DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR - 621212

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

B.E. BIOMEDICAL ENGINEERING

CURRICULUM & SYLLABI

DEPARTMENT OF BIOMEDICAL ENGINEERING

(Applicable to students admitted from the Academic year 2023 – 2024 and subsequently under Choice Based Credit System)

Discussed in BOS-4 meeting Dated: 20.09.2024 / BME Ratified & Approved in Academic Council

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VISION MISSION OF THE INSTITUTION

Vision:

An active and committed centre of advanced learning focused on research and training in the fields of Engineering, Technology and Management to serve the nation better.

Mission:

- To develop eminent scholar with a lifelong follow up of global standards by offering UG, PG and Doctoral Programmes.
- To pursue Professional and Career growth by collaborating mutually beneficial partnership with industries and higher institutes of research.
- To promote sustained research and training with emphasis on human values and leadership qualities.
- To contribute solutions for the need based issues of our society by proper ways and means as dutiful citizen.

DEPARTMENT OF BIOMEDICAL ENGINEERING

About the Department

The Department of Biomedical Engineering was established in 2005. Biomedical Engineering is the application of Engineering principles and design concepts to medicine and biology. This field seeks to bridge the gap between Engineering and Medicine. It combines the design and problem solving skills of engineering with medical and biological sciences to improve healthcare diagnosis, monitoring and therapy.

The Biomedical area represents at most dynamic and leading research field and areas of innovation. It has a huge existing and emerging industrial base. The Biomedical Engineering, one of the most fascinating fields in medical has a great future as it combines the knowledge of sophisticated technology with the biology of mankind in order to solve the physiological problems of human beings.

Vision:

Emergence of advanced learning, research and training to strengthen technologies in biomedical engineering for human welfare and Nation needs.

Mission:

The Mission of the Biomedical Engineering is to construct a platform for bridging engineering principles, science and medicine.

M1: To engage with the specific to generic community for knowledge dissemination and career development.

M2: To update, analyze and impel the knowledge in the multi-disciplinary fields to strengthen technologies in biomedical engineering.

M3: To encourage the students to be aware of engineering principles in medicine for welfare of society.

M4: To expertise the students both in engineering and technical fields related to competitive medical technology in research and continuing education.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	To enable the graduates to demonstrate their skills in design and develop medical devices for health care system through the core foundation and knowledge acquired in engineering and biology.
PEO 2	To enable the graduates to exhibit leadership in health care team to solve health care problems and make decisions with societal and ethical responsibilities.
PEO 3	To Carryout multidisciplinary research, addressing human healthcare problems and sustain technical competence with ethics, safety and standards.
PEO 4	To ensure that graduates will recognize the need for sustaining and expanding their technical competence and engage in learning opportunities throughout their careers.

PROGRAM OUTCOMES (POs)

PO	Graduate Attributes
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problem sreaching 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 andenvironmentalconsiderations.
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 assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevantt otheprofessional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life – long learning**: Recognize the need for and have the preparation and ability to engage in independent and life – long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of the program, the graduates will be able to:

PSO 1	Design and develop diagnostic and therapeutic devices that reduces physician burnout and enhance the quality of life for the end user by applying fundamentals of Biomedical Engineering.
PSO 2	Apply software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector.
PSO 3	Adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions for current societal and scientific issues thereby developing indigenous medical instruments that are on par with the existing technology.

PEO's – PO's & PSO's MAPPING:

PEO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I.	3	3	2	2	2	2	-	-	-	-	-	3	3	2	3
II.	3	3	3	2	2	-	-	-	2	1	2	3	3	3	3
III.	3	2	3	3	2	-	-	-	2	2	-	3	3	3	3
IV.	3	3	3	2	2	-	-	2	-	-	-	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE (AUTONOMOUS)

PERAMBALUR – 621 212

REGULATIONS – 2023

B.E. BIOMEDICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	U23HST11	Communicative English	HSMC	3	0	0	3	3
3.	U23MAT12	Matrices and Calculus	BSC	3	1	0	4	4
4.	U23PHT13	Physics for Engineers and Technologists	BSC	3	0	0	3	3
5.	U23CYT14	Chemistry for Engineering and Technology	BSC	3	0	0	3	3
6.	U23GET16	Engineering Graphics	ESC	3	1	0	4	4
7.	GE3152	Heritage of Tamils / தமிழர் மரபு	HSMC	1	0	0	1	1
PRACTICALS								
8.	U23BSP11	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9.	U23HSP12	English Laboratory	EEC	0	0	2	2	1
10.	U23GEP14	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL								**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23HST21	Professional English	HSMC	3	0	0	3	2
2.	U23MAT22	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	U23GET15	Problem Solving and Python Programming	ESC	3	0	0	3	3
4.	U23BMT21	Medical Physics	PCC	3	0	0	3	3
5.	U23BMT22	Biosciences for Medical Engineering	PCC	3	0	0	3	3
6.	U23PHT26	Physics of Materials	BSC	3	0	0	3	3
7.		NCC Credit Course Level 1	-	2	0	0	2	-
8.	GE3252	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
PRACTICALS								
9.	U23BMP21	Biosciences Laboratory	PCC	0	0	4	4	2
10.	U23HSP22	Communication Laboratory	EEC	2	0	2	4	2
11.	U23GEP13	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
TOTAL								**25**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23MAT31	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	U23BMT31	Anatomy and Human Physiology	PCC	3	0	0	3	3
3.	U23BMT32	Biomaterials	PCC	3	0	0	3	3
4.	U23BMT33	Sensors and Measurements	ESC	3	0	0	3	3
5.	U23BMT34	Electronic Devices and Circuits	PCC	3	0	0	3	3
6.	U23BMT35	Electric Circuit Analysis	PCC	3	0	0	3	3
PRACTICALS								
7.	U23BMP31	Anatomy and Human Physiology Laboratory	PCC	0	0	3	3	1.5
8.	U23BMP32	Sensors and Measurements Laboratory	PCC	0	0	3	3	1.5
9.	U23BMP33	Electric Circuits and Electronic Devices Laboratory	ESC	0	0	3	3	1.5
TOTAL								**23.5**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23MAT41	Probability and Statistics	BSC	3	1	0	4	4
2.	U23BMT41	Biomedical Instrumentation	PCC	3	0	0	3	3
3.	U23BMT42	Signal Processing	PCC	3	1	0	4	4
4.	U23BMT43	Analog and Digital Integrated Circuits	PCC	3	0	0	3	3
5.	U23BMT44	Microcontrollers & Embedded system	PCC	3	0	0	3	3
6.	U23GET41	Environmental Sciences and Engineering	BSC	2	0	0	2	2
PRACTICALS								
7.	U23BMP41	Biomedical Instrumentation Laboratory	PCC	0	0	3	3	1.5
8.	U23BMP42	Signal Processing Laboratory	PCC	0	0	3	3	1.5
9.	U23BMP43	Analog and Digital Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
TOTAL								**23.5**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMT51	Biocontrol Systems	PCC	3	1	0	4	4
2.	U23BMT52	Biomechanics	PCC	3	0	0	3	3
3.	U23BMT53	Diagnostic and Therapeutic Equipments	PCC	3	0	0	3	3
4.		Professional Elective – I	PEC	3	0	0	3	3
5.		Professional Elective – II	PEC	3	0	0	3	3
6.		Open Elective – I	OEC	3	0	0	3	3
PRACTICALS								
7.	U23BMP51	Diagnostic and Therapeutic Equipments Laboratory	PCC	0	0	3	3	1.5
8.	U23BMP52	Microcontrollers & Embedded system Laboratory	PCC	0	0	3	3	1.5
9.	U23HSP51	Professional Communication Laboratory	HSMC	0	0	2	2	1.5
TOTAL								**23.5**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23ITT62	Artificial Intelligence and Machine Learning	PCC	3	0	0	3	3
2.	U23BMT62	Medical Imaging Techniques	PCC	3	0	0	3	3
3.	U23BMT63	Medical Image Processing	PCC	3	0	0	3	3
4.		Professional Elective – III	PEC	3	0	0	3	3
5.		Professional Elective – IV	PEC	3	0	0	3	3
6.		Open Elective-II (Emerging Technologies)	OEC	3	0	0	3	3
PRACTICALS								
7.	U23BMP61	Medical Image Processing Laboratory	PCC	0	0	3	3	1.5
8.	U23BMP62	Community Service Project	EEC	0	0	3	3	1
TOTAL								**20.5**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMT71	Design and Development of Healthcare Product	PCC	3	0	0	3	3
2.	U23BMT72	Medical Ethics and Standards	PCC	3	0	0	3	3
3.	U23BMT73	Electrical Safety and Quality Assurance	PCC	3	0	0	3	3
4.		Professional Elective – V	PEC	3	0	0	3	3
5.		Professional Elective – VI	PEC	3	0	0	3	3
PRACTICALS								
6.	U23BMP71	Hospital Training	PCC	0	0	2	2	1
7.	U23BMP72	Medical Equipment startups and Entrepreneurship	EEC	3	0	0	3	1
TOTAL								**17**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMT81	Bio MEMS & System On-Chip	PCC	3	0	0	3	3
2.		Professional Elective – VII	PEC	3	0	0	3	3
PRACTICALS								
3.	U23BMP81	Project Work	EEC	0	0	16	16	8
TOTAL								**14**

TOTAL COURSES & CREDITS – SEMESTER WISE

SEMESTER	I	II	III	IV	V	VI	VII	VIII	TOTAL
NO. OF COURSES	10	11	9	9	9	8	7	3	66
CREDITS	23	25	23.5	23.5	23.5	20.5	17	14	170

SUMMARY

B.E. BIOMEDICAL ENGINEERING											
S. No.	**SUBJECT AREA**	**CREDITS PER SEMESTER**								**CREDIT TOTAL**	**PERCENTAGE %**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1.	**Humanities Sciences and Management Science Course (HSMC)**	4	3	-	-	1.5	-	-	-	**8.5**	**5.00**
2.	**Basic Sciences Course (BSC)**	12	7	4	6	-	-	-	-	**29**	**17.06**
3.	**Engineering Sciences Course (ESC)**	5	5	4.5	-	-	-	-	-	**14.5**	**8.53**
4.	**Professional Core Course (PCC)**	-	8	15	17.5	13	10.5	10	3	**77**	**45.29**
5.	**Professional Elective Course (PEC)**	-	-	-	-	6	6	6	3	**21**	**12.35**
6.	**Open Elective Course (OEC)**	-	-	-	-	3	3	-	-	**6**	**3.53**
7.	**Employability Enhancement Course (EEC)**	2	2	-	-	-	1	1	8	**14**	**8.24**
TOTAL		**23**	**25**	**23.5**	**23.5**	**23.5**	**20.5**	**17**	**14**	**170**	**100**

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Bio Engineering	Vertical II Medical Device Innovation and Development	Vertical III Management (Healthcare)	Vertical IV Mechanics	Vertical V Signal and Image Processing	Verticals VI Communication	Verticals VII Advanced Healthcare Devices
Nanotechnology in medicine	Fundamentals of Healthcare Analytics	Clinical Engineering	Rehabilitation Engineering	Virtual Instrumentation for Biomedical Engineers	Communication Systems	Bio Analytic Equipments
Artificial Organs and Implants	Medical Device Design	Hospital Planning and Management	Physiological Modelling	Computer Vision	Wearable Devices	Critical Care Equipment
Biomedical Optics and Photonics	Patient safety, Standards and Ethics	Medical Waste Management	Assistive Technology	Speech and Audio Signal Processing	Body Area Networks	Human Assist Device
Neural Engineering	Medical Device Regulations	Economics and Management for Engineers	Continuum Model in Biomedical Engineering	Bio Mimetics	Virtual Reality and Augmented Reality in Healthcare	Advancements in Healthcare Technology
Principles of Tissue Engineering	Medical Innovation and Entrepreneurship	Biostatistics	Ergonomics	Brain Computer Interface and Applications	Telehealth Technology	Robotics in Medicine
Genetic Engineering	Rapid Prototyping	Forensic Science in Healthcare	Haptics	Biometrics	Medical Informatics	Therapeutic Equipments

VERTICALS-I: BIO ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMV11	Nanotechnology in medicine	PEC	3	0	0	3	3
2.	U23BMV12	Artificial Organs and Implants	PEC	3	0	0	3	3
3.	U23BMV13	Biomedical Optics and Photonics	PEC	3	0	0	3	3
4.	U23BMV14	Neural Engineering	PEC	3	0	0	3	3
5.	U23BMV15	Principles of Tissue Engineering	PEC	3	0	0	3	3
6.	U23BMV16	Genetic Engineering	PEC	3	0	0	3	3

VERTICALS – II: MEDICAL DEVICE INNOVATION AND DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMV21	Fundamentals of Healthcare Analytics	PEC	3	0	0	3	3
2.	U23BMV22	Medical Device Design	PEC	3	0	0	3	3
3.	U23BMV23	Patient safety, Standards and Ethics	PEC	3	0	0	3	3
4.	U23BMV24	Medical Device Regulations	PEC	3	0	0	3	3
5.	U23BMV25	Medical Innovation and Entrepreneurship	PEC	3	0	0	3	3
6.	U23BMV26	Rapid Prototyping	PEC	3	0	0	3	3

VERTICALS – III: MANAGEMENT (HEALTHCARE)

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMV31	Clinical Engineering	PEC	3	0	0	3	3
2.	U23BMV32	Hospital Planning and Management	PEC	3	0	0	3	3
3.	U23BMV33	Medical Waste Management	PEC	3	0	0	3	3
4.	U23BMV34	Economics and Management for Engineers	PEC	3	0	0	3	3
5.	U23BMV35	Biostatistics	PEC	3	0	0	3	3
6.	U23BMV36	Forensic Science in Healthcare	PEC	3	0	0	3	3

VERTICALS – IV: MECHANICS

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMV41	Rehabilitation Engineering	PEC	3	0	0	3	3
2.	U23BMV42	Physiological Modelling	PEC	3	0	0	3	3
3.	U23BMV43	Assistive Technology	PEC	3	0	0	3	3
4.	U23BMV44	Continuum Model in Biomedical Engineering	PEC	3	0	0	3	3
5.	U23BMV45	Ergonomics	PEC	3	0	0	3	3
6.	U23BMV46	Haptics	PEC	3	0	0	3	3

VERTICALS – V: SIGNAL AND IMAGE PROCESSING

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMV51	Virtual Instrumentation for Biomedical Engineers	PEC	3	0	0	3	3
2.	U23CSV17	Computer Vision	PEC	3	0	0	3	3
3.	U23BMV53	Speech and Audio Signal Processing	PEC	3	0	0	3	3
4.	U23BMV54	Bio Mimetics	PEC	3	0	0	3	3
5.	U23BMV55	Brain Computer Interface and Applications	PEC	3	0	0	3	3
6.	U23BMV56	Biometrics	PEC	3	0	0	3	3

VERTICALS – VI: COMMUNICATION

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23ECT41	Communication Systems	PEC	3	0	0	3	3
2.	U23BMV62	Wearable Devices	PEC	3	0	0	3	3
3.	U23BMV63	Body Area Networks	PEC	3	0	0	3	3
4.	U23BMV64	Virtual Reality and Augmented Reality in Healthcare	PEC	3	0	0	3	3
5.	U23BMV65	Telehealth Technology	PEC	3	0	0	3	3
6.	U23BMV66	Medical Informatics	PEC	3	0	0	3	3

VERTICALS – VII: ADVANCED HEALTHCARE DEVICES

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BMV71	Bio Analysis	PEC	3	0	0	3	3
2.	U23BMV72	Critical Care Equipment	PEC	3	0	0	3	3
3.	U23BMV73	Human Assist Device	PEC	3	0	0	3	3
4.	U23BMV74	Advancements in Healthcare Technology	PEC	3	0	0	3	3
5.	U23BMV75	Robotics in Medicine	PEC	3	0	0	3	3
6.	U23BMV76	Therapeutic Equipments	PEC	3	0	0	3	3

IP3151 **INDUCTION PROGRAMME**

Induction Programme is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer
familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References: Guide to Induction program from AICTE

U23HST11	COMMUNICATIVE ENGLISH (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L 3	T 0	P 0	C 3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To enhance students listening ability for academic and Professional purposes.
2. To learn to use basic grammatical structures in suitable contexts
3. To help students acquire the ability to speak effectively in English in real -life situations.
4. To help learners use language effectively in professional contexts.
5. To develop student's ability to read and write complex texts, summaries, articles, definitions, Paragraph user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 9

Define communication. Kinds of communication. Quintessential of communication in technical progression. Key characteristics of an effective communicator- listening, attitude modification, way of response with appropriate language, tone modulation.

Listening- Listening to TV news, Guest lectures. Speaking- Answering the Questions.

Reading - Reading brochures and technical magazines (technical context), telephone messages / social media messages relevant to technical contexts and emails, **Writing**-Reading comprehension, Parts of Speech.

UNIT II READING QUEST 9

Listening- listening and responding to video lectures/talks. **Speaking**- Day today conversations. **Reading** –Edison of India-GD Naidu "The Great Inventor". **Writing-** Emails / Informal Letters - Inviting, Congratulating & Thanking, Punctuations.

UNIT III LANGUAGE RESOURCE GROWS CRITICAL JUDGEMENT 9

Listening- listening to specific task-focused audio tracks. Speaking- summary of Robert Frost "Stopping by woods on a snowy evening". Reading – Reading advertisements, gadget reviews; user manuals. Writing – Essay Writing: Analytical essay: Narrative Essay, Developing Hints, Usage of tenses in sentence formation. Voices.

UNIT IV LANGUAGE IN LIFE SKILL 9

Listening- Listening to speech of Great Scholars. Speaking- mechanics of presentation. **Reading** – Newspaper articles, power point presentation. **Writing** – Checklist, Jumbled sentences-Rearrange the sentences in correct order, WH-Questions-Form questions by using statements, Prefixes and Suffixes.

UNIT V IMPROVING SPEAKING &READING 9

Listening- listening to situational based dialogues; **Speaking-** Stating intention to do something-Expressing opinion-asking people to repeat themselves**. Reading** – Summary of O.Henry's "The last Leaf". **Writing** – Dialogue Writing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Remember appropriate words in a situational conversation.

CO2 : Gain understanding of basic grammatical structures and use them in right context.

CO3 : Read and infer the denotative and connotative meanings of technical texts.

CO4 : Write Dialogue, Letter and paragraphs on various topics.

CO5 : Make the students prepare effective notes for main sources available.

CO6 : Enhance them to give operational talk.

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. The Gift of the Magi by O.Henry, McClure,Philips and company.

REFERENCE BOOKS:

1. Technical Communication – Principles And Practices By Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) by Aysha Viswamohan, Mcgraw Hill Education.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.

5 Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

U23MAT12	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize the students with differential calculus.
3. To familiarize the student with functions of several variables.
4. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

UNIT I MATRICES 12

Introduction – Characteristic equation – Eigen values and Eigenvectors of a real matrix – Properties of Eigen values and Eigenvectors – Cayley Hamilton theorem – Diagonalization of the matrices by Orthogonal Transformations – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit of a function – Continuity – Derivatives – Differentiation rules – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variable.

UNIT III MULTIVARIABLE CALCULUS 12

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

UNIT IV MULTIPLE INTEGRAL AND THEIR APPLICATIONS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Use the matrix algebra methods for solving practical problems.

CO2 : Use both the limit definition and rules of differentiation to differentiate functions.

CO3 : Apply differential calculus tools in solving various application problems.

CO4 : Able to use differential calculus ideas on several variable functions.

CO5 : Apply multiple integral ideas in solving areas, volumes and other practical problems.

CO6 : Solve the ordinary differential equations using different techniques for that model engineering problems.

TEXT BOOKS:

1. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal. B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCE BOOKS:

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, 5th Edition,2016.
3. Narayanan. S. and Manicavachagom Pillai. T. K.,“Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt.Ltd, New Delhi, 2016.
5. Thomas. G. B., Hass. J, and Weir. M.D,"Thomas Calculus", 14th, Pearson India, 2018.

U23PHT13	PHYSICS FOR ENGINEERS AND TECHNOLOGISTS (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To make the students to gain the knowledge in elastics and plastic nature of the materials in the presence and absence of load.
2. To understand the students to know the application of the sound waves in different fields.
3. To motivate the students towards the applications of photo electric phenomena.
4. To know the physical principle of LASER, the working of LASER applications.
5. To understand the propagation of light in optical fibers and its applications.

UNIT I ELASTICITY 9

Introduction- Elasticity - plasticity– Hooke's law - relationship between three Modulii of elasticity (Qualitative) – stress & strain diagram and its uses -Poisson's ratio - factors affecting elasticity –

twisting ouple of wire - Torsion Pendulum: theory and experiment.

Beam: Internal bending moment – Cantilever: theory and experiment – Young's Modulus: uniform and non – uniform bending (Qualitative) – I-shaped girders- advantages and applications.

UNIT II ULTRASONICS 9

Introduction – classification of sound- properties of infrasonic, audible and ultrasonics - production: Magnetostriction and Piezoelectric methods – determination of velocity of sound in liquid (Acoustic Grating Method) – general applications – industrial application: Non - Destructive Testing: pulse echo system through transmission and reflection modes. ultrasonic scanning methods – medical application: sonogram.

UNIT III MODERN PHYSICS 9

Introduction –Black Body Radiation – Classical and Quantum Laws of Black Body Radiation - Photon and its Properties - Wave Particle Duality and Matter waves – De - Broglie Wavelength - Schrodinger's Time Independent and Time Dependent Wave Equations - Physical Significance of the Wave Function. Application: Particle in One Dimensional Box - Normalization Process – Photo Electric Effect – Laws Governing the Photoelectric Effect – Einstein's Formula - Derivation – Applications: Solar Cell – Solar Water Heater – Photo resistor (LDR).

UNIT IV LASERS 9

Lasers: Introduction - Properties of Laser-Spontaneous and Stimulated Emission Process - Einstein's Theory of Matter Radiation Interaction & A and B Coefficients; Amplification of Light By Population Inversion – Pumping Methods - Types of Lasers: Solid-State Laser (Homo And Hetero Junction Semiconductor Lasers), Gas Laser (CO_2), Applications: Laser Cutting and Welding, LIDAR and Barcode Scanner.

UNIT V FIBER OPTICS AND APPLICATIONS 9

Optical Fiber: Structure - advantages- Principle [TIR]–Propagation Phenomena in optical fiber - Expression For Acceptance Angle and Numerical Aperture – Relation between Refractive Index of Core, Numerical Aperture and Fractional Index Change – Fabrication: Double Crucible Method - Types: Material, Mode, Refractive Index - Applications: Optical Fiber Communication System – fiber optic sensors (Displacement and pressure sensors) – Medical Endoscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Differentiate the elastic and plastic nature of the materials.

CO2 : Know the experimental techniques in both production and applications of ultrasonic waves.

CO3: Gain knowledge in the basics of quantum mechanics concepts.

CO4: Develop new devices based on LASER source.

CO5: Understand the advantages of optical fiber than metal wire.

CO6: Demonstrate the some useful experiments based on optical fibre

TEXT BOOKS:

1. Dr. P.Mani, “Engineering Physics”, Dhanam Publications, 2013.
2. Dr. G. Senthilkumar, “Engineering Physics”, VRB Publishers, 2017.
3. K. Thyagarajan, Ajoy Ghatak, “Lasers Fundamentals and Applications” II nd Edition, Springer, 2010.
4. D.K. Bhattacharya, Poonam Tandon,” Engineering Physics”, Oxford HED Publishers, 2017.

REFERENCE BOOKS:

1. Marikani, “Engineering Physics”, PHI, New Delhi, 2013.
2. Bhattacharya & Bhaskaran, “Engineering Physics”, Oxford Publications, 2012.
3. R Murugeshan, Kiruthiga, Sivaprasath S, “Modern Physics”, Chand Publishing, 2021.
4. S. Rajivgandhi & A. Ravikumar, “ Engineering Physics I”, RK Publications, 2023
5. Sathyaprakash, “Quantum Mechanics”, Pragati Prakashan, Meerut, 2016.

U23CYT14	CHEMISTRY FOR ENGINEERING & TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To inculcate sound understanding of water quality parameters and water treatment techniques.
2. To Impart knowledge on the basic principles and preparatory methods of nanomaterials.
3. To introduce the basic concepts and applications of phase rule and composites.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER TREATMENT 9

Water: Sources, impurities, Parameters. Types of water Hardness of water -types – expression of hardness – units – Estimation of hardness of water by EDTA. Desalination - Reverse Osmosis. Boiler troubles: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.

UNIT II ELECTRO AND NANO CHEMISTRY 9

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf by Poggendorff's compensation principle. Single electrode potential – Nernst equation – reference electrodes -types–Calomel electrode - electrolysis of water.

Nanomaterials: Basics of Nano Chemistry: Distinction between molecules, nanomaterials and bulk materials. Preparation of nanomaterials- laser ablation method and Chemical Vapour Deposition(CVD). Application of Nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule terms with examples. water system; Reduced phase rule Two component system: lead-silver system – Composites , Need , Constitution: Matrix materials, Applications and Reinforcement and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS & COMBUSTION 9

Fuels –Classification-Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy;

Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; Electric vehicles-working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CO2 : Apply the basic knowledge of Corrosion and various electrodes.

CO3 : Know the economically and new methods of synthesis nano materials.

CO4 : Apply the knowledge of phase rule and composites for material selection requirements.

CO5 : Understand the concepts of suitable fuels for engineering processes and applications.

CO6 : Have the knowledge of different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
4. J.Manivel , "Engineering Chemistry" R.K. Publishers, 1st Edition 2022.

REFERENCE BOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.

U23GET16 ENGINEERING GRAPHICS L T P C

2 0 4 4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.
3. To Develop proficiency in 2D drafting using drawing tools.
4. To Learn sectional views and assembly drawing techniques.
5. To Enhance visualization skills for improved problem-solving and communication in engineering.

UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 6+12

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimension. Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method (polygonal and circular surfaces) inclined to both the planes.

UNIT III PROJECTION OF SOLIDS 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC PROJECTION 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions-Perspective Projection.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1 : Identify the significance of graphics in engineering applications.

CO2 : Project straight lines inclined to both principal planes and determine true lengths and inclinations.

CO3 : Apply orthographic projection techniques to project solids.

CO4 : Apply the principles of development to prisms, pyramids, cylinders, and cones.

CO5 : Combine two solid objects in simple vertical positions using isometric projection.

CO6 : Utilize the isometric scale effectively.

TEXT BOOKS:

1. Natrajan K.V., ―A text book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., ―Engineering Graphics‖, New Age International (P) Limited, 2008.

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., ―Engineering Drawing‖, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., ―Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, ―Engineering Graphics‖, Oxford University, Press, New Delhi, 2015.

GE3152	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3152 **தமிழர் மரபு** **L T P C**
1 0 0 1

அலகு I **மொழி மற்றும் இலக்கியம்**: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**: **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்**: **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**: **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

U23BSP11	PHYSICS AND CHEMISTRY LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student as an active participant in each part of all lab exercises.
6. To inculcate experimental skills to test basic understanding of water quality parameters as acidity, alkalinity, chloride.
7. To Induce the students to analyze the hardness of water
8. To induce the students to familiarize with electro analytical techniques such as, pH metry, conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1. Torsion pendulum - Determination of rigidity modulus of wire and moment of inertia of regular disc.
2. Non - Uniform bending–Determination of Young's modulus.
3. Laser – (i) Determination of the wavelength of the laser using grating.
   (ii) Determination of size of the particles using laser source.
4. Air wedge – Determination of thickness of a thin sheet/wire.
5. Determination of Band gap of a semiconductor using PN junction kit.
6. To study the V-I Characteristics of Light Dependent Resistor (LDR).
7. Determination of types and amount of alkalinity in water sample.
8. Determination of total, temporary & permanent hardness of water by EDTA method.
9. Determination of chloride content of water sample by Argentometric method.
10. Determination of strength of given hydrochloric acid using pH meter.
11. Determination of strength of acids in a mixture of acids using conductivity meter.
12. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Quantity
1.	Torsion pendulum set up (Metal Disc, Symmetrical Mass(2x100g), Stop Clock, Screw Gauge)	**5**
2.	Non – Uniform bending set up (Travelling Microscope, Knife Edges, Weight Hanger with Mass(5x50g), Screw Gauge, Vernier Calliper, Meter Scale)	**5**
3.	Laser set up (Semiconductor Laser, Screen, Grating Stand, Wooden Stand With Meter Scale)	**5**
4.	Air wedge (Air Wedge Set Up, Travelling Microscope, Sodium Vapour Lamp, Transformer)	**5**
5.	Band gap of a semiconductor (PN Junction Kit, Thermometer, Heater, Beaker, Oil)	**5**
6.	Light Dependent Resistor (Power Suppy, Voltmeter, Ammeter, LDR, Bulb, Resistors)	**5**
7.	PH meter	**5**
8.	Conductivity meter	**10**
9.	Common Apparatus(Pipette, Burette, Conical Flask, Porcelain tile, Dropper)	**15**

COURSE OUTCOMES:

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

CO1 : Understand the functioning of various physics laboratory equipment.

CO2 : Observe and tabulate experimental data.

CO3: Solve problems individually and collaboratively.

CO4: Analyse the quality of water samples with respect to their acidity, alkalinity

CO5: Determine the amount of hardness in the water

CO6: Analyse quantitatively the impurities in solution by electro analytical techniques

U23HSP12	ENGLISH LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To improve the communicative competence of learners.
2. To help learners use language effectively in academic /work contexts.
3. To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
4. To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
5. To use language efficiently in expressing their opinions via various media.

LIST OF EXPERIMENTS

1. Listening for general information-specific details.
2. Conversation: Introduction to classmates.
3. Speaking - making telephone calls-Self Introduction.
4. Talking about current and temporary situations & permanent and regular situations.
5. Listening to podcasts, anecdotes / stories / event narration.
6. Event narration; documentaries and interviews with celebrities.
7. Events-Talking about current and temporary situations & permanent and regular situations.
8. Engaging in small talk.
9. Describing requirements and abilities- Picture description.
10. Discussing and making plans.
11. Talking about tasks- progress- positions -directions of movement.
12. Talking about travel preparations and transportation.
13. Listening to debates/ discussions.
14. Making prediction talking about a given topic.
15. Describing processes.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	**30**
2.	Server	**1**
3.	Head phone	**30**
4.	Audio mixture	**1**
5.	Collar mike	**1**
6.	Television	**1**
7.	Speaker set with amplifier	**1**
8.	Power point projector and screen	**1**
9.	Cordless mike	**1**

COURSE OUTCOMES:

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

CO1 : Identify and comprehend complex academic texts.

CO2 : Interpret accurately and fluently in formal and informal communicative contexts.

CO3: Demonstrate their opinions effectively in both oral and written medium of communication.

CO4: Plan travelogue and construct paragraphs on various aspects.

CO5: Develop journal reading skills and small talk.

CO6: Utilizing technical terms and making power point presentations.

U23GEP14	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common house hold wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts;
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.
5. Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.

GROUP – A (CIVIL AND MECHANICAL)

PART I **30**

CIVIL ENGINEERING PRACTICES PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) Turning
b) Drilling
c) Tapping

BASIC MACHINING WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.

SHEET METAL WORK:

a) Making of a square tray

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint Mortise joint and Tenon joint and Dovetail joint.

PART II ELECTRICAL & ELECTRONICS 30

ELECTRICAL:

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

ELECTRONICS:

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

CIVIL

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

MECHANICAL

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

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 1 each

4. Megger (250V/500V) 1No.
5. Power Tools:
    a) Range Finder 2Nos
    b) Digital Live-wire detector 2Nos

ELECTRONICS

1. Soldering guns 10Nos.
2. Assorted electronic components for making circuits 50Nos.
3. Small PCBs 10Nos.
4. Multimeters 10Nos.

Study purpose items: Telephone, FM radio, low-voltage power supply.

COURSE OUTCOMES:

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

CO1 : Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2 : Wire various electrical joints in common household electrical wire work.

CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common Household equipments; Make a tray out of metal sheet using sheet metal work.

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO5: Apply fundamental engineering principles to analyze and solve real-world problems.

CO6: Demonstrate proficiency in using engineering tools and equipment.

U23HST21	PROFESSIONAL ENGLISH (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To engage learners in meaningful language activities to improve their reading and writing skills.
2. To learn various reading strategies and apply in comprehending documents in professional context.
3. To help learners understand the purpose, audience, contexts of different types of writing.
4. To enable students write letters and reports effectively in formal and business situations.
5. To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT I PREPARATORY DOCUMENTATIONS 9

Listening- Listening to formal conversations and Participating**. Speaking-** speaking about one's family. **Reading –** Summary of W.W Jacobs "The monkey's paw". **Writing –** Subject verb Agreement, Numerical -Adjectives, Kinds of sentences**,** Writing reviews (book / film), writing Instructions, Writing Recommendation.

UNIT II LECTURA ENRICHMENT AND PASSAGE COMPOSE 9

Listening- listening to lectures on academic topics; **Speaking-** Asking for and giving directions. **Reading -** Reading longer technical texts; **Writing -** Compound words, Homophones and Homonyms, Cause and Effect expressions. Essay Writing, Writing Letter to the Editor (complaint, acceptance, Requesting, Thanking).

UNIT III ANALYTICAL SKILL 9

Listening- Watching videos/documentaries and responding to questions based on them. **Speaking –**Speaking about ones favourite place**. Reading –** Summary of the poem – John keats "Ode to a Nightingale". **Writing-** Purpose statement, Extended Definitions. Writing Job/ Internship application – Cover letter & Resume.

UNIT IV REPORT WRITING 9

Listening- Listening to class room lectures/talks on engineering/technology. **Speaking–** Introduction to technical presentations. **Reading –** Newspaper articles; **Writing –** Comparative Adjectives Direct and Indirect speech**.** Report Writing- Fire Accident Report, Road Accident, Feasibility Report).

UNIT V ENABLING LINGUA IDEALITY & INFORMATION 9

Listening- TED/Ink talks. **Speaking –** Making presentation on a given topic. **Reading –**Company profiles, Statement of Purpose, (SOP), **Writing –** Relative Clauses, If conditions, Cause and Effect. Chart Interpretations - Bar Chart, Pie Chart, Flow Chart & Tables.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Compare and contrast products and ideas in technical texts.

CO2 : Identify cause and effects in events, industrial processes through technical texts.

CO3: Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.

CO4: Motivate students to write reports and winning job applications.

CO5: Recall and comprehend different discourses and genres of texts.

CO6: Making the students to become virtuous presenters.

TEXT BOOKS:

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.

U23MAT22	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. This course aims at providing the necessary basic concepts of a few statistical tools and give procedures for solving different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of classifications of design of experiments in the field of agriculture.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 12

Introduction – Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 12

Introduction – Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen Value of a matrices by power method and jacobi's method for Symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order differential equations – Multi step methods : Milne's and Adams Bashforth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2 : Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3: Solve the algebraic and transcendental equations.

CO4: Understand the knowledge of numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO5: Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

CO6: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson , R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCE BOOKS:

1. Burden,R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi , 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi,12th Edition, 2020.
5. Spiegel.M.R.,Schiller.J. and Srinivasan. R.A., "Schaum’s Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.

U23GET15	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the basics of algorithmic problem solving.
2. To learn to solve problems using Python conditionals and loops.
3. To define Python functions and use function calls to solve problems.
4. To use Python data structures - lists, tuples, dictionaries to represent complex data.
5. To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

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

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Develop algorithmic solutions to simple computational problems.

CO2 : Develop and execute simple Python programs.

CO3 : Write simple Python programs using conditionals and loops for solving problems.

CO4 : Decompose a Python program into functions.

CO5 : Represent compound data using Python lists, tuples, dictionaries etc.

CO6 : Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
4. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

REFERENCE BOOKS:

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. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.

U23BMT21	MEDICAL PHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

1. To provide understanding of the application of the radiation concepts and methods of Physics in Medical science
2. To accentuate the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation.
3. To enunciate the fundamentals of acoustic waves and their interaction with human tissues.

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION 9

Introduction and objectives - Tissue as a leaky dielectric, Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unit-limits of vision and color vision an overview, Ultraviolet. . Radiometry and photometry- Electrical impedance and Biological Impedance.

UNIT II NUCLEAR RADIATION 9

Radionuclide's used in medicine and biology-LD50-Cause of radiation death-Radiation carcinogenesis-Cataract- Genetic effects-Permissible exposures-Maximum permissible occupational doses- Protective measures. KARMA.

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES 9

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

UNIT IV MEDICAL ULTRASOUND 9

Production-properties and propagation of ultrasonic waves-Bioacoustics-Acoustical characteristics of human body-Ultrasonic Dosimetry-Destructive and nondestructive tests-Cavitation-Piezo electric receivers, thermoelectric probe-Lithotrophy-High power ultrasound in therapy.

UNIT V RADIOACTIVE INTERACTION WITH MATTER AND DETECTOR 9

Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation **.**Scintillation Detectors - Solid Scintillation Counters. Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Muller Counters.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Interpret the properties of electromagnetic radiations and its effect on human.

CO2 : Apply the principles and understand the production of radioactive nuclides.

CO3: Explain the interaction of radiation with matter.

CO4: Identify and analyse the radiation quantities and its effects.

CO5: Demonstrate the knowledge on the properties of sound and its application in medicine.

CO6: Apply the principles and understand the process of physics in medical field.

TEXT BOOKS:

1. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013.
2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers, 2001.
3. R.Hendee and Russell Ritenour, Medical Imaging Physics, 4th Edition William, Wiley-Liss, 2002.

REFERENCE BOOKS:

1. Paul Suetens, Fundamentals of Medical Imaging, 3rd edition, Cambridge: Cambridge University Press, 2017.doi:10.1017/9781316671849.
2. Mayles, Philip, Alan E. Nahum and Jean-Claude Rosenwald, Handbook of Radiotherapy Physics: theory and practice, CRC Press, 2007.
3. S. Webb, The Physics of Medical Imaging, Taylor and Francis, 1988.

U23BMT22	BIOSCIENCES FOR MEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To study structural and functional properties of carbohydrates, proteins, lipids and amino acids.
2. To emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules.
3. To Gain knowledge on the structural and functional aspects of living organisms.
4. To Know the aetiology and remedy in treating the pathological diseases.

UNIT I FUNDAMENTALS TO BIOCHEMISTRY 9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hassel balch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT II BIOMOLECULES 9

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates - Classification of lipids- simple, compound, and derived lipids. Nomenclature of fatty acid - Structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA.

UNIT III CELL DEGENERATION, REPAIR AND NEOPLASIA 9

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

UNIT IV FLUID AND HEMODYNAMIC DERANGEMENTS 9

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

UNIT V FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY 9

Structure of Bacteria and Virus - Morphological features and structural organization of bacteria and virus - List of common bacterial, fungal and viral diseases of human beings.- Basics of Microscopes : Light microscope, Electron microscope (TEM & SEM). - Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury, Immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the fundamentals of biochemistry

CO2 : Analyze structural and functional aspects of living organisms.

CO3: Understand the changes in cell cycle & relevant diseases

CO4: Explain the body cell functions and some bleeding disorder

CO5: Know the structural organization of microbes & microbe causing diseases

CO6: Describe the methods involved in treating the pathological diseases

TEXT BOOKS:

1. Rafi M.D. "Text book of biochemistry for Medical Student" Fourth Edition, Universities Press, Orient Blackswan Private Limited - New Delhi 2021.
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 10th edition: South Asia Edition Elsevier India, 2020. (Units III & IV).
3. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2017 10th edition.

REFERENCE BOOKS:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
3. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007.
4. Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017.

		L	T	P	C
U23PHT26	PHYSICS OF MATERIALS (COMMON TO AGRI, BME, BIOTECH, CHEM, FOOD PHARMA PROGRAMMES)	3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To make the students to understand the basics of crystallography and its importance in studying materials properties.
2. To expand their knowledge in applications of magnetic and superconducting materials in small scale industries.
3. To inculcate an idea of significance of new materials, nanostructures ensuing nano device applications.

UNIT I CONDENSED MATTER PHYSICS 9

Introduction - Lattice - Unit Cell - Seven Crystal Systems -Bravai's Lattices - Lattice Planes - Calculation of Number of Atoms per Unit Cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP Structures. Miller Indices – Derivation for Inter-Planar Spacing in terms of Miller Indices-Crystal Growth Techniques: Melt Growth Technique (Bridgman and Czochralski Techniques).

UNIT II MAGNETIC AND SUPER CONDUCTING MATERIALS 9

Magnetic Materials: Dia, Para and Ferromagnetic Materials and Its Properties – Ferromagnetic Domains – Wiess Theory of Ferromagnetism – Hysteresis - B-H Curve Studies – Soft and Hard Magnetic Materials- Applications.

Super Conducting Materials: Properties – Type I and Type II Super Conductors – London equations – Applications: Magnetic Levitated Train – Magnetic Resonance Imaging.

UNIT III MODERN ENGINEERING MATERIALS 9

Shape Memory Alloys – Structures – Properties – Applications. Metallic Glasses – Preparation and Applications. Ceramics – Types - Properties and Applications.

Nano Materials – Types – Properties and Applications – Preparation Techniques: Electrodeposition – Pulsed Laser Deposition. CNT – Structure – Types – Properties – Applications

UNIT IV INSTRUMENTATION PHYSICS 9

X – rays – Production – Diffraction of X – rays – Laue'e experiment – Bragg's law – Bragg's X – ray Spectrometer – Diffraction methods – Laue method – Rotating Crystal method – Powder Crystal method.

Optical microscope – Electron microscope – Scanning electron microscope – Transmission electron microscope – EDAX – FTIR.

UNIT V RADIOACTIVE MATERIALS 9

Nucleus: Classification, Properties – Radioactivity – Alpha, Beta and Gamma rays – Properties – Laws of disintegration – Half-life period – Mean life -Neutron and its properties.

Artificial radioactivity – Applications and hazards of nuclear radiations – Detectors of Nuclear radiations: Solid State detectors – Proportional Counter – Geiger-Muller Counter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Know basics of crystallography and its importance for varied materials properties.

CO2 : Gain knowledge on the magnetic and superconductor properties of materials and their applications.

CO3: Illustrate the SMA and metallic glasses.

CO4: Gain knowledge in the development of instruments.

CO5: Get knowledge about radioactive materials.

CO6: Understand the concept of detectors and counters.

TEXT BOOKS:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019
2. G.W. Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.
3. Dr. P. Mani, “Physics for Electronics Engineering” Dhanam Publications, 2017.
4. Dr. G. Senthilkumar, “Engineering Physics II” VRB Publishers, 2013.

REFERENCE BOOKS:

1. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
2. S. Rajivgandhi, Dr. I. Cicil Ignatius & A. Ravikumar, “ Engineering Physics II”, RK Publications, 2023
3. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.
4. Dr. G. Senthilkumar, A. Ravikumar & S. Rajivgandhi, “ Engineering Physics II”, VRB Publishers, 2023

GE3252	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

GE3252 **தமிழரும் தொழில்நுட்பமும்** **L T P C**
1 0 0 1

அலகு I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்**: **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**: **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III **உற்பத்தித் தொழில் நுட்பம்**: **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்**: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்**: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

U23BMP21	BIOSCIENCES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Learn basic principles for testing of body essentials chemicals.
2. Understand the qualitative and quantitative analysis of different biomolecules.
3. Understand the catalytic role of chemical analysis of blood.

LIST OF EXPERIMENTS

1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
4. General tests for carbohydrates, proteins and lipids.
5. Preparation of serum and plasma from blood
6. Estimation of blood glucose and creatnine.
7. Estimation of urea and Uric acid
8. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
9. Basic staining – Hematoxylin and eosin staining.
10. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS
11. Types of Staining : Simple stain, Gram stain
12. Study of parts of compound microscope
13. Study of Histopathological slides of benign and malignant tumours.
14. Study of Haematology slides of anemia and leukemia.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Colorimeter	2
2.	Spectrophotometer	1
3.	pH meter	1
4.	Weighing balance	1
5.	Refrigerator	1
6.	SDS gel electrophoresis	1
7.	TLC, ready TLC plates	1
8.	Wintrobe‘s tube	2
9.	Centrifuge Normal	1
10.	Micro slides (packets)	2
11.	Lancet (boxes)	5
12.	Microscope	1
13.	Neubaur‘s Chamber	2
14.	Heparinized Syringe (box)	1
15.	Haemoglobinometer	1

16.	Elisa reader	1
17.	Capillary tubes (box)	1

COURSE OUTCOMES:

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

CO1 : Describe the principles governing the complex interactions of chemicals in living system

CO2 : Understand the importance of carbohydrates and vitamins in cellular machinery

CO3: Describe the structure of proteins and elucidate the clinical significance of biological catalysts

CO4: Understand the structure of various lipids and its derivatives with their implications in physiology

CO5: Elucidate the different bonds and structural components of nucleic acids.

CO6: Understand the structure of various Biosciences and its applications.

U23HSP22	COMMUNICATION LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		0	0	2	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

1. To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
2. To be able to communicate effectively through writing.
3. To Encouraging plan designing and decision making.
4. To Understanding and writing technical instruction.
5. To understand the value of letter writing with correct format.

LIST OF EXPERIMENTS:

1. Speaking-Role Play Exercises Based on Workplace Contexts.
2. Talking about competition.
3. Discussing progress toward goals-talking about experiences.
4. Discussing likes and dislikes.
5. Discussing feelings about experiences.
6. Discussing imaginary scenarios.
7. Writing short essays.
8. Speaking about the natural environment.
9. Describing communication system.
10. Describing position and movement- explaining rules.
11. Understanding technical instructions-Writing: writing instructions.
12. Speaking: describing things relatively-describing clothing.
13. Discussing safety issues (making recommendations) talking about electrical devices.
14. Describing controlling actions.
15. Writing a job application (Cover letter + Resume).

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	**30**
2.	Server	**1**
3.	Head phone	**30**
4.	Audio mixture	**1**
5.	Collar mike	**1**
6.	Television	**1**
7.	Speaker set with amplifier	**1**
8.	Power point projector and screen	**1**
9.	Cordless mike	**1**

COURSE OUTCOMES:

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

CO1 : Distinguish their technical competency through language skill.

CO2 : Predict context effectively in-group discussions held in a formal / semi-formal discussions.

CO3: Understanding candidates' key characteristics.

CO4: Finding personality traits by sharing and comparing thoughts and ability.

CO5: Understanding the value of ethics.(rules and regulations).

CO6: Construct emails and effective job applications**.**

U23GEP13	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the problem solving approaches.
2. To learn the basic programming constructs in Python.
3. To practice various computing strategies for Python-based solutions to real world problems.
4. To use Python data structures - lists, tuples, dictionaries.
5. To do input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Intel Desktop System with Suitable software	30

COURSE OUTCOMES:

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

CO1 : Develop algorithmic solutions to simple computational problems

CO2 : Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems.

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

U23MAT31	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

1. To introduce the basic concepts of PDE for solving standard partial differential equations.
2. To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
3. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
4. To acquaint the student with Fourier transform techniques used in wide variety of situations.
5. To enable the students to study the Laplace transforms and some applications to solve the differential equations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients of both homogenous and non – homogenous type.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions–Half range sine series and cosine series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation — One dimensional equation of heat conduction — Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms — Properties — Transforms of simple functions — Convolution theorem — Parseval's identity.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals - Initial and final value theorems – Inverse transforms – Convolution theorem–Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand how to solve the given standard partial differential equations.

CO2 : Able to solve various types of partial differential equations.

CO3: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO4: Appreciate the physical significance of Fourier series techniques in solving One and two dimensional heat flow problems and one dimensional wave equations.

CO5: Understand the mathematical principles on transforms would provide them the ability to formulate and solve some of the physical problems of engineering.

CO6: Use the method of Laplace Transform to solve initial value problem for Linear differential equations with constant coefficients.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers , New Delhi , 2018.
2. Kreyszig E, "Advanced Engineering Mathematics", 10th Edition, John Wiley,New Delhi,India,2016.

REFERENCE BOOKS:

1. Andrews. L.C and Shivamoggi .B, "Integral Transforms for Engineers "SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Text book of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pears on Education, New Delhi, 2016.
4. Narayanan. S.,Manicavachagom Pillay. T.K and Ramanaiah. G "Advanced Mathematics for Engineering Students",Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, NewDelhi, 2018.

U23BMT31	ANATOMY AND HUMAN PHYSIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To identify all the organelles of an animal cell and their function.
2. To understand structure and functions of the various types of systems of human body, types of glands.
3. To demonstrate their knowledge of importance of anatomical features and physiology of human systems.
4. To identify all the organelles of an animal cell and their function.

UNIT I CELL AND TISSUE STRUCTURE 9

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division. Types of Specialized tissues – Functions, Tissue, Types of glands.

UNIT II SKELETAL MUSCULAR AND RESPIRATORY SYSTEM 9

Skeletal: Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle – Movements. Respiratory: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration.

UNIT III CARDIOVASCULAR AND LYMPHATIC SYSTEMS 9

Cardiovascular: Components of Blood and functions.- Blood Groups and importance – 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, Coronary Circulation. Factors regulating Blood flow. Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels.

UNIT IV NERVOUS AND ENDOCRINE SYSTEMS AND SENSE ORGANS 9

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. Endocrine - Pituitary and thyroid gland, Sense Organs: Eye and Ear.

UNIT V DIGESTIVE AND URINARY SYSTEMS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Identify the organelles of a typical cell and describe their functions.

CO2 : Understand the major components of the skeletal system and describe their functions, then breathing mechanisms.

CO3: Describe the role of blood cells and major components of the circulatory system and describe their functions.

CO4: Understand the importance of the reflex arc as a homeostatic regulator and nervous function.

CO5: Know about the functions among the primary organs and accessory organs of the digestive tract.

CO6: Describe the basic components and functions of urinary and special sensing system.

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. Rose and Wilson, Anatomy and Physiology in Health and Illness, 11th Edition.

REFERENCE BOOKS:

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 Biomedical and Health Sciences, Oxford University Press, USA, 2013.
3. William F.Ganong, ―Review of Medical Physiology, 22nd Edition, Mc Graw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, ―Introduction to Human Anatomy and Physiology, W.B. Saunders Company, 2015.
5. Guyton & Hall, ―Medical Physiology, 13th Edition, Elsevier Saunders, 2015.

U23BMT32	BIOMATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Learning characteristics and classification of Biomaterials
2. Understand different metals, ceramics and its nanomaterials characteristics as biomaterials
3. Learn polymeric materials and its combinations that could be used as a tissue replacement implants
4. Get familiarized with the concepts of Nano Science and Technology
5. Understand the concept of biocompatibility and the methods for biomaterials testing

UNIT I INTRODUCTION TO BIO-MATERIALS 9

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

UNIT II METALLIC AND CERAMIC MATERIALS 9

Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

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

UNIT V TESTING OF BIOMATERIALS 9

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.

CO2 : Identify significant gap required to overcome challenges and further development in metallic and ceramic materials

CO3: Identify significant gap required to overcome challenges and further development in polymeric materials

CO4: Analyze different types of Biomaterials surgical operations and other medical applications.

CO5: Create combinations of materials that could be used as a tissue replacement implant.

CO6: Learn the concept of designing implants using Nanomaterials.

TEXT BOOKS:

1. Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2. JoonB.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press, 2003.

REFERENCE BOOKS:

1. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.
3. Biomaterials- Basic Theory with Engineering Applications C.Mauli Agarwal, Joo L.Ong, Mark R. Appleford, Gopinath Mani. Cambrige University Press, New York- 2016.

U23BMT33	SENSORS AND MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
2. To know the principle of transduction, classifications and the characteristics of different transducers.
3. To know the different transducers and application.
4. To know the different display and recording devices.
5. To explore the characteristics of sensor, transducer and medical application.

UNIT I FUNDAMENTALS OF MEASUREMENTS 9

Measurement System – Instrumentation - Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis- methods of error analysis,- uncertainty analysis-expression of uncertainty: accuracy and precision index, propagation of errors– Calibration - Primary and secondary standards.

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS 9

Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, Thermistor characteristics, Active type: Thermocouple - characteristics.

UNIT III PHOTO ELECTRIC AND PIEZO ELECTRIC SENSORS 9

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.

UNIT IV SIGNAL CONDITIONING CIRCUITS AND METERS 9

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering, Q-meter, PMMC, MI and dynamometer type instruments - DC potentiometer- Digital voltmeter – Multi meter.

UNIT V RECORDING DEVICES AND ADVANCED SENSORS 9

CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Biosensors: transduction mechanism in a biosensor and Classification – Electronic nose.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Measure various electrical parameters with accuracy, precision, resolution.

CO2 : Select appropriate light sensors for measurement of physical phenomenon

CO3: Select appropriate passive or active transducers for measurement of physical phenomenon.

CO4: Employ multimeter, CRO and different types of recorders for appropriate measurement.

CO5: Understand the importance of the sensors and transducers for medical Application.

CO6: Understand the importance of recording and display devices for signal processing.

TEXT BOOKS:

1. A.K. Sawhney, "Electrical & Electronics Measurement and Instrumentation",10th edition, Dhanpat Rai & Co, New Delhi, 19th Revised edition 2011, Reprint 2014.
2. Prof. H. T. Kashipara, Biomedical Transducers, Akshat publication.
3. Ernest O Doebelin and Dhanesh N Manik, "Measurement systems, Application and design", 6th edition, McGraw-Hill, 2012.

REFERENCE BOOKS:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw-Hill, New Delhi, 2014.
3. Albert D. Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1st edition, 2016.

U23BMT34	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Introduce the concept of diodes, Bipolar Junction Transistors and FET.
2. Study the various model parameters of Transistors.
3. Impart the knowledge of various configurations, characteristics, applications.
4. Introduce the basic concepts of DC and AC circuits behavior.
5. Introduce different methods of circuit analysis using Network theorems, duality and topology.

UNIT I SEMICONDUCTOR DIODE 9

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE,CB, CC - Hybrid -π model - h-parameter model, Ebers Moll Model- Gummel Poon- model, Multi Emitter Transistor.

UNIT III FIELD EFFECT TRANSISTORS 9

MOSFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- Threshold voltage -Channel length modulation, small signal Characteristics, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with BJT.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9

Metal-Semiconductor Junction - MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Point Contact Diode, p-i-n Diode, Avalanche Photodiode, Schottky barrier diode- Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

UNIT V POWER DEVICES AND DISPLAY DEVICES 9

UJT, Thyristor - SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Opto Coupler, Solar cell, CCD.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze the characteristics of semiconductor diodes.
CO2 : Analyze and solve problems of Transistor circuits using model parameters.
CO3 : Identify and characterize diodes and various types of transistors.
CO4 : Comprehend and design ac/dc circuits.
CO5 : Apply circuit theorems in real time.

CO6: Analyze the Electronic devices and its applications.

TEXT BOOKS:

1. Millman and Halkias, “Electronic Devices and Circuits”, 4th Edition, McGraw Hill, 2015.
2. Mohammad Rashid, “Electronic Devices and Circuits”, Cengage Learning Pvt. Ltd, 2015.
3. Salivahanan. S, Suresh Kumar. N, “Electronic Devices and circuits”, 4th Edition, McGraw Hill, 2016.

REFERENCE BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory” Pearson Prentice Hall, 11th Edition, 2014.
2. Bhattacharya and Sharma, “Solid State Electronic Devices”, 2nd Edition, Oxford University Press, 2014.
3. R.S.Sedha, “A Textbook of Electronic Devices and Circuits”, 2nd Edition, S.Chand Publications, 2008.
4. David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.

U23BMT35	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce the basic concepts of DC and AC circuits behavior
2. To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
3. To introduce different methods of circuit analysis using Network theorems, duality and topology

UNIT I BASIC CIRCUITS ANALYSIS 9

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchhoff's Laws, Mesh current and node voltage method of analysis for D.C and A.C. circuits. The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT II NETWORK THEOREM AND DUALITY 9

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin's and Norton Equivalent Circuits, Maximum Power Transfer, application of Network theorems. Network reduction: voltage and current division, source transformation, Delta-Wye Conversion. Duals, Dual circuits.

UNIT III SINUSOIDAL STEADY STATE ANALYSIS 9

Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS 9

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT V COUPLED CIRCUITS AND TOPOLOGY 9

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Comprehend and design ac/dc circuits.

CO2 : Apply circuit theorems in real time.

CO3: Evaluate ac/dc circuits.
CO4: Analyse the electrical circuits
CO5: Develop and understand ac/dc circuits.
CO6: Understand the application and design.

TEXT BOOKS:

1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2. Joseph Edminister and Mahmood Nahvi, “Electric Circuits”, Schaum’s Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCE BOOKS:

1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.
2. John O Mallay, Schaum’s Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.
3. Charles.K.Alexander, Mathew N.O.Sadiku,"Fundamentals of Electric Circuits", McGraw Hill, 5th Edition, 2012.
4. Allan H.Robbins, Wilhelm C.Miller, “Circuit Analysis Theory and Practice”, Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.

U23BMP31	ANATOMY AND HUMAN PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To estimation and quantification of blood cells
2. To learnt methods for identification of blood groups
3. To estimation of haematological parameters
4. To learnt the analysis of visual and hearing test

LIST OF EXPERIMENTS

1. Collection of Blood Samples
2. Identification of Blood groups (Forward and Reverse)
3. Bleeding and Clotting time
4. Estimation of Hemoglobin
5. Total RBC Count
6. Total WBC Count
7. Differential count of Blood cells
8. Estimation of ESR
9. PCV, MCH, MCV, MCHC
10. Hearing test – Tuning fork
11. Visual Activity – Snellen's Chart and Jaeger's Chart

TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Microscope	2
2.	Centrifugal Normal	1
3.	Wintrobe's tube	2
4.	PVC tube	2
5.	Neubaur's Chamber	2
6.	Heparinized Syringe	1 box
7.	Haemoglobinometer	1
8.	Blood grouping kit	1
9.	Capillary tube	1 box
10.	Ophthalmoscope	1
11.	Tuning fork	5
12.	Microslides	2 packets
13.	Lancet	5 boxes

COURSE OUTCOMES:

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

CO1 : Identification and enumeration of blood cells

CO2 : Enumeration of haematological parameters

CO3: Analysis of special sensory organs test

CO4 : Understand the importance of the RBC and WBC

CO5 : Describe the physiological process of Blood samples.

CO6: Know about the functions among the primary organs and accessory organs of the digestive tract.

U23BMP32	SENSORS AND MEASUREMENTS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce the relevance of this course to the existing technology through demonstrations
2. To study the characteristics of sensors
3. To identify the sensors with respect to the measurements
4. To understand the applications of sensors
5. To analyse the application of sensors

LIST OF EXPERIMENTS

1. Calibration of voltmeter and ammeter using shunt type Potentiometer
2. Characteristics of Thermistor
3. Characteristics of Thermocouple
4. Characteristics of LDR
5. Characteristics of Photo Diode
6. Characteristics of Photo transistor
7. Characteristics of RTD
8. Characteristics of LVDT
9. Measurement of unknown Resistance using Kelvin Double Bridge and Wheatstone bridge
10. Characteristics of Hall effect transducer
11. Characteristics of strain gauge
12. Study of Electronic nose
13. Characteristics of Piezoelectric Transducer

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Thermocouple	10
2.	RTD	10
3.	Strain Gauge (Bonded and Unbounded type)	10/each
4.	Photo Transistor, Photo diode	10/each
5.	Resistor Range (1-0.0001 ohm)	30/each
6.	CRO	10
7.	DSO	5
8.	LVDT	5
9.	Hall effect Transducer	10
10.	Piezoelectric Transducer	10
11.	Potentiometer, Thermistor, LDR	5/each
12.	Trainer kits - Kelvin Double Bridge and Wheatstone bridge	1/each
13.	Ammeter, Voltmeter, Wattmeter	5/each

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Design and understand characteristics and calibration of various transducers.

CO2 : Design and develop bridge circuits to find unknown variables.

CO3: Select proper transducer for various applications.

CO4: Understand various read out and display devices.

CO5: Design a measurement system for various applications.

CO6: Design and understand biosensors

U23BMP33	ELECTRIC CIRCUITS AND ELECTRONIC DEVICES LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To assist the students in obtaining a better understanding of the operation of electronic circuits and devices
2. To provide experience in analyzing network theorems.

LIST OF EXPERIMENTS

1. Characteristics of PN and Zener diode.
2. Characteristics of CE, CB configurations.
3. Half wave and Full wave rectifier with capacitor filter.
4. Voltage regulation using Zener diode.
5. Study of characteristics of photo diodes
6. Study of characteristics of SCR
7. Verification of KVL and KCL
8. Verification of Thevenin's and Norton's Theorems.
9. Verification of superposition Theorem.
10. Verification of Maximum power transfer and reciprocity theorems.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	BC 107	25
2.	BC 148	25
3.	2N2646	25
4.	BFW10	25
5.	1N4007	25
6.	Zener diodes	25
7.	Resistors, Capacitors, Inductors (sufficient quantities)	25
8.	Bread Boards	15
9.	CRO (30MHz)	10
10.	Function Generators (3MHz)	10
11.	Dual Regulated Power Supplies (0-30V)	10

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Experiment and determine the VI characteristics of given PN junction diode, Zener diode, Photo diode and Silicon Controlled Rectifier.

CO2 : Experiment and determine the Input & output characteristics of BJT

CO3: Experiment and test half wave and full wave rectifier circuit using PN Junction diode and obtain the ripple factor, rectifier efficiency and experiment and test voltage regulation characteristics using Zener diode voltage regulator circuit.

CO4: Experiment and test the given electric circuit using Kirchhoff's laws and obtain the mesh current & node voltage and obtain the load current for the given circuit using Superposition, Thevenin's, and Norton's and Reciprocity theorems.

CO5: Construct and test RLC series and parallel circuits to compute the resonant frequency and bandwidth by plotting the frequency response.

CO6: Develop and understand AC/DC circuits.

U23MAT41	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

1. To introduce the basic concepts of probability and random variables.
2. To introduce the basic concepts of two dimensional random variables.
3. This course aims at providing the required skill to apply the statistical tools in engineering problems.
4. To acquaint the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
5. To introduce the basic concepts of classifications of chart in statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

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

UNIT III ESTIMATION THEORY 12

Unbiased estimators – Efficiency - Consistency – Sufficiency -Robustness - Method of moments – Method of maximum Likelihood - Interval estimation of Means – Differences between means , variations and ratio of two variances.

UNIT IV NON - PARAMETRIC TESTS 12

Introduction - The Sign test - The Signed - Rank test – Rank - sum tests – The U test -The H test – Tests based on Runs – Test of randomness – The Kolmogorov Tests.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the fundamental knowledge of the concepts of probability and have Knowledge of standard distributions which can describe real life phenomenon.

CO2 : Understand the basic concepts of two dimensional random variables and Apply in engineering applications.

CO3: Apply the concept of testing of hypothesis for small and large samples in real life

problems.

CO4: Apply the basic concepts of testing of hypothesis for small and large samples.

CO5: Have the notion of sampling distributions and statistical quality control techniques used in engineering And management problems.

CO6: Understand the knowledge of correlation and Regression for distributed random variables.

TEXT BOOKS:

1. Johnson. R.A., Miller .I.R and Freund. J.E, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia , 9th Edition , 2016.
2. Milton. J.S. and Arnold .J.C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007.
3. John E. Freund, "Mathematical Statistics", Prentice Hall, 5th Edition, 1992.

REFERENCE BOOKS:

1. Gupta. S.C. and Kapoor.V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons , New Delhi , 12th Edition,2020.
2. Devore. J.L., "Probability and Statistics for Engineering and sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Ross. S.M and the Sciences, "Introduction to Probability and Statistics for Engineers and Scientists" , 5th Edition , Elsevier , 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2010.

U23BMT41	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
2. To understand the characteristics of Bio signals.
3. To understand the design of bio amplifiers.
4. To explain the different techniques used for measurement of non-electrical bio-parameters.
5. To explain the biochemical measurement techniques as applicable for diagnosis and treatment

UNIT I ELECTRODE CONFIGURATIONS 9

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

UNIT II BIOSIGNAL CHARACTERISTICS 9

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

UNIT III BIOAMPLIFIERS 9

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT IV MEASUREMENT OF BIO SIGNALS 9

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

UNIT V BIOCHEMICAL MEASUREMENTS 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe and understand the origin of Biopotentials and different types of electrodes used in bio-potential recording.

CO2 : Understand and design the basic bioelectric signal recording systems and bio amplifiers

CO3: Illustrate and design the medical instrument used to measure non electrical parameters.

CO4: Understand & design the basic Bioelectric signal recording systems.

CO5: Understand and illustrate the working principle of basic life supporting instruments.

CO6: Describe the working and usage of analytical equipment and electrical hazards and safety in handling medical equipment

TEXT BOOKS:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2014.

REFERENCE BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007
2. John G. Webster, "Medical Instrumentation Application and Design", John Willey and Sons, 2009
3. Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th edition or current
4. Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley Inter Science (1989) 3rd or current Edition.

U23BMT42	SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand about the continuous time and discrete time signals and systems.
2. To learn the analysis of LTI systems using Laplace and Z transform.
3. To represent the signal in frequency domain using FFT.
4. To gain knowledge about the design of IIR and FIR filters.
5. To obtain knowledge about the Biosignals and its processing.

UNIT I DISCRETE FOURIER TRANSFORM 12

Review of signals and systems, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution, Linear filtering using DFT, Filtering long data sequences - overlap save and overlap add method, Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in- frequency (DIF), Fast Fourier transform (FFT), Linear filtering using FFT.

UNIT II INFINITE IMPULSE RESPONSE FILTERS 12

Characteristics of practical frequency selective filters, characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation, Frequency transformation in the analog domain. 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 and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT IV NOISE CANCELLATION 12

Adaptive filters – Principle noise canceller model – 50 Hz adaptive cancelling using a sine wave model – Maternal ECG cancellation in fetal electrocardiography – ECG cancellation in EMG recording – High frequency noise cancellation in Electro surgery. Signal averaging – Basics and limitations.

UNIT V BIO SIGNALS ANALYSIS 12

EEG signal characteristics – EEG analysis - time and frequency domain methods parametric model – Phenomenological model – linear prediction theory – Autoregressive method, ECG QRS detection Techniques – Estimation of R-R interval – Estimation of ST segment inclination – Arrhythmia analysis monitoring – Long term ECG recording – Basics of ECG data reduction techniques.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able

CO1 : To apply DFT for the analysis of digital signals & systems

CO2 : To design IIR filter to process real world signals.

CO3 : To design FIR filter to process real world signals.

CO4 : To Analyze the filters for appropriately in bio systems

CO5 : To analyze the bio signals in both continuous time and discrete time.

CO6 : To analyze the biosignals in different applications

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. DC Reddy, Biomedical Signal Processing – Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2005 (UNITS V)

REFERENCE BOOKS:

1. Willis J.Tompkins, Biomedical Digital signal processing, Prentice Hall of India Pvt.Litd.,2000
2. Biomedical Signal Analysis A case study approach by Rangaraj M.Rangayyan, John Wiley publications
3. J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill.
4. P.Ramesh Babu, "Digital Signal Processing", Second Edition, Scitech publications, Chennai, 2003.

U23BMT43	ANALOG AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To know the Digital fundamentals, Boolean algebra and its applications in digital systems
2. To understand the concept of combinational and sequential circuits
3. To provide understanding of the fundamentals of Op-Amp and various circuits using 741.
4. To expose the students to the principles of integrated circuit fabrication
5. To know the concepts of ADC and DAC and its types.

UNIT I INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS 9

Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.

UNIT II DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1_s and 2_s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT III COMBINATIONAL LOGIC CIRCUITS 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux.

UNIT IV SEQUENTIAL LOGIC CIRCUITS 9

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

UNIT V ADC, DAC AND PLL 9

Analog switches, High speed sample and hold circuit and IC‘s, Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Use Boolean algebra and apply it to digital systems.
CO2 : Explain the application of combinational and sequential circuit.
CO3 : Design new analog linear circuits and develop linear IC based Systems.
CO4 : Design various functional circuits using these ICs.
CO5 : Know about types of DAC and ADC devices
CO6 : Understand the knowledge in digital applications.

TEXT BOOKS:

1. John. F.Wakerly, "Digital design principles and practices", Pearson Education, 5th Edition, 2018.
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Mc Graw Hill Education, 3rd Edition, 2017.

REFERENCE BOOKS:

1. S.Salivahanan and S.Arivazhagan―Digital Electronics‖, Ist Edition, Vikas Publishing House pvt Ltd, 2012
2. D Roy Choudhury and Shail Jain, "Linear integrated circuits", New Age Science Limited, 4th edition,2011.
3. Taub and Schilling, "Digital Integrated Electronics", Mc Graw Hill, 2017.
4. Charles H.Roth, Jr, "Fundamentals of Logic Design", Jaico Books, 7th Edition, 2013.
5. S Salivahanan and V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw Hill Education, 3rd Edition, 2018.

U23BMT44	MICROCONTROLLERS & EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the Architecture of 8086 microprocessor
2. To study the Architecture of 8051 microcontroller
3. To design a microcontroller based system.
4. To Acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
5. To Understand the hardware architecture and features of embedded microcontrollers and peripherals.

UNIT I 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming.

UNIT III INTERFACING MICROCONTROLLER 9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

UNIT IV EMBEDDED DESIGN WITH MICROCONTROLLERS 9

Product specification – hardware / software partitioning, Detailed hardware and software design – integration, product testing, Microprocessor versus microcontroller, Performance tools, bench marking processors, RTOS micro controller -issues in selection of processors. Hardware / software duality, Hardware-software portioning, coding for hardware/software development, ASIC revolution, Managing the risk, co-verification, execution environment, Memory organization of controller

UNIT V FUNCTIONALITIES FOR SYSTEM DESIGN 9

Timers, watch dog timers, RAM, flash memory, basic toolset, integration of hardware & firmware, Application programming, IDE, target configuration, Host based debugging analyser Remote debugging, ROM emulators, logic.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand and execute programs based on 8086 microprocessor.
CO2 : Design and implement 8051 microcontroller based systems.
CO3 : Comparison of microprocessor and microcontroller.
CO4 : Attain knowledge on the basic concepts and the building blocks for embedded system & Understand the hardware and software partitioning in embedded systems
CO5 : Gain knowledge about timers and memory organization of embedded systems
CO6 : Get the knowledge in functionalities for a embedded system design.

TEXT BOOKS:

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Jane W.S.Liu, Real Time Systems, Pearson Education, Third Indian Reprint, 2003.

REFERENCE BOOKS:

1. Lyla B.Das, ―Embedded Systems : An Integrated Approach‖ Pearson Education, 2013.
2. Jonathan W.Valvano, ―Embedded Microcomputer Systems Real Time Interfacing‖, Third Edition Cengage Learning, 2012.
3. David. E. Simon, ―An Embedded Software Primer‖, 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.

U23GET41	ENVIRONMENTAL SCIENCES AND ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To the study of nature and the facts about environment.
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems.
3. To study the interrelationship between living organism and environment.
4. To appreciate the importance of environment by assessing its impact on the human world envisions the surrounding environment, its functions and its value.
5. To study the integrated themes and biodiversity, natural resources, pollution control and waste Management.

UNIT I ECOSYSTEM AND BIODIVERSITY 9

Definition, Scope and importance of environment – Need for public awareness. Eco-system- Types and Energy flow– Ecological succession. Types of biodiversity: genetic, species and ecosystem diversity – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 9

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV ENVIRONMENTAL ISSUES 9

Social Issues and possible solutions – climate change, global warming, acid rain,ozone layer depletion, nuclear accidents and holocaust - Population growth, variation among nations population explosion – family welfare programme – human rights – value education – HIV / AIDS – women and child welfare.

UNIT V SUSTAINABILITY PRACTICES 9

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Development, GDP, Sustainability- Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio- economic and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.

CO2 : Discover knowledge in ecological perspective and value of environment

CO3 : Categorize different types of pollutions and their control measures.

CO4 : Understand the significance of various natural resources and its management.

CO5 : Analyse global environmental problems and come out with best possible solutions.

CO6: Understand environmental laws and sustainable development.

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004
3. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall
4. Dr.J. Manivel and Dr.A. Arunkumar, "Environmental Science & Engineering" R.K.Publishers, 1st Edition 2023

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005
4. Erach Bharuch "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

U23BMP41	BIOMEDICAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To provide hands-on training on designing of bio signal acquisition system and measurement of physiological parameters, biochemical parameters.

LIST OF EXPERIMENTS

1. Design and analysis of biological pre amplifiers
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Recording of ECG amplifier and design a suitable circuit to detect QRS complex and measure heart rate.
4. Recording of various physiological parameters using patient monitoring system and telemetry units.
5. Recording of EMG Signal
6. Recording of frontal EEG amplifier
7. Measurement of visually evoked potential.
8. Galvanic skin resistance (GSR) measurement
9. Measurement of pH and conductivity.
10. Measurement and recording of peripheral blood flow
11. Design a PCB layout for any bio amplifier using suitable software tool.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Multiparameter Patient Monitoring System	1
2.	EEG Recorder With Accessories For Evoked Studies	1
3.	ECG Recorder	1
4.	EMG Recorder	1
5.	PH Meter, Conductivity Meter	1
6.	Blood Flow Measurement System Using Ultrasound Transducer	1
7.	GSR Measurement Setup	1
8.	Function Generators	5
9.	DSOs	5
10.	Regulated Power Supplies	4
11.	Bread Boards	5
12.	IC741	6

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Design the amplifier for Bio signal measurements

CO2 : Measure heart rate and heart sounds.

CO3 : Record and analyze pulse rate and respiration rate

CO4 : Measure blood pressure and blood flow

CO5 : Design isolation amplifier

CO6 : Acquire knowledge about Recording of Bioelectric potentials, various Physiological measurements used in Medical field.

U23BMP42	SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To impart the basic concepts of signal processing applied to various bio signals so as to analyse them.
2. To understand the major areas of biomedical engineering include Medical instrumentation, Biosensors and signal Rehabilitation engineering, Medical image processing etc.
3. To know the basics of various bio signals, their characteristics, processing and analysis.

LIST OF EXPERIMENTS

1. Sine wave generation using MATLAB.
2. Generation of AM, FM & PWM waveforms using MATLAB.
3. Computation of convolution and correlation sequence using MATLAB.
4. Discrete Fourier Transform: (Unfolding the spectrum, Frequency Unwrapping) using MATLAB.
5. Design & implementation of IIR filters. (Butterworth and Chebyshev Filters) using MATLAB.
6. Design & implementation of FIR filters. (Window method and Frequency sampling Method) using MATLAB.
7. Implementation of FFT for ECG Signal using MATLAB.
8. Spectrum analysis & Noise removal of biomedical signals.
9. Design of Notch filter for elimination of 50 Hz from ECG signal.
10. PC based ECG analyser.
11. ECG data reduction algorithms.
12. EMG processing using MATLAB –Rectification and Signal Averaging.
13. Down sampling & up-sampling of ECG signal.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	PCs with MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems.	30

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Classify the continuous time and discrete time signals and systems.

CO2 : Analyze the signals in both continuous time and discrete time.

CO3 : Understand the basic concepts of signal processing applied to various bio signals.

CO4 : Know the major areas of biomedical engineering include Medical instrumentation,

CO5 : Biosensors and signal Rehabilitation engineering, Medical image processing etc.

CO6 : Know the basics of various bio signals, their characteristics, processing and analysis.

U23BMP43	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To design digital logic and circuits
2. To learn the function of different ICs & generating waveforms using ICs.
3. To understand the applications of operation amplifier.
4. To learn the working of multivibrators

LIST OF EXPERIMENTS

1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Design and analysis of active filters using opamp
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier using operational amplifier
6. RC and LC oscillators
7. Multivibrators using IC555 Timer
8. Study of logic gates, Half adder and Full adder
9. Encoder and BCD to 7 segment decoder
10. Multiplexer and demultiplexer using digital ICs
11. Universal shift register using flip flops
12. Design of mod-N counter
13. Simulation and analysis of circuits using software.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Dual power supply/ single mode power supply	15
2.	IC Trainer Kit	15
3.	Bread Boards	15
4.	Seven segment display	15
5.	Multimeter	15
6.	ICs 7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 / 74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 / 7485 / 7473 / 74138 / 7411 / 7474	Each 50
7.	Signal Generator /Function Generators (2 MHz)	15
8.	CRO/DSO (Min 30MHz)	15
9.	IC Tester	5
10.	Standalone desktops PC	15

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Design Combinational Circuits using logic gates

CO2 : Design and implement arithmetic circuits for different applications using opamp

CO3 : Design Sequential Circuits using logic gates

CO4 : Design wave form generators and analyse their characteristics
CO5 : Simulate and analyse circuits using ICs.
CO6 : Design Multi Combinational and sequential circuits.

U23BMT51	BIO CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Understand the concept behind feedback and continuum in various systems and subsystems and the need for mathematical modeling of various systems.
2. Analyze the systems in time and frequency domains.
3. Understand the concept of stability of various systems.
4. Apply mathematical modeling principles in understanding the various fundamental biological systems.
5. Understand and analyse the Biocontrol system models.

UNIT I INTRODUCTION 12

Open and Closed loop Systems, Modelling 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 12

Step and impulse responses of first order and second order systems - Time domain specifications of first and second order systems - steady state error constants.

UNIT III STABILITY ANALYSIS 12

Definition of stability, Routh - Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability.

UNIT IV BIOLOGICAL SYSTEM MODELS 12

Distributed parameter versus lumped parameter models, Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Lung tissue visco-elastance-chest wall- airways, Interaction of Pulmonary and Cardiovascular models, Static analysis of physiological systems – Regulation of cardiac output, Regulation of ventilation.

UNIT V BIOLOGICAL CONTROL SYSTEM ANALYSIS 12

Simple models of muscle stretch reflex action, Study of steady state analysis of muscle stretch reflex action, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Interpret 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.

CO2 : Determine the time response of various systems.

CO3 : Discuss the concept of system stability.

CO4 : Understand the modelling concepts of physiological control system models.

CO5 : Appraise the concept of modelling basic physiological systems.

CO6 : Design and analyse the Biocontrol systems.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., Control Systems Engineering, Pearson Education India, 2015.
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3. Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, Vol 4, Prentice-Hall, 2002.
4. Carson, E. Salzsieder, Modelling and Control in Biomedical Systems 2000 (including Biological Systems) (IFAC Proceedings Volumes) (Paperback), Pergamon Publishing, January 2001.
5. John Enderle Susan Blanchard, Joseph Bronzino ―Introduction to Biomedical Engineering, second edition, Academic Press, 2005.

U23BMT52	BIOMECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Learn the fundamental concepts of the principles of mechanics.
2. Understand the basics of biofluid mechanics.
3. Review the mechanical properties of musculoskeletal elements.
4. Study the biomechanics of joints and implants.
5. Learn the application of biomechanics into modelling and ergonomic design.

UNIT I INTRODUCTION TO MECHANICS 9

Introduction - Scalars and vectors, Statics -Resolution and composition of forces, Moments, couple, Resultant, equilibrium of coplanar forces, Dynamics - Linear motion, Newton's laws of motion, Velocity and acceleration, Kinematics - Models, Transducers Constitutive equations -Non- viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

UNIT II BIOFLUID MECHANICS 9

Intrinsic fluid properties, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube, Structure of blood vessels, Material properties and modelling of Blood vessels, Heart - Cardiac muscle characterization, Native heart valves, Prosthetic heart valve fluid dynamics.

UNIT III MUSCULOSKELETAL MECHANICS 9

Constitutive equation of viscoelasticity - Maxwell, Voight and Kelvin models, anisotropy, Hard Tissues - Structure, viscoelastic properties, functional adaptation, Soft Tissues - Structure, functions, material properties and modelling of Soft Tissues - Cartilage, Tendons and Ligaments Skeletal Muscle, Bone fracture mechanics, Implants for bone fractures.

UNIT IV BIOMECHANICS OF JOINTS 9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT V MODELLING AND ERGONOMICS 9

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; models for voice biomechanics, Ergonomics -Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted and whole-body vibrations. Case Study: Finite element analysis of Lumbar Spine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Get an insight into the principles of mechanics.

CO2 : Envision the basics of bio fluid mechanics.

CO3 : Review the mechanical properties of musculoskeletal elements.

CO4 : Study the structure and functions of skeletal muscle and modelling

CO5 : Study the biomechanics and ergonomic design

CO6 : Learn the application of biomechanics into modelling.

TEXT BOOKS:

1. Y C Fung, Biomechanics: "Mechanical Properties of Living Tissues", Springer, 2nd edition, 1993.
2. Susan .J. Hall: "basic biomechanics", Tata Mcgraw hill, 4th edition, 2004.

REFERENCE BOOKS:

1. J. G Webster, "Medical instrumentation –Application & design", John Wiley and Sons Inc., 3rd edition, 2003
2. D. J. Schneck and J. D. Bronzino, "Biomechanics- Principles and Applications", CRC Press, 2nd Edition, 2000
3. Duane Knudson, "Fundamentals of Biomechanics", Springer, 2nd edition, 2007

U23BMT53	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

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

UNIT I CARDIAC EQUIPMENT 9

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

UNIT II NEUROLOGICAL EQUIPMENT 9

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

UNIT III MUSCULAR AND BIOMECHANICAL MEASUREMENTS 9

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

UNIT IV RESPIRATORY MEASUREMENT SYSTEM 9

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

UNIT V SAFETY MEASUREMENTS 9

Physiological effects of electrical currents, macroshock and microshock, preventive measures to reduce shock hazards, Leakage current, isolation of patient circuits, safety of electrically susceptible patients, radiation hazards and safety, shielding, open ground problem and earthing methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the working and recording setup of all basic cardiac equipment.
CO2 : Understand the working and recording of all basic neurological equipment‘s.
CO3 : Discuss the recording of diagnostic and therapeutic equipment‘s related to EMG.
CO4 : Explain about measurements of parameters related to respiratory system.
CO5 : Describe the measurement techniques of sensory responses.
CO6 : Analyse the behaviour of electrotherapy equipments.

TEXT BOOKS:

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, 2012
3. R.S Khandpur, Hand Book of Biomedical Instrumentation 3rd Edition.

REFERENCE BOOKS:

1. Myer Kutz, Standard Handbook of Biomedical Engineering & Design, McGraw Hill, 2003
2. L.A Geddes and L.E. Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, 2008.
3. Leslie Cromwell, Biomedical Instrumentation and Measurement, Pearson Education, New Delhi, 2007.
4. Antony Y.K.Chan, Biomedical Device Technology, Principles and design, Charles Thomas Publisher Ltd, Illinois, USA, 2008.
5. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers, 2001.

U23BMP51	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To demonstrate recording and analysis of different Bio potentials
2. To examine different therapeutic modalities.

LIST OF EXPERIMENTS

1. Measurement of visually evoked potential
2. Study of shortwave and ultrasonic diathermy
3. Measurement of various physiological signals using biotelemetry
4. Study of haemodialysis model
5. Electrical safety measurements
6. Measurement of Respiratory parameters using spirometry.
7. Study of medical stimulator
8. Analyze the working of ESU – cutting and coagulation modes
9. Recording of Audiogram
10. Analysis of ECG, EEG and EMG.
11. Study the working of Defibrillator and pacemakers
12. Study of ventilators
13. Study of Ultrasound Scanners
14. Study of heart lung machine model
15. Study of CATH LAB setup
16. Study of Laparoscopy

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Visually evoked potential setup	1
2.	GSR setup	1
3.	Multi-output power supply (+15v, -15v,+30V variable, +5V, 2A)	2
4.	Short wave Diathermy	1
5.	Ultrasound diathermy	1
6.	Multiparameter biotelemetry system	1
7.	Electrical Safety Analyser	1
8.	Spirometry with associated analysis system	1
9.	ECG Simulator	1
10.	Medical stimulator	1
11.	Surgical diathermy with analyzer	1
12.	Audiometer	1
13.	Pacemaker	1
14.	Defibrillator	1

15.	Haemodialysis model	1
16.	Heart lung Model	1
17.	Ventilator	1
18.	Ultrasound Scanner	1
19.	Software to Analyze ECG,EEG and EMG	1

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Measure different bioelectrical signals using various methods

CO2 : Assess different non-electrical parameters using various methodologies

CO3 : Illustrate various diagnostic and therapeutic techniques

CO4 : Examine the electrical safety measurements

CO5 : Analyze the different bio signals using suitable tools.

CO6 : Illustrate Multimedia technologies in Telemedicine.

U23BMP52	MICROCONTROLLERS & EMBEDDED SYSTEM LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce ALP concepts, features and Coding methods.
2. To write ALP for arithmetic and logical operations in 8051.
3. To acquire knowledge and understand the hardware architecture and programming aspects of embedded system design.
4. To understand IoT architecture and Build simple IoT Systems using embedded target boards.

LIST OF EXPERIMENTS

8051 Experiments using kits and MASM

1. Basic arithmetic and Logical operations
2. Square and Cube program, Find 2‘s complement of a number
3. Unpacked BCD to ASCII
4. Move a data block without overlap
5. Code conversion, decimal arithmetic and Matrix operations.
6. Explore AVR/ARM based controllers using Embedded C.
7. Write Basic and arithmetic Programs Using Embedded C.
8. Write Embedded C program to test interrupt and timers.
9. Develop Real time applications – clock generation, waveform generation, counter using embedded C.
10. Explore different communication methods with IoT devices.
11. To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.
12. To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on motor if push button is pressed.
13. Develop simple application – testing infrared sensor – IoT Applications – using open platform/Raspberry Pi.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	8086 Development Kits	30
2.	Interfacing Units	10
3.	Microcontroller	30
4.	Intel Desktop System With MASM 8086 Assembler 8051 Cross Assembler	30

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Write ALP Programs for fixed and Floating Point and Arithmetic operations

CO2 : Execute Programs in 8051

CO3 : Explain hardware architecture of embedded systems and use of software design tools.

CO4 : Analyse the different bio signals using suitable tools.

CO5 : Exhibit understanding of IoMT infrastructure for healthcare with simple applications.

CO6 : Describe IoT Architectures and Build simple IoT Systems using embedded target boards.

U23HSP51	PROFESSIONAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1.5

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. Making effective presentations.
2. Participating confidently in Group Discussions.
3. Attending job interviews and be successful in them.
4. Developing adequate Soft Skills required for the workplace.
5. Nurturing out ward look.
6. Impressing the listener by positive body language.

LIST OF EXPERIMENTS:

1. Introduction to Soft Skills.
2. Employability and career Skills.
3. Grooming as a professional with values.
4. Time Management.
5. General awareness of Current Affairs.
6. Self-Introduction.
7. Introducing oneself to the audience .
8. Introducing the topic.
9. Individual presentation practice.
10. Participating in group discussions.
11. GD strategies- activities to improve GD skills.
12. Interview etiquette.
13. Telephone/skype interview -one to one interview &panel interview.
14. The International English Language Testing System (IELTS).
15. Test of English as a foreign Language (TOFEL)-Verbal Ability.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	**30**
2.	Server	**1**
3.	Head phone	**30**
4.	Audio mixture	**1**
5.	Collar mike	**1**
6.	Television	**1**
7.	Speaker set with amplifier	**1**
8.	Power point projector and screen	**1**
9.	Cordless mike	**1**

COURSE OUTCOMES:

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

CO1 : Organize an effective group discussion.

CO2 : Develop confidence to attend job interviews.

CO3: Explain their opinion effectively in oral medium of communication

CO4: Prove as technical managers and problem solvers.

CO5: Motivate them to move smartly in professional society.

CO6: Build hope to prove their entrepreneurial ship.

U23ITT62	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. To introduce problem-solving agents
2. To explore probabilistic reasoning
3. To understand supervised learning
4. To study ensemble techniques
5. To explore neural networks

UNIT I PROBLEM SOLVING 9

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

UNIT II PROBABILISTIC REASONING 9

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

UNIT III SUPERVISED LEARNING 9

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

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

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

UNIT V NEURAL NETWORKS 9

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Use appropriate search algorithms for problem solving.

CO2 : Explain reasoning under uncertainty.

CO3 : Understand supervised learning models.

CO4 : Understand ensemble and unsupervised models.

CO5 : Explain deep learning neural network models.

CO6 : Explain the concept of batch normalization and regularization.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education, 2007.
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, Mc Graw Hill, 2008.
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4. Deepak Khemani, “Artificial Intelligence”, Tata Mc Graw Hill Education, 2013 (http://nptel.ac.in/).

NPTEL LINKS:

1. https://onlinecourses.nptel.ac.in/noc24_cs88/preview
2. https://onlinecourses.nptel.ac.in/noc24_ce107/preview

U23BMT62	MEDICAL IMAGING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

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

UNIT I MEDICAL X-RAY EQUIPMENT 9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Cathode and filament currents, Focusing cup, Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, Causes of x- ray tube failure: x-ray tube rating charts. X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit.

UNIT II COMPUTED TOMOGRAPHY 9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Advantages of computed radiography over film screen radiography: Differences between conventional imaging equipment and digital imaging equipment: Image plate, Plate readers, Image characteristics, Image reconstruction techniques- back projection and iterative method. Spiral CT, 3D Imaging and its application.

UNIT III MAGNETIC RESONANCE IMAGING 9

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

UNIT IV NUCLEAR MEDICINE TECHNIQUES 9

Nuclear imaging – Anger scintillation camera –Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances .Radionuclide imaging-Bone imaging, dynamic renal function, myocardial perfusion. Non imaging techniques hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement.

UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments-Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the working principle of X-ray machine and its application.

CO2 : Illustrate the principle computed tomography.

CO3 : Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging

CO4 : Demonstrate the applications of radio nuclide imaging.

CO5 : Outline the methods of radiation safety

CO6 : Analyze the techniques used for visualizing various sections of the body.

TEXT BOOKS:

1. Steve Webb, The Physics of Medical Imaging‖, Adam Hilger, Philadelpia, 1988
2. R.Hendee and Russell Ritenour Medical Imaging Physics‖, Fourth Edition William, Wiley-Liss, 2002

REFERENCE BOOKS:

1. Gopal B. Saha Physics and Radiobiology of Nuclear Medicine - Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood, D R Hose, D C Barber, ―Medical physics and Biomedical Engineering, CRC Press, 1999.
3. Myer Kutz, Standard handbook of Biomedical Engineering and design, McGraw Hill, 2003.
4. P.Ragunathan, Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques, Paperback – Import, 2007Anil Jain K, Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011.

U23BMT63	MEDICAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Learn the fundamental concepts of medical Image Processing techniques.
2. Understand the concepts of various image intensity transformation and filtering operations.
3. Be familiar in the techniques of segmentation and restoration of medical images.
4. Gain knowledge in medical image registration and visualization.
5. Be familiar with the application of medical image analysis.

UNIT I FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS 9

Overview of Image Processing system and human Visual system- Image representation – pixel and voxels, Gray scale and color models- Medical image file formats- DICOM, ANALYZE 7.5, NIFTI and INTERFILE- Discrete sampling model and Quantization- Relationship between the pixels, Arithmetic and logical operations- Image quality and Signal to Noise ratio- Image Transforms- 2D DFT, DCT, KLT. Interpret the basics of image models, Digitization of images and the transformations of medical images using MATLAB.

UNIT II ENHANCEMENT TECHNIQUES 9

Gray level transformation- Log transformation, Power law transformation, Piecewise linear transformation. Histogram processing- Histogram equalization, Histogram Matching. Spatial domain Filtering-Smoothing filters, sharpening filters. Frequency domain filtering- Smoothing filters, Sharpening filters- Homomorphic filtering -Medical image enhancement using Hybrid filters- Performance measures for enhancement techniques. Experiment with various filtering techniques for noise reduction and enhancement in medical images using MATLAB.

UNIT III SEGMENTATION AND RESTORATION TECHNIQUES 9

ROI definition -Detection of discontinuities–Edge linking and boundary detection – Region based segmentation- Morphological processing, Active contour models. Image Restoration- Noise models– Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering- linear position- Invariant degradation- Estimation of degradation function, Inverse filter, Weiner filtering. Analyze the segmentation techniques to extract the region of interest and restoration of degraded images using MatLab.

UNIT IV REGISTRATION AND VISUALISATION 9

Registration–Rigid body transformation, principal axes registration, and feature based. Visualisation- Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image. Explain the significance of registration of various imaging modalities and appraise the concepts of image visualization in healthcare using Matlab

UNIT V APPLICATIONS OF MEDICAL IMAGE ANALYSIS 9

Medical Image compression- DCT and Wavelet transform based image compression, Pre-processing of medical images -Retinal images, Ultrasound –liver, kidney, Mammogram. Segmentation of ROI - blood vessels, lesions, tumour, lung nodules, feature extraction- shape and texture, Computer aided diagnosis system – performance measures (confusion matrix, ROC, AUC).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain and apply the fundamental concepts of image processing techniques for the analysis of medical images.

CO2 : Understand fundamental concepts of medical Image Processing techniques.

CO3 : Identify and apply suitable filtering and intensity transformation techniques for given medical applications.

CO4 : Design different application of medical image analysis.

CO5 : Identify and segment the Region of Interest from the given medical image.

CO6 : Explore and apply current research in registration and visualization for medical image analysis.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Atam P.Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA 2003
2. Rangaraj M. “Rangayyan, Biomedical Image Analysis”, 1st Edition, CRC Press,Published, December 30, 2004
3. Joseph V.Hajnal, Derek L.G.Hill, David J Hawkes, “Medical image registration”, Biomedical Engineering series, CRC press,2001
4. Milan Sonka, Image Processing, Analysis And Machine Vision, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999
5. Anil Jain K, Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011

U23BMP61	MEDICAL IMAGE PROCESSING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To practice the basic image processing techniques.
2. To compute magnitude and phasor representation of images.
3. To understand the concepts of image restoration and segmentation.
4. To explore the applications of image processing techniques.

LIST OF EXPERIMENTS

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)
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. Segmentation using watershed transformation
12. Analysis of images with different Color models.
13. Study of Mammography imaging
14. Study of Thermography Imaging
15. Study of SPECT imaging
16. Study the importance of gamma camera in Imaging

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	PCs with MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems	30

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Perform enhancing operations on the image using spatial filters and frequency domain filters.

CO2 : Use transforms and analyse the characteristics of the image.

CO3 : Perform segmentation operations in the images.

CO4 : Estimate the efficiency of the compression technique on the images.

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

CO6 : Compute magnitude and phasor representation of images.

U23BMP62	COMMUNITY SERVICE PROJECT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1 : Formulate a real world problem, identify the requirement and develop the design solutions.

CO2 : Express the technical ideas, strategies and methodologies.

CO3 : Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

CO4 : Test and validate through conformance of the developed prototype and analysis the cost effectiveness.

CO5 : Prepare report and present the oral demonstrations.

CO6 : Understand new tools, algorithms and techniques required to carry out the projects.

U23BMT71	DESIGN AND DEVELOPMENT OF HEALTH CARE PRODUCT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To be exposed to principle of designing and developments
2. To be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

UNIT I INTRODUCTION AND CLASSIFICATION OF MEDICAL DEVICES 9

Medical devices definition, design life cycle, Design process versus design control, FDA regulation and inspection, Design models-Pahl and Beitz , Pugh model, Divergent-convergent model, Common design management models , Cross reference with regulatory requirements.

UNIT II IMPLEMENTING DESIGN PROCEDURE 9

Classification /Product specification procedure, Design verification/validation/Evaluation procedure, Risk assessment procedure, Product design specification, Regulatory bodies, Generating and selecting concepts and ideas.

UNIT III QUALITY IN DESIGN 9

Optimization, Overview of quality function deployment (QFD), QFD process, House of quality, Failure mode and effect of analysis, six sigma.

UNIT IV DESIGN REALIZATION 9

The process to design realization, Design calculation, Material selection and standards, Design for usability, Fundamental safety and effectiveness principle, FDA'S interest in standards, Intellectual property.

UNIT V EVALUATION 9

Risk analysis, Criteria based evaluation- Invitro/Invivo, Value to health care analysis, Clinical trials and clinical studies, Synthetic crafts, total hip prosthesis, Hazard analysis and quality control, Analyzing the outcomes and limits to analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Solve complex engineering problems by applying principles of engineering, science, and mathematics

CO2 : Medical device and in vitro diagnostic (IVD), classification and types of medical devices

CO3 : Medical device and testing, personnel involved, quality assurance, quality management system

CO4 : Biocompatibility studies, clinical investigation, risk management, International

practices

CO5 : Summarise the concept of medical device development.

CO6 : Recall the engineering design and project metrics.

TEXT BOOKS:

1. Peter Ogrodnik, “Medical Device Design Innovation from Concept to Market”, Elsevier, 2013
2. Richard C. Fries, “Handbook of Medical Device Design”, Marcel Dekker AG, 2ndedition, 2005

REFERENCE BOOKS:

1. Gail Baura, “Medical Device Technologies: A Systems Based Overview Using Engineering”, Elsevier science, 2012
2. Matthew B.Weinger, Michael E, Wiklund, DaryleJ. Gardner-Bonneau, “Handbook of Human factors in Medical Device Design”, Taylor and Francis group, 2010

U23BMT72	MEDICAL ETHICS AND STANDARDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To Achieve familiarity with some basic ethical frameworks & understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
2. To know about the legal and ethical principles
3. To apply these principles in health care settings & gain knowledge about the medical standards those are to be followed in hospitals.

UNIT I INTRODUCTION TO MEDICAL ETHICS 9

Definition of Medical ethics, Scope of ethics in medicine, American Medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor and Society.

UNIT II ETHICAL THEORIES & MORAL PRINCIPLES 9

Theories-Deontology & Utilitarianism, Casuist theory, Virtue theory, The Right Theory. Principles-Non- Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research, Bioethical issues in Human Genetics & Reproductive Medicine.

UNIT III HOSPITAL ACCREDITATION STANDARDS 9

Accreditation- JCI Accreditation & its Policies. Patient Organization management standards.

UNIT IV HOSPITAL SAFETY STANDARDS 9

Life Safety Standards- Protecting Occupants, Protecting the Hospital from Fire, Smoke, and Heat, Protecting Individuals from Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

UNIT V MEDICAL EQUIPMENT SAFETY STANDARDS 9

General requirements for basic safety & essential performance of medical equipment. IEC 60601 standards, Indian and International standards, ISO standards - Base Standard-general requirement of electrical medical devices, Collateral Standards- EMC radiation protection & programmable medical device system, Particular Standards-type of medical device.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the Social responsibility in healthcare systems

CO2 : Discuss the Bioethics and engineers role

CO3 : Apply Legal and professional guidelines for the hospital accreditation

CO4 : Understand hospital safety aspects

CO5 : Comprehend the medical equipment safety standards and medical device maintenance.

CO6 : Legal and Professional guidelines for the Health Profession.

TEXT BOOKS:

1. Domiel A Vallero, Biomedical Ethics for Engineers, Elsevier Pub.1st edition, 2007
2. Johnna Fisher, Biomedical Ethics: A Canadian Focus., Oxford University Press Canada,2009
3. Robert M Veatch, The Basics of Bio Ethics, 3rd Edition. Routledge, 2011

REFERENCE BOOKS:

1. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HCPro, Inc. 2010
2. Joint Commission Accreditation Standards for Hospitals, 6th Edition 2018
3. Ben Mepham, Bioethics-An Introduction for the biosciences, 2nd Edition, Oxford University Press, 2008
4. Nils Hoppe and Jose Miola - Medical law and Medical Ethics - Cambridge University Press-2014

U23BMT73	ELECTRICAL SAFETY AND QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To provide electrical protection and maintenance in working environment and ensure that electrical safety.

UNIT I ELECTRICAL HAZARDS 9

Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity.

UNIT II STANDARDS AND REQUIREMENTS 9

National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards).

UNIT III ELECTRICAL PROTECTION AND MAINTENANCE 9

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation (CPR).

UNIT IV STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 9

Define Quality- Need for Standardization & Quality Management, QM in Health care organization- Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments.

UNIT V REGULATORY REQUIREMENT FOR HEALTH CARE 9

CE and FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities.

CO2 : Safety measures to be followed in hospitals.

CO3 : Brief out the patient safety laws and regulations

CO4 : Understand the concept of the patient safety specialities in clinical

CO5 : know about various health care organization

CO6 : Brief out the patient safety laws and regulations

TEXT BOOKS:

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd. 2024
2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977

REFERENCE BOOKS:

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Englewood Cliffs, New Jersy, 1979.
2. Karen Parsley, Karen Parsley Philomena Corrigan" Quality improvement in Healthcare, 2nd edition, Nelson Thrones Pub, 2002.
3. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012.
4. Joseph F Dyro "Clinical Engineering Handbook" Elsevier Publishers, 2004.

U23BMP71	HOSPITAL TRAINING	L	T	P	C
		0	0	2	1

ASSESSMENT:

1. Students need to complete training in any leading Multi-specialty hospital for a period of 15 days.
2. They need to prepare an extensive report and submit to their respective course incharges during the session.
3. Out of the following departments, it is mandatory to complete training in any 10 departments.
4. The students can give a presentation of the remaining departments during laboratory hours

LIST OF EXPERIMENTS

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Advocate a patient-centred approach in healthcare

CO2 : Communicate with other health professionals in a respectful and responsible manner

CO3 : Recognize the importance of inter-professional collaboration in healthcare.

CO4 : Propose a patient-centred inter-professional health improvement plan based upon the patient‘s perceived need.

CO5 : Recognize the importance of Medical Records / Telemetry

CO6 : Propose a medical applications

U23BMP71	MEDICAL EQUIPMENT STARTSUPS AND ENTREPRENEURSHIP	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Introduce the basic principles of innovation and entrepreneurship and to demonstrate their value in the ongoing improvement of healthcare and population health.
2. Describe the healthcare value chain and the different types of healthcare innovation, as well as to explore the reasons why healthcare differs from other sectors of the economy.
3. Examine the adoption of innovation in healthcare, and the critical role of the leader in creating an environment that facilitates innovation.
4. Highlight the need to view and manage healthcare innovation from a complex systems perspective.
5. Equip students with the ability to identify a problem in an evidence-based manner, and to develop an innovative solution, taking into account existing infrastructure and networks.

LIST OF EXPERIMENTS

1. Introduction to Innovation and Entrepreneurship
2. Opportunity Identification and Innovation Development
3. Creating the Start-up
4. The Unique Case of the Healthcare Sector
5. Innovation in the Biopharma and Medical Device Industry
6. Health Innovation Adoption

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Innovation and Entrepreneurship in the Healthcare Sector: From Idea to Funding to Launch (1st edn.) Pareras LG Green branch Publishing, LLC 2011 978- 098270 5537
2. Introduction to Social Entrepreneurship Chahine T Taylor & Francis Group, LLC 2016 978-149871 7052.

COURSE OUTCOMES:

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

CO1 : Define and describe innovation and entrepreneurship.

CO2 : Examine the general process of innovation and the fundamentals from research and management practice.

CO3: Compare the different forms that innovation can take, such as product, process and service innovation.

CO4: Compare the different types of innovation such as radical and incremental innovation.

CO5: Examine the ways in which innovations are adopted and diffused.

CO6: Describe the healthcare value chain.

Teaching Methodology:

- This programme is delivered via distance learning (online) and includes recorded lectures, interactive online tutorials (webinars) and discussion forums, as well as online exercises and other activities.

ASSESMENT:

- Online quiz (formative)
- Participation 10% Coursework (Group and individual exercise assignments) 30% Final exam 60%

U23BMT81	BIO MEMS AND SYSTEM ON CHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce the students with the historical background of evolution of MEMS and acquaint with the various modern micromachining techniques.
2. To optimize various detection techniques and applications of biosensors.
3. The fundamentals of micro fluidics and lab-on-chip with various applications of BioMEMS and implantable devices.
4. To infer the scaling effects in miniaturizing devices with the recent trends in BioMEMS applications
5. To introduce the students with the historical background of evolution of MEMS and acquaint with the various modern micromachining techniques.

UNIT I INTRODUCTION 9

Historical background of Micro Electro Mechanical Systems-Types of MEMS devices-MEMS in automotive and aeronautical industry-Microsystems-Integrated MEMS and Microsystems.

UNIT II MATERIALS AND PROCESSES 9

Materials used in MEMS-Properties of silicon-Fabrication techniques-Lithography, Etching-Wafer bonding-Bulk and Surface micromachining-Ion implantation-Thin film deposition.

UNIT III BIOSENSORS 9

Types of biosensors-Detection techniques-Optical-Electrical,-Mechanical-SPR based. Specific examples: glucose sensor and urea sensor.

UNIT IV MICRO FLUIDICS AND BIOCHIPS 9

Fundamentals of Micro fluidics-Lab-on-a-chip devices-Silicon and glass micromachining for micro total analysis systems-Surface chemistry in polymer micro fluidic system- Biochips and their applications in medical treatment.

UNIT V APPLICATIONS OF BIOMEMS 9

MEMS devices for diagnostics-Drug delivery, Implantable devices- Shape memory implants- MEMS for neurosurgery-Micro needles. Drug delivery systems and MEMS-Application models-Blood pressure sensors-Biochip-Micro needles Microelectrodes – Neural prosthesis and catheter end sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Inception of historical background of evolution of MEMS and Microsystems to the students.

CO2 : Demonstration of basic properties of silicon and acquainted with the various modern micromachining techniques.

CO3 : Differentiate the various detection techniques and applications of biosensors.

CO4 : Exposure to fundamentals of micro fluidics and lab-on-chip.

CO5 : Acquaintance with various applications of BioMEMS and implantable devices and acquainted with the recent trends in BioMEMS applications.

CO6 : Apply the concept to the design of different types of Micro systems.

TEXT BOOKS:

1. E. Meng, Biomedical Microsystems, CRC Press, 2010, 1st Edition.
2. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata Mc Graw Hill Publishing Company, New Delhi. 2002.
3. Madou, Marc J. "Fundamentals of Microfabrication:The Science of Miniaturization" 2012 edition, CRC Press, Florida, USA
4. Edwin Oosterbroek, A Van Den Berg "Lab-on-a-Chip: Miniaturized Systems for (Bio) Chemical analysis and Synthesis " 2011 1st edition, Elsevier Science, Amsterdam, Netherlands

REFERENCE BOOKS:

1. P.Tabeling, S.Chen, Introduction to Microfluids, Oxford University Press, 2010, 1st Edition.
2. Rai-Choudhury, Prosenjit, MEMS and MEMS Technology and Applications, SPIE, 2000.
3. Wanjun Wang, Stephen A.Soper,"BioMEMS: Technologies and Applications" CRC Press, New York,2007.
4. Abraham P.Lee, L.James Lee "BioMEMS and Biomedical Nanotechnology" Springer,2016

U23BMP81	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2. To train the students in preparing project report and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
3. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the 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 would be able to

CO1 : Take up any challenging practical problems and find solution by formulating proper methodology.

CO2 : On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Bio Engineering	**Vertical II Medical Device Innovation and Development**	**Vertical III Management (Healthcare)**	**Vertical IV Mechanics**	**Vertical V Signal and Image Processing**	**Verticals VI Communication**	**Verticals VII Advanced Healthcare Devices**
Nanotechnology in medicine	Fundamentals of Healthcare Analytics	Clinical Engineering	Rehabilitation Engineering	Virtual Instrumentation for Biomedical Engineers	Communication Systems	Bio Analytic Equipments
Artificial Organs and Implants	Medical Device Design	Hospital Planning and Management	Physiological Modelling	Computer Vision	Wearable Devices	Critical Care Equipment
Biomedical Optics and Photonics	Patient safety, Standards and Ethics	Medical Waste Management	Assistive Technology	Speech and Audio Signal Processing	Body Area Networks	Human Assist Device
Neural Engineering	Medical Device Regulations	Economics and Management for Engineers	Continuum Model in Biomedical Engineering	Bio Mimetics	Virtual Reality and Augmented Reality in Healthcare	Advancements in Healthcare Technology
Principles of Tissue Engineering	Medical Innovation and Entrepreneurship	Biostatistics	Ergonomics	Brain Computer Interface and Applications	Telehealth Technology	Robotics in Medicine
Genetic Engineering	Rapid Prototyping	Forensic Science in Healthcare	Haptics	Biometrics	Medical Informatics	Therapeutic Equipments

U23BMV11	NANOTECHNOLOGY IN MEDICINE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the concept of nanoparticles
2. To understand the properties of nanoparticles
3. To understand the concept of nanotherapies
4. To know the material used for diagnosis purpose
5. To know the application of nanotechnology in medicine

UNIT I FUNDAMENTALS OF NANOPARTICLES 9

Overview of nanotechnology from medical perceptive, Introduction to nano, Nano-bio mimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterization of nanomaterials.

UNIT II BIOFUNCTIONALIZATION 9

DNA nanotechnology, Protein &glyco nanotechnology, Lipid nanotechnology, Bionanomachines, Carbon nanotube and its bio-applications. Cellular uptake mechanisms of nanomaterials, Nano pharmacology& drug targeting, In vitro methods to study antibacterial and anticancer properties of nanomaterials

UNIT III NANOPARTICLES IN DIAGNOSIS 9

Introduction to nanoparticles in diagnostics nuclear imaging, optical imaging, PET, Micro PET,cardio vascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials.

UNIT IV NANOTHERAPEUTICS 9

Nanoparticles as carriers in drug delivery- design, manufacture and physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, lung infectious disease, bone treatment, nano particles for oral vaccination and skin disease.

UNIT V POTENTIAL APPLICATIONS OF NANOTECHNOLOGY IN MEDICINE 9

Nanotubes, nano wires, and nano devices-introduction - Functional Nanostructures – Introduction to molecular electronics - Field emission and Shielding – Nano electromechanical systems (NEMs). Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe and understand the synthesis, characterization, and properties of nanoparticles.

CO2 : Understand about the protein and DNA nanotechnology and in vitro methods to study antibacterial and anticancer properties of nanomaterials

CO3 : Describe the nanoparticles used to diagnosis and its ethical issues and toxicology.

CO4 : Describe the nanoparticles used in therapeutics.

CO5 : Understand the applications of nanotechnology in medical field.

CO6 : To apprehend and explain the Biomedical application of nanotechnology.

TEXT BOOKS:

1. Malsch, N.H., "Biomedical Nanotechnology", CRC Press. (2005).

REFERENCE BOOKS:

1. Kumar, C. S. S. R., Hormes, J. and Leuschner C., "Nanofabrication Towards Biomedical Applications: Techniques, Tools, Applications, and Impact", WILEY -VCH Verlag GmbH & Co. (2005).
2. Mirkin, C.A. and Niemeyer, C.M., "Nanobiotechnology II: More Concepts and Applications", Wiley-VCH. (2007).
3. Lamprecht, A., "Nanotherapeutics: Drug Delivery Concepts in Nanoscience", Pan Stanford Publishing Pte. Ltd. (2009).
4. Jain, K.K., "The Handbook of Nanomedicine", Humana press. (2008).

U23BMV12	ARTIFICIAL ORGANS AND IMPLANTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To have an overview of artificial organs & transplants
2. To describe the principles of implant design with a case study
3. To explain the implant design parameters and solution in use
4. To study about various blood interfacing implants
5. To study about soft tissue replacement and hard tissue replacement

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS 9

ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLES OF IMPLANT DESIGN 9

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION 9

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS 9

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS 9

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Gain adequate knowledge about artificial organs & transplants

CO2 : Get clear idea about implant design and its parameters and solution

CO3 : Have in-depth knowledge about blood interfacing implants

CO4 : Explain different types of soft tissue replacement and hard tissue replacement
CO5 : Assess compatibility and functioning of artificial organs inside the living system.
CO6 : Design a Implantable Medical Devices

TEXT BOOKS:

1. Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976

REFERENCE BOOKS:

1. J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000
2. R S Khandpur, Handbook of Biomedical Instrumentation,Tata McGraw Hill, 2003
3. Yannas, I. V, "Tissue and Organ Regeneration in Adults", New York, NY: Springer, 2001. ISBN:9780387952147
4. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, ""Introduction to Biomedical Engineering", Elsevier, 2005

U23BMV13	BIOMEDICAL OPTICS AND PHOTONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Acquire knowledge about the physical properties of light and optical properties of tissues.
2. Learn the design and working principle of various optical components.
3. Understand the principles and applications of optical biosensors.
4. Understand the engineering and practical applications of optics related to diagnostic and surgical applications.
5. Understand the phenomenon of laser tissue interaction and practical applications of optics related to therapeutic applications.

UNIT I OPTICAL PROPERTIES 9

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

UNIT II OPTICAL INSTRUMENTATION 9

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

UNIT III OPTICAL BIOSENSORS 9

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

UNIT IV APPLICATIONS OF LASERS 9

Diagnostic - Optical coherence tomography, Fluorescence, Raman, Photoacoustic tomography, Laser induced breakdown spectroscopy (LIBS), Hyperspectral imaging. Surgical - Lasers in dentistry, Dermatology, Ophthalmology.

UNIT V LASER TISSUE INTERACTION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the various physical properties of light and optical properties of tissues.

CO2 : Consolidate the working principles of optical components.
CO3 : Discuss the various applications of biosensors in medicine.
CO4 : Summarize the diagnostic and surgical applications of lasers in medicine.
CO5 : Explain the laser tissue interaction and various therapeutic applications of lasers.
CO6 : Exported the photo dynamic in Therapeutic applications.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23BMV14	NEURAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. To be familiar with the nervous system development
2. To be exposed to neuronal diseases and disorders
3. To be familiar with nerve reconstruction and repairing.

UNIT I BASICS OF NEURON STRUCTURE AND FUNCTIONS 9

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

UNIT II BRAIN, BRAIN STEM AND SPINAL CORD 9

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

UNIT III NEURONAL DISEASES AND DISORDERS 9

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

UNIT IV NEUROPHYSIOLOGY & NEURORADIOLOGY 9

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

UNIT V NERVE RECONSTRUCTION AND REHABILITATION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the basic structure and functions of human nervous system.
CO2 : Understand diseases and degeneration related to nervous system.
CO3 : Analyze visualization and radiological assessment of nervous system.
CO4 : Apply neural tissue engineering for rehabilitation.
CO5 : Discuss about Regeneration of nervous system.
CO6 : Ability to design, implement & analyze the behaviour of simple neural network.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23BMV15	PRINCIPLES OF TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To study the cell types and differentiation.
2. To study basics about stem cells and its applications
3. To understand the methods and design involved in tissue engineering

UNIT I INTRODUCTION TO CELL BIOLOGY 9

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

UNIT II FUNDAMENTALS OF TISSUE ENGINEERING 9

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

UNIT III STEM CELLS 9

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

UNIT IV ENGINEERING METHODS AND DESIGN 9

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

UNIT V APPLICATION OF TISSUE ENGINEERING 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the basic concepts of tissue engineering

CO2 : Acquire ability to function on multi-disciplinary teams

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

CO4 : Design and develop different biomaterial in tissue engineering application

CO5 : Gain knowledge in research or clinical application on tissue repair/ engineering

CO6 : Understand the concepts of Stem Cells

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23BMV16	GENETIC ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics.
2. To explain the heterologous expression of cloned genes in different hosts.

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Manipulation of DNA – Restriction and Modification enzymes - Design of linkers and adaptors - Characteristics of cloning and expression vectors - Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Artificial chromosomes – Bacteria, Yeast - Chromosomal walking.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert's and Sanger's methods of DNA sequencing – PCR: Inverse PCR, Nested PCR, Allele specific PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES 9

Organization and structure of genomes - Genome sequencing methods: Conventional and shotgun genome sequencing methods, Next generation sequencing technologies - Ordering the genome sequence - Genetic maps and Physical maps, STS content based mapping, Hybridization mapping, Optical mapping.

UNIT V CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9

Introduction to Functional genomics – Microarrays - Serial Analysis of Gene expression (SAGE), Subtractive hybridization, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Would be aware of how to clone commercially important genes.

CO2 : The students would be aware of how to produce the commercially important recombinant proteins.

CO3 : Will be familiarized with gene and genome sequencing techniques
CO4 : Will be aware of microarrays, Analysis of Gene expression and proteomics.
CO5 : Acquire ability to function on multi-disciplinary teams
CO6 :

TEXT BOOKS:

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering", Blackwell Science Publications, 1993.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, 3rd Ed. (Blackwell Publishing).

REFERENCE BOOKS:

1. Isil Aksan Kurnaz, "Techniques in Genetic Engineering", CRC Press, 2015.
2. Oksana Ableitner, "Introduction to Molecular Biology: Working with DNA and RNA (essentials)", Springer International, 2022.
3. Arun K. Shukla, "Proteomics in Biology", Academic Press, 2017.

U23BMV21	FUNDAMENTALS OF HEALTHCARE ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the global trends and development methodologies of various types of products and services
2. To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
4. To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation.

UNIT IV **SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT** **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal.

UNIT V **BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY** **9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia – The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Define, formulate, and analyze a problem

CO2 : Solve specific problems independently or as part of a team

CO3 : Gain knowledge of the Innovation & Product Development process in the Business Context

CO4 : Work independently as well as in teams

CO5 : Manage a project from start to finish

CO6 : Design and Manage Business Dynamics – Engineering Services Industry

TEXT BOOKS:

1. Book specially prepared by NASSCOM as per the MoU
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005

REFERENCE BOOKS:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

U23BMV22	MEDICAL DEVICE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Introduce the Medical device standards and requirements.
2. Illustrate the design procedure of medical devices.
3. Outline the quality assessment in design.
4. Describe about the design realization.
5. Understand the validation and verification of various medical devices

UNIT I NEEDS FINDING AND CONCEPT GENERATION 9

Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping – final concept selection. Safety and Risk Management - Tools, Documents and Deliverables.

UNIT II MEDICAL DEVICES STANDARDS AND REQUIREMENTS 9

FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO13485, ISO 14971, IEC60601-1, IEC 62304. Reliability, Concept of failure, Product Design and Development Process.

UNIT III DESIGN MEDICAL ENGINEERING 9

Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.

UNIT IV TESTING AND VALIDATION 9

Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

UNIT V DESIGN TRANSFER AND MANUFACTURING 9

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Define the medical devices standards and requirements.

CO2 : Summarise the concept of medical device development.

CO3 : Recall the engineering design and project metrics.
CO4 : Demonstrate the testing and validation of medical equipment.
CO5 : Interpret the various design transfer and manufacturing methods.
CO6 : Analyze the quality assessment in design.

TEXT BOOKS:

1. Zenios, Makower and Yock, ―Biodesign – The process of innovating medical technologies‖, Canbridge University Press, 2009
2. Theodore R. Kucklick , The Medical Device R&D Handbook, Second Edition, CRC Press, 2012
3. Peter Ogrodnik,Medical Device Design Innovation from Concept to Market, Elsevier, 2013

REFERENCE BOOKS:

1. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design,2ndedition, 2005.
2. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.
3. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau‘Handbook of Human Factors in Medical Device Design‘,CRC press,2010.
4. Jagdish Chaturvedi, Inventing medical devices: A perspective from India, Create Space Independent Publishing Platform, 1st edition, 2015.

U23BMV23	PATIENT SAFETY, STANDARDS AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the importance of patient safety against electrical hazards
2. To explain the patient safety laws and regulations
3. To understand the standards and testing of patient
4. To know the patient safety specialities in clinical
5. To know about the health care organization

UNIT I EFFECTS OF ELECTRICITY 9

Physiological effects of electricity - important susceptibility parameters - microshock - macroshock hazards -patients electrical environment - isolated power system - conductive surfaces.

UNIT II PATIENT SAFETY LAWS AND REGULATIONS 9

Mandatory Reporting systems. Anatomy of a patient safety Law: Compliance Tips, Federal patient safety Legislation Initiatives, Medical Device Reporting, Clinical trials and Adverse-Event Reporting, Patient safety Goals and standards, The Quality Assessment and performance Improvement rule.

UNIT III STANDARDS AND TESTING 9

Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-1 2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system.

UNIT IV PATIENT SAFETY IN MAIN CLINICAL SPECIALITIES 9

Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology.

UNIT V MEDICAL ETHICS 9

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society, Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Outline the importance of patient safety against electrical hazards.

CO2 : Brief out the patient safety laws and regulations

CO3 : Explain the standards and testing of patient

CO4 : Understand the concept of the patient safety specialities in clinical

CO5 : Know about various health care organizations.

CO6 : Analyze the different health care organizations.

TEXT BOOKS:

1. John G.Webster, “Medical Instrumentation Application and design”, 4th edition, Wiley India PvtLtd, New Delhi, 2015.
2. Liam Donaldson,Walter Ricciardi, “Textbook of patient safety and clinical Risk management”, Springer.
3. Fay A. Rozovsky, James R. Woods, Jr, “ The Handbook of Patient Safety Compliance”, 2016

U23BMV24	MEDICAL DEVICE REGULATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To study the regulation of medical devices, process of development, ethical and quality considerations.
2. To learn the various ISO standards of quality and risk management for regulatory purposes
3. To explore the process of approval and marketing of medical devices.
4. To comprehend the regulatory process for medical devices in India, US, and EU.
5. To familiarize with clinical evaluation and investigation of medical devices.

UNIT I MEDICAL DEVICE REGULATIONS 9

History of medical device regulation, regulatory affairs professional's roles, required competencies, medical device classification: scope, definitions, main classifications, Risk based classification, practical examples, labeling of medical devices: definition, elements, risk management, clinical evaluation and labeling, language level and intended users. Differentiating medical devices IVDs and combination products from that of pharmaceuticals.

UNIT II ISO STANDARDS 9

ISO 13485:2016: Requirements for regulatory purposes: Quality Management Systems, certification process. ISO 14971: Application of Risk management to medical Devices.

UNIT III IEC, REGULATORY SYSTEMS IN USA & EU 9

IEC international standards and conformity assessment for medical devices, Good submission process, medical device regulatory system in the USA and European Union.

UNIT IV INDIAN REGULATORY SYSTEM 9

India: Medical device regulatory system: market environment, functions undertaken by DGGI, central government, FDA and state governments, guidance documents, details of key regulators, IMDRF and CDSCO, regulatory overview in India, product registration on conformity assessment, quality system regulation, technical material and labeling requirements, commercial aspects, upcoming regulation changes.

UNIT V CLINICAL TRIALS AND DIGITAL REGULATIONS 9

Regulatory strategy and competitive advantage, Preclinical and Clinical Trial Design for Medical Devices in India; FDA approved devices, post-market surveillance/vigilance, Digital health regulations: Connected care, intelligent design control, reducing design time and cost with in-silico clinical trials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Define and explain the basic concepts of medical device regulations.

CO2 : Decipher the meaning of ISO standards from a regulatory perspective.

CO3 : Explain US-FDA, IEC and European regulations.

CO4 : Discuss regulations in India

CO5 : Explain the regulatory aspects of clinical trials and digital alternatives

CO6 : Evaluate and investigate of medical devices.

TEXT BOOKS:

1. Medical Regulatory Affairs: An International Handbook for Medical Devices and Healthcare Products, 3rd Edition, Taylor & Francis Group, 2021

REFERENCE BOOKS:

1. Reliable Design of Medical Devices, Second Edition by Richard Fries, CRC Press, 2006
2. Medical Device Quality Assurance and Regulatory Compliance by Richard C Fries, CRC Press, 1998
3. Product Safety in the European Union by GaborCzitan, Attila Gutassy, Ralf Wilde, TUV Rheinland Akademia, 2008

U23BMV25	MEDICAL INNOVATION AND ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To learn fundamentals of entrepreneurship
2. To apply the methods of entrepreneurship in medical field
3. To evaluate the medical devices and market trends.

UNIT I CREATIVITY, INNOVATION AND IPR 9

The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

UNIT II SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP 9

Definition– Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.

UNIT III NEW VENTURE 9

Developing an Effective Business Model: The Importance of a Business Model – Starting a small-scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. case study**.**

UNIT IV FINANCING THE NEW VENTURE AND GLOBALIZATION 9

Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.

UNIT V MARKETING FUNCTION 9

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the role of biomedical engineers in entrepreneurship

CO2 : Interpret the background for biomedical engineers in entrepreneurship

CO3 : Acquire the skills and techniques required towards innovation

CO4 : Categorize the resources and funding agencies and judge the right product based on market needs

CO5 : Compile and quantify the opportunities and challenges

CO6 : Design the methods of entrepreneurship in medical field.

TEXT BOOKS:

1. Jen-Shih Lee "Biomedical Engineering Entrepreneurship", World Scientific Publishing, USA. 2010
2. Vasant Desai, ―The Dynamics of Entrepreneurial Development and Management‖, Himalaya Publishing House, 2010

REFERENCE BOOKS:

1. Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy, 2016
2. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organization", Harvard Business Press, Boston, 2014
3. Donald F.Kuratko and Richard M. Hodgetts, "Entrepreneurship", South-Western
4. Gupta S.L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012
5. Prasanna Chandra, "Projects- Planning, Analysis, Financing, Implementation and review‖, TATA McGraw Hill, 2012
6. Sudha G. S., "Management and Entrepreneurship Development", Indus Valley Publication, 2009

U23BMV26	RAPID PROTOTYPING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Learn the need and fundamentals of rapid prototyping
2. Understand the concepts of design and assembling of various parts
3. Study the process and material selection for UV and Laser based AM
4. Investigate the process of fused deposition moulding and sheet lamination
5. Explore droplet formation and beam deposition process.

UNIT I INTRODUCTION 9

Overview –Need -Development of Additive Manufacturing Technology -Principle – AM Process Chain-Classification –Rapid Prototyping-Rapid Tooling –Rapid Manufacturing – Applications-Benefits –Case studies.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing -CAD model preparation –Part orientation and support structure generation –Model slicing –Tool path generation-Design for Additive Manufacturing: Concepts and objectives-AM unique capabilities –DFAM for part quality improvement-Customised design and fabrication for medical applications.

UNIT III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA-Photo curable materials –Process -Advantages and Applications. Powder Bed Fusion: SLS-Process description –powder fusion mechanism –Process Parameters –Typical Materials and Application. Electron Beam Melting.

UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction –Basic Principle –Materials –Applications and Limitations –Bio extrusion. Sheet Lamination Process: LOM-Gluing or Adhesive bonding –Thermal bonding.

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies –Continuous mode –Drop on Demand mode –Three Dimensional Printing –Advantages –Bioplotter -Beam Deposition Process: LENS-Process description –Material delivery –Process parameters –Materials –Benefits –Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate the basics of Additive manufacturing.

CO2 : Design and assembly of various parts for the desired task.

CO3 : Explain the process involved in laser and UV based AM

CO4 : Illustrate the process of fused deposition moulding and sheet lamination

CO5 : Support design and manufacturing, case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools.

CO6 : Analyze the process of fused deposition moulding and sheet lamination.

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, World Scientific Publishers, Third edition, 2010
2. Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007
3. Kamrani A.K. and Nasr E.A., Rapid Prototyping: Theory and practice, Springer, 2006

REFERENCE BOOKS:

1. Ian Gibson, David W.Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010
2. Tom Page Design for Additive Manufacturing, LAP Lambert Academic Publishing, 2012
3. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005

U23BMV31	CLINICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Understand of the clinical engineering profession, qualifications, roles, activities, and expectations.
2. Practice medical equipment and analyze challenges with their healthcare technology.
3. Work as a team to address problems and errors in medical devices.
4. Design better medical devices with computerized approaches.
5. Explore the Health Technology Management systems with medical devices and supportive services with advanced application.

UNIT I INTRODUCTION 9

Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.

UNIT II MEDICAL TECHNOLOGY MANAGEMENT PRACTICES 9

Strategic Medical Technology Planning, Scope , Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequist for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT III ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP) 9

Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis.

UNIT IV CLINICAL ENGINEERING PROGRAM INDICATOR 9

Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

UNIT V ADVANCED TECHNOLOGY FOR PATIENT SAFETY 9

Factors Contributing to Medical Errors: Heath Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology

CO2 : Give the program and framework to recognize the errors of medical equipment

CO3 : State the issues or errors in patient safety and formulate patient safety package system

CO4 : Define the problem precisely and examine the possible issues using program indicators.

CO5 : Demonstrate computer based equipment with automated system by using CPOE method.

CO6 : Explore the Health Technology Management systems with medical devices.

TEXT BOOKS:

1. Ernesto Iadanza, Joseph Dyro, “Clinical Engineering Handbook”, Elsevier Academic Press, 2014
2. Robert Miniati, “Clinical Engineering from Devices to Systems”, Academic Press, 23-Dec-2015 - Technology & Engineering

U23BMV32	HOSPITAL PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
2. To understand the principles, practices and areas of application in Hospital management.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

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

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT III MARKETING RESEARCH & CONSUMER BEHAVIOUR 9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the principles, practices and areas of application in Hospital Management.

CO2 : Understand the biomedical waste disposal concept.

CO3 : Explain the importance of supportive services.

CO4 : Comprehend the quality aspect specified by the international standards.

CO5 : Knowledge on Hospital safety.

CO6 : Understand the Hospital Planning And Management.

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 edition Reprint 2007
3. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York, 1977

REFERENCE BOOKS:

1. Peter Berman, "Health Sector Reform in Developing Countries", Harvard University Press, 1995
2. Norman Metzger , "Handbook of Health Care Human Resources Management", Aspen Publication Inc. Rockville, Maryland, USA, 2nd Edition 1990
3. Arnold D. Kalcizony & Stephen M.Shortell, "Health Care Management", 6th Edition, 2011
4. Blane, David, Brunner, Eric , "Health and Social organization: Towards a health policy for the 21st century", Calrendon Press, 1994

U23BMV33	MEDICAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Understand the hazardous materials used in hospital and its impact on health
2. Understand various waste disposal procedures and management.

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II BIOMEDICAL WASTE MANAGEMENT 9

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III HAZARDOUS MATERIALS 9

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

UNIT IV FACILITY SAFETY 9

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY 9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic

Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyse various hazards, accidents and its control

CO2 : Design waste disposal procedures for different biowastes

CO3 : Categorise different biowastes based on its properties

CO4 : Design different safety facility in hospitals

CO5 : Propose various regulations and safety norms

CO6 : Understand various waste disposal procedures and management.

TEXT BOOKS:

1. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012)
2. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).

REFERENCE BOOKS:

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006
2. V.J. Landrum, “Medical Waste Management and disposal”, Elsevier, 1991

U23BMV34	ECONOMICS AND MANAGEMENT FOR ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the concepts of Economics with respect to the demand and supply analysis.
2. To analyze the theory of production and the analysis of the cost parameter by using the Elasticity.
3. To manage and plan the situation with the help of the available strategies to support the decision making process.

UNIT I INTRODUCTION TO ECONOMICS 9

Introduction to Economics – Scope of Economics – Positive and Normative Science – Methodology of Economics – Economic Laws - Economy and its basic problems: Economy and its working – Kinds of economy systems – Basic problems of economy.

UNIT II DEMAND AND SUPPLY ANALYSIS 9

The Law of Demand – The Law of Supply – Elasticities of Demand and Supply: Price Elasticity of Demand - Price Elasticity and Consumption Expenditure- Cross Elasticity of Demand – Income Elasticity of Demand – The Elasticity of Price Expectations – The uses of Elasticity– Price Elasticity of Supply.

UNIT III THEORY OF PRODUCTION AND ANALYSIS OF COST 9

Meaning of Production – Production concepts – Production Function – Laws of Production – Cost Concepts - Short-Run Cost Output Relations – Long Run Cost output relations – Economics of Scale.

UNIT IV INTRODUCTION TO MANAGEMENT 9

Management: Overview – Management Defined – Managerial skills – Managerial roles – Management responsibilities – Management functions. Evolution of Management: Classical approaches to Management – Contemporary Management Perspectives.

UNIT V PLANNING 9

Planning and Forecasting: Importance of Planning – Principles of effective Planning – Planning process – Types of Plans. Strategic Planning: Strategic Planning process – Rational decision making.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Summarize how to solve economics principles to solve economic problems in engineering discipline by satisfying the economic laws.

CO2 : Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity.

CO3 : Interpret short run and long run costs in the process of production for carrying out a business.

CO4 : Apply managerial skills to make decisions and solve problems for achieving organizational objectives.

CO5 : Express the principles of effective planning for survival and success of all organizations using standing and single use planning methods.

CO6 : Analyze in the physiological data.

TEXT BOOKS:

1. D.N.Dwivedi, "Principles of Economics", Second Edition, Vikas Publishing House (P) Limited, New Delhi, 2012
2. J.S.Chandan, "Management Concepts and Strategies", Vikas Publishing House (P) Limited, New Delhi, 2003

REFERENCE BOOKS:

1. RanbirSingh,"Principles of Engineering Economics and Management", S.K.Kataria& Sons, New Delhi, 2013
2. Manish Varshney and Vidhan Banerjee,"Engineering and Managerial Economics",First Edition, CBS Publishers and Distributors Pvt. Ltd., 2015

U23BMV35	BIOSTATISTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the statistical methods for the data.
2. Comprehend the fundamental of mathematical and statistical theory in the application of biomedical field.
3. Apply the regression and correlation analyze in the physiological data.
4. Understand the source of Medical data
5. Understand the Visual analytics of Healthcare data.

UNIT I INTRODUCTION 9

Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and medical data analysis, Introduction to probability, likelihood & odds, distribution variability.

UNIT II STATISTICAL PARAMETERS 9

Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, ratio of two population variances and tests of goodness of fit, tests of independence, tests of homogeneity.

UNIT III REGRESSION AND CORRELATION ANALYSIS 9

Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.

UNIT IV INTERPRETING DATA 9

Interpreting life tables clinical trials, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V ANALYSIS OF VARIANCE 9

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Define the new and existing statistical methodology for their research problem.

CO2 : Explain p- values for different statistical tests.
CO3 : Analyze the biomedical research data and be able to report the study results.
CO4 : Describe the various sources of medical data
CO5 : Demonstrate the visual analytical procedure of Medical Data.
CO6 : Define the new and existing statistical methodology for their research problem.

TEXT BOOKS:

1. Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, John Wiley & Sons Publication, 10th Edition, 2013
2. Peter Armotage, Geoffrey Berry and J.N.S.Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001
3. Bernard Rosner. Fundamentals of biostatistics. Nelson Education, 8th Edition 2015 ISBN: 978-1-305-26892-0
4. Editors: Chandan K. Reddy, Charu C. Agarwal, Healthcare Data Analytics, CRC Press

REFERENCE BOOKS:

1. Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2ndEdition, 2018
2. Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014
3. Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 2006

U23BMV36	FORENSIC SCIENCE IN HEALTHCARE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. The history of the forensic sciences and its place in popular culture
2. The roles of different types of professionals involved in evaluating a crime scene and the collected evidence
3. Forensic microscope and Anthropology
4. The Blood stain identification
5. The methodology of collecting & interpreting data for fingerprint application.

UNIT I BASICS OF FORENSIC SCIENCE 9

Forensic science, Introduction to the Forensic Sciences, History and Development of Forensic Science, Deductive Reasoning, Organization of a Crime Laboratory Case Studies: The Enrique Camarena Case. A Forensic Nightmare Organization of forensic science laboratories of center and state -NCRA AND NICFS, fundamental rights, criminal profiling, concept of quality control management in forensic institutions.

UNIT II OBSERVATION AND CRIME SCENE 9

Observational Skills - Sherlock Holmes and Deductive Reasoning - Observations by Witnesses. Case Studies. The Crime Scene -Locard's Exchange Principle, Securing and Recording the Crime Scene, Legal Considerations at the Crime Scene, Evidence Collection and Recordation Techniques. Mock Crime Scene: Processing and Documenting a Crime Scene.

UNIT III FORENSIC MICROSCOPE AND ANTHROPOLOGY 9

Forensic Use of the Microscope -The Compound, Comparison, and Stereoscopic Microscope, The Scanning Electron Microscope (SEM). Forensic Anthropology- Introduction, Human Anatomy–The Skeletal System, Skeletal Determination of Demographic Data from Skeletal Remains, Determining Types of Trauma and Disease from Skeletal Remains, Case Studies.

UNIT IV BLOOD STAIN IDENTIFICATION 9

Detection and identification of Blood stains, Determination of species of origin, Blood Group systems, Techniques of Determination of Blood groups of Blood stains, Determination of seminal and other fluids and their Blood Grouping, DNA, DNA Phenotyping and RNA Profiling & their applications. Wildlife forensics.

UNIT V FINGERPRINT APPLICATION 9

Fingerprints -Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track

marks, Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Define the significance of forensic sciences

CO2 : Observe and document crime scenes

CO3 : Determine Trauma and Diseases.

CO4 : Describe the various sources of medical data related to forensic science.

CO5 : Demonstrate the visual analytical procedure of finger print application.

CO6 : Visual analytics of Healthcare data.

TEXT BOOKS:

1. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi
2. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press

REFERENCE BOOKS:

1. Saferstein : Criminalistics (1976) Prentice Hall Inc., USA
2. Deforest, Gansellen & Lee : Introduction to Criminalistics
3. Sharma, B.R. (1974) Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad, 1974

U23BMV41	REHABILITATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Explain the need for medical aids.
2. Understand the sensory rehabilitation systems.
3. Learn the use of orthopedic prosthetics and orthotics in rehabilitation.
4. Understand virtual reality in rehabilitation
5. Have an understanding of rehabilitation medicine and advocacy.

UNIT I INTRODUCTION TO REHABILITATION 9

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT II ENGINEERING CONCEPTS IN SENSORY AUGMENTATION AND SUBSTITUTION 9

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system - Tactual augmentation, Tactual substitution.

UNIT III ORTHOPEDIC PROSTHETICS AND ORTHOTICS 9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT IV VIRTUAL REALITY 9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Summarize the key terminologies used by the rehabilitation team.

CO2 : Illustrate Engineering Concepts in Sensory & Motor rehabilitation.

CO3 : Design different orthotics and prosthetics for rehabilitation applications.

CO4 : Summarize the need of virtual reality tools for different aids.

CO5 : Appraise the legal aspects for building rehabilitation aids for the needed people.

CO6 : Analyze the virtual reality in rehabilitation.

TEXT BOOKS:

1. Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press, 2000
2. Robinson C.J, "Rehabilitation Engineering", CRC Press, 2006

REFERENCE BOOKS:

1. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007
2. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007
3. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000
4. Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis, 1988

U23BMV42	PHYSIOLOGICAL MODELLING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

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

UNIT I INTRODUCTION TO PHYSIOLOGICAL MODELING 9

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

UNIT II MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM 9

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

UNIT III NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS 9

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

UNIT IV COMPARTMENTENTAL PHYSIOLOGICAL MODEL 9

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

UNIT V SIMULATION OF PHYSIOLOGICAL SYSTEMS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the application of Physiological models

CO2 : Describe the methods and techniques for analysis and synthesis of Linear and dynamic system

CO3 : Develop differential equations to describe the compartmental physiological model

CO4 : Describe Nonlinear models of physiological systems

CO5 : Illustrate the Simulation of physiological systems

CO6 : Design a dynamic models, simulate and visualize

TEXT BOOKS:

1. Michel C Khoo, "Physiological Control Systems -Analysis, simulation and estimation", Prentice Hall of India, 2001
2. Marmarelis, "Nonlinear Dynamic Modeling of Physiological Systems", Wiley-IEEE Press, 2004.

REFERENCE BOOKS:

1. Benjamin C Kuo, "Automatic control systems", Tenth Edition, McGraw-Hill Education, 2017
2. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,"Advanced Computational Methods in Life System Modeling and Simulation", *Springer*,2017
3. DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, Wiley-IEEE Press, 2003

U23BMV43	ASSISTIVE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To know the hardware requirement various assistive devices
2. To understand the prosthetic and orthotic devices
3. To know the developments in assistive technology

UNIT I CARDIAC ASSIST DEVICES 9

Principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II HEMODIALYSERS 9

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS 9

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Interpret the various mechanical techniques that will help in assisting the heart functions.

CO2 : Describe the underlying principles of hemodialyzer machine.

CO3 : Indicate the methodologies to assess the hearing loss.

CO4 : Evaluate the types of assistive devices for mobilization.

CO5 : Explain about TENS and biofeedback system.

CO6 : Understand the Principle of prosthetic and orthotic devices

TEXT BOOKS:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006

2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010

REFERENCE BOOKS:

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola , Elsevier 2019 ISBN 978 -0-323-662116
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

U23BMV44	CONTINUUM MODEL IN BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To elucidate the relationship between continuum physics and mathematics.
2. To governing equations for all branches of continuum physics
3. Focus on application to biological and biomedical processes

UNIT I BASIC CONCEPTS OF PHYSIOLOGICAL SYSTEM 9

Introduction to physiological system and mathematical modelling of physiological system The technique of mathematical modelling, classification of models-black box & building block, characteristics of models. Purpose of physiological modelling and signal analysis, linearization of nonlinear models. Engineering system and physiological system, System variables & properties-Resistance, Compliance & their analogy. Time invariant and time varying systems for physiological modelling.

UNIT II EQUIVALENT CIRCUIT MODEL 9

Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of the whole neuron.

UNIT III LINEAR MODEL 9

Respiratory mechanics & muscle mechanics, Huxley model of isotonic muscle contraction, modelling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis. Modelling of Blood flow and Urine formation: Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

UNIT IV COMPARTMENTENTAL MODEL 9

Cardio-Pulmonary Modelling: Cardiovascular system and pulmonary mechanics modelling and simulation, Model of Cardiovascular Variability, Model of Circadian Rhythms Eye Movement Model: Types of Eye movement, Eye movement system and Wetheimer's saccade eye model. Robinson's Model, Oculomotor muscle model, Linear Reciprocal Innervations Oculomotor Model.

UNIT V SIMULATION OF PHYSIOLOGICALSYSTEMS 9

Simulation of physiological systems using Open CV / MATLAB software, MIMMICS. Biological

receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and Perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the requirements for the development of mathematical and computational models in the analysis of physiological process/ biological systems

CO2 : Select and apply appropriate analytical and numerical tools to solve ordinary differential equation models of biological problems.

CO3 : Integrate electrical, electrochemical, physiological and mechanical phenomena into the design of models to assess their inter-dependencies.

CO4 : Break down a complex physiological system into the function of its component subsystems, and then build an engineering model based on subsystems.

CO5 : Understand the application to biological and biomedical processes

CO6 : Analyze the different application to biological and biomedical processes

TEXT BOOKS:

1. Endarle, Blanchard &Bronzino, Introduction to Biomedical Engg. , Academic press
2. Suresh.R.Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers
3. V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press
4. L.Stark, Neurological Control System, Plenum Press.
5. R.B. Stein, Nerve and Muscle, Plenum Press

REFERENCE BOOKS:

1. Michel C Khoo, Physiological Control Systems -Analysis, simulation and estimation, Prentice Hall of India, 2001
2. Joseph D, Bronzino, “The Biomedical Engineering Handbook”, CRC Press, 3rd edition, 2006
3. Modeling and Simulation in Medicine and the Life Sciences (2nd Edition), by F.C. Hoppensteadt and C.S.Peskin, Springer 2002
4. John D. Enderle, “Model of Horizontal eye movements: Early models of saccades and smooth pursuit”, Morgan &Claypool Publishers, 2010

U23BMV45	ERGONOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To get exposed to principles of visual capabilities.
2. To learn the mechanics of muscle physiology and significance of rest cycle.
3. To learn spatial compatibility and the relation between control orders and control response.
4. To know about the measurements and proportions of the human body.
5. 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 Equipment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand principles of ergonomics.

CO2 : Understand the significance of posture

CO3 : Learn about tracking tasks.

CO4 : Learn about ergonomics and its implications to various domain

CO5 : Perform case studies on electronic instruments and medical equipment.

CO6 : Analyse the mathematical models, analysis and design of biomedical devices using case studies.

TEXT BOOKS:

1. Pascale Carayon, "Handbook of Human Factors and Engineering", Second Edition, CRC Press, 2011
2. Martin Helander, "Guide to Human Factors and Ergonomics", Second Edition, CRC Press,2005
3. Benjamin W.Niebel, "Motion and Time Study", Richard, D. Irwin Inc., Seventh Edition, 2002

REFERENCE BOOKS:

1. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press2007
2. George Kanawaty, "Introduction to work study", ILO, 3rd edition, Oxford & IBH publishing, 2001
3. Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, 2005

U23BMV46	HAPTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Expose to basic principles of Haptics and their property.
2. Give knowledge on machines in haptics.
3. Learn types of sensors and actuators.
4. Understand basic concepts of human locomotion, biomechanical analysis using Finite Element Analysis.

UNIT I HUMAN HAPTICS 9

Somatosensory System; Motor System, Muscle Physiology; Haptics Psychophysical experiments.

UNIT II MACHINE HAPTICS 9

Design Haptic devices; Human factors involved;

UNIT III HAPTIC SENSORS AND ACTUATORS 9

Barriers in human haptics; Ergonomics.

UNIT IV COMPUTATIONAL HAPTICS 9

Haptic Rendering; Rigid bodies, Deformable bodies, Stability Rendering effects, Human performance and evaluation; Biomechanics of manipulation; Neuromuscular Models.

UNIT V HAPTICS FOR MEDICAL APPLICATIONS 9

Applications: Telemedicine; Rehabilitation; Medical Simulations for education.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the laws of principles of haptics for human

CO2 : Discuss the behavior of machines in haptics

CO3 : Analyse the suitable sensor and actuator for haptics

CO4 : Identify suitable computation for haptics

CO5 : Describe the finite element analysis, design the work station depending upon the haptics

CO6 : Understand the principle of different types of sensors and actuators.

TEXT BOOKS:

1. Kay M.Stanney, Handbook of Virtual Environments: Design, Implementation, and Applications, Lawrence Erlbaum Associates, Publications. N. I. Durlach and A. S. Mavor, eds., Virtual Reality: Scientific and Technological Challenges, National Academy Press, Washington, D.C., 1994
2. G.C. Burdea, Force and Touch Feedback for Virtual Reality, John Wiley & Sons, 1996
3. Kandel, Eric R., et al., eds. Principles of neural science. Vol. 4. New York: McGraw-hill, 2000

REFERENCE BOOKS:

1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012
2. Marc J. Madou, Fundamentals of Micro fabrication: the Science of miniaturization, CRC Press, 2002
3. Nadim Maluf and Kirt Williams, An introduction to Microelectro Mechancial Systems Engineering, Second Edition, Artech House Inc, MA, 2004
4. Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey, USA, 2006
5. Nitaigour Premch and Mahalik, MEMS, Tata McGraw Hill Publishing Company, New Delhi, 2007

U23BMV51	VIRTUAL INSTRUMENTATION FOR BIOMEDICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Understand the importance and applications of virtual instrumentation.
2. Develop the basic VI programs.
3. Learn different Data Acquisition System concepts.
4. Develop real time applications using LabVIEW.
5. Create Virtual Instruments for practical works.

UNIT I GRAPHICAL PROGRAMMINGENVIRONMENT 9

Introduction, History of Virtual Instrumentation, Lab VIEW and VI, Conventional and Graphical Programming, Future Perspective. Introduction, Components of Lab VIEW, Owned and Free Labels, Tools and Other Palettes, Arranging Objects, Pop-up menus, Colour Coding, Code Debugging, Context Sensitive Help, Types of VI's, Creating Sub – VIs, Concepts of graphical programming Lab VIEW software.

UNIT II FUNDAMENTALS OF VIRTUALINSTRUMENTATION VI 9

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency – Multiplexing of analog inputs – Single-ended and Differential inputs – Different strategies for sampling of multi-channel analog inputs – Concept of universal DAQ card – Use of timer-counter and analog outputs on the universal DAQ card.

UNIT III CLUSTER OF INSTRUMENTS IN VI SYSTEM 9

Interfacing of external instruments to a PC – RS232 – RS 422 – RS 485 – USB standards – IEEE 488 standard – ISO-OSI model for serial bus –Introduction to bus protocols of MOD bus and CANbus.

UNIT IV GRAPHICAL PROGRAMMING ENVIRONMENT IN VI 9

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI – Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures – Types of data – Arrays – Formulae nodes – Local and global variables – String and file I/O.

UNIT V ANALYSIS TOOLS AND BIOMEDICAL APPLICATIONS IN VI 9

Fourier transform – Power spectrum – Correlation – Windowing and filtering tools – Simple temperature indicator – VI based cardiac monitor, Bio bench-A virtual instrument application for (ECG), data acquisition and analysis of physiological signals, ECG signal processing, Generation of HTML page.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Knowledge of technological similarities and differences between the different modalities and choice of equipment for different clinical applications.

CO2 : Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging

CO3 : Knowledge of ionizing radiation related risks and radiation protection principles in medical imaging.

CO4 : Knowledge of new applications and technology trends for the different modalities.

CO5 : Knowledge on how to analyse and assess a scientific article.

CO6 : Analyse the Virtual Instruments for practical works.

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, Wiley-Liss, 2002

REFERENCE BOOKS:

1. Gopal B. Saha ―Physics and Radiobiology of Nuclear Medicine - Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood, D R Hose, D C Barber, ― Medical physics and Biomedical Engineering, - CRC Press, 1999
3. Myer Kutz, ― Standard handbook of Biomedical Engineering and design, McGraw Hill, 2003
4. P.Ragunathan, ― Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques, Paperback – Import, 2007
5. Khandpur R S, ― Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 2003

U23CSV17	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To review image processing techniques for computer vision.
2. To understand various features and recognition techniques
3. To learn about histogram and binary vision
4. To Apply three-dimensional image analysis techniques
5. To Study real world applications of computer vision algorithms

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV 3D RECONSTRUCTION 9

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture map.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Understand basic knowledge, theories and methods in image processing and computer vision.

CO 2: Explain about advanced image processing techniques in OpenCV.

CO 3: Apply 2D a feature-based based image alignment, segmentation and motion

estimations

CO 4: Apply 3D image reconstruction techniques

CO 5: Design and develop innovative image processing and computer vision applications

CO 6: Design and develop innovative computer vision applications

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE BOOKS:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

U23BMV53	SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Provide students with basic knowledge about speech production and hearing.
2. Understand time-frequency analysis concepts.
3. Learn fundamentals of audio coding and transform coders.
4. Understand time and frequency domain methods for speech processing.
5. Study linear predictive analysis of speech.

UNIT I MECHANICS OF SPEECH AND AUDIO 9

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Nonsimultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS 9

Introduction -Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree-Structured QMF and CQF M-band Banks - Cosine Modulated “Pseudo QMF” M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies.

UNIT III AUDIO CODING AND TRANSFORM CODERS 9

Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4AudioCoding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.

UNIT IV TIME AND FREQUENCY DOMAIN 9

Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods. HOMOMORPHIC SPEECH ANALYSIS**:** Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.

UNIT V LINEAR PREDICTIVE ANALYSIS 9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Examine auditory models to design perceptual audio quality measure.
CO2 : Design analysis-by-synthesis model for speech perception.
CO3 : Analyze and design algorithms for speech and audio coding.
CO4 : Analyze and design algorithms for extracting parameters from the speech signal.
CO5 : Implement pitch detection and formant analysis in speech signals.
CO6 : Analyze the linear predictive analysis of speech.

TEXT BOOKS:

1. Rabiner. L. R and Schaffer. R. W., "Digital Processing of Speech signals", Prentice Hall, 1978
2. Andreas Spanias, Ted Painter, Venkatraman AttiWayne Tomasi, "Audio signal processing and coding", John Wiley & Sons, 2007

REFERENCE BOOKS:

1. Udo Zölzer , Digital Audio Signal Processing, A John Wiley& sons Ltd Publication, Second Edition, 2008
2. Mark Kahrs, Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio And Acoustics", KLUWER ACADEMIC PUBLISHERS NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW, 2002
3. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002
4. Martin S. Roden, "Analog and Digital Communication System", Prentice Hall of India, 3rd Edition, 2002

U23BMV54	BIO MIMETICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To know the basic mechanism in biomimetic design in various applications
2. To Identify the basic biologically inspired mechanism, materials and process
3. To understand the mechanism of cognition and open ended design automation
4. To Analyze the importance bio-inspired sensors and biomimetic actuators
5. To Analyze the biomechanics and rhythmic of motion

UNIT I INTRODUCTION TO BIOMIMETICS 9

Introduction : Biologically Inspired Mechanisms-Biologically Inspired Mechanisms-Biologically Inspired Structures and Part-Defense and Attack Mechanisms in Biology-Materials and Processes in Biology-BIOSENSORS-Robotics Emulating Biology-interfacing Biology and Machines-muscle function-design-Muscle adaptation-Biomimetics of muscle design-Bio-inspired fiber composite

UNIT II MECHANISM OF COGNITION AND OPEN ENDED DESIGN AUTOMATION 9

Mechanized Cognition-Training and education-Language Cognition-sound & vision cognition-Machine Bodies and Brains: Evolving Controllers and Some Aspects of the Morphology-Evolving Bodies and Brains-Morphology Representations: Tree representations-Developmental representations-Regulatory network representations-Evolving Machines in Physical Reality-Economy of Design Automation-Principles of Design-research metnodology.

UNIT III BIO-INSPIRED SENSORS 9

Biomimetic tactile sensing: Human sense of touch-Biomimetic artificial touch-Examples of bio-inspired tactile sensing-Bio-Inspired hair based interial sensors: Hair structures for inertial sensing-Cricket-inspired accelerometer-Fly-inspired gyroscope-Olfactory sensor system for the e-nose.

UNIT IV BIOMIMETICS OF MOTION 9

Biomechanics of motion: Control centeR-passive -active external and internal actuation - Agonist Mechanism: Hygroscopic mechanism-Muscular actuation-Antagonist mechanism: Spring Antagonism-muscle-Power amplification: Elastic amplification-Deformation of a constant volume-Mechanics of hydrostatic systems: Single compartment systems-Multiple compartment systems-Rhythmics of motion: Gait-passive- limbless-multi limb locomotion.

UNIT V APPLICATION OF BIOMIMETIC TECHNOLOGIES 9

Artificial intelligence through symbolic connectionism-Localist & Distributed symbolic connectionism-Symbolic connectionism in biological models-neuro fuzzy system-Bio-Inspired adhesion technologies-Bio-Inspired locomotion mechanisms-size and current-Quadruped robot system: Mechanical components-Electrical components of quadruped robot-Biologically inspired

antenna array design-antenna beam design –patterns

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply the basic mechanism in biomimetic design in various applications
CO2 : Identify the basic biologically inspired mechanism, materials and process
CO3 : Identify the mechanism of cognition and open ended design automation
CO4 : Analyze the importance bio-inspired sensors and biomimetic actuators
CO5 : Analyze the biomechanics and rhythmic of motion
CO6 : Outline the application of biomimetic technologies

TEXT BOOKS:

1. Yoseph Bar-Cohen, "BIOMIMETICS Biologically Inspired Technologies", CRC Press, 1st Edition, 2006.
2. Trung Dung Ngo, "Biomimetic Technologies: Principles and Applications", Wood head Publishing Ltd, 1 st Edition, 2015.

REFERENCE BOOKS:

1. Sandra Persiani, "Biomimetics of Motion: Nature-Inspired Parameters and Schemes for Kinetic Design", Springer, 1 st Edition, 2019.
2. P Gruber, D Bruckner, C Hellmich, · H B. Schmiedmayer, H. Stachelberger, I C. Gebeshuber, "Biomimetics – Materials,Structuresand ProcessesExamples, Ideas and Case Studies", Springer, 1 st Edition, 2011

U23BMV55	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the basic concepts of brain computer interface
2. To study the various signal acquisition methods
3. To study the signal processing methods used in BCI

UNIT I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA, ARMA models – PCA – Linear and Non-Linear Features.

UNIT IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks

UNIT V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe BCI system and its potential applications.
CO2 : Analyze event related potentials and sensory motor rhythms.
CO3 : Compute features suitable for BCI.
CO4 : Design classifier for a BCI system.
CO5 : Implement BCI for various applications.
CO6 : Collaborate with different BCI database and inventions.

TEXT BOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010

REFERENCE BOOKS:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995

U23BMV56	BIOMETRICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
2. To understand the general principles of design of biometric systems and the underlying trade-offs.
3. To study the technologies of fingerprint, iris, face and speech recognition.
4. To study of evaluation of biometrics systems.

UNIT I INTRODUCTION TO BIOMETRICS 9

Introduction and back ground – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate- Derived metrics-Biometrics and Privacy.

UNIT II FINGERPRINT TECHNOLOGY 9

History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT III FACE RECOGNITION AND HAND GEOMETRY 9

Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images, Neural networks for face recognition, Hand geometry – scanning – Feature Extraction – classification.

UNIT IV IRIS RECOGNITION 9

Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde‘s approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.

UNIT V VOICE SCAN AND MULTIMODAL BIOMETRICS 9

Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture –

level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate the principles of biometric systems.
CO2 : Develop fingerprint recognition technique.
CO3 : Design face recognition and hand geometry system.
CO4 : Design iris recognition system.
CO5 : Develop speech recognition and multimodal biometric systems.
CO6 : Administrate different emerging biometric technologies

TEXT BOOKS:

1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 1st Edition, 2011
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004

REFERENCE BOOKS:

1. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint recognition system'', Springer, 2003
2. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition", CRC Press, 1st Edition, 1999
3. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003

U23ECT41 COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To introduce Analog Modulation Schemes
2. To impart knowledge in random process
3. To study various Digital techniques
4. To introduce the importance of sampling & quantization
5. To impart knowledge in demodulation techniques
6. To enhance the class room teaching using smart connectivity instruments

UNIT I AMPLITUDE MODULATION 9

Review of signals and systems, Time and Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filter and Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Super heterodyne Receiver.

UNIT II RANDOM PROCESS & SAMPLING 9

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation. Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM.

UNIT III DIGITAL TECHNIQUES 9

Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK.

UNIT V DEMODULATION TECHNIQUES 9

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Gain knowledge in amplitude modulation techniques

CO2 : Understand the concepts of Random Process to the design of communication systems

CO3 : Gain knowledge in digital techniques

CO4 : Understand the concepts of Digital modulation techniques

CO5 : Gain knowledge in sampling and quantization

CO6 : Understand the importance of demodulation techniques

TEXT BOOKS:

1. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.(Unit I - V)
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.

REFERENCE BOOKS:

1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education, 2008.
2. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, edition, 1991.
3. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007.

U23BMV62	WEARABLE DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To know the hardware requirement of wearable systems
2. To understand the communication and security aspects in the wearable devices
3. To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the concepts of wearable system.

CO2 : Explain the energy harvestings in wearable device.
CO3 : Use the concepts of BAN in health care.
CO4 : Illustrate the concept of smart textile
CO5 : Compare the various wearable devices in healthcare system
CO6 : Analyze the hardware requirement of wearable systems

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCE BOOKS:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006

U23BMV63	BODY AREA NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To know the hardware requirement of BAN
2. To understand the communication and security aspects in the BAN
3. To know the applications of BAN in the field of medicine

UNIT I INTRODUCTION 9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK 9

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1 :** Comprehend and appreciate the significance and role of this course in the present contemporary world.
- **CO2 :** Design a BAN for appropriate application in medicine.
- **CO3 :** Assess the efficiency of communication and the security parameters.
- **CO4 :** Understand the need for medical device regulation and regulations followed in various regions.
- **CO5 :** Extend the concepts of BAN for medical applications.
- **CO6 :** Measure energy consumption and security challenges while health monitoring.

TEXT BOOKS:

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013
2. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012

REFERENCE BOOKS:

1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks'', Springer, 2006
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011

U23BMV64	VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
2. Understand virtual reality, augmented reality and using them to build Biomedical engineering applications
3. Know the intricacies of these platforms to develop PDA applications with better optimality.
4. Learn the various applications of VR.
5. Learn the possibilities of implementing target-specific VR applications on mobile.

UNIT I INTRODUCTION 9

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT II VR DEVELOPMENT PROCESS 9

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model management.

UNIT III CONTENT CREATION CONSIDERATIONS 9

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB & VR ON THE MOBILE 9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

UNIT V APPLICATIONS 9

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze and Design a system or process to meet given specifications with realistic engineering constraints.

CO2 : Identify problem statements and function as a member of an engineering design team.

CO3 : Analyze the implications and issues pertaining to VR

CO4 : Propose technical documents and give technical oral presentations related to design VR mini project results.

CO5 : Develop simple and portable VR applications using appropriate software.

CO6 : Design the various applications of VR.

TEXT BOOKS:

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA

REFERENCE BOOKS:

1. Ollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1 edition, 2016
4. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 2015
5. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1 edition, 2014
6. Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015

U23BMV65	TELEHEALTH TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Learn the key principles for telemedicine and health
2. Understand telemedical technology.
3. Know telemedical standards, mobile telemedicine and it applications

UNIT I FUNDAMENTALS OF TELEMEDICINE 9

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

UNIT II COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 9

Audio, video, still images, text and data, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9

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

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

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

UNIT V APPLICATIONS OF TELEMEDICINE 9

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : To analyze the benefits and limitations of telemedicine.
CO2 : To apply multimedia technologies in telemedicine.
CO3 : To explain protocols behind encryption techniques for secure transmission of data.
CO4 : To develop radiology based information system.
CO5 : To apply telemedicine in various healthcare domains.
CO6 : Illustrate Multimedia technologies in telemedicine.

TEXT BOOKS:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, “Handbook of Telemedicine”, IOS Press, Netherland, 3. 2002
2. Khandpur R S, “TELEMEDICINE – Technology and Applications”, PHI Learning Pvt Ltd., New Delhi, 2017

REFERENCE BOOKS:

1. H K Huang, “PACS and Imaging Informatics: Basic Principles and Applications” Wiley, New Jersey, 2010
2. Khandpur R S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003
3. Keith J Dreyer, Amit Mehta, James H Thrall, “Pacs: A Guide to the Digital Revolution”, Springer, New York, 2002
4. Garrett Grolemund, *Hands–On Programming with R*, O'Reilly , 1 edition , 2014

U23BMV66	MEDICAL INFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To study the applications of information technology in health care management.
2. To provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING 9

Automated clinical laboratories-Automated methods in haematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD 9

Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine – computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and health care information and computer assisted instruction in medicine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the structure and functional capabilities of Hospital Information System.

CO2 : Describe the need of computers in medical imaging and automated clinical laboratory.

CO3 : Articulate the functioning of information storage and retrieval in computerized patient record system.

CO4 : Apply the suitable decision support system for automated clinical diagnosis.

CO5 : Discuss the application of virtual reality and telehealth technology in medical industry

CO6 : Design the applications of information technology in health care management

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Kathryn J. Hannah, Marion J Ball, "Health Informatics", 3rd Edition, Springer, 2006

U23BMV71	BIO ANALYTIC EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Provide knowledge of Biochemistry Laboratory Equipments.
2. Understand the principles of operation Haematology and Histo Pathology Equipments.
3. Understand the principles of the Serology Equipments systems.
4. Know on the applications of Microbiology Lab Equipments in different field of medicine.

UNIT I BIOCHEMISTRY LABORATORY EQUIPMENTS 9

Fully and Semi Auto Analyzer (Chemistry Analyzer), Flame Photometry, Electrolyte Analyser, Spectrophotometer, Immune Assay analyzer, ABG (Arterial Blood Gas Analyzer) , Haemoglobin System/D10, Electrolyte Analyzer, Colorimeter, Water plant, Conductivity Meter, Cyclomixer, Sample incubator.

UNIT II HEAMATOLOGY AND HISTO PATHOLOGY EQUIPMENTS 9

Cell Counter, Fully automatic coagulation Analyzer, Centrifuge, ESR Reader, Incubator, Hot Air Oven, Flotation Water Bath, Tissue Flotation water Bath, FumeDetector, TissueProcessor, Parafin Wax dispenser, Microtome, Glass Thermometer, PH Meter.

UNIT III SEROLOGY EQUIPMENTS 9

Erba Elisa Washer, Elisa Reader, Electronic Mini Shaker, Centrifuge, Micro Pipettes (variable & fixed), Blood Mixer, PCR, Blood bank unit equipments.

UNIT IV MICROBIOLOGY LAB EQUIPMENTS 9

Hot Air Oven, Incubator, Auto Clave (For sterile the Media), Auto Clave (For Disinfection Room), Colony counter, Laminar Flow, Biosafety Cabinet.

UNIT V CENTRAL STERILE STORES DEPARTMENT 9

Steam Sterilizer, ETO sterilizer, Plasma Sterilizer, Ultrasonic Automatic Washer Disinfector.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Summarize various Equipments used in Biochemistry Laboratory
CO2 : Understand the knowledge of Haematological Equipments
CO3 : Explain the Microbiological Equipments in Laboratory
CO4 : Understand the equipments in Blood Bank and Eliza Reader
CO5 : Knowledge about the Sterilization equipment
CO6 : Apply the knowledge in designing new devices for laboratory analysis.

REFERENCE BOOKS:

1. Handbook of Analytical Instrumentation, Second edition, R.S. Khandpur
2. Sterilization of Medical Device"Anne F.Book", First Edition
3. Hematology and Blood Banking"Poona Bachhhheti ,Aruna Singh, First Edition

U23BMV72	CRITICAL CARE EQUIPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To offer clear understanding of various intensive care equipment and their working.
2. To understand the necessity of different operation theatre equipment.
3. To know about different dialyzers and ventilators.

UNIT I INTENSIVE CARE UNIT EQUIPMENT 9

Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer

UNIT II CRITICAL CARE EQUIPMENT 9

Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators.

UNIT III OPERATION THEATRE EQUIPMENT 9

Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator,, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyles apparatus. Endoscopy – Laparoscopy - Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, - surgical microscope.

UNIT IV CENTRALISED SYSTEMS 9

Centralized Oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.

UNIT V PATIENT SAFETY 9

Patient electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, Hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply the knowledge acquired, in designing new monitoring devices for ICU and assist the medical personnel's during emergency situations

CO2 : Suggest suitable surgical instruments and operational devices.

CO3 : Compare the various techniques for clinical diagnosis, therapy and surgery, and its recent methods

CO4 : Apply the knowledge in minimizing the central storage systems

CO5 : Assess the merits of the operation theatre equipment based on its applications

CO6 : Design the devices for the particular application based on given specifications

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India PvtLtd,New Delhi, 2015
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012
3. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co.,Ltd. 2003

REFERENCE BOOKS:

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008
2. Antony Y.K.Chan,"Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007

U23BMV73	HUMAN ASSIST DEVICE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

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

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

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

UNIT II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT III ARTIFICIAL KIDNEY 9

Indication and Principle of 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 OUTCOMES:

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

CO1 : Explain the principles and construction of artificial heart

CO2 : Understand various mechanical techniques that improve therapeutic technology

CO3 : Explain the functioning of the membrane or filter that cleanses the blood.

CO4 : Explain the modes of working of respiratory assist devices

CO5 : Describe the tests to assess the hearing loss and development of wearable devices for the same.

CO6 : Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

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 (Asia) Pvt Ltd – 2004
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

REFERENCE BOOKS:

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

U23BMV74	ADVANCEMENTS IN HEALTHCARE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Understand the needs for wearable devices and the technology
2. Learn the concepts in digital health care and digital hospitals
3. Apply the tools in design, testing and developing digital health care equipment

UNIT I DIGITAL HEALTH 9

Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT II DIGITAL RADIOLOGY 9

Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT III E-HEALTH 9

E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology

UNIT IV M-HEALTH CARE AND WEARABLE DEVICES 9

Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT V MODALITY AND STANDARDS FOR INTER-OPERABILITY 9

Multimodality registration in daily clinical practice. Mobile healthcare. Selection and Implementation in e-Health project, design of medical equipment based on user needs. Security and privacy in digital health care. Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Interpret the need for digital methods of handling medical records

CO2 : Explain the digital radiology

CO3 : Modify the tools and methods for work flow in E-Health

CO4 : Identify the available technology for wearable healthcare devices

CO5 : Compare various standards for inter-operability of devices, quality and safety standards for developing healthcare systems

CO6 : Suggest suitable things to built good security & privacy in E-health services.

TEXT BOOKS:

1. Christoph Thuemmler, Chunxue Bai, “Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare”, Springer, 1st ed. 2017
2. Wlater Hruby, “Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006
3. Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, “Requirements Engineering For Digital Health”, Springer, 2015

REFERENCE BOOKS:

1. Rick Krohn (Editor), David Metcalf, Patricia Salber, “Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013
2. Khandpur,R.S,”Handbook of Biomedical Instrumentation ”,Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003
3. John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, New Delhi. 2013

U23BMV75	ROBOTICS IN MEDICINE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Get introduced to the fundamental of robotics and position analysis
2. Learn about Parallel robots, different types of motions and force analysis
3. Know the basics of trajectory planning, Motion control systems and actuators
4. Have an insight into various sensors and vision systems
5. Be acquainted to Fuzzy control and Applications of Robotics in Medicine

UNIT I FUNDAMENTALS AND POSITION ANALYSIS 9

Fundamentals – Classification, Advantages and disadvantages, Components, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Characteristics, Workspace, Languages, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Forward and inverse kinematics, Denavit Hartenberg Representation, Degeneracy and Dextrerity, Screw based robots, Position analysis of Articulated robot

UNIT II PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS 9

Parallel robots – Physical characteristics, Forward and Inverse Kinematic approaches, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics, Moments of Inertia, Dynamic Equations of Multiple DOF Robots, Static force analysis, Transformation of forces and moments between coordinate frames.

UNIT III TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS 9

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Block diagrams, Laplace Transform, Block diagram Algebra, Transfer Functions, Characteristic equation, Steady state error, Root locus, Proportional, Integral and Derivative controllers, Compensators, Bode, Loops, Multiple IO systems, Control - State space and Digital, Nonlinear systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators, Speed reduction.

UNIT IV SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS 9

Sensor Characteristics, Position, Velocity, Acceleration, Force, Pressure and Torque, Micro switches, Visible and IR, Touch, Proximity, Range finders, Sniff, Vision, Transforms – Fourier, Hough, Resolution, Quantization, Sampling, Image processing, Segmentation, Region growing and splitting, Operations, Object recognition, Depth, Specialized lighting, Compression, Colour images,

Heuristics.

UNIT V FUZZY CONTROL AND APPLICATIONS IN MEDICINE 9

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering, Applications in rehabilitation, Nanobots in medicine, Clinical diagnosis and Surgery – Cardiac and abdominal procedures with tele operated robots, Orthopedic surgery with cooperative robot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the fundamental of robotics and position analysis

CO2 : Outline the functioning of parallel robots, different types of motions and force analysis.

CO3 : Portray the basics of trajectory planning, Motion control systems and actuators.

CO4 : Recognize and explain the use of various sensors and vision systems in robotics.

CO5 : Employ Fuzzy control in robotics and apply it to Robotics in Medicine

CO6 : Design Robotic systems for Medical applications

TEXT BOOKS:

1. S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003
3. Fu Gonzales and Lee, Robotics, McGraw Hill, 1987
4. J Craig, Introduction to Robotics, Pearson Education, 2005

REFERENCE BOOKS:

1. Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012
2. Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989
3. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003
4. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999
5. Mikell P. Groover, Mitchell Weiss, Industrial robotics, technology, Programming and Applications, McGraw Hill International Editions, 1986
6. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Robotic engineering - An Integrated Approach, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989

U23BMV76	THERAPEUTIC EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. To learn the principles of cardiac assist devices.
2. To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
3. To enable the students to gain knowledge on the working of therapeutic clinical equipment.

UNIT I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT 9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter.

Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.

UNIT II BIOMECHANICAL THERAPEUTIC EQUIPMENT 9

Electro diagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.

UNIT III BODY CARE EQUIPMENT 9

Skin Treatment: Ultrasonic spot remover, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.

UNIT IV DENTAL CARE EQUIPMENT 9

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed hand piece, High-speed hand piece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

UNIT V HEAT & PHOTON THERAPY EQUIPMENT 9

High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1 :** Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc
- **CO2 :** Explain the GAIT assessment & its mode of therapy.
- **CO3 :** Comprehend the principles of body care equipment
- **CO4 :** Understand the operation of dental care equipment.
- **CO5 :** Apply knowledge in minimizing the central storage systems.
- **CO6 :** Analyze the different types of therapies for suitable applications.

TEXT BOOKS:

1. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003
2. John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition.Wiley &s ons, Inc., NewYork. 2009

REFERENCE BOOKS:

1. Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2000
2. John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition. Butterworth Heinemann Ltd. 2000
3. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

U23BMO11	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To Introduce Fundamentals of Biomedical Engineering
2. To study the communication mechanics in a biomedical system with few examples
3. To study measurement of certain important electrical and non-electrical parameters
4. To understand the basic principles in imaging techniques
5. To have a basic knowledge in life assisting and therapeutic devices

UNIT I HUMAN BODY SUBSYSTEM AND TRANSDUCERS 9

Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analysers, pH of blood – Measurement of blood pCO2, pO2.

UNIT III ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY 9

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms -Electrical safety in medical environment, shock hazards – leakage current - Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND BIO-TELEMETRY 9

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermo graphy – Different types of biotelemetry systems.

UNITV LIFE ASSISTING AND THERAPEUTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine – Dialysers - Diathermy – Lithotripsy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Ability to understand communication mechanics in a biomedical system.

CO2 : Ability to understand and analyze measurement of certain electrical and non-electrical parameters.

CO3 : Ability to understand basic principles of imaging techniques, life assisting and therapeutic devices.

CO4 : Knowledge in measurement of certain important electrical and non-electrical Parameters

CO5 : Understand the basic principles in imaging techniques

CO6 : Knowledge in life assisting and therapeutic devices

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.

2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.

REFERENCE BOOKS:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur,Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

U23BMO12	DAY-TO-DAY BIOLOGY	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. The student can understand the biology of human system and health.
2. This provides student with a scope for selection of healthy food, cosmetics and sustain environment.
3. To explain physiological mechanism of various organ systems and to explain the pathophysiology of underlying common diseases

UNIT I BIOLOGY OF HUMAN DISEASES AND DISORDERS 9

Diabetes mellitus, communicable diseases, genetic disorders, vector borne diseases, antibiotics - mode of action.

UNIT II BIOLOGY FOR HUMAN 9

Blood pressure, immune system and immunity, cardiac infarction, in vitro fertilization, cord blood bank, stem cells.

UNIT III BIOLOGY OF COSMETICS AND DETERGENTS 9

Biology of complexion and texture, bioactive natural products in industrial use, bio surfactants, antioxidants**.**

UNIT IV BIOLOGY AND NUTRITION 9

Dietary index, carbohydrates, proteins and fats, HDL and LDL, dairy products and application, herbal plants and home remedies**.**

UNITV BIOLOGY AND ENVIRONMENT 9

Water pollution, air pollution, bioremediation, species biodiversity, global warming and green house effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : The student should be able to locate, identify and functionally describe the organ systems of human body.

CO2 : Utilize appropriate reference resources to clarify and expand knowledge of physiology and pathophysiology.

CO3 : Appreciate the similarities and complexities of the chemical components in foods.

CO4 : Explain the pathophysiology of underlying common diseases

CO5 : Understand the biology of human system and health

CO6 : Analyse the physiological mechanism of various organ systems

TEXT BOOKS:

1. Gareth J. Price, Biology: An Illustrated Guide to Science, Diagram Group, Infobase Publishing, 2006.
2. Pam Dodman, Real-Life Science Biology, Walch Publishing, 2008.

REFERENCE BOOKS:

1. Biology:The Science of Life, Stephen Nowicki, http://www.thegreatcourses.com/tgc/courses.
2. Neil Schlager, Science of everyday things: Real-Life Biology, Gale Publishing 2002**.**

U23BMO13	BIOMETRIC SYSTEMS	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

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

UNIT I INTRODUCTION TO 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

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

UNITV BIO METRIC AUTHENTICATION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate knowledge engineering principles underlying biometric systems.

CO2 : Analyze design basic biometric system applications

CO3 : Understand about the face recognition and hand geometry

CO4 : Apply a multimodal technique in biometrics and evaluation

CO5 : Know about the Authentication in SVM Techniques

CO6 : Know about the biometrics based identification technology.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23BMO14	BIOINFORMATICS	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences

UNIT I BIOLOGICAL DATA ACQUISITION 9

The form of biological information. Retrieval methods for DNA sequence, protein sequence and protein structure information

UNIT II DATABASES 9

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence and structure databases, Organism specific databases

UNIT III DATAPROCESSING 9

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local versus global. Distance metrics. Similarity and homology. Scoring matrices.

UNIT IV METHODS OF ANALYSIS 9

Dynamic programming algorithms, Needleman-wunschand Smith-waterman. Heuristic Methods of sequence alignment, FASTA, and PSI BLAST. Multiple Sequence Alignment and software tools for pairwise and multiple sequence alignment;

UNITV APPLICATIONS 9

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis : Comparative genomics, orthologs, paralogs. Genome analysis – Genome annotation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply mathematical technologies in biological sequences

CO2 : Explain Protocols behind encryption techniques for secure transmission of data.

CO3 : Know about the Data acquisition in healthcare.

CO4 : Know about how genome characteristics applied in informatics.

CO5 : Analyse Dynamic programming algorithms

CO6 : Design the different applications

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford UniversityPress.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, CambridgeUniversity Press.

REFERENCE BOOKS:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.
2. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by Durbin, S.Eddy, A.Krogh, G.Mitchison.
3. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
4. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O‟Reilley Media

U23BMO15	INTRODUCTION OF CELL BIOLOGY	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To provide knowledge on cell structure and its function.
2. To understand structure and functions of the various types of systems of human body.
3. To emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules

UNIT I CELL STRUCTURE **9**

Cell organization, structure of organelles, extra cellular matrix and cell junctions.

UNIT II CELL ORGANELLEAND FUNCTION **9**

Nuclues, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall.

UNIT III DIVISION **9**

Cell cycle – mitosis, meiosis, cell cycle regulation and apoptosis.

UNIT IV MACROMOLECULES **9**

DNA, RNA and Proteins – basic units, architectural hierarchy and organisation, functions.

UNITV ENZYMES **9**

Enzymes – Structure, Mechanism of action, Factors that affect enzyme activity, Common enzymes used in industrial setup of plant and animal origin.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Identify the organelles of a typical cell and describe their functions.

CO2 : Understand the major components of the skeletal system and describe their functions, then breathing mechanisms.

CO3 : Describe the role of blood cells and major components of the circulatory system and describe their functions.

CO4 : Know about the Genetic Information in the DNA is selectively expressed as functional proteins.

CO5 : Know about how enzymes are able to speed up chemical reactions by generalizes enzyme-substrate reaction.

CO6 : Understand the basic information on specific metabolic diseases and disorders of these biomolecules

TEXT BOOKS:

1. Lodish, Harvey etal., “Molecular Cell Biology”, 5th Edition, W.H.Freeman,2005.
2. Cooper, G.M. and R.E. Hansman “The Cell : A Molecular Approach”, 4 th Edition, ASM Press, 2007.

REFERENCE BOOKS:

1. Mc Donald, F etal., “ Molecular Biology of Cancer” 2nd Edition, Taylor & Francis,2004.
   King, Roger J.B. “Cancer Biology” Addison Wesley Longman, 1996.
2. Alberts, Bruce etal., “Molecular Biology of the Cell”, 4 th Edition, Garland Science (Taylors Francis),2002.

U23BMO21	TELEHEALTH TECHNOLOGY	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Know Scope, Benefits and Limitations of Telemedicine.
2. Know Security and Standards and their use in Telemedicine Applications
3. Explain basic parts of Teleradiology Systems like Image Acquisition System, Display System, Communication Network, and Interpretation.
4. Describe the need of Various Communication Networks, Antennas in Designing the Telemedicine System.

UNIT I HISTORY **9**

History of Telemedicine, Block diagram of telemedicine system, Definition of telemedicine, Tele health, Tele care, origins and Development of Telemedicine, Scope, Benefits and limitations of Telemedicine.

UNIT II INFORMATION TECHNIQUE **9**

Types of information: Audio, Video, still Images, text and data, Fax. Types of Communication and Network: PSTN, POTS, ATN, ISDN, Internet, Wireless Communications: GSM, satellite and Micro Wave. Different modulation techniques, Types of antennas depending on requirements, Integration and Operational issues: system integration, Store-and-forward operation, real time Telemedicine.

UNIT III DATA EXCHANGE **9**

Network Configuration, Circuit and packet switching, H.320 series (Video phone based ISBN) T.120, h.324 (Video phone based PSTN), Video Conferencing.

UNIT IV DATA SECURITY AND STANDARDS **9**

Encryption, Cryptography, Mechanisms of encryption, Phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7.Ethical and legal aspects of Telemedicine

UNITV APPLICATIONS **9**

Tele radiology: Basic parts of Teleradiology system: Image Acquisition system, Display system, Communication network, Interpretation. Tele Pathology: Multimedia databases, color images of sufficient resolution: Dynamic range, spatial resolution, compression methods, Interactive control of colour, Controlled sampling, security and confidentiality tools. Tele cardiology, Teleoncology, Telesurgery.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1 :** Apply multimedia technologies in telemedicine
- **CO2 :** Explain protocols behind encryption techniques for secure transmission of data
- **CO3 :** Apply telehealth in healthcare.
- **CO4 :** Understand the Various Communication Networks, Antennas in Designing the Telemedicine System.
- **CO5 :** Analyze the Teleradiology Systems like Image Acquisition System, Display System, Communication Network, and Interpretation
- **CO6 :** Design and Analyze the different telehealth applications

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23BMO22	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To review background information required for studying virtual instrumentation.
2. To study the basic building blocks of virtual instrumentation.
3. To study the various techniques of interfacing of external instruments of PC.
4. To study the various graphical programming environments in virtual instrumentation.
5. To study a few applications in virtual instrumentation

UNIT I REVIEW OF DIGITAL INSTRUMENTATION 9

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT II FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 9

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT III CLUSTER OF INSTRUMENTS IN VI SYSTEM 9

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

UNIT IV GRAPHICAL PROGRAMMING ENVIRONMENT IN VI 9

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI – Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

UNITV ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI 9

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Knowledge of technological similarities and differences between the different modalities and choice of equipment for different clinical applications.

CO2 : Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging

CO3 : Knowledge of ionizing radiation related risks and radiation protection principles in medical imaging.

CO4 : Knowledge of new applications and technology trends for the different modalities.

CO5 : Knowledge on how to analyse and assess a scientific article.

CO6 : Analyze the various graphical programming environments in virtual instrumentation.

TEXT BOOKS:

1. S. Gupta and J.P Gupta, „PC Interfacing for Data Acquisition and Process Control‟,Instrument society of America, 1994.
2. Peter W. Gofton, „Understanding Serial Communications‟, Sybex International.
3. Robert H. Bishop, „Learning with Lab-view‟, Prentice Hall, 2003.

REFERENCE BOOKS:

1. Kevin James, „PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control‟, Newness, 2000.
2. Gary W. Johnson, Richard Jennings, „Lab-view Graphical Programming‟, McGraw Hill Professional Publishing, 2001.

U23BMO23	TISSUE ENGINEERING	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To gain an appreciation for the concepts and applications of molecular,
2. To know the basics of cellular and tissue engineering.
3. To know the basic techniques in biotechnology, cell and tissue dynamics,
4. To give the overview of stem cell technology and cell transplantation.
5. Physiology of cell growth and culturing along with adhesion dynamics.

UNIT I INTRODUCTION 9

Introduction: Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

UNIT II CELL CULTURE 9

Cell culture: Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell - cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT III MOLECULAR BIOLOGY 9

Molecular biology aspects: Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor- ligand binding, and Cell surface markers.

UNIT IV TRANSPLANT 9

Scaffold and transplant: Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells: introduction, hepatopoiesis.

UNITV ADVANCEMENT IN TISSUE ENGINEERING 9

Case study and regulatory issues: Case study of multiple approaches: cell transplantation for

liver, musculo skeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Learn how to derive weak formulations for mechanics problems.

CO2 : Understand theory of finite element modeling.

CO3 : Learn how to use software for finite element modeling of biologic tissues

CO4 : Learn how to formulate multiscale approaches for tissue mechanics problems and solve these problems numerically

CO5 : Analyse the Physiology of cell growth and culturing along with adhesion dynamics.

CO6 : Analyse the stem cell technology and cell transplantation.

TEXT BOOKS:

1. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008.

REFERENCE BOOKS:

1. Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick, Academic press.
2. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.
3. Introduction to Biomedical Engg., Endarle, Blanchard & Bronzino, Academic press.
4. Tissue Engineering, B. Palsson, J.A. Hubbell, R.Plonsey & J.D. Bronzino, CRC - Taylor & Francis

U23BMO24	LASER IN MEDICINE	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. The optical properties of the tissues and the interactions of light with tissues.
2. The instrumentation and components in Medical Optics.
3. The Medical Lasers and their applications.
4. The optical diagnostic applications.
5. The emerging optical diagnostic and therapeutic techniques.

UNIT I INTRODUCTION **9**

Historical background .Medical Lasers: Introduction, Laser physics- fundamentals, principles, advances. Medical Laser system-fundamentals, principles. Laser safety-fundamentals.

UNIT II LASER-TISSUE INTERACTION **9**

Laser interaction with tissue-principles; laser assisted diagnostic – principles, application of lasers in diagnosis and imaging-advances, laser surgery and therapy – principles - photo thermal & photo mechanical mechanism, thermal interaction between laser and tissue-advances.

UNIT III SINGLE OPTICAL FIBER **9**

Introduction, historical background, optical fiber fundamentals. Light transmission in optical fibers- principles, optical properties of optical fibers-advances, fabrication of optical fibers- principles , optical fibers for UV, visible, IR light-principles, power transmission through optical fibers- principles.

UNIT IV OPTICAL FIBER BUNDLES **9**

Introduction, non ordered fiber optic bundles for light guides-fundamental & principles, ordered fiber optic bundles for imaging devices-fundamentals & principles, fiberoscopes and endoscopes- fundamentals fiber optic imaging systems-advances.

UNITV CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS **9**

Introduction, fiber optic laser system in cardiovascular disease, gastroenterology. Gynecology, neurosurgery, oncology, ophthalmology, orthopaedics, otolaryngology (ENT), urology, and flow diagram for laser angioplasty & photodynamic therapy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate knowledge of the fundamentals of optical properties of tissues

CO2 : Analyze the components of instrumentation in Medical Photonics and Configurations

CO3 : Describe surgical applications of lasers.

CO4 : Describe photonics and its diagnostic applications.

CO5 : Investigate emerging techniques in medical optics

CO6 : Understand the emerging optical diagnostic and therapeutic techniques.

TEXT BOOKS:

1. Laser and optical fibers in Medicine by Abraham Katzir, Academics Press,1998.

REFERENCE BOOKS:

1. Therapeutic Lasers-Theory and Practice by G. David Baxter, Churchill Livingstone Publications.
2. Medical Lasers and their safe use DAVID H Shiney .Stephen and L Trokel, Springer, Springer. Verlag publications.
3. Elements of fiber optics S.L.Wymer,Regents PHI
4. Biomedical Electronics and Instrumentation S.K.Venkata Ram Galgotia publications.

U23BMO25	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the fundamentals of hospital administration and management.
2. To know the market related research process
3. To explore various information management systems and relative supportive services.
4. To learn the quality and safety aspects in hospital.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

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

UNIT II HUMAN RESOURCE MANAGEMENT 9

Human Resource Management in Hospital Principles of HRM – Functions of HRM – Profile of HRD Manager -Human Resource Inventory – Manpower Planning.

UNIT III TRAINING AND RECRUITMENT 9

Recruitment and Training Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services

UNITV SAFETY ASPECT 9

Communication and Safety Aspects in Hospital Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System - Safety Rules.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the principles of Hospital administration.

CO2 : Identify the importance of Human resource management.

CO3 : List various marketing research techniques.

CO4 : Identify Information management systems and its uses.

CO5 : Understand safety procedures followed in hospitals.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Cesar A. Caceres and Albert Zara, The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, Handbook of Health Care Human Resources Management, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman Health Sector Reform in Developing Countries – Harvard University Press, 1995.
4. William A. Reinke Health Planning For Effective Management – Oxford University Press.1988
5. Blane, David, Brunner, Health and SOCIAL Organization: Towards a Health Policy for the 21st Century, Eric Calrendon Press 2002.
6 Arnold D. Kalcizony and Stephen M. Shortell, Health Care Management, 6th Edition Cengage Learning, 2011.