bio Feedback Instrumentation.Respiratoryequipments – Spirometer ,Pnemotachometer, Types of Ventilators – Patient Cycle Ventilators, Oxygen concentrator,CPAP, BiPAP.Neuromuscular stimulators - TENS ,Phrenic Nerve stimulator.

UNIT IV   ULTRASONIC AND DIATHERMY EQUIPMENTS   9
Basic principles of Echo technique, display techniques A, B and M scan modes, Application of ultrasound as diagnostic tool –Measurement of blood parameters – Blood velocity, blood pressure, Doppler ultrasound - Echocardiogram,Echoencephalogram,4D and 5D ultrasound techniques in obstetrics and gynecology,Diathermyequipments – Shortwave, Ultrasonic, Microwave diathermy, Electro cautery machine.

UNIT V EXTRA CORPOREAL DEVICES AND SPECIAL TECHNIQUES 9
Heart lung machine, Hemo Dialyser unit,ECMO, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laproscopy, Thermography.

TOTAL: 45 PERIODS

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 biomechanicaldiagnostic 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 Jersy, 1982.

WEBSITE REFERNCES :
1. 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

		L	T	P	C
JEC 1501	**DISCRETE TIME SIGNAL PROCESSING**	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 TRANSFORM12
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. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2010.

REFERENCES
1. Emmanuel C. Ifeachor& 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
3. https://nptel.ac.in/courses/117/105/117105134/, Prof. Mrityunjoy 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 ARITHMATIC PROBLEM   6
          SOLVING
Crptoarithmatic 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", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition,
   Prentice Hall, 2013.
3. Dr. R.S Agrawal, "Quantitative Aptitude" and Non Verbal Reasoningpublishedin 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.freshers world.com
4. www.careerride.com
5. www.youtube.com/watch/python
6. www.youtube.com/watch/concepts of python
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

JBM1611	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:
- To study the equipments used for biosignal acquisition .
- To understand the working of different therapeutic equipments.
- To use simulationtool 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. Multiout put 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 Ultra sound scanner
- Demonstrate the transmission of biosignals using Biotelemetry

WEBSITE LINKS:

1. https://www.youtube.com/watch?v=iUW_l5YAEEM
2. https://www.youtube.com/watch?v=Q03SbmORSbY
3. https://www.youtube.com/watch?v=UTtCfvlQRBs
4. https://www.youtube.com/watch?v=7USeIrVW320
5. 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

		L	T	P	C
JEC 1511	**DISCRETE TIME SIGNAL PROCESSING LABORATORY**	**0**	**0**	**4**	**2**

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,
6. 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

JBM 1701	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

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 smoothening 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

JBA1711	ENTREPRENEURSHIP FOR ENGINEERS	L	T	P	C
		0	0	2	1

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,RobertD.,MichaelPeters 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, NewDelhi. 2008.

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1. https://ideadrop.co/innovation-management/top-five-favourite-idea-generationtechniques/
2. https://www.bajajfinserv.in/what-are-the-sources-of-finance-for-entrepreneurs
3. https://www.babson.edu/academics/undergraduate-school/core-experiences/foundations-of-management-and-entrepreneurship/
4. https://www.businessgig.com/business-plan-preparation
5. https://www.financierworldwide.com/the-impact-of-social-entrepreneurship-on-economic-growth.

JBM 1711	DIGITAL IMAGE PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

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

		L	T	P	C
JBM 1731	**PROJECT PHASE-I**	**0**	**0**	**6**	**3**

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:

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

JNC 1861	INDIAN CONSTITUTION	L	T	P	C
		3	0	0	0

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
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

JBM 1811	**COMPREHENSION & TECHNICAL SEMINAR**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

- 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

JBM 1001	BIO-MEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To analyze the working principle of MEMS & Microsystems in healthcare domain
- To explain the micro system fabrication processes and materials used for MEMS
- To differentiate the various Micro manufacturing techniques
- To study the working principle of Micro fluidic Systems
- To understand the concepts of BioMEMS with suitable Applications

UNIT I   MEMS MATERIALS AND FABRICATION   9

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

UNIT II MECHANICAL AND THERMAL SENSORS
AND ACTUATORS   9

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

UNIT III ELECTROSTATIC , PIEZOELECTRIC SENSORS AND
ACTUATORS   9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICRO MANUFACTURING AND MICROFLUIDIC
SYSTEMS   9

Bulk micro manufacturing -isotropic and anisotropic etching - Dry and wet etching techniques - Surface micromachining description - LIGA process description-Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, Applicaions of microfluidic systems: microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers

UNIT V   APPLICATIONS OF BIO-MEMS   9

MEMS based drug delivery, Micro tools for surgery, micro total analysis systems (MicroTAS) detection and measurement methods, micro system approaches to polymerase chain reaction (PCR), DNA sensor, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:
- Discuss various MEMS fabrication techniques
- Explain different types of sensors and actuators and their principles of operation at the micro scale level
- Understand the process of micro manufacturing and applications of microfluidic systems
- Know the working principles of electrostatic and piezoelectric sensors
- Apply MEMS devices in different field of medicine

TEXT BOOKS:
1. TaiRan Hsu, -MEMS and Microsystems Design and Manufacture , Tata McGraw Hill Publishing Company, New Delhi, 2002. (UNITS- I, II,III, IV)
2. Wanjun Wang, Stephen A. Soper, -- BioMEMS : Technologies and Applications, CRC Press, NewYork, 2006. (UNIT- V)
3. Steven S. Saliterman, - Fundamentals of BioMEMS and Medical Microdevices, SPIE Publications, 2006. (UNITS- I, V)

REFERENCES:
1. Albert Folch, "Introduction to BioMEMS", 1st edition, CRC Press, Taylor and Francis Group, 2016.
2. Marc J. Madou, "Fundamentals of Micro fabrication: the Science of Miniaturization", CRC Press, 2002.
3. Nadim Maluf, Kirt Williams, "An introduction to Micro electro Mechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
4. Chang Liu, "Foundations of MEMS", Pearson Education International, New Jersey, USA, 2006 .
5. Nitaigour Premch and Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007.

WEBSITE REFERENCES:
- http://www2.nkfust.edu.tw/~cjli/MEMS/Chapter_1.doc
- https://www.slideshare.net/MuhammadMustafa129/mems-micro-systems
- https://www.sciencedirect.com/topics/engineering/piezoelectric-actuator
- https://www.elveflow.com/microfluidic-reviews/general-microfluidics/a-general-overview-of-microfluidics/
- https://nptel.ac.in/content/syllabus_pdf/112104181.pdf

CO- PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1002	BIO TRANSPORT PHENOMENA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide a broad view of biotransport process
- 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 modeling

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 ASSITIVE DEVICES 9
Modeling 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 modeling 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 the 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

REFERENCES :
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 & Jasprit singh, "Semiconductor Device physics and Design", Springer 2008.

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1. https://www.youtube.com/watch?v=7O0kvtUueNg
2. https://bme.osu.edu/research/biotransport
3. https://link.springer.com/article/10.1007/BF02647343
4. https://www.youtube.com/watch?v=WMUTvLnZbYo
5. https://en.wikipedia.org/wiki/Compartmental_models_in_epidemiology

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1003	IMMUNO TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To describe the role of the immune system in human health and diseases
- To provide an overview of humoral and cell mediated immunity.
- To elucidate the reasons for immunization and aware of different types of vaccines
- To describe the immunological response against tumor and blood transfusion.
- To explain immunological techniques for diagnosis of various diseases.

UNIT I   INTRODUCTION TO IMMUNE SYSTEM   9

Cells and organs of immune system, Process of hematopoiesis and role of each cells, primary and secondary lymphoid organs,Antigens: Chemical and biological Factors affecting antigenicity/Immunogenicity and molecular nature, Haptens, adjuvants, Antibodies: their structure and function, Immunoglobulin classes and subclasses

UNIT II   HUMORAL AND CELL MEDIATED IMMUNITY   9

B-lymphocytes,switching mechanism , antibody genes and generation of diversity, production of monoclonal antibodies, polyclonal antibodies and applications, cytokines, Thymus derived lymphocytes (T cells) - their ontogeny and types, Activation of T-cells, Major histocompatibility Complex (MHC) Complex - Class I and II molecules. Antigen processing and presentation process.

UNIT III   IMMUNE SYSTEM IN HEALTH AND DISEASE   9

Complement system and its pathways, Gell and Coombs classification of Hypersensitivity reactions and Diagnosis and treatment. Autoimmune disorders, types, animal model and treatment. Vaccines and their types, classification and immunization schedule-case studies on corana vaccines

UNIT IV TRANSPLANTATION AND TUMOR IMMUNOLOGY   9

Transplantation and its classification, Immunologic basis of graft rejection and its mechanism , Transplantation antigens, tissue typing role of MHC molecules in allograft rejection, Clinical transplantations, bone marrow, HSC transplantation and immune suppressive therapy. Tumor immunotherapy.

UNIT V MOLECULAR IMMUNOLOGY & IMMUNODIAGNOSIS   9

Precipitation reactions, Agglutination reactions, ABO Blood typing principles. Principles and applications of ELISA, Radio Immuno Assay (RIA), western blot analysis,Immuno fluorescence, chemiluminescence assay, fluorescence activated cell sorting (FACS) analysis. Role of stem cells technology in immunology,immunotherapy with genetically engineered antibodies

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Describe which cell types and organs present in the immune response.
- Compare and contrast humoral and cell mediated immunity.
- Exemplify the adverse effect of immune system including allergy, hypersensitivity and autoimmunity.
- Explain the principles of transplant immunology.
- Illustrate the immunological concepts and methods to diagnose immune disorders.

TEXT BOOKS:

1. Ashim K Chakravarthy ''Immunology &Immunotechnology'',Oxford University Press,2006.
2. T. Kindt, R. Goldsby, B. A. Osborne, Kuby, "Immunology", W. H. Freeman, 6th edition, 2006. ISBN 13: 9781429202114.

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1. Roitt I, "Essential Immunology", Blackwell Scientific Publications, Oxford 13th Edition 2017.
2. Richard Coico, Geoffrey Sunshine, "Immunology: A Short Course", Wiley-Blackwell 7th Edition 2015.
3. Peter Wood, "Understanding Immunology", Pearson Education,2001.
4. Abbas A., Litchman A. H., and Pober J., "Cellular and Molecular Immunology", W B Saunders & Co.(2000), ISBN: 9780323222754.
5. Ajoy Paul, "Textbook of Immunology", Books and Allied (P) Ltd. (2016), ISBN-13: 9789384294724.

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- https://www.coursera.org/courses?query=immunology
- https://www.coursera.org/specializations/immunology
- https://www.edx.org/learn/immunology
- https://www.jimmunol.org/

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1004	BIO MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose to basic principles of mechanics, fluid and solid mechanics and their property and basic equations.
- 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 learn types of tissues, to understand their 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 basic concepts of human locomotion, biomechanical analysis using Finite Element Analysis.

UNIT I   INTRODUCTION TO MECHANICS   9

Introduction to mechanics, branch of mechanics, rigid bodies, anthropometry, statics - force vectors and equilibrium, vectors for mechanics, equations of equilibrium, force and pressure, momentum, work and energy, free body diagram, Dynamics – Newton's law of motion, Mechanics of motion, torque, Kinetics and Kinematics, velocity and acceleration, link segments, force transducers and force plates.

UNIT II   BIOFLUID MECHANICS   9

Types of fluids, types of fluid flow, 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, Cardiovascular system, Physics of cardiovascular diseases, mechanics of prosthetic heart valves, material properties and modelling of Blood vessels.

UNIT   III   BIOSOLID MECHANICS   9

Hard Tissues: Bone structure & composition, blood circulation, elasticity, viscoelasticity and strength of bones, functional adaptation, Maxwell & Voight models – anisotropy.

Soft Tissues: material properties and modelling of Soft Tissues, Muscle action, Hills models, mathematical modelling, bone fracture mechanics.

UNIT IV   BIOMECHANICS OF JOINTS AND IMPLANTS   9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Design of orthopaedic implant, specifications for a prosthetic joint, manufacturing process of implants, fixation of implants.

UNIT V   MODELING AND ERGONOMICS   9

Introduction to Finite Element Analysis, finite element analysis of lumbar spine, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the laws of motion and energy function.
- Explain the behaviour of fluids inside the body and its simulation.
- Detail the material properties and composition of the tissues.
- Differentiate between the rigid bodies and free body and to characterize biomaterials.
- Describe the finite element analysis, design the work station depending upon the ergonomics

TEXT BOOKS:

1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1993.
2. Duane Knudson, "Fundamentals of Biomechanics", Second Edition Springer Science & Business Media, 2007
3. Marcelo Epstein, "The Elements of Continuum Biomechanics", ISBN: 978-1-119-99923-2, 2012.

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1. Cees Oomens, Marcel Brekelmans, Sandra Loerakker, Frank Baaijens, "Biomechanics: Concepts and Computation", Cambridge University Press, second edition, 2018.
2. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science Business Media, 2004.
3. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press, 2007.

4. Bruce M. Koeppen and Bruce A. Stanton, "Berne & Levy Physiology", Mosby, 6th Updated Edition, 2009.
5. Robert L.Huston, "Principles of Biomechanics", CRC Press, 2008.

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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 MAPPING:

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

CO-PSO MAPPING:

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

JBM 1005	VIRTUAL INSTRUMENTATION FOR BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

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, blockdiagram, 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   ANDAPPLICATION   OF   VIRTUAL INSTRUMENTATION IN BIOMEDICAL ENGINEERING   9

Fourier Transforms, Power spectrum, Correlation methods,Major equipments - 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, the 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 By Jon B. Olansen, Eric Rosow, 2001

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- https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_basic.php
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- https://nptel.ac.in/courses/111/104/111104100/
- https://onlinecourses.nptel.ac.in/noc21_ma37/preview\
- https://www.ni.com/getting-started/labview-basics/

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1006	MEDICAL OPTICS	L	T	P	C
		3	0	0	3

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 equipments 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 (Fluoroscence 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 - LEDs and Lasers, Optical Waveguides - Hollow waveguides, Optical fibers, coupling devices and tips, Optical filters – Prism and Monochromators, 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 - Biostimulation effect, Tissue Engineering with light, Overview of Bionanophotonics.

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

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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.

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3. https://www.youtube.com/watch?v=DYz9B0sO7e4
4. https://www.youtube.com/watch?v=JlpRgsfMZUk
5. https://www.youtube.com/watch?v=8VljkMyLJ2g
6. https://www.youtube.com/watch?v=qUD865w2Drw

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

P

ROFESSIONAL ELECTIVE 2
(VI Semester)

JBM 1007	BIO FLUIDS AND DYNAMICS	L	T	P	C
		3	0	0	3

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   **BIOFLUID MECHANICS**   **9**

Newton's laws, Hooks-law, force and moment, 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**

Newton's laws, Hooks-law, force and moment, 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 III   CARDIAC MECHANICS   **9**

Introduction to cardiovascular system, 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, Structure, Entropic elasticity-stretching, bending and twisting, persistence length, function and mechanical properties of skin, ligaments and tendons.

UNIT V   ORTHOPEDIC MECHANICS   **9**

Mechanical properties of cartilage, diffusion properties of Articular cartilage, mechanical properties of bone, adaptive nature of bone, kinetics and kinematics of joints, lubrication of joints

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

- Understand the basic concepts of how fluid mechanics principles can be applied to blood circulation
- Acquire knowledge on basic principles of Blood flow in living body and analyse if the flow is steady or pulsatile
- Explain the heart pumping functions through various involuntary movements and its mechanics properties of heart, artery, collagen and skeletal muscle tissue that can be used for diagnosis

- Explain the non-linear stress-strain relationship among various soft tissues
- Acquire knowledge on how to potentially optimize the mechanical stresses experienced by normal, diseased, injured, or surgically treated bones and joints

TEXT BOOKS:

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 & Goodarz Ahmadi, "Computational Fluid and Particle Dynamics in the Human Respiratory System", Springer, 1st edition, 2013.**
3. Philip J Pritchard and John W Mitchell, "Fox and McDonald's Introduction to fluid Mechanics", John Wiley, 9thedition, 2012.

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2. Nihanth ozkai, D.A Mc Donald, "Biomechanics, Blood flow in arteries", Edward Arnold ltd, 1998.
3. D.O Cooney, "Biomedical Engineering Principles", Marcel Dekker, INC New York.1976.

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3. https://biomedical-engineering-online.biomedcentral.com/articles/10.1186/1475-925X-12-34
4. https://bmcmusculoskeletdisord.biomedcentral.com/articles/sections/orthopedics-and-biomechanics
5. https://www.sciencedirect.com/topics/engineering/biofluid-mechanics

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

		L	**T**	**P**	**C**
JBM 1008	**PATTERN RECOGNITION AND NEURAL NETWORKS**	**3**	**0**	**0**	**3**

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 neighbor classifier, estimation of error rates..

UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS   9

Unsupervised learning- Hierarchial 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 students will 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 andprogramming techniques", Addison – Wesley,2003.
2. S.N.Sivanandam, " Introduction to Artificial Neural Networks using MATLAB 6.0",Tata McGrawhill Publication,2016.

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1. .Robert Schalkoff, " Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons(Asia) Pte. Ltd., Singapore, 2005. Laurene Fausett " Fundamentals of neural networks – Architectures, algorithms and applications", Prentice Hall, 1994.
2. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press, 2009.
3. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
4. S. Haykin, "Neural Networks and Learning Machines" , Prentice Hall of India, 2010.
5. D. E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", 1stEdn, Pearson, 2016.

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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:

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

CO-PSO MAPPING:

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

JBM 1009	NANOTECHNOLOGY AND APPLICATIONS	L	T	P	C
		3	0	0	3

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-Interdynamic 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 the course, the student will be able to:

- Describe the basic science behind the properties of materials.
- Interpret the creation, characterization, and manipulation of nanoscale materials.
- Learn the measurements of nanoparticles
- Comprehend the exciting applications of nanotechnology at the leading edge of scientific research
- Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

TEXT BOOKS:

1. Bharat Bhushan, "Encyclopedia of Nanotechnology", Springer Netherlands, 2012.

2. Sunipa Roy, Chandan Kumar Ghosh, Chandan Kumar Sarkar, "Nanotechnology Synthesis to Applications", CRC Press, Taylor & Francis Group, 2018.

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1. D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, "Nanomaterials, Nanotechnologies and Design: An Introduction to Engineers and Architects", 2009.

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4. https://pubmed.ncbi.nlm.nih.gov/17292053/#:~:text=Cells%20clearly%20respond%20to%20the ,components%20in%20the%20nanometer%20scale.

5. https://www.iberdrola.com/innovation/nanotechnology-applications

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1010	PSYCHOTHERAPEUTIC TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the history, evolution of psychotherapy and its techniques.
- To identify a contemporary perspective on the general effectiveness of behavioural psychotherapy.
- To illustrate the principles of cognitive therapy.
- To understand the ethical issues in psychotherapy.
- To explain different approaches towards psychotherapeutic techniques

UNIT I   PRINCIPLES OF PSYCHOTHERAPY   9

Introduction to Psychotherapy – Main features – Objectives of Psychotherapy – Therapeutic process – Effectiveness of Psychotherapy – negative beliefs vs self attitudes. Psychoanalytic
Psychotherapy- Autonomous psychotherapy, Dynamic Psychotherapy – Ego Psychology – Object Relations Psychology – Self Psychology- Adlerian psychotherapy

UNIT II   BEHAVIOUR THERAPY   9

Person Centered Psychotherapy: Introduction to Carl Rogers and Rogerian theory of personality – Logo Therapy–Asian approaches to counselling –Behavioural therapeutic process – Techniques – Application of behavioural techniques and procedures – Therapy with diverse populations. Lazarus Multimodal Approach to Psychotherapy.

UNIT III   COGNITIVE BEHAVIOR THERAPY   9

Cognitive Behaviour Modification: Donald Meichenbaum's approach to therapy, Albert Ellis Rational Emotive Behavioral theory, Aron Beck's Therapy Integrative Approach to Psychotherapy: Integration vs. Eclecticism – An introduction to therapy, techniques and applications

UNIT IV   ETHICAL CONSIDERATIONS   9

Therapeutic Skills – Preliminary considerations – the setting – Phases of the session and its ethical issues– Mental Status Examination - Current issues in Psychotherapy – Case studies in Psychotherapy - Other approaches to Psychotherapy – Supportive therapy Psychobiology – Zen Psychology – Overview of NLP in Psychotherapy

UNIT V   APPROACHES TO PSYCHOTHERAPEUTIC RESEARCH   9

Research Methods – Statistical issues – Psychological Research - Professional issues in Psychotherapy - Rational Emotive Therapy and its applications – Child Psychoanalysis and Therapy - Current trends in Psychoanalytic Research- Gestalt Psychotherapy- Existential Therapy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain different psychotherapeutic techniques.
- Elucidate behaviour change strategies based on learning principles.
- Illustrate the principles of cognitive therapeutic change.
- Define the ethical health issues from Indian context and perspective.
- Contrast the different approaches towards psychotherapy

TEXTBOOKS:

1. Christian,C.,"Advanced Techniques for Counselling and Psychotherapy",Springer (2009).
2. Sharf, R.S., " Theories of psychotherapy and counselling: Concepts and cases", (2nd Ed.) Singapore: Brooks/Cole,2000.

REFERENCES:
1. Schaffer G.W. and Lazarus R.S.," Fundamental concepts in Clinical Psychology",McGraw – Hill, 1966.
2. Miltenberger, R.G., " Behaviour Modification: Principles and Procedures". 5th edition. Wadsworth Cengage Learning,2012.
3. Beck, J.S., "Cognitive Behavior Therapy: Basics and Beyond", 2nd edition. The Guilford Press, New York,2011.
4. O'Donohue, W.T., Fisher, J.E, "Cognitive Behavior Therapy: Core Principles for Practice", John Wiley & Sons, Inc.,2012.
5. Simos, G. "Cognitive Behavior Therapy: A Guide for the Practicing Clinician", Vol 1. Brunner-Routledge, London,2002.

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2. https://psychology.wikia.org/wiki/Psychotherapeutic_techniques
3. https://www.coursera.org/courses?query=psychotherapy
4. https://www.mooc-list.com/tags/psychotherapy
5. https://www.open-lectures.co.uk/psychoanalysis-psychotherapy/

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1011	TELEHEALTH TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To learn the key principles for telemedicine and health
- To apply multimedia technologies in medicine
- To understand legal issues of telemedicine
- To Know telemedical standards, mobile telemedicine
- To apply telehealth in healthcare

UNIT I   FUNDAMENTALS OF TELEMEDICINE   9

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

UNIT II   TELEMEDICINE TECHNOLOGIES   9

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

UNIT III   ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE   9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights. 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   MOBILE TELEMEDICINE   9

Tele radiology: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution. Medical information storage and management for telemedicine-patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system, Pharmaceutical information system, - Teleoncology, Smart medical homes, Telemedicine in neurosciences

<div align="right">

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

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

- Explain 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

REFERENCES:

1. Jung HeeSeo, Vijay Vedula, Theodore Abraham and ajat Mittal, Multiphysics Computational models for cardiaclow and virtual cardiography‖, Int.J.Numer.Meth. Biomed. Engng.(2013) Published online in Wiley Online Library
2. LeeWaite, JerryFine,-Applied BiofluidMechanics‖,McGrawHill,2007
3. John K-JLi,-Dynamics of Vascular System‖, World Scientific, 2004
4. C.Ross Ethier, Craig A Simmons,-Introduction to Biomechanics-From Cellsto
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6. H K Versteeg,WMalalasekera,-AnIntroductiontoComputationalFluidDynamics
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2. https://chironhealth.com/telemedicine/telehealth-technology/
3. https://catalyst.nejm.org/doi/full/10.1056/CAT.18.0268
4. https://www.healthit.gov/faq/what-telehealth-how-telehealth-different-telemedicine
5. https://radiopaedia.org/articles/picture-archiving-and-communication-system

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1012	PHYSIOLOGICAL MODELING	L	T	P	C
		3	0	0	3

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 the methods and techniques for analysis and 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 SYSTEM CONCEPT 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, Comparison of muscle model isotonic response, Step response of resistant/compliant systems.

UNIT II TRANSFER FUNCTION 9
System as an operator and use of Transfer function, Bio Engineering of coupled systems, Examples of transformed signals and circuits for transfer function with impedance concept- Development of lung model, Impedance of a two-stage ladder network

UNIT III PERIODIC SIGNALS 9

Sinusoidal Functions, Analysis of Instrumentation to measure air flow system, second order system, Evaluation of Transfer function from frequency response for muscle response modes, Relationship between Phase lag and Time Delay-closed loop aspects of pupillary control system, Impulse response – undamped, under damped, critically damped, and over damped behaviour, Physical Significance of under damped responses of post systolic operations in aortic arch.

UNIT IV ANALYSIS OF PHYSIOLOGICAL SYSTEMS 9

Introduction to Matlab and SIMULINK in simulation of physiological systems, Characterization of Physiological systems- Hypophysis adrenal systems, pupillary hippus, Uses and Testing of System Stability, Simulation-Hodgkin-Huxley model, Regulation of Cardiac output, Regulation of Glucose – Insulin regulation by MATLAB tool (SIMULINK model).

UNIT V SIMULATION OF PHYSIOLOGICAL SYSTEMS 9

Simulation of thermal regulation, pressure and flow control in circulation, occulo-motor system, Wetheimer's saccade eye model, Cardio vascular system and pulmonary mechanics modelling and simulation, Model of Cardiovascular Variability

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to
- Explain application of physiological models.
- Know how to 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 & Claypool Publishers, 2010.
2. Micheal C.K.Khoo, "Physiological Control System – Analysis, Simulation and Estimation", Prentice Hall of India , New Delhi , 2001.

REFERENCES:
1. Willian B. Blesser, "A System Approach to Biomedicine", Mc Graw Hill Book Co., New York, 1969.
2. Richard Skalak and Shu Chien, "Hand Book of Biomedical Engineering", Mc Graw Hill and Co. New York, 1987.
3. Douglas S.Rigg, "Control Theory and Physiological Feedback Mechanism", The Wilkliam and Wilkins Co. Baltimore, 1970.
4. Joseph D, Bronzino, "The Biomedical Engineering Handbook", CRC Press, 3rdedition, 2006.
5. Claudio Cobelli Ewart Carson, "Introduction to Modelling in Physiology and Medicine", second edition, Academic Press, 2019.

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2. https://www.nature.com/articles/ncb3510
3. 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 MAPPING:

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

CO-PSO MAPPING:

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

PROFESSIONAL ELECTIVE 3
(VI Semester)

JBM 1013	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES
- To understand the fundamentals of hospital administration and management.
- To elucidate human resource management in hospital
- To know the marketing in hospital administration related research process
- To explore various supportive services in hospital
- To learn the quality and legal aspects in health care setting .

UNIT I   OVERVIEW OF HOSPITAL ADMINISTRATION   9
Distinction between Hospital and Industry, Challenges in Hospital Administration – Types of hospitals, Governing body, Hospital committee and hospital functionaries - Hospital Engineering :Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management - Bio-Medical Waste Management.

UNIT II   HUMAN RESOURCE MANAGEMENT IN HOSPITAL   9
Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III   MARKETING RESEARCH PROCESS   9
Marketing Elements And Marketing Mix -Market Segmentation-The Expanded Marketing-Mix Of Services- Marketing information systems in health services - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets - Consumer Buyer Behavior - Model of consumer behaviour

UNIT IV   CLINICAL & SUPPORTIVE SERVICES   9
Radiology and Imaging Services -functional planning in laboratory services - Medical Records Department – operation theatre planning -Central Sterilization and Supply Department Pharmacy– Food Services – Laundry Services

UNIT V   QUALITY AND LEGAL ASPECTS IN HOSPITAL   9
Purpose of Quality Assurance-Quality system-NABH, JCI, NABL-clinical Audit – Hazard and Safety in a hospital Setup. - Medico- Legal Problems in relation to health administration -Consumer Protection Act and Hospitals-health care disaster management -case studies on covid pandemic .

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:
- Explain the principles of Hospital administration.
- Exemplify the importance of Human resource management in health care setting
- Elucidate the marketing in hospital
- Describe the planning of different supportive department of hospital
- Analyze Quality procedures,standards followed in hospitals.

TEXT BOOKS:
1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI , 4th Edition, 2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management" ,TMH, New Delhi, 5th Reprint2007.

REFERENCES:
1. Peter Berman , " Health Sector Reform in Developing Countries" , Harvard University Press, 1995.
2. William A.Reinke, " Health Planning For Effective Management",Oxford University Press.1988
3. Jones, Anthony K., " Leading a hospital turnaround : a practical guide", Health Administration Press,2013
4. Edda Weimann, Peter Weimann, "High Performance in Hospital Management: A Guideline for Developing and Developed Countries", Springer International Publishing,2017

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2. https://books.google.co.in/books/about/Hospitals.html?id=N_mvAAAACAAJ&redir_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
5. http://environmentclearance.nic.in/writereaddata/online/RiskAssessment/220620179ZM1AS GJAnnexure-documentofRiskAssessment.pdf

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
CO 1	3	3	3	-	-	-	-	-	-	-	1	1
CO 2	3	3	3	-	-	-	-	-	-	-	1	1
CO 3	3	3	3	-	-	-	-	-	-	-	1	1
CO 4	3	3	3	-	-	-	-	-	-	-	1	2
CO 5	3	3	3	-	-	-	-	-	-	-	2	2

CO-PSO MAPPING:

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

		L	T	P	C
JGE 1004	**INTELLECTUAL PROPERTY RIGHTS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:
- To infer an idea about IPR.
- To build the knowledge on registration and its enforcement.
- To discuss various agreements and legislations with respect to IPR
- To appraise digital products and law
- To infer an idea about enforcement of IPRS

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UNIT I   BASIC CONCEPTS IN IPR   9
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II   REGISTRATION OF IPRs   9
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad 95

UNIT III   AGREEMENTS AND LEGISLATIONS   9

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

UNIT IV   DIGITAL PRODUCTS AND LAW   9
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V   ENFORCEMENT OF IPRs   9

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

TOTAL : 45 PERIODS

TEXT BOOKS:
1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India private Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2002

REFERENCES:
1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. PrabuddhaGanguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Derek Bosworth and Elizabeth Webster, "The Management of Intellectual Property", Edward Elgar Publishing Ltd., 2013.
4. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited, 2019.
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5. http://www.ipindia.nic.in/

JBM 1014	HEALTH CARE INFORMATICS	L	T	P	C
		3	0	0	3

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 AND
MEDICAL IMAGING   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,cognitivemodel,semester networks,decisions analysis in clinical medicine-computers inthe 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 & 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:
At the end of the course, students will be able to:
- Identify and describe various information technologies and standards in healthcare.
- Elucidate the methods of storing healthrecords and patient data.
- Explain the procedure of computer operation in Medical Imaging equipments.
- 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.

REFERENCES:
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 & 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, 4th ed. 2014.

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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
4. https://www.coursera.org/browse/health/health-informatics
5. https://participatorymedicine.org/epatients/2020/04/health-informatics-and-why-participatory-healthcare-is-key-to-its-future.html

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	-	-	-	-	-	-	-	2	2
CO5	3	3	3	-	-	-	-	-	-	-	2	2

CO-PSO MAPPING:

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

JBM 1015	MEDICAL INFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn ICT applications in medicine with an introduction to health informatics.
- To understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems.
- To understand the data storage and automation in informatics.
- To know about health Informatics
- To study about 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 MEDICAL DATA ACQUISTION 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 IN MEDICAL INFORMATICS 9

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.- Nanomedicine – 3D Bioprinting

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the 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
- Analyze 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 &IV).
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Ltd, 2003 (Units II, IV &V).

REFERENCES:
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 Learnig Pvt Ltd., New Delhi, 2017.
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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 MAPPING:

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

CO-PSO MAPPING:

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

JGE 1001	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To create an awareness on Human Values in Engineering Ethics.
- To enable the students to create an awareness on Engineering Ethics
- To instill the Engineering as Experimentation process.
- To impart knowledge on safety, responsibilities and rights of Engineers.
- To impart knowledge on global issues.

UNIT I HUMAN VALUES   10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS   9

Senses of ‗Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III   ENGINEERING AS SOCIAL EXPERIMENTATION   9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS   9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – OccupationalCrime– ProfessionalRights–EmployeeRights Intellectual Property Rights (IPR) Discrimination.

UNIT V GLOBAL ISSUES   8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

COURSE OUTCOME:
At the end of the course the students will be to
- Understand the concept of on Human Values
- Understand about the Engineering Ethics concepts.
- Understand the concept of Moral and Social Values
- Gain knowledge on safety, responsibilities and rights of   Engineers.
- Understand the concept of global issues.

TEXT BOOKS:

1. Mike W.Martin and Roland Schinzinger, -Ethics in Engineering‖,Tata Mc GrawHill, NewDelhi, 2003.
2. Govindarajan M, Natarajan S, SenthilKumarV.S,- Engineering Ethics‖, Prentice Hall of India, New Delhi,2004.
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.

REFERENCES:

1. Charles B.Fleddermann,-Engineering Ethics‖, Pearson Prentice Hall, New Jersey, 2004.
2. John R Boatright,-Ethics and the Conduct of Business‖, Pearson Education,NewDelhi,2003
3. Edmund G Seebauerand Robert L Barry, -Fundamentals of Ethics for Scientists
4. and Engineers‖, Oxford University Press,Oxford,2001.
5. LauraP.HartmanandJoeDesjardins,-BusinessEthics:DecisionMakingforPersonalIntegrity andSocialResponsibility‖McGrawHilleducation,IndiaPvt.Ltd.,NewDelhi,2013.
6. World Community Service Centre, ‗ Value Education', Vethathiri publications, Erode,2011.

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1. www.nptel.ac.in
2. https://www.nspe.org/resources/ethics
3. https://www.slideshare.net/
4. https://www.tutorialspoint.com/engineering_ethics/engineering_ethics
5. https://sites.tufts.edu/

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1016	PRINCIPLES OF COMMUNICATION FOR BIOMEDICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand analog and digital communication techniques.
- 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 - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II   PULSE AND DATA COMMUNICATION 9

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

UNIT III DIGITAL COMMUNICATION 9

Amplitude Shift Keying(ASK)–FrequencyShiftKeying(FSK)–PhaseShiftKeying(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 BOOK:

1. Wayne   Tomasi, -Advanced Electronic Communication Systems‖, 6thEdition, 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, 1st edition, 2010.

REFERENCES:

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

4. Huang H.K. Ratib. O, Bakker. A. R, Witte. G, "Picture Archiving and Communication Systems (PACS) in Medicine", Nato ASI Series F: Computer and System Sciences, Vol.74,1991.
5. Christi Carter, Beth L. Vealé , "Digital Radiography and PACS", ELSEVIER, 2018.

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1. https://electronicspost.com/explain-the-need-for-modulation-in-a-communication-system/
2. https://www.tutorialspoint.com/analog_communication/analog_communication_pulse_modulation.htm
3. https://www.postdicom.com/en/blog/cloud-based-pacs
4. https://science.jrank.org/pages/6722/Telemetry-System-components.html
5. https://blog.peekmed.com/pacs-systems/

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
CO 1	3	3	3	2	-	-	-	-	-	-	1	1
CO 2	3	3	3	3	-	-	-	-	-	-	1	1
CO 3	3	3	3	3	-	-	-	-	-	-	1	1
CO 4	3	3	3	3	-	-	-	-	-	-	1	2
CO 5	3	3	3	3	-	-	-	-	-	-	2	2

CO-PSO MAPPING:

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

PROFESSIONAL ELECTIVE 4
(VII Semester)

JBM1017	BIOMETRIC SYSTEMS	L	T	P	C
		3	0	0	3

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 Recoginition 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 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

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 - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition-Support Vector Machines- Biometric authentication by fingerprint –biometric-Multibiometrics and Two-Factor Authentication.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course student will be able to
- To explain the basic principles of biometric modalities
- To collect the finger print data collections, and apply for finger print
- To apply different models for face Recoginition and hand geometry in biometric application
- To Deploy statistical methods in Iris and retinal biometrics
- To apply real biometric applications for human authentication

TEXT BOOKS:

1. Anil K jain, Patrick Flynn, Arun A. (Eds.), Handbook of Biometrics, Springer, 2008
2. Benjamin Muller, Security, Risk and the Biometric State: Governing Borders and Bodies, 1st Edition, Routledge, 2010.
3. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach" Prentice Hall, 2005
4. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.

REFERENCES:

1. K. Jain, A. Ross, K. Nandakumar, Introduction to Biometrics: A Textbook, (2011), Springer Publishers, 2011. ISBN: 978-0-387- 77325-4.
2. Guide to Biometrics, By: Ruud M. Bolle, SharathPankanti, Nalini K. Ratha, Andrew W.Senior, Jonathan H. Connell, Springer 20093. Pattern Classification, By: Richard O. Duda, David G.Stork, Peter E. Hart, Wiley 2007
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.

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2. https://www.youtube.com/watch?v=R-Q6lM6PoVk
3. https://www.digimat.in/nptel/courses/video/106104119/L08.html
4. https://www.digimat.in/nptel/courses/video/106104119/L05.html

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	3	2
CO2	3	3
CO3	3	2
CO4	3	3
CO5	3	3

JBM 1018	ROBOTICS IN MEDICINE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To Understand the basics of Robotics, Kinematics.
- To Understand the basics of Inverse Kinematics.
- To Explore various kinematic motion planning solutions for various Robotic configurations.
- To Design techniques used for planning and decision-making in robotics and examine case studies.
- To Explore various applications of Robots in Medicine

UNIT I   INTRODUCTION TO MEDICAL ROBOTICS   9
Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT II   KINEMATICS   9 Kinematics –
General properties of solutions tool configuration, Five axis robots, Three- Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III   ROBOT VISION   9
Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis,, 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, Planning, 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
Application in Biomedical Engineering – Bio Engineering Biologically Inspired Robots-Rehabilitation–Interactive Therapy,Bionic Arm,Clinical and Surgical Gynaecology, Orthopaedics, Neurosurgery, Cardiac, abdominal, and urologic procedures with teleoperated robots - Prostate interventions with manual robots

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", 1st ed. 2015 Edition..

REFERENCES:

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 & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012

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1. www.medicalroboticsreports.com
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6625162/
3. https://www.sciencedirect.com/topics/engineering/medical-robot
4. https://onlinecourses.nptel.ac.in/noc21_me76/preview
5. http://medrobotics.ri.cmu.edu/node/128439 (Medical Robotics at CMU)

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1019	NEURAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the physiological concepts of nerve impulse generation and Electromyography
- To discuss about neuronal disorder.
- To Explore Evoked potentials and its importance in medicine
- To introduce various techniques to study central and peripheral nerve function
- To discuss the electrophysiological evaluation in special situations.

UNIT I   NERVE EXCITABILITY AND ELECTROMYOGRAPHY   9

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurologic diseases: Chemotherapy induced neurotoxicity, Porphyric Neuropathy, Inflammatory Neuropathy and its Treatment, Spinal Cord Injury; Nerve conduction studies, Microneurography and its potential clinical applications. Clinical Electromyography (EMG), Quantitative EMG, Electrophysiological evaluation of movement disorders, Evaluation of autonomic nervous system.

UNIT II   NEURONAL DISEASES AND DISORDERS   9

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

UNIT III   EVOKED POTENTIALS   9

Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electroretinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Brainstem Auditory Evoked Potentials (AEPs), Brainstem AEPs in infants and children, Somatosensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology.

UNIT IV   FUNCTIONAL NEUROIMAGING AND COGNITION   9

Historical and physiological perspective, Functional neuro imaging methods: PET and fMRI, Network analyses, Functional neuro imaging of: Attention, Visual recognition, Semantic memory, Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients

UNIT V ELECTROPHYSIOLOGICAL   EVALUATION   INSPECIAL SITUATIONS   9

Regeneration of the nervous system. Nerve graft; Neural tissue engineering; Drug delivery system in CNS. Cognitive & neurobehavioral rehabilitation. Electrophysiological evaluation of sacral function: Bladder, bowel and sexual function, Vestibular laboratory testing, Polysomnographic evaluation of sleep disorders, Electrophysiologic evaluation of: brain death, patients in the intensive care unit, patients with suspected neuro toxic disorders.Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation.

TOTAL : 45 PERIODS

COURSE COUTCOMES:

At the end of the student will be able to,

- Understand the physiology behind generation of nerve impulses.
- Describe various techniques that are used to evaluate the functioning of central and peripheral nervous system.
- Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system respectively.
- Understand about Functional Neuroimaging and cognitive concepts.
- Elaborate about electrophysiology.

TEXT BOOKS:

1. MichaelJ.Aminoff,et.al., "Aminoff 'electrodiagnosis in Clinical Neurology",Sixth Edition, Elsevier Saunders,2012.
2. KimE. Baretteet. al., "Ganong' s review of Medical Physiology", 23rd Edition, Mc Graw Hill Medical, 2010.
3. W. Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement organs and tissue", Oxford University Press Inc New York, 2004.

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1. Eric R.Kandelet. al.,"Principles of Neural Science",McGraw-Hill,NewYork,2012.
2. R.Cooper,et.al,"Techniques in Clinical Neurophysiology:A Practical Manual",Elsevier, Amsterdam, The Netherlands,2005.
3. Holodny, AndreiI., et al, "Functional neuro imaging: a clinical approach". Informa Health Care,2008.

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2. https://onlinecourses.nptel.ac.in/noc22_ee66/preview
3. https://onlinecourses.nptel.ac.in/noc22_bt14/preview
4. https://www.classcentral.com/course/swayam-neural-science-for-engineers-58524
5. https://iopscience.iop.org/journal/1741-2552

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1020	ERGONOMICS	L	T	P	C
		3	0	0	3

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   VISUAL AND AUDITORY ERGONOMICS   9
Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display – process of hearing – principles of auditory display. Measures for monitoring control & mitigation.

UNIT II   MUSCLE PHYSIOLOGY   9
Muscle physiology – muscle metabolism – respiratory response – joint motion study – measure of physiological in-efficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.

UNIT III   CONTROLS AND DISPLAYS   9
Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task

UNIT IV   ANTHROPOMETRY   9
Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

UNIT V   CASE STUDIES   9
Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc.
Case Study 2: Biomedical Application, Design optimization of Medical Equipments.

TOTAL: 45 PERIODS

COURSE COUTCOMES:

At the end of the course student will be able to,
- Understand principles of ergonomics.
- Understand the significance of posture
- Learn about tracking task.
- Learn about ergonomics and its implications to various domain
- Perform case studies on 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
4. Francesca Tosi, "Design for ergonomics", First edition, Springer International Publishing, 2019.

REFERENCES:
1. George Kanawaty, "Introduction to work study", ILO, 3rd edition, Oxford & 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 Press2007.

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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 MAPPING:

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

CO-PSO MAPPING:

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

JBM 1021	MEDICAL IMAGING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To learn the scanner specifications and technique of diagnostic Ultrasound imaging.
- To acquire knowledge on the sectional imaging and imaging principles of a Computed Tomographic imaging technique.
- To understand the principle of imaging using a MRI scanner.
- To gain knowledge on the radio isotopic imaging technique.
- To understand the concepts of infrared imaging and optical imaging

UNIT I   ULTRASOUND IMAGING TECHNIQUE   9

Production of ultrasound –Ultrasound scanner - Pulse echo principle of image formation, Two-dimensional image display and storage, Mechanical and electronic scanning and display, Ultrasound contrast agents, Three dimensional imaging,– Doppler ultra sound and colour flow mapping – applications of diagnostic ultra sound.

UNIT II   X-RAY COMPUTED TOMOGRAPHIC IMAGING TECHNIQUE   9

Priniciples of sectional imaging – Principle of Computed Tomography - CT scanners, Details of acquisition - Slice thickness, pitch, Tomographic reconstruction - sinogram, preprocessing the data, reconstruction techniques, Digital image display - windowing, levelling, multiplanar reconstruction, Three dimensional image display.

UNIT III   MAGNETIC RESONANCE IMAGING   9

Priniciples of MRI pulse sequence – MRI instrumentation, Localization of the MR signal, 'K-space" data acquisition and image reconstruction, Two-dimensional Multiplanar acquisition,Three dimensional Fourier transform image acquisition, Artifacts, Introduction to functional MRI – Application of MRI .

UNIT IV   RADIO ISOTOPIC IMAGING   9

Principle of image formation in nuclear imaging, Nuclear system resolution and efficiency, Digital image formats in nuclear medicine - image acquisition and processing.

UNIT V INFRA RED IMAGING AND OPTICAL IMAGING   9

Physics of thermography – imaging systems – pyroelectric vidicon camera, clinical thermography – liquid crystal thermography. Principle of Optical Imaging - Multispectral imaging.

TOTAL : 45 PERIODS

COURSE COUTCOMES:

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

- Explain the scanner specifications and technique of diagnostic Ultrasound imaging.
- Apply acquired knowledge on sectional imaging principles of a Computed Tomographic imaging technique to reconstruct the image.
- Understand the principle of imaging using a MRI scanner.
- Explain the principles of radioisotopic imaging techniques.
- Explain the concepts of infrared imaging and optical imaging.

TEXT BOOKS :

1. Jerrold T Bushberg, "The Essential Physics of Medical Imaging", Lippincott Williams & Wilkins, Fourth Edition, 2020.
2. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. second edition 2006.

REFERENCES :

1. Steve Webb, "The Physics of Medical Imaging", Adam Hilger, Philadelpia,1988.
2. William R. Hendee, E. Russell Ritenour, "Medical Imaging Physics", A John Wiley & sons, Inc., Publication, Fourth Edition 2002.
3. Z.H. Cho., J-oie, P. Jones and Manbir Singh, "Foundations of Medical Imaging", John Wiley and sons Inc., 2010.
4. Avinash C. Kak, Malcolm Shaney, "Principles of Computerized Tomographic Imaging", IEEE Press, Newyork-1998.

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1. https://medcraveonline.com/MOJAP/a-review-of-imaging-techniques-in-scientific-researchclinical-diagnosis.html
2. https://www.rasmussen.edu/degrees/health-sciences/blog/types-of-diagnostic-imaging/
3. https://medlineplus.gov/diagnosticimaging.html
4. https://study.com/academy/lesson/medical-imaging-techniques-types-uses.html

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1022	FUZZY LOGIC AND OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Understand the fundamental concepts in Artificial Intelligence, ANN, Fuzzy systems.
- To Understand the various Swarm Intelligence techniques
- To learn about the fuzzification of scalar variables and the defuzzification of membership functions
- To learn three different inference methods to design fuzzy rule based system
- To Understand the fundamental concepts in Genetic Algorithms.

UNIT I   ARTIFICIAL INTELLIGENCE   9
Introduction – Foundations of AI – History of AI – Intelligent agent – Types of agents - Structure – Problem solving agents – Uninformed and informed search strategies.

UNIT II   SWARM INTELLIGENCE   9

Particle swarm optimization: Global PSO- Local PSO-Ant colony Optimization:Simple Ant Colony – Ant System- Max, Min Ant System.

UNIT III   BASICS OF FUZZY LOGIC   9

Introduction to Fuzzy Set Theory – Basic Concepts of Fuzzy Sets – Classical Set Vs Fuzzy Set – Properties of Fuzzy Set – Fuzzy Logic Operation on Fuzzy Sets – Fuzzy Logic Control Principles – Fuzzy Relations – Fuzzy Rules – Defuzzification-Approximate reasoning, Other forms of the implication operation.

UNIT IV   FUZZY APPLICATIONS   9

Logic Controller – Fuzzification Interface – Knowledge Base – Decision Making Logic – Defuzzification Interface – Application Of Fuzzy Logic To Control Of Blood Pressure During Anaesthesia – Cardio Vascular Signals , Fuzzy Logic Patient Deterioration Index.

UNIT V   GENETIC ALGORITHMS   9

Survival of the fittest – Fitness Computations – Cross over- Mutation – Reproduction – Rank method – Rank Space method-GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TOTAL: 45 PERIODS

COURSE COUTCOMES :
At the end of the course, the student will be able to:
- Explain the concepts of Artificial Intelligence.
- Analyse the various Swarm optimization techniques
- Evaluate the basic features of membership functions, fuzzification process and defuzzification process.
- Elaborate on the applications of Fuzzy systems
- Explain the concepts of Genetic Algorithms

TEXT BOOKS:

1. Elain Rich & Kevin Knight, "Artificial Intelligence", Tata McGraw Hill 1991.
2. Timothy J.Ross," Fuzzy logic with Engineering Applications", McGraw Hill, 1997.
3. Goldberg.D.E, "Genetic Algorithm: Search, Optimization and Machine Learning", Addison Wesley, N.Y, 1989.
4. S.Rajasekaran, G.A.Vijayalakshmi ,"Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications", PHI, New Delhi,2003.

REFERENCES:

1. Andries . P. Engelbrecht , Computational Intelligence, Wiley Publications, Second Edition.2007.
2. George Klir, Bo Yuan, Bo Yuan Fuzzy Sets And Fuzzy Logic, Prentice hall of India pvt ltd 2015
3. Kosko, B., Neural Network and Fuzzy Systems, Prentice Hall of India Pvt., Ltd.,2015
4. Zimmerman H.J., Fuzzy set theory – and its applications, Kluwer Academic Publishers.,2005
5. Drainkov, Hallendoor and Reinfrank, An introduction to fuzzy control, 2nd Edition, Springer, 1996
6. Stuart J.Russel, Peter Norvig, Artificial Intelligence A Modern Approach, 2nd Edition, Pearson Education, 2003.

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1. https://www.sciencedirect.com/topics/engineering/fuzzy-logic-technique
2. https://nptel.ac.in/courses/106105173
3. https://www.intechopen.com/books/6806
4. https://www.youtube.com/watch?v=JRaZAYuKURU
5. https://vtechworks.lib.vt.edu/handle/10919/27893

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

<div align="center">

PROFESSIONAL ELECTIVE 5
(VII Semester)

</div>

JBM 1023	BRAIN COMPUTER INTERFACE TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of brain computer interface
- To acquire knowledge on different activation potentials of brain
- To learn about the signal processing methods used in BCI
- To impart knowledge on BCI hardware and software
- To understand and perform various applications of BCI.

UNIT I   INTRODUCTION TO BCI   9

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, Artifacts removal - BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

UNIT II   BRAIN ACTIVATION   9

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials, Error potential in BCI, BCI based on cognitive tasks - Visual Evoked Potentials – P300 and Auditory Evoked Potentials

UNIT III   SIGNAL PROCESSING METHODS   9

Spike sorting, Frequency domain analysis -Hjorth parameters, Auto regressive modelling, Bayesian filtering, Wavelet analysis, Time domain analysis, Spatial filtering - Principal Component Analysis, Artifact Reduction Techniques, Brain Responses Useful for Building BCIs

UNIT IV   BCI HARDWARE AND SOFTWARE   9

Hardware -sensors, EEG Electrode design, electrode placement and signal characteristics, - ECoG, ECoG electrode design - Intracortical recording, Intracortical signal characteristics - Amplifier - Amplifier design -A/D conversion, Filtering, Digitization, Artifacts - Hardware Interfaces - Interface protocol -software - Design principles for BCI Software.

UNIT V   BCI APPLICATIONS   9

Sensory restoration, motor restoration, Rehabilitation, brain controlled wheelchairs, Case Studies - Invasive BCIs: controlling prosthetic devices such as orthotic hands, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs: P300 Mind Speller, Visual cognitive BCI, Ethics of Brain Computer Interfacing.

TOTAL : 45 PERIODS

COURSE COUTCOMES:

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

- Understand the basics of brain computer interfaces.
- Evaluate the concept of activation potential of the brain.
- Select appropriate signal processing methods for BCI
- Assign hardware and software appropriately to the human and to the machine.
- Understand BCI applications in the present contemporary world

TEXT BOOKS:

1. Rajesh.P.N.Rao,―Brain-Computer Interfacing: An Introduction, Cambridge University Press, First edition,2013 (UNIT -I, II, III,V)
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, ―Brain Computer Interfaces: Principles and practice‖, Oxford University Press, USA, Edition 1, January 2012. (UNIT - IV)

REFERENCES:

1. Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.
2. Bernhard Graimann, Brendan Allison, Gert P furtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato,Florida.
5. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
6. Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.

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1. https://ocw.mit.edu/resources/res-9-003-brains-minds-and-machines-summer-course-summer-2015/
2. https://www.sciencedirect.com/science/article/pii/B9780323911979000151
3. https://www.sciencedirect.com/science/article/pii/S1110866515000237
4. http://www.ece.uprm.edu/~manian/BCI%20principles%20and%20practice.pdf
5. https://www.sciencedirect.com/science/article/abs/pii/001346949190040B

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1024	HUMAN ASSIST DEVICE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To study the role and importance of machines that takes over the functions of the heart and lungs,
- To study various mechanical techniques that help a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications

UNIT I   HEART LUNG MACHINE AND ARTIFICIAL HEART   9
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT II   CARDIAC ASSIST DEVICES   9
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counterpulsation techniques.

UNIT III   ARTIFICIAL KIDNEY   9
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV   RESPIRATORY AND HEARING AIDS   9
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT V   RECENT TRENDS   9
Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms**.**

TOTAL : 45 PERIODS

COURSE COUTCOMES:

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

- Understand the basics of brain computer interfaces.
- Evaluate the concept of activation potential of the brain.
- Select appropriate signal processing methods for BCI
- Assign hardware and software appropriately to the human and to the machine.
- Understand BCI applications in the present contemporary world

TEXT BOOKS:

1. Gray E Wnek, Gray L Browlin "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc. New York, 2004.
2. John. G . Webster, "Bioinstrumentation", John Wiley & Sons Pvt Ltd, 2004.
3. Joseph D.Bronzino, "The Biomedical Engineering Handbook", Third Edition, CRC Press, 2006.

REFERENCES:

1. Albert M. Cook, Janice Miller Polgar, "Essentials of Assistive Technologies", Elsevier Health Sciences, 2014.
2. D.S.Sunder, "Rehabilitation Medicine", Third Edition, Jaypee Medical Publication, 2019.

WEBSITE REFERENCESS:

1. https://www.nichd.nih.gov/health/topics/rehabtech/conditioninfo/device
2. https://www.who.int/news-room/fact-sheets/detail/assistive-technology
3. https://www.thenationaltrust.gov.in/content/innerpage/aids-and-assistive-devices

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

JBM 1025	BODY AREA NETWORK AND HEALTHCARE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To Study about working of Body Area Network
- To learn about body area networks and different hardwares 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   INTRODUCTION OF BAN   9
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction of BAN.

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 AND COMMUNICATION NETWORK 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 - wireless technology categories

UNIT V   BAN APPLICATIONS   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 -human application - animal applications.

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 K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press,2013. (UNIT II, I

REFERENCES:

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.

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1. https://www.nist.gov/publications/application-link-adaptation-body-area-networks
2. https://www.elprocus.com/ban-body-area-network/
3. https://www.sciencedirect.com/science/article/pii/S187705091630299X
4. https://www.lairdconnect.com/resources/white-papers/overview-of-medical-body-area-networks
5. https://www.youtube.com/watch?v=iw9pQeFhN74

CO-PO MAPPING:

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

JBM 1026	REHABILITATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and analyze 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 INTRODUCTION TO REHABILITATION & PRINCIPLES OF REHABILITATION 9

Rehabilitation, Goals of rehabilitation, Class of Rehabilitation applied to human system, Optimal Health, Levels of Prevention, Diagnosis of Disability and its importance, Functional Diagnosis, Importance of Physchiatry in Functional diagnosis, Impairment, disability, handicap, Primary & secondary Disabilities, Rehabilitation team; Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles

UNIT II PROSTHETIC AND ORTHOTIC DEVICES 9

Limb replacement, different types of models for limb prosthetics, Upper limb Prosthesis - Body powered, Myoelectric arm, Bionic arm, wireless robotic arm, Lower limb prosthesis - prosthetic ankle and foot systems. Orthotic systems, General principles of Orthosis, Classification of orthotics , Material and considerations for design of limb prosthetics and orthotics. Calipers- FO, AFO, KAFO, HKAFO and mobility aids - clutches, Wheelchair.

UNIT III SENSORY AUGMENTATION AND SUBSTITUITION DEVICES 9

Introduction to impairment in sensory communication, Augmentative and Alternative communication, Auditory and speech assist devices **:** Types of deafness, types and design models of hearing aids, Cochlear implants, electrolaryx,voice synthesizer, speech trainer ; visual aids **:** Ultrasonic and laser canes, Intraocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter.

UNIT IV THERAPEUTIC EXERCISE TECHNIQUE AND MEDICAL STIMULATORS 9

Muscular and neural degeneration- Movement analysis - Gait pattern, Gait analyses- obseravtional parameters, Gait Training. Therapeutic exercises - Co-ordination exercises, Frenkels exercises, Relaxation exercises, Strengthening exercises, Mobilisation exercises, Endurance exercises. Functional Electrical Stimulation - Muscle and nerve stimulators for functional restoration and therapeutic benefit

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life

TOTAL: 45 PERIODS

COURSE COUTCOMES:
At the end of the course, the student will be able to:
- Understand and analyze the importance and 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 in development of a prototypical assistive technology device.

- Learn and understand the different methods and devices concerned with sensory augmentation and substitution.
- Explain the various Therapeutic Exercises and assistive technology devices that help to restore and strengthen the neuromuscular functional activity.
- Understand 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
3. Albert M.Cook and Webster J.G, Therapeutic Medical devices, Prentice Hall Inc., New Jersy, 1982.

REFERENCES:

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.
4. Levine.S.N., Advances in Bio Medical Engineering and Medical Physics, Inter
5. University Publication, New York 1968.

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1. https://cmasuki.org/introduction-to-movement-analysis/
2. https://www.enablingguide.sg/
3. https://www.mobility-aids.com/advancements-in-mobility-aids.html
4. https://www.ispoint.org/
5. https://www.movementforlife.com/articles/therapeutic-exercise

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	3	3	2	3	-	-	2	-	-	3
CO3	3	3	3	3	2	3	-	-	2	-	-	3
CO4	3	3	3	-	2	2	-	-	2	-	-	3
CO5	-	-	2	-	2	3	-	-	2	-	-	2

CO-PSO MAPPING:

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

JBM 1027	COGNITIVE NEUROSCIENCE	L	T	P	C
		3	0	0	3

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 COUTCOMES:

At the end of the course, the 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", (4thEdition). New York: Norton. Goldstein, E. Bruce (2007).
2. Wadsworth. Matlin, M W (2009), "Cognitive Psychology: connecting mind, research and everyday experience" (2nd Edition).

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1. Mathews G.G. "Neurobiology", 2nd edition, Blackwell Science, UK, 2000
2. Eric R.Kandelet. 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.

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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 MAPPING:

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

CO-PSO MAPPING:

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

JBM 1028	MODERN TECHNIQUES FOR CANCER THERAPY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES
● To impart knowledge on basic biology of cancer
● To explain the impact of antibodies against cancer in the human body leading to more effective treatments
● To elucidate the carcinogenesis and its types
● To detail out chemotherapy, Radiation therapy and immunotherapy in treating cancer
● To explain proton therapy and its application various cancer
.

UNIT I   INTRODUCTION   9
Growth characteristics of cancer cells; Morphological and ultrastructural properties of cancer cells.Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Epidemiology of cancer.

UNIT II   CANCER BIOLOGY AND BIOCHEMISTRY   9
Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation. Growth factors-EGF, TNF-α and TGF-β and growth factor receptors–Signal transduction in cancer – Role of transcription factors.

UNIT III   CARCINOGENESIS   9
Radiation and chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression. Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses and human cancer; Cancer endocrinology.

UNIT IV   CANCER THERAPY   9
Strategies of anticancer drug therapy – Surgical treatment of cancer:Modern techniques and technology - chemotherapy - gene therapy. Immunotherapy and Radiotherapy-image guided procedures to chemotherapy, Stem Cells and Cancer. 3-D conformal radiation therapy-carbon ion Radiotherpy

UNIT V   PROTON THERAPY   9

Physics of Proton Interactions in Matter- Proton Accelerators -Early Therapeutic Uses of Proton Beam Therapy -Current Clinical Applications of Proton Beam Therapy in Pediatric Conditions- Prostate Cancer- Lung Cancer- Mediastinal Tumors- Skull Tumors.

TOTAL: 45 PERIODS

COURSE OUTCOME :

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

- To explain on basics of cancer biology
- To explain the impact of antibodies against cancer in the human body leading to more effective treatments
- To describe the carcinogenesis and its types
- To comprehend on chemotherapy, Radiation therapy and immunotherapy in treating cancer
- To explain proton therapy and its application various cancer

TEXT BOOK:

1. R. G. McKinnell, R. E. Parchment, A. O. Perantoni, G.Barry Pierce, I. Damjanov. "The Biological Basis of Cancer",2 nd Edition , Cambridge University Press, 2006.
2. R. A. Weinberg, "The Biology of Cancer", Garland Science. 2006.
3. Santosh Yajnik, "Proton Beam Therapy", Springer Science, Business Media New York 2013
4. Francesco Pezzella, Mahvash Tavassoli, David Kerr ,"oxford text book of cancer biology ",Oxford University Press,2019

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1. S. Pelengaris, M. Khan. "The Molecular Biology of Cancer", Blackwell Publication. 2002
2. Malcolm R. Alison. "The Cancer Hand Book", Nature Publishing Group. 2003
3. Roitt I., Brostoff J. and Male D., "Immunology" , 6th ed. Mosby, 2001
4. Tannock I. and Hill. R.P. "The basic science of oncology" 3rd ed. McGraw-Hill, 1998

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1. https://www.cancer.gov/news-events/cancer-currents-blog/2020/radiopharmaceuticals-cancer-radiation-therapy
2. https://www.cancer.org/treatment
3. https://onlinecourses.nptel.ac.in/noc20_ee14/preview
4. https://dth.ac.in/medical/courses/pharmacology/2/8/index.php
5. https://www.mskcc.org/cancer-care/diagnosis-treatment/cancer-treatments

CO-PO MAPPING:

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

CO-PSO MAPPING:

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

OPEN ELECTIVES OFFERED BY BIOMEDICAL ENGINEERING

SEMESTER - IV

JBM9001	HUMAN BIOLOGY FOR ENGINEERS	L	T	P	C
		3	0	0	3

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
- Have a detailed acquaint on the blood and its components
- Explain the structure and function of the cardiac and respiratory system
- Explain on basic anatomy and the mechanism involved in digestion of the food and formation of urine.
- Elucidate the different bio inspired Technologies.

TEXT BOOKS:

1. Prabhjot Kaur.-Text Book of Anatomy and Physiology- Lotus Publishers.2014.
2. Elaine.N. Marieb―Essential of Human Anatomy and Physiology, Eight Edition, Pearson Education, New Delhi,2007
3. J.S.R.Jang, C.T.Sun and E.Mizutani, ―Neuro-Fuzzy and Soft Computing , PHI, 2004, Pearson Education 2004.
4. James A Freeman and David M.Skapra, ―Neural Networks: Algorithms, Applications, and Programming Techniques‖, Addison-Wesley, 1991, Digital Version 2007.

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers,2014
2. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for
3. Biomedical and Health Sciences, Oxford University Press, USA,2013
4. WilliamF.Ganong―ReviewofMedicalPhysiology,22ndEdition,McGrawHill,NewDelhi, 2010
5. EldraPearl Solomon―Introduction to Human Anatomy and Physiology, W.B. Saunders Company,2015
6. Guyton &Hall,―Medical Physiology,13thEdition, ElsevierSaunders,2015

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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
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CO2	3	3	3	-	-	-	-	-	-	-	1	3
CO3	3	3	3	-	-	-	-	-	-	-	1	3
CO4	3	3	3	-	-	-	-	-	-	-	1	2
CO5	3	3	3	-	-	-	-	-	-	-	1	2

JBM9002	INTRODUCTION TO MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

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 ACQUISTION   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, 2nd edition, Prentice hall of India, New Delhi, 2015**.**

REFERENCES:

1. JohnG.Webster,-MedicalInstrumentationApplicationandDesign, 4thedition,Wiley India PvtLtd,New Delhi, 2015.
2. JosephJ.CarrandJohnM.Brown,-IntroductiontoBiomedicalEquipmentTechnology|, Pearson Education,2004.
3. MyerKutz,-Standard Handbook ofBiomedical Engineering and Design , McGraw-Hill Publisher,2003.
4. KhandpurR.S,-Handbook ofBiomedicalInstrumentation, 3rdedition,TataMcGraw-Hill New Delhi,2014

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2. https://www.youtube.com/watch?v=49CWbXNJ3WE&t=35s
3. https://www.youtube.com/watch?v=NeiD87ZkJ8&list=PLXcK6l9b40r_WeJMfo7Wb5RYMd P6brgpj
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO2	3	3	3	-	-	-	-	-	-	-	1	3
CO3	3	3	3	-	-	-	-	-	-	-	1	3
CO4	3	3	3	-	-	-	-	-	-	-	1	2
CO5	3	3	3	-	-	-	-	-	-	-	1	2

JBM9003	INTRODUCTION TO BIO SENSORS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

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_2 and pCO_2, 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
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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

		L	**T**	**P**	**C**
JBM 9004	**BIOMEDICAL EQUIPMENTS**	**3**	**0**	**0**	**3**

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 Jersy, 1982.

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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

JBM9005	HOSPITAL PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

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, Tendoring 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.

UNIT V QUALITY STANDARDS AND RECENT ADVANCES   9

Purpose of Quality Assurance-Quality system-NABH, JCI, NABL
Green Hospitals, Energy efficiency in hospitals, Robotics in Hospitals and Geriatric Care

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:
- Explain the principles of fundamentals of hospital administration and hospital planning.
- Identify the importance of planning medical and ancillary services in hospital.
- Describe the purchase and procurement process in a hospital
- Elucidate the equipment planning in a hospital
- Describe the quality standards of hospital and recent trends in hospital planning

TEXT BOOKS:
1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI , 4th
2. Edition, 2006.
3. G.D.Kunders, "Hospitals – Facilities Planning and Management" ,TMH, New Delhi, 5th Reprint2007.
4. Dr. Gupta Shakti , "Hospital Stores Management- An IntegratedApproach,", JaypeeBrothers. 2nd edition ,2016

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1. CesarA. Caceres and Albert Zara, " The Practice of Clinical Engineering"   Academic Press , New York, 1977
2. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition , Aspen Publication Inc. Rockville, Maryland, USA,1990.
3. Peter Berman , " Health Sector Reform in Developing Countries" , Harvard University Press, 1995.
4. Jones, Anthony K., " Leading a hospital turnaround : a practical guide",Health Administration Press,2013
5. Edda Weimann, Peter Weimann, "High Performance in Hospital Management: A Guideline for Developing and Developed Countries",Springer International Publishing,2017

CO-PO MAPPING:

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

JBM 9006	INTRODUCTION TO BIOMETRIC SYSTEMS	L	T	P	C
		3	0	0	3

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
- Explain the concepts and techniques of fingerprint processing
- Explain face recognition and hand geometrybiometric technology
- Elaborate on various multimodal biometrics and performance evaluation
- Explain thebiometric authentication systems

TEXT BOOKS:

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

REFERENCES:

1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
   Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003
2. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face   Recognition" CRC Press, 1999.
3. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley, 2003.
4. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain, "Handbook of Multibiometrics", Springer,   2006.
5. David Zhang, Guangming Lu, "3D Biometrics: Systems and Applications", Springer New York2013.
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3. https://machinelearningmastery.com/introduction-to-deep-learning-for-face-recognition/
4. https://www.nec.co.nz/market-leadership/publications-media/what-is-iris-recognition-and-how-does-it-work/
5. https://securitytrails.com/blog/two-factor-auth-vs-multi-factor-auth

CO PO MAPPING:

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

JBM9007	BASICS OF IMAGE PROCESSING	L	T	P	C
		3	0	0	3

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.

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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.

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- http://www.imageprocessingplace.com/
- 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

JBM9008	COMPUTERS IN MEDICINE	L	T	P	C
		3	0	0	3

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.

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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

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

JBM 9009	NANOTECHNOLOGY IN MEDICINE	L	T	P	C
		3	0	0	3

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 - Nanodiagnostics 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.

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2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4684063/
3. https://link.springer.com/chapter/10.1007/978-3-030-44921-6_4
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:

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CO1	1	2	2	-	-	-	-	-	-	-	2	1
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CO3	2	2	3	-	-	-	-	-	-	-	2	1
CO4	1	1	1	-	-	-	-	-	-	-	1	2
CO5	2	1	2	-	-	-	-	-	-	-	2	2

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 wirelss 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 reords, 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.

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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, NewJersey, 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
4. https://telehealth.hhs.gov/providers/getting-started
5. https://www.healthit.gov

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CO3	3	3	-	3	2	3	-	-	2	3	-	3
CO4	-	-	-	-	2	2	-	3	2	-	-	3
CO5	3	3	-	-	2	3	3	-	2	3	-	2

JBM 9011	MATERIAL SCIENCE FOR BIOIMPLANTS	L	T	P	C
		3	0	0	3

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.

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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.

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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
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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 subsitution 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

TEXT BOOKS:

1. Levine S.N. (ed), "Advances in Bio-medical Engineering and Medical physics", Vol. I, II, IV, inter university publications, New York, 1968
2. Kopff W.J, "Artificial Organs", John Wiley and sons, New York, 1976.
3. Albert M.Cook and Webster J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey,1982
4. Hersh, M. (2008). "Assistive Technology for Visually Impaired and Blind People". Germany: Springer London.

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1. Andreas.F. Von racum, "Hand book of bio material evalution", Mc-Millan publishers, 1980.
2. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
3. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010

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4. https://onlinecourses.swayam2.ac.in/cec22_ed24/preview
5. https://www.thoracic.org/patients/patient-resources/resources/mechanical-ventilation.pdf
6. https://www.coursera.org/lecture/disability-awareness/assistive-technology

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CO3	3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	3
CO5	3	3	-	-	-	-	-	-	-	-	-	3