INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Marching Beyond 30 Years Successfully
INSTITUTION WITH UGC 12B STATUS

B.Tech
Biomedical
Engineering

Curriculum and Syllabus

(Based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE))

Effective from the Academic year

2023 - 2024

Department of Biomedical Engineering

School of Engineering

VISION OF THE DEPARTMENT

To be a premiere in Biomedical Engineering field by imparting technical knowledge and nurture talents with strong research focus towards betterment of healthy nation**.**

MISSION OF THE DEPARTMENT

M1. To provide quality education in Biomedical Engineering by effective teaching learning process and inculcating value-based education.

M2. To incorporate collaborative research with institution, hospitals and health care industry to bring out leadership and professionalism.

M3. Encourage to explore innovative ideas to create enabling technologies to improve healthcare technologies.

M4. Exhibit societal and ethical values, teamwork spirit, multidisciplinary approach for successful careers globally, as entrepreneurs and to engage in lifelong learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The Graduates of the B.E biomedical engineering within few years will be

PEO 1: Engaged in professional practice as biomedical engineers/related positions in industry, academia, hospital and government sectors.

PEO 2: Continuing towards professional development in biomedical engineering or other related fields by successfully engaging in post graduate education, scientific research, entrepreneurship throughout their careers.

PEO 3: Utilizing Engineering knowledge in creating innovative solutions or enabling technologies for the betterment of healthcare society

PEO 4: Exhibiting leadership and decision-making skills with societal and ethical responsibilities to function in multi-disciplinary settings.

PROGRAM OUTCOME (PO)

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

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

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

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

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

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

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

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

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

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

PO12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1: To examine, interpret, recognize and resolve challenges through acquired knowledge, skills, values to draw conclusions in multidisciplinary fields.

PSO2: To design, develop and Evaluate innovative solutions to meet healthcare needs and committed with ethical values for well-being of healthy society

COMPETENCIES AND PERFORMANCE INDICATORS			
PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.			
1.1	Demonstrate competence in mathematical modelling	1.1.1	1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
		1.1.2	1.1.2 Apply advanced mathematical techniques to model and solve engineering problems
1.2	Demonstrate competence in basic sciences	1.2.1	1.2.1 Apply laws of natural science to an engineering problem
1.3	Demonstrate competence in engineering fundamentals	1.3.1	1.3.1 Apply fundamental engineering concepts to solve engineering problems
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	1.4.1 Apply basic biomedical engineering concepts to solve engineering problems.
PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.			
2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1	2.1.1 Articulate problem statements and identify objectives
		2.1.2	2.1.2 Identify engineering systems, variables, and parameters to solve the problems and mathematical, engineering and other relevant knowledge that applies to a given problem
2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1	2.2.1 Reframe complex problems into interconnected sub-problems and Identify, assemble and evaluate information and resources.
		2.2.2	2.2.2 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
2.3	Demonstrate an ability to formulate and interpret a model	2.3.1	2.3.1 Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
		2.3.2	2.3.2 Identify assumptions (mathematical and physical) necessary to allow modelling of a system at the level of accuracy required.
2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1	2.4.1 Apply engineering mathematics and computations to solve mathematical models
		2.4.2	2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models
		2.4.3	2.4.3 Identify sources of error in the solution process, and limitations of the solution.
		2.4.4	2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
PO 3: 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 public health and safety, and cultural, societal, and environmental considerations.			
3.1	Demonstrate an ability to define a complex/ open- ended problem in engineering terms	3.1.1	3.1.1 Recognize that need analysis is key to good problem definition
		3.1.2	3.1.2 Elicit and document, engineering requirements from stakeholders and Synthesize engineering requirements from a review of the state-of-the-art
		3.1.3	3.1.3 Extract engineering requirements from relevant engineering Codes and Standards
		3.1.4	3.1.4 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues and Determine design objectives, functional requirements and arrive at specifications
3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions
		3.2.2	3.2.2 Build models/prototypes to develop a diverse set of design solutions and Identify suitable criteria for the evaluation of alternate design solutions
3.3	Demonstrate an ability to select an optimal design scheme for further development	3.3.1	3.3.1 Apply formal decision-making tools to select optimal engineering design solutions for further development
		3.3.2	3.3.2 Consult with domain experts and stakeholders to select candidate engineering/ biomedical engineering design solution for further development
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1	3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources)
		3.4.2	3.4.2 Generate information through appropriate tests to improve or revise the design
PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.			
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1	4.1.1 Define a problem, its scope and importance for purposes of investigation
		4.1.2	4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation
		4.1.3	4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities
		4.1.4	4.1.4 Establish a relationship between measured data and underlying physical principles
4.2		4.2.1	4.2.1 Design and develop an experimental approach, specify appropriate equipment and procedures

	Demonstrate an ability to design experiments to solve open-ended problems	4.2.2	4.2.2 Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data
		4.3.2	4.3.2 Analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	4.3.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.			
5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1	5.1.1 Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities
		5.1.2	5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline- specific tools, techniques and resources	5.2.1	5.2.1 Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.2.2	5.2.2 Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.31	5.3.1 Discuss limitations and validate tools, techniques and resources
		5.3.2	5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.			
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	6.1.1 Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	6.2.1 Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public
PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.			
7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	7.1.1 Identify risks/impacts in the life-cycle of an engineering product or activity
		7.1.2	7.1.2 Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	7.2.1 Describe management techniques for sustainable development
		7.2.2	7.2.2 Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.			
8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	8.1.1 Identify situations of unethical professional conduct and propose ethical alternatives
8.2	Demonstrate an ability to apply the Code of Ethics	8.2.1	8.2.1 Identify tenets of the professional code of ethics as Biomedical Engineers
		8.2.2	8.2.2 Examine and apply moral & ethical principles to known case studies
PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.			
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		9.1.2	9.1.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills	9.2.1	9.2.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
		9.2.2	9.2.2 Treat other team members respectfully, Listen to other members and Maintain composure in difficult situations
9.3	Demonstrate success in a team-based project	9.3.1	9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions			
10.1	Demonstrate an ability to comprehend technical literature and document project work	10.1.1	10.1.1 Read, understand and interpret technical and non-technical information
		10.1.2	10.1.2 Produce clear, well-constructed, and well-supported written engineering documents and Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2	Demonstrate competence in listening, speaking, and presentation	10.2.1	10.2.1 Listen to and comprehend information, instructions, and viewpoints of others
		10.2.2	10.2.2 Deliver effective oral presentations to technical and non-technical audiences
10.3	Demonstrate the ability to integrate different modes of communication	10.3.1	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations
		10.3.2	10.3.2 Use a variety of media effectively to convey a message in a document or a presentation
PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.			
11.1	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1	11.1.1 Describe various economic and financial costs/benefits of an engineering activity
		11.1.2	11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3	Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.
		11.3.2	11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.
PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.			
12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1	12.1.1 Describe the rationale for the requirement for continuing professional development
		12.1.2	12.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1	12.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
		12.2.2	12.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3	Demonstrate an ability to identify and access sources for new information	12.3.1	12.3.1 Source and comprehend technical literature and other credible sources of information
		12.3.2	12.3.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.
PSO1: To examine and interpret the challenges through acquired knowledge, skills, and values to draw conclusions in multidisciplinary fields.			
1.1	1.1 Demonstrate the competencies to examine and interpret the knowledge in different field	1.1.1	1.1.1 Describe the competencies to examine the knowledge in multiple disciplines
		1.1.2	1.1.2 Identify the solutions to examine different problems in various disciplinary fields
1.2	1.2 Demonstrate the ability to recognize and resolve the complex problems with acquired skills	1.2.1	1.2.1 Describe complex problems and recognize the techniques for solutions
		1.2.2	1.2.2 Describe the techniques to resolve the problems with acquired skills
PSO2: To design, develop and evaluate innovative solutions for the medical problems and committed with ethical values for the well-being of a healthy society			
2.1	2.1 Demonstrate the ability to design and develop solutions for biomedical and healthcare needs	2.1.1	2.1.1 Describe the design of processes establishing the needs of healthcare
		2.1.2	2.1.2 Identify and develop solutions to biomedical needs with skills
2.2	2.2 Demonstrate the ability of success to develop innovative ideas and solutions for well being of medical society	2.2.1	2.2.1 Describe the ability to innovate ideas for medical field
		2.2.2	2.2.2 Describe solutions for the well being of medical society respective to healthcare needs

VELS INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES
(VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC ACT, 1956)

SCHOOL OF ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

The Panel members for Board of studies meeting are listed below

S. No	Name with Designation	Position
1	Dr.S.Jerritta, Head of the Department, Department of Biomedical Engineering, VISTAS	Chairman
2	Dr..R.J. Hemalatha, Associate Professor , Department of Biomedical Engineering, VISTAS	Member
3	Ms.T.R. Thamizhvani, Assistant Professor, Department of Biomedical Engineering, VISTAS	Member
4	Ms.A.Josephin Arockia Dhivya, Assistant Professor, Department of Biomedical Engineering, VISTAS	Member
5	MS.Syed Uzma Farheen, Sales and Solutions Developer, Laerdal Medical India Pvt Ltd, Chennai.	Alumni Member
6	Dr.Varshini Karthick, Professor and Head, SRM Institute of Science and Technology, Chennai	Academic Expert
7	Mr. B. Venkatraman, Managing Partner (Technical), Biovision Medical Systems, Chennai.	Industrial Expert

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES

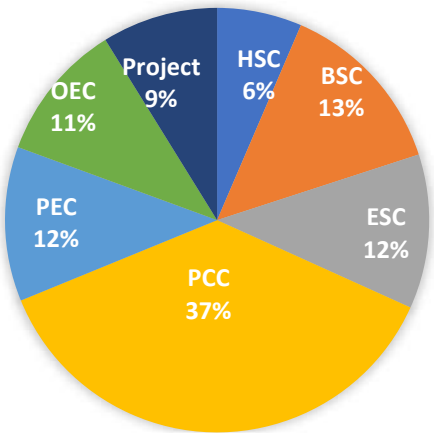
SCHOOL OF ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

CREDITS DISTRIBUTION

B.E (Biomedical Engineering)										
Credits Per Semester										
S. No	**Course Category**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total Credits**
1	HSC	3	-	2	2	2	2	-	-	11
2	BSC	8	8	4	3	-	-	-	-	23
3	ESC	7	10	3	-	-	-	-	-	20
4	PCC	-	-	12	18	15	12	6	-	63
5	PEC	-	-	-	-	3	7	7	3	20
6	OEC	-	-	-	-	3	3	6	6	18
7	Project	-	-	-	-	-	-	5	10	15
8	MC	-	-	-	-	-	-	-	-	-
	TOTAL	**18**	**18**	**21**	**23**	**23**	**24**	**24**	**19**	**170**

HSC	Humanities and Social Science Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
EEC	Employability Enhancement Courses
MC	Mandatory Courses



CREDIT DISTRIBUTION AMONG COURSES

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

B.E. BIOMEDICAL ENGINEERING DEGREE COURSE

COURSES OF STUDY AND SCHEME OF ASSESSMENT

(MINIMUM CREDITS TO BE EARNED: 170)

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER I							
HSC	English	2	-	-	2	40	60	100
BSC	Physics (Oscillations, waves and optics)	3	-	-	3	40	60	100
BSC	Mathematics I (Calculus and Linear Algebra)	3	1	-	4	40	60	100
ESC	Basic Electrical and Electronics Engineering	3	-	-	3	40	60	100
ESC	Engineering Graphics and Design	1	-	4	3	40	60	100
HSC	English Laboratory	-	-	2	1	40	60	100
BSC	Physics Laboratory	-	-	2	1	40	60	100
ESC	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1	40	60	100
MC	Constitution of India	**2**	**-**	**-**	**-**			100
MC	Student Induction Program	**-**	**-**	**-**	**-**	-	-	-
		14	**1**	**10**	**18**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER II							
BSC	Chemistry	3	-	-	3	40	60	100
BSC	Mathematics II (Probability and Statistics)	3	1	-	4	40	60	100
ESC	Programming for Problem Solving	3	-	-	3	40	60	100
ESC	Basics of Civil and Mechanical Engineering	3	-	-	3	40	60	100
ESC	Workshop and Manufacturing Practices	1	-	4	3	40	60	100
BSC	Chemistry Laboratory	-	-	2	1	40	60	100
ESC	Programming for Problem Solving Laboratory	-	-	2	1	40	60	100
MC	Universal Human Values : Understanding Harmony	2	-	-	-			100
		15	**1**	**8**	**18**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER III							
BSC	Mathematics III (Numerical Methods)	3	1	-	4	40	60	100
ESC	Electronic Devices and Circuits	3	-	-	3	40	60	100
PCC	Human Anatomy and Physiology	3	-	-	3	40	60	100
PCC	Bioinstrumentation and measurements	3	-	-	3	40	60	100
PCC	Biochemistry	3	-	2	4	40	60	100
PCC	Human Anatomy and Physiology Laboratory	-	-	2	1	40	60	100
PCC	Electronic Devices and Circuits Laboratory	-	-	2	1	40	60	100
HSC	Personality Development I	2	-	-	2	40	60	100
MC	Basic Life Skills	2	-	-	-			100
		19	**1**	**6**	**21**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER IV							
PCC	Signals and systems	3	-	-	3	40	60	100
PCC	Analog and Digital Integrated Circuits	3	-	-	3	40	60	100
PCC	Biosensors and Transducers	3	-	-	3	40	60	100
PCC	Biomaterials and biomechanics	3	-	-	3	40	60	100
PCC	Basics of Python and MATLAB Programming	3	-	2	4	40	60	100
PCC	Biosensors and Transducers Laboratory	-	-	2	1	40	60	100
PCC	Analog and Digital Integrated Circuits Laboratory	-	-	2	1	40	60	100
HSC	Personality Development II	2	-	-	2	40	60	100
BSC	Environmental Science and Engineering	3	-	-	3	40	60	100
MC	Gender Institution and Society	2	-	-	-			100
		22	**-**	**6**	**23**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER V							
PCC	Microprocessor and microcontroller	3	-	-	3	40	60	100
PCC	Biosignal Processing	3	-	-	3	40	60	100
PEC	Professional Elective -I	3	-	-	3	40	60	100
OEC	Open Elective -I	3	-	-	3	40	60	100
PCC	Biocontrol Systems	3	-	2	4	40	60	100
PCC	Microprocessor and microcontroller Laboratory	-	-	3	2	40	60	100
PCC	Biosignal Processing Laboratory	-	-	2	1	40	60	100
HSC	Personality Development III	2	-	-	2	40	60	100
PCC	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/ Mathworks) - Minimum 4 weeks	-	-	4	2			100
		17	**-**	**11**	**23**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER VI							
PCC	Diagnostic Instrumentation	3	1	-	4	40	60	100
PCC	Medical Image Processing	3	-	-	3	40	60	100
PEC	Professional Elective -II	3	-	-	3	40	60	100
PEC	Professional Elective -III	3	-	2	4	40	60	100
OEC	Open Elective -II	3	-	-	3	40	60	100
PCC	Diagnostic Instrumentation Laboratory	-	-	2	1	40	60	100
PCC	Medical Image Processing Laboratory	-	-	3	2	40	60	100
HSC	Personality Development – IV	2	-	-	2	40	60	100
PCC	Summer Internship (4 weeks)	-	-	4	2			100
		17	**1**	**11**	**24**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER VII							
PCC	Therapeutic Equipments	3	-	-	3	40	60	100
OEC	Open Elective -III	3	-	-	3	40	60	100
OEC	Open Elective -IV	3	-	-	3	40	60	100
PEC	Professional Elective -IV	3	-	-	3	40	60	100
PEC	Professional Elective -V	3	-	2	4	40	60	100
PCC	Therapeutic Equipments Laboratory	-	-	2	1	40	60	100
PCC	Biosimulation Laboratory	-	-	3	2	40	60	100
Project	Project Phase I	-	-	10	5	40	60	100
		15	**-**	**17**	**24**			

Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
	SEMESTER VIII							
PEC	Professional Elective -VI	3	-	-	3	40	60	100
OEC	Open Elective -V	3	-	-	3	40	60	100
OEC	Open Elective -VI	3	-	-	3	40	60	100
Project	Project Phase II	-	-	20	10	40	60	100
		9	**-**	**20**	**19**			

LIST OF ALL BASIC SCIENCE COURSES (BSC)

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
BSC-1	Physics (Oscillations, waves & optics)	3	-	-	3
BSC-2	Mathematics I (Calculus & Linear Algebra)	3	1	-	4
BSC-3	Physics Laboratory	-	-	2	1
BSC-4	Chemistry	3	-	-	3
BSC-5	Mathematics II (Probability and Statistics)	3	1	-	4
BSC-6	Chemistry Laboratory	-	-	2	1
BSC-7	Mathematics III (Numerical Methods)	3	1	-	4
BSC-8	Environmental Science and Engineering	3	-	-	3

LIST OF ALL HUMANITIES AND SOCIAL SCIENCES COURSES

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
HSC-1	English	2	-	-	2
HSC-2	English Laboratory	-	-	2	1
HSC-3	Personality Development I	2	-	-	2
HSC-4	Personality Development II	2	-	-	2
HSC-5	Personality Development III	2	-	-	2
HSC-6	Personality Development IV	2	-	-	2

LIST OF ALL ENGINEERING SCIENCE COURSES

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
ESC-1	Basic Electrical and Electronics Engineering	3	-	-	3
ESC-2	Engineering Graphics and Design	1	-	4	3
ESC-3	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1
ESC-4	Programming for Problem Solving	3	-	-	3
ESC-5	Basics of Civil and Mechanical Engineering	3	-	-	3
ESC-6	Workshop and Manufacturing Practices	1	-	4	3
ESC-7	Programming for Problem Solving Laboratory	-	-	2	1
ESC-8	Electronic Devices and Circuits	3	-	-	3

LIST OF ALL PROFESSIONAL CORE COURSES

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
PCC-1	Human Anatomy and Physiology	3	-	-	3
PCC-2	Bioinstrumentation and measurements	3	-	-	3

PCC-3	Biochemistry	3	-	2	4
PCC-4	Human Anatomy and Physiology Laboratory	-	-	2	1
PCC-5	Electronic Devices and Circuits Laboratory	-	-	2	1
PCC-6	Signals and systems	3	1	-	3
PCC-7	Analog and Digital Integrated Circuits	3	-	-	3
PCC-8	Biosensors and Transducers	3	-	-	3
PCC-9	Biomaterials and biomechanics	3	-	-	3
PCC-10	Basics of Python and MATLAB Programming	3	-	2	4
PCC-11	Biosensors and Transducers Laboratory	-	-	2	1
PCC-12	Analog and Digital Integrated Circuits Laboratory	-	-	2	1
PCC-13	Microprocessor and microcontroller	3	-	-	3
PCC-14	Biosignal Processing	3	1	-	3
PCC-15	Biocontrol Systems	3	-	2	4
PCC-16	Microprocessor and microcontroller Laboratory	-	-	3	2
PCC-17	Biosignal Processing Laboratory	-	-	2	1
PCC-18	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/ Mathworks) - Minimum 4 weeks	-	-	4	2
PCC-19	Diagnostic Instrumentation	3	1	-	4
PCC-20	Medical Image Processing	3	-	-	3
PCC-21	Diagnostic Instrumentation Laboratory	-	-	2	1
PCC-22	Medical Image Processing Laboratory	-	-	3	2
PCC-23	Summer Internship (4 weeks)	-	-	4	2
PCC-24	Therapeutic Equipments	3	-	-	3
PCC-25	Therapeutic Equipments Laboratory	-	-	2	1
PCC-26	Biosimulation Laboratory	-	-	3	2
PCC-27	Project Phase I	-	-	10	5
PCC-28	Project Phase II	-	-	20	10

LIST OF ALL MANDATORY COURSES

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
MC-1	Constitution of India	2	-	-	-
MC-2	Student Induction Program	2	-	-	-
MC-3	Universal Human Values: Understanding Harmony	2	-	-	-
MC-4	Basic Life skills	2	-	-	-
MC-5	Gender Institution and Society	2	-	-	-

LIST OF ALL PROFESSIONAL ELECTIVE COURSES

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
PEC-1	Medical Physics	3	-	-	3
PEC-2	Tissue Engineering	3	-	-	3
PEC-3	Medical Optics	3	-	-	3
PEC-4	Entrepreneurship for Biomedical Engineers	3	-	-	3

PEC-5	Effects of Radiation and Radiation safety	3	-	-	3
PEC-6	Rehabilitation Engineering	3	-	-	3
PEC-7	Wearable Medical Systems	3	-	-	3
PEC-8	Biomems and Nanotechnology	3	-	-	3
PEC-9	Biomedical informatics	3	-	-	3
PEC-10	Hospital Management	3	-	-	3
PEC-11	Pathology and Microbiology	3	-	2	4
PEC-12	Robotics in medicine	3	-	2	4
PEC-13	Pattern Recognition and Neural Networks	3	-	2	4
PEC-14	Internet of Medical Things	3	-	2	4
PEC-15	Analog and Digital Communications	3	-	2	4
PEC-16	Human Assist Devices	3	-	-	3
PEC-17	Neuroscience for Biomedical Applications	3	-	-	3
PEC-18	Telehealth Technology	3	-	-	3
PEC-19	Medical Waste Management	3	-	-	3
PEC-20	Radiological Equipments	3	-	-	3
PEC-21	Artificial Intelligence and Deep learning	3	-	2	4
PEC-22	Virtual Instrumentation in medicine	3	-	2	4
PEC-23	Troubleshooting of medical Equipments	3	-	2	4
PEC-24	Principles of 3D Printing Technology in Healthcare	3	-	2	4
PEC-25	Real time signal Acquisition and Analysis	3	-	2	4
PEC-26	Physiological Modelling and Simulation	3	-	-	3
PEC-27	Brain Computer Interface	3	-	-	3
PEC-28	Regulatory Aspects in bioscience	3	-	-	3
PEC-29	Advanced Bioanalytical and Therapeutic Techniques	3	-	-	3
PEC-30	Body Area Networks	3	-	-	3

LIST OF ALL OPEN ELECTIVE COURSES

	Course	LECTURE	TUTORIAL	PRACTICAL	CREDITS
OEC-1	Fibre optics and lasers in Medicine	3	-	-	3
OEC-2	Clinical Engineering	3	-	-	3
OEC-3	Electronics in Healthcare Industry	3	-	-	3
OEC-4	Basics of Biomedical Engineers	3	-	-	3
OEC-5	Health Policy and Equipment Management	3	-	-	3

SEMESTER I

22CBBM11	ENGLISH	2	0	0	2

Course Objective:

- To acquire ability to speak effectively in real life situations.
- To write letters and reports effectively in formal and business situations.
- To develop listening skills for academic and professional purposes.
- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their career.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

UNIT I VOCABULARY BUILDING **6 hours**

General Vocabulary –Nouns--Compound nouns, Synonyms , Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.-Instructions.

UNIT II BASIC WRITING **6 hours**

Sentences structures –Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations,Blending and Clipping,Framing questions- Yes/No types and "Wh" questions, Summarizing, Precise writing, Paragraph Writing.

UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH **6 hours**

Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives& Gerund , Checklist.

UNIT IV NATURE AND STYLE OF SENSIBLE WRITING **6 hours**

Situational Dialogues, Process description, Definitions, Numerical Expressions, Recommendation, Information Transfer- Flow chart Bar chart and Pie chart, ,Writing introduction and conclusion.

UNIT V WRITING PRACTICES **6 hours**

Active voice and Passive voice, ,Making negative sentences ,Tenses,Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Reading Comprehension Passages.

TOTAL - 30 HOURS

TEXT BOOKS:

T1: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.

T2: Department of Humanities and Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.

T3: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.

T4: Department of Humanities and Social Sciences, Anna University, ''English for Engineers and Technologists'' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.

T5: M.AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

REFERENCE BOOKS:

R1: Practical English Usage. Michael Swan. OUP. 1995.

R2: Remedial English Grammar. F.T. Wood. Macmillan.2007

R3: On Writing Well. William Zinsser. Harper Resource Book. 2001

R4: Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

R5: Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

R6: Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

WEBLINKS:

W1: https://ehlion.com/magazine/technical-english/

W2: https://www.kkcl.org.uk/pdf/KKCL_Technical_English_for_Engineers_Brochure.pdf

COURSE OUTCOMES

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

CO1:	Improve the language proficiency of a technical under-graduate in English with emphasis on Learn, Speak, Read and Write skills.	**K2**
CO2:	Develop listening skills for academic and professional purposes	**K3**
CO3:	Describe the ability to speak effectively in English in real life situations	**K3**
CO4:	Provide learning environment to practice listening, speaking, reading and writing skills.	**K3**
CO5:	Variety of self-instructional modes of language learning and develop learner autonomy.	**K4**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	-	-	-	2	2	-	2	3	3	3	3	-	2
CO 2	-	-	-	-	2	2	-	2	3	3	3	3	--	2
CO 3	-	-	-	-	-	-	2	-	1	1	1	1	-	2
CO 4	-	-	-	-	2	1	3	1	-	-	-	-	-	2
CO 5	-	1	2	2	2	2	-	2	3	3	3	3	-	2
Average		1	2	2	2	1.75	2.5	1.75	2.5	2.5	2.5	2.5	-	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
			✓	✓

22CBBM12	OSCILLATIONS, WAVES AND OPTICS (For B.E. Biomedical)	3	0	0	3

Course Objectives

- To learn the basic ideas of oscillations, waves-optics, and lasers.
- To apply these fundamental principles to solve practical problems involving optical systems used in engineering applications.

UNIT I Oscillations **9 hours**

Harmonic oscillator – Differential equation and solution of simple harmonic oscillator – Simple pendulum – damped harmonic oscillator: Equation of motion and its solution, qualitative description of heavy, critical and light damping - Differential equation for forced harmonic oscillator – Forced oscillations.

UNIT II Non-dispersive transverse and longitudinal waves **9 hours**

Waves, travelling waves - Characteristics of a waves - Longitudinal and transverse waves- Acoustics, waves and speed of sound- Characteristics of musical sound, quality of tone, decibel- Noise pollution- Acoustics of buildings - Reverberation - Reverberation time – Sabine's formula for reverberation time (derivation).

UNIT III Geometric optics **9 hours**

Fermat's principle of stationary time - Fresnel equations, reflectance and transmittance - Brewster's angle - Total internal reflection – Dispersion - Dispersive power of prism - Defect of lenses - spherical aberration in lens - coma- Achromatic lenses.

UNIT IV Wave optics **9 hours**

Huygens' Principle - Superposition of waves - Young's double slit experiment- Newton's rings- Michelson interferometer - Mach Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture - Plane diffraction grating - Dispersion power and resolving power of grating.

UNIT V Lasers **9 hours**

Introduction - Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles - Einstein's theory of matter radiation interaction and A and B coefficients - Population inversion - Different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (ruby, Neodymium), dye lasers - Applications of lasers in science, engineering and medicine.

TOTAL: 45 HOURS

TEXT BOOKS:

T1: Mechanics, D. S. Mathur and P. S. Hemne, S. Chand & Co. Pvt Ltd., New Delhi
T2: A text book of waves and oscillations, Brij Lal and N. Subrahmanyam, Vikas Publishing
T3: A text book of optics, M. N. Avadhanulu, Brij Lal and N. Subrahmanyam, S. Chand & Co. Pvt .Ltd.

REFERENCE BOOKS:

R1: I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
R2: H. J. Pain, The physics of vibrations and waves, Wiley, 2006.
R3: E. Hecht, "Optics", Pearson Education, 2008.
R4: A. Ghatak, "Optics", McGraw Hill Education, 2012.
R5: O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
R6: N.K. Bajaj, "The Physics of Waves and Oscillations", Tata McGraw-Hill, 1988
R7: K. Uno Ingard, "Fundamentals of Waves & Oscillations", Cambridge University Press, 1988.

WEB LINKS:

W1: https://nptel.ac.in/courses/115102124
W2: https://nptel.ac.in/courses/122106034

COURSE OUTCOMES

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

CO1:	Analyze the basic concepts of simple harmonic oscillator.	**K2**
CO2:	Identify the remedies for acoustic of building.	**K2**
CO3:	Analyze the different types of aberration in lens.	**K3**
CO4:	Distinguish between Fresnel and Fraunhofer diffraction.	**K3**
CO5:	Classify the different types of lasers and their applications.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	1	-	-	-	-	-	-	-	1	-
CO2	1	1	1	1	1	3	1	-	-	-	-	-	1	-
CO3	1	1	1	2	1	1	-	-	-	-	-	-	1	1
CO4	1	1	1	1	-	-	-	-	-	-	-	-	1	-
CO5	1	1	1	2	3	1	3	-	-	-	-	-	3	3
Average	1	1	1	1.6	1.2	1	0.8	-	-	-	-	-	1.4	0.8

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

22CBBM13	**Mathematics-I (Calculus and Linear Algebra)**	**3**	**1**	**0**	**4**

Course Objectives

- The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra.
- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well in tackling more advanced levels of mathematics and applications that they would find useful in their disciplines

UNIT-I Calculus **12 hours**

Rolle's theorem-Mean value theorems-Taylor's and Maclaurin theorems -Indeterminate forms and L'Hospital's rule-Curvature-radius of curvature – Evolutes and envelopes.

Unit-II Multivariable Calculus **12 hours**

Limits-continuity- partial derivative – total derivative – maxima and minima- saddle points-method of Lagrange multipliers

Unit-III: Sequence and series **12 hours**

Convergence of sequence and series – test for convergence- power series – Comparison test- Root test, D'Alembert's test and Leibnitz's test

Unit-IV: Matrices **12 hours**

Introduction to Matrices- Rank of matrix- Linear systems of equations-symmetric- skew symmetric matrix and orthogonal matrices-Eigen values and Eigen vectors Diagonalization of matrices- Cayley-Hamilton theorem and orthogonal transformation.

Unit-V: Vector spaces **12 hours**

Vector Space- linear Independence and dependence of vectors, basis, dimension- Linear transformations (maps), range and kernel of a linear map, rank and nullity- Inner product spaces-Gram-Schmidt Orthogonalization.

Total: 60 HOURS

TEXTBOOKS:

T1: G.B.Thomas and R.L.Finney, Calculus and Analytic geometry, 9th Edition,Pearson,Reprint, 2002.
T2: Ramana B.V., Higher Engineering Mathematics,Tata McGraw Hill New Delhi, 11,Reprint,2010
T3: N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

REFERENCE BOOKS:

R1: P. Sivaramakrishna Das and C. Vijayakumari, Mathematics-I, First Edition, Pearson India Education services Pvt. Ltd.
R2: Erwinkreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley&Sons, 2006.
R3: VeerarajanT.,Engineering Mathematics for firstyear,TataMcGraw-Hill,NewDelhi,2008.
R4: D.Poole, LinearAlgebra: A ModernIntroduction,2nd Edition, Brooks/Cole,2005.
R5: B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.

WEB LINKS:

W1: https://www.iare.ac.in/sites/default/files/CSE_LINEAR_ALGEBRA_AND_CALCULUS_LECTURE_NOTES.pdf

COURSE OUTCOMES

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

CO1:	Apply the concept of differential calculus and to evaluate the curvature, radius of curvature and envelope	**K3**
CO2:	Illustrate the concept of limits, continuity and to evaluate derivatives	**K2**
CO3:	Analyze the convergence of the series using root test, D'Alembert's test, Leibnitz'stest	**K3**

CO4:	Determine the rank of a matrix, linear system of Equation and Eigen values and Eigenvectors	**K3**
CO5:	Evaluate the linear independence and dependence of vectors, linear transformations and inner product space.	**K4**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	1	3	-	-	-	-	-	-	-	3	-
CO 2	3	3	2	2	3	-	-	-	-	-	-	-	3	-
CO 3	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO 4	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO 5	3	3	2	2	3	-	-	-	-	-	-	-	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**

22CBBM14	BASIC ELECTRICAL ENGINEERING	3	0	0	3

Course Objectives

- To obtain basic knowledge on electrical quantities such as current, voltage, power and energy.
- To provide employability skill of adequate working knowledge on basic DC and AC circuits used in electrical and electronic devices. To understand the working principle, construction, applications of DC machines, AC machines & measuring instruments.

UNIT I DC Circuits **9 hours**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation, Wye↔Delta Transformation, Superposition, Thevenin and Norton Theorems.

UNIT II AC Circuits **9 hours**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III Transformers **9 hours**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT IV Electrical Machines & Power Converters **9 hours**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Construction of Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

UNIT V Basics of Electronics **9 hours**

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics. Binary Number System — Boolean Algebra theorems– Logic gates- Introduction to sequential Circuits– Flip-Flops.

TOTAL : 45 HOURS

Text Books:

T1: D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.

T2: D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.

T3: John Bird, “Electrical Circuit theory and technology”, Routledge; 5th edition,2013

Reference Books:

R1: L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.

R2: E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

R3: V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989 Text book 1

Web Links:

W1: https://www.electricaltechnology.org/category/basic-electrical-fundamentals

W2: https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/

COURSE OUTCOMES

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

CO1:	Illustrate and analyse DC circuits	**K2**
CO2:	Illustrate and analyse AC circuits	**K2**
CO3:	Explain the construction, operation and characteristics of transformer and classify the types of three –phase transformer connections.	**K3**
CO4:	Examine the various electrical machines and converter circuits	**K2**
CO5:	Identify the basics of electronics	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	1	-	1	3	-
CO2	3	2	1	1	1	-	-	-	-	1	-	1	3	-
CO3	1	1	1	1	1	3	3	2	-	1	1	1	-	-
CO4	1	-	1	1	1	3	1	1	-	1	1	1	-	1
CO5	2	1	1	1	1	1	-	-	-	1	-	1	1	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
√	√			√	√

22CBBM15	ENGINEERING GRAPHICS AND DESIGN	1	0	4	3

COURSE OBJECTIVE:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I INTRODUCTION TO ENGINEERING DRAWING AND PLANE CURVES **12 hours**

Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. Scales – Plain, Diagonal and Vernier Scales.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **12 hours**

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

UNIT III PROJECTION OF SOLIDS **12 hours**

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

UNIT IV **12 hours**

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

UNIT V **12 hours**

Free hand sketching: Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

TOTAL: 60 HOURS

TEXT BOOKS:

T1: N.D. Bhatt, “Engineering Drawing” Charotar Publishing House, 46 th Edition, (2003).

T2: K. V. Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2006).

REFERENCES

R1: M.S. Kumar, “Engineering Graphics”, D.D. Publications, (2007).

R2: K. Venugopal & V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited (2008).

R3: M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education (2005).

R4: K. R. Gopalakrishnana, “Engineering Drawing” (Vol.I&II), Subhas Publications (1998).

R5: Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited (2008).

R6: Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

WEBLINKS:

W1: https://siiet.ac.in/wp-content/uploads/2019/05/EG.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the theory of projection able to know and understand the conventions and the methods of engineering drawing	**K2**
CO2:	Improve their visualization skills so that they can apply these skills in projections of surfaces	**K3**
CO3:	Improve their visualization skills so that they can apply these skills in projections of solids	**K3**
CO4:	Impart and inculcate a proper understanding of the theory of projection. Improve the visualization skills	**K3**
CO5:	Understand the various concepts like dimensioning, conventioning and standards related to working drawings in order to become professionally efficient. Impart the knowledge for understanding and drawing of simple residential/office buildings	**K4**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	2	3	-	-	-	-	-	-	-	3	-
CO 2	3	3	3	2	3	-	-	-	-	-	-	-	3	-
CO 3	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO 4	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO 5	3	3	2	2	3	-	-	-	-	-	-	-	3	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
				✓

22PBBM11	ENGINEERING PRACTICAL - ENGLISH	0	0	2	1

Course Objectives

- To enable the student to explore the knowledge in communication skills.
- To gain knowledge in the process of Placement Interviews, Group Discussions and other recruitment procedures.

List of Experiments

1. Introduction to English sounds
2. Consonants and vowels
3. Syllable and Stress
4. Intonation
5. Communication Skills
6. Summarizing
7. Report Writing
8. Information Transfer
9. Presentation Skills
10. Group Discussion
11. Letter Writing
12. Cover letter and Resume

Total: 30 HOURS

TEXT BOOKS:

T1: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.

T2: M.AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

REFERENCE BOOKS:

R1: Practical English Usage. Michael Swan. OUP. 1995.

R2: Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

R3: Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

WEBLINKS:

W1: https://onlinemasters.ohio.edu/blog/engineering-communication/

W2: https://online.rice.edu/courses/communication-skills-for-engineers-specialization

COURSE OUTCOMES

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

CO1:	Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly.	**K5**
CO2:	Use appropriate pronunciation and rhythm of spoken language in oral communication	**K4**
CO3:	Draft and interpret the written communication in officialcontexts like narrative, descriptive, creative, critical and analytical reports	**K5**
CO4:	Infer implied meanings of different genres of texts and critically analyze and evaluate them for ideas, as well as for method of oral presentation.	**K4**
CO5:	Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions , negotiation and conversations.	**K2**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	2	-	-	-	-	-	-	2
CO2	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO3	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO4	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO5	3	2	1	1	3	1	3	3	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observations**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**
✓		✓	✓	✓

22PBBM12	ENGINEERING PRACTICAL - PHYSICS	0	0	2	1

Course Objectives

- To enable the student to explore the field of Properties of Matter and Optics.
- To gain knowledge in the scientific methods and learn the process of measuring different Physical variables.

Any Eight Experiments

1. Determination of Rigidity Modulus – Torsional pendulum
2. Determination of wavelength and particle size using laser
3. Ultrasonic Interferometer
4. Determination of band gap of a semiconductor material
5. Hooke's law – Determination of spring constant
6. Determination of Young's Modulus – Uniform Bending
7. Determination of Young's Modulus – Non Uniform Bending
8. Determination of Viscosity of a liquid - Poiseuille's method
9. Spectrometer – Grating
10. Deflection Magnetometer - Tan A position
11. Deflection Magnetometer - Tan B position
12. Potentiometer - Calibration of low range Voltmeter

TOTAL: 30 HOURS

TEXT BOOKS:

T1: C. C. Ouseph, U. J. Rao, V. Vjiayendran, Practical Physics,1st Edition, 2015.
T2: Biswajit Saha, Practical Physics Book, LAP LAMBERT Academic Publishing, 1st Edition, 2020.

REFERENCE BOOKS:

R1: G.L. Squires, Practical Physics, 4th Edition, Cambridge University Press, 2001.
R2: D. Chattopadhyay, P.C. Rakshit, B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.

WEB LINKS:

W1: http://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=2
W2: https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1509&cnt=4

COURSE OUTCOMES

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

CO1:	Measure the wavelength and particle size of semiconductor diode laser.	**K5**
CO2:	Analyze the wavelength of spectral lines using spectrometer	**K4**
CO3:	Estimate the band gap energy of given semiconductor material.	**K5**
CO4:	Determine the compressibility of the liquid using ultrasonic interferometer.	**K4**
CO5:	Measure the Young's modulus of the given solid materials.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	-	1	1	3	2	1	1	-	-	-	-	-	3	3
CO2	-	1	1	2	-	-	-	-	-	-	-	-	1	-
CO3	-	1	1	3	2	1	1	-	-	-	-	-	1	1
CO4	-	1	1	3	-	-	-	-	-	-	-	-	1	-
CO5	-	1	1	3	1	1	1	-	-	-	-	-	1	-
Average	-	1	1	2.8	1	0.6	0.6	-	-	-	-	-	1.4	0.8

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

22PBBM13	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1

Course Objectives

- To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.
- To expose the students to learn experimental skills about Transformers, DC Motor, Converters.

LIST OF EXPERIMENTS

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter,ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line- line voltage, phase-to-neutral voltage, line and phase currents).
5. Load Characteristics of a DC Motor
6. Torque - Slip Characteristic of an Induction motor
7. Three phase induction motors – Direction reversal by change of phase-sequence of connections.
8. Demonstration of DC-DC Converter.
9. Demonstration of DC-AC converter.
10. Demonstration of AC-DC converter.

TOTAL: 30 HOURS

TEXT BOOKS

T1: V. N. Mittal and Arvind Mittal;, " Basic Electrical Engineering" McGraw Hill
T2: Vincent DelToro, " Electrical engineering Fundamentals", PHI second edition 2011
T3: Bolestaad, :"Electronics Devices and Circuits Theory", Pearson Education India.

REFERENCE BOOKS

R1: Edward Hughes, " Electrical Technology,", Pearson Education
R2: D.P. Kothari and Nagrath " Theory and Problems in electrical Engineering", PHI edition 2011

WEB LINKS:

W1: https://jru.edu.in/studentcorner/lab-manual/diploma/EE/ 2nd sem/ BASIC% 20ELECTRICAL%20&%20ELECTRONICS%20ENGINEERING.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the basic safety precautions and learn to make use of measuring instruments	**K2**
CO2:	Analyse the steady state response of R-L, R-C circuits	**K3**
CO3:	Experiment with loading of transformer to measure the primary and secondary voltages, currents and power and classify the different types of transformer connections	**K3**
CO4:	Illustrate and Experiment with single phase induction motor and three phase induction motor	**K2**
CO5:	Demonstrate DC-DC, DC-AC and AC-DC converters	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO2	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

22MCBM11	CONSTITUTION OF INDIA	2	0	0	0

COURSE OBJECTIVES:

1. The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working.
2. To help students be familiar with the historical and significant aspects of the constitution of India.
3. To make students aware of their fundamental duties and rights.
4. To know about central and state government functionalities in India.

UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6 hours

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

UNIT II FUNDAMENTAL RIGHTS 6 hours

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES

6 hours

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV FEDERAL STRUCTURE 6 hours

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

UNIT V AMENDMENT AND EMERGENCY PROVISIONS 6 hours

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

TOTAL: 30 HOURS

TEXT BOOKS:

T1: V.N. Shukla, Constitutional Law of India
T2: D.D. Basu, Commentary on the Constitution of India
T3: J.N. Pandey, Constitution of India
T4: Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
T5: R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
T6: Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
T7: K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

R1: V.D. Mahajan, Constitutional Law of India
R2: H.M. Seervai, Constitution of India
R3: Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
R4: U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
R5: R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

WEBLINKS:

W1: https://unacademy.com/content/upsc/study-material/polity/a-short-note-on-constitution-of-india/
W2: https://www.icsi.edu/media/webmodules/CONSTITUTION.pdf

COURSE OUTCOMES

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

CO1:	Elaborate the constitution of India and its salient features.	**K2**
CO2:	Know the fundamental rights and duties.	**K2**
CO3:	Discuss the Parliamentary Form of Government in India.	**K2**
CO4:	Recognize the Directive Principles of State Policy.	**K3**
CO5:	Understand and abide the rules of the Indian constitution and to appreciate different culture among the people.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	3	-	1	-	-	-	2	3	-
CO2	-	-	-	-	-	3	2	2	-	-	-	3	3	-
CO3	-	-	-	-	-	3	2	2	1	-	-	3	3	-
CO4	-	-	-	-	-	3	2	2	1	-	-	3	3	-
CO5	-	-	-	-	-	3	3	2	1	-	-	3	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

SEMESTER II

22CBBM21	Engineering Chemistry	3	0	0	3

Course Objectives

- To learn about the molecular orbitals, ionic interactions and periodic properties.
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

UNIT I Atomic and molecular structure, Intermolecular forces and potential energy surfaces **9 hours**

Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene, benzene and aromaticity. Valence Bond Theory and the energy level diagrams for transition metal ions and their magnetic properties. Ionic, dipolar and van Der Waals interactions, potential energy surfaces of H_3, H_2F and HCN.

UNIT II Spectroscopic techniques and applications **9 hours**

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational, rotational spectroscopy of diatomic molecules, Morse equations and Mossbauer spectroscopy. Applications. Diffraction and scattering

UNIT III Use of free energy in chemical equilibria **9 hours**

Thermodynamic functions: energy, entropy , free energy and fugacity. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

UNIT IV Periodic properties **9 hours**

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, diagonal relationship, anomalous behaviour of Lithium, carbon and Nitrogen, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT V Organic reactions and synthesis of a drug molecule **9 hours**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, Coupling reaction and ring openings. Synthesis of a commonly used drug molecule.

TOTAL: 45 HOURS

TEXT BOOKS

T1: Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
T2: Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
T3: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

REFERENCE BOOKS

R1: Physical Chemistry, by P. W. Atkins.
R2: Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp.
R3: University chemistry, by B. H. Mahan.

WEB LINKS:

W1: https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
W2: https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
W3: https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Thermodynamics/Chemical_Energetics/Free_Energy_and_Equilibrium
W4: https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Periodic_Trends_of_Elemental_Properties/Periodic_Properties_of_the_Elements
W5: https://www.bcebhagalpur.ac.in/wp-content/uploads/2020/03/Organic-Reactions-Synthesis-of-Drug-Molecule.pdf

COURSE OUTCOMES

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

CO1:	Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.	**K2**
CO2:	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.	**K3**
CO3:	Analyze bulk properties and processes using thermodynamic considerations.	**K4**
CO4:	Classify the properties and reactivity of different types of elements based on the periodic table.	**K3**
CO5:	Apply the basic terms involved in an Organic reactions and synthesis of a drug molecule.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	1	1	1	1	1	-	1	-	1	1	-	1	1	-
CO2	2	1	1	1	1	-	-	-	1	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	1	-	-	-	-
CO4	1	1	1	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	-	1	-	-	1	-	-	-	-	-	-	1
Average	1.6	1	0.8	1	0.4	-	0.4	-	0.4	0.4	-	0.2	0.2	0.67

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

22CBBM22	Mathematics-II (Probability and Statistics)	3	1	0	4

Course Objective:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

UNIT I Basic Probability **12 hours**

Introduction to Probability-Conditional probability – Baye's Theorem- Random Variables-Discrete random variables-Continuous Random Variables –Probability mass function-Probability density function.

UNIT II Standard Distributions **12 hours**

Introduction to theoretical distribution-Discrete Distributions- Binomial, Poisson, Geometric Distributions-Continuous Distribution-Uniform, Normal, Exponential and Gamma distribution-Properties.

UNIT III Correlation and Regression Analysis **12 hours**

Correlation: Types of Correlation-Methods of studying correlation- Scatter diagram method, Karl Pearson's Coefficient of correlation, Spearman's Rank Correlation Coefficient. Regression: Regression Lines and Regression equations - simple problems

UNIT IV Basic Statistics **12 hours**

Introduction-Measures of Central tendency: Mean, Median and Mode- Measure of Dispersion- Range, Mean deviation- Standard Deviation and coefficient of variation

UNIT V Sampling **12 hours**

Introduction to small sample – t-test-Single mean, difference of means, and Paired t-test- F-test- Chi-square test for goodness of fit and independence of attributes.

Total : 60 HOURS

TEXT BOOKS

T1: N.P. Bali and Manish Goyal, A text book of engineering mathematics, laxmi publications, reprint, 2014 (Ninth Edition)

T2: S.P.Gupta, Statistical Methods. Sultan Chand & Sons, New Delhi

T3: S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition, 2001.

T4: S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books

R1: Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

R2: P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal, Book Stall, 2003 (Reprint).

R3: W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd, Ed., Wiley, 1968.

R4: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

Web Links:

W1: https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_P%26S_Lecture_Notes_0.pdf

COURSE OUTCOMES

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

CO1:	Apply the fundamental concepts of probability.	**K3**
CO2:	Describe the standard distributions which can describe real life phenomenon.	**K2**
CO3:	Illustrate and critically discuss the issues surrounding of correlation and Regression	**K3**
CO4:	Evaluate the underlying assumptions of analysis tools of measures of central tendency and dispersion	**K4**
CO5:	Analyze the uses and limitations of Testing of hypothesis used in engineering	**K4**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO 2	3	2	2	1	1	-	-	-	-	-	-	-	3	-
CO 3	3	2	2	1	1	-	-	-	-	-	-	-	3	-
CO 4	3	2	2	1	1	-	-	-	-	-	-	-	3	-
CO 5	3	2	2	1	1	-	-	-	-	-	-	-	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**

22CBBM23	PROGRAMMING FOR PROBLEM SOLVING	3	0	0	3

Course Objectives

- To understand the basic concepts of programming – Flow chart, Pseudocode.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.
- To understand the concepts of arrays, basic sorting and searching algorithms.
- To find the order of time complexity of basic algorithms

UNIT I INTRODUCTION TO PROGRAMMING 9 hours

Introduction to Programming (Flow chart/pseudo code, compilation etc.), Variables (including data types), Input / Output - Arithmetic expressions and precedence, Conditional Branching and Loops -Writing and evaluation of conditionals and consequent branching - Iteration and loops

UNIT II ARRAYS AND BASIC ALGORITHMS 9 hours

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

UNIT III FUNCTIONS AND POINTERS 9 hours

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers- Defining pointers, Use of Pointers in self-referential structures

UNIT IV STRUCTURES AND UNIONS 9 hours

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation

UNIT V STRING FUNCTIONS AND FILES 9 hours

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Preprocessor directives, use of typedef, Command line arguments, Enumerated data types.

TOTAL : 45 HOURS

TEXT BOOKS:

T1: E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill
T2: Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill

REFERENCE BOOKS:

R1: Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, PrenticeHall of India
R2: YashavantKanetkar, “Let Us C”, BPB Publications
R3: Ashok.N.Kamthane, “Computer Programming”, Pearson Education (India)

WEB LINKS:

W1. https://www.edx.org/course/c-programming-getting-started

COURSE OUTCOMES

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

CO1:	Determine a pictorial representation with a stepwise procedure for solving complex problems	**K2**
CO2:	Develop a high level programming code using c languages.	**K3**
CO3:	Evaluate the various functional operations for solving problem.	**K4**
CO4:	Make use of various c operations like array, pointer, strings and searching method	**K3**
CO5:	Develop a C module for a given set of instruction.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	2	1	1	-	-	-	-	-	-	2	3	-
CO2	3	2	3	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	2	3	1	2	-	-	-	-	-	-	2	3	2
CO5	3	2	3	2	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

22CBBM24	BASIC CIVIL AND MECHANICAL ENGINEERING	3	0	0	3

Course Objectives

- To understand the basic concepts of programming – Flow chart, Pseudocode.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9 hours

Surveying: Objects — classification — principles — measurements of distances — angles — leveling — determination of areas– contours — examples. Civil Engineering Materials:Bricks — stones — sand — cement — concrete — steel — timber — modern materials

UNIT II BUILDING COMPONENTS AND STRUCTURES 9 hours

Foundations: Types of foundations — Bearing capacity and settlement — Requirement of good foundations. Civil Engineering Structures: Brickmasonry — stonemasonry — beams — columns — lintels — roofing — flooring — plastering — floor area, carpet area and floor space index — Types of Bridges and Dams — water supply — sources and quality of water — Rain water harvesting — introduction to high way and rail way.

C — MECHANICAL ENGINEERING

UNIT III INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9 hours

Classification of Power Plants — Internal combustion engines as automobile power plant — Working principle of Petrol and Diesel Engines — Four stroke and two stroke cycles — Comparison of four stroke and two stroke engines — Working principle of steam, Gas, Diesel, Hydro — electric and Nuclear Power plants — working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT IV REFRIGERATION AND AIR CONDITIONING SYSTEM 9 hours

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

UNIT V MANUFACTURING PROCESS 9 hours

Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications. Metal Joining Processes- List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications Basic Machining operations- Turning, Drilling, Milling and Grinding.

TOTAL: 45 HOURS

TEXT BOOKS:

T1: Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
T2: Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

REFERENCE BOOKS:

R1: G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018

WEB LINKS:

W1: https://www.stannescet.ac.in/cms/staff/qbank/EEE/Notes/BE3255-BASICCIVIL%20AND%20MECHANICAL%20ENGINEERING-48522634-BCM%20notes.pdf
W2: https://www.vidyarthiplus.com/vp/attachment.php?aid=406

COURSE OUTCOMES

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

CO1:	Describe the basic concepts in civil engineering	**K2**
CO2:	Illustrate the building components and structural features	**K3**
CO3:	Distinguish the mechanical concepts of engines and power plants	**K3**
CO4:	Explain the functioning of Refrigerators and AC's	**K3**
CO5:	Describe the Manufacturing and machining process in industries	**K3**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	2	2	1	-	-	-	-	-	-	2	1	-
CO 2	1	2	2	2	1	-	-	-	-	-	-	2	2	-
CO 3	1	2	2	2	1	-	-	-	-	-	-	3	2	-
CO 4	1	2	2	2	1	-	-	-	-	-	-	3	2	-
CO 5	1	2	2	2	1	-	-	-	-	-	-	2	2	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
				✓

22CBBM25	WORKSHOP AND MANUFACTURING PRACTICES	1	0	4	3

GROUP A – MECHANICAL AND CIVIL ENGINEERING PRACTICES

COURSE OBJECTIVE:

- To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
- To study Arc welding drawings for making common weld joints as per the given dimensions.
- To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

MECHANICAL ENGINEERING PRACTICE

1. Welding

To make single V, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

2. Basic Machining

To make Simple Turning and Taper turning in the lathe.

3. Fitting Work

To make square, hexagonal, V joint in bench fitting as per the given dimensions and Tolerances.

4. Sheet Metal Work

To make simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.

CIVIL ENGINEERING PRACTICE

1. Buildings

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

2. Plumbing Works

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

b. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

TOTAL: 60 HOURS

TEXT BOOKS:

T1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements ofWorkshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

T2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House,2017.

REFERENCE BOOKS

R1: Workshop Technology Vol. 1 and 2 by Raghuvanshi B.S. Dhanpat Rai & Sons1998.

R2: Workshop Technology by Chapman W.A. J and Arnold E. Viva low priced student edition, 1998

R3: Workshop Practices, H S Bawa, Tata McGraw-Hill,2009.

WEB LINKS:

W1: https://www.jiscollege.ac.in/me/pdf/Workshop%20practice%201st%20year.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the various type of workshop machines and practices in manufacturing	**K2**
CO2:	Develop operating skills in different workshop machines	**K3**
CO3:	Develop simple objects and illustrations based on the dimensions	**K3**

CO4:	Measure the parameters and features of the workshop and manufacturing machines	**K5**
CO5:	Demonstrate the complete functioning and process of the workshop machines	**K2**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	2	3	-	-	-	-	-	-	-	2	-
CO 2	3	2	1	2	3	-	-	-	-	-	-	2	2	-
CO 3	3	2	1	2	3	-	-	-	-	-	-	2	2	-
CO 4	3	2	1	2	3	-	-	-	-	-	-	2	2	-
CO 5	3	2	1	2	3	-	-	-	-	-	-	2	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
				✓

22PBBM21	ENGINEERING CHEMISTRY PRACTICALS	0	0	2	1

Course Objectives

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
- The students will learn to:
  - Estimate rate constants of reactions from concentration of reactants/products as a function of time.
  - Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
  - Synthesize a small drug molecule.

Any Eight Experiments

1. Determination of the rate constant of a reaction.
2. Determination of the partition coefficient of a substance between two immiscible liquids.
3. Determination of surface tension and viscosity.
4. Thin layer chromatography.
5. Determination of chloride content in water.
6. Determination of cell constant and conductance of solutions.
7. Synthesis of a polymer/drug.
8. Determination of saponification / acid value of an oil.
9. Determination of redox potentials and emf by Potentiometric method.
10. Estimate the adsorption of acetic acid by charcoal.

TOTAL: 30 HOURS

TEXT BOOKS

T1: S. Sundaram and K. Raghavan "Practical Chemistry", S. Viswanathan. Co. 3rd edition 2011.

T2: Gnanaprakasam, Ramamurthy, "Organic Chemistry Lab Manual" S. Viswanathan Pvt. Ltd. 3rd edition 2011.

REFERENCE BOOKS

R1: Vogel's – "Textbook of qualitative organic Analysis", Longmann, 12th edition, 2011

R2: J. N. Gurtu and R. Kapoor "Advanced experimental Chemistry", S. Chand and Co. 6th edition, 2010.

WEB LINKS

W1: https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:kinetics/x2eef969c74e0d802:introduction-to-rate-law/v/experimental-determination-of-rate-laws

W2: https://www.youtube.com/watch?v=qdmKGskCyh8

W3: https://www.youtube.com/watch?v=7_6_dKlo67k

COURSE OUTCOMES

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

CO1:	Estimate the rate constants of reactions and partition coefficient of immiscible liquids.	**K3**
CO2:	Determine the viscosity and to test the purity of the compound.	**K5**
CO3:	Estimate the amount of chlorine content present in drinking water and to know the conductance of a solution.	**K4**
CO4:	Develop a small drug molecule and to know the saponification of an oil.	**K5**
CO5:	Find out the unknown element by Potentiometric method and to remove some of the toxic chemical by charcoal method.	**K5**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	1	1	3	2	1	1	-	-	-	-	-	3	3
CO 2	-	1	1	2	-	-	-	-	-	-	-	-	1	-
CO 3	-	1	1	3	2	1	1	-	-	-	-	-	1	1
CO 4	-	1	1	3	-	-	-	-	-	-	-	-	1	-
CO 5	-	1	1	3	1	1	1	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

22PBBM22	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	0	0	2	1

Course Objective:

- To design and develop C Programs for various applications

LIST OF EXPERIMENTS:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. Recursive functions
11. Pointers and structures
12. File operations

TOTAL: 30 HOURS

TEXT BOOKS

T1: Schaum's Outline of Programming with C by Byron Gottfried , McGraw-Hill
T2: The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education .
T3: Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
T4: Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill

REFERENCE BOOKS:

R1: Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
R2: Let Us C By Yashwant P. Kanetkar.
R3: Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.

WEB LINKS:

W1: https://www.iare.ac.in/sites/default/files/lab1/AERO_PROGRAMMING_FOR_PROBLEM_SOLVING_LABORATORY_LAB_MANUAL.pdf

COURSE OUTCOMES

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

CO1:	Determine the advanced features of the C language	**K5**
CO2:	Develop the model data using primitive and structured types.	**K5**
CO3:	Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.	**K4**
CO4:	Develops the ability to analyze a problem, develop an algorithm to solve it.	**K5**
CO5:	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	3	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	3	-	-	-	-	-	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

22MCMB21	UNIVERSAL HUMAN VALUES 2 : UNDERSTANDING HARMONY	2	0	0	2

COURSE OBJECTIVES:

1.Development of a holistic perspective based on self-exploration aboutthemselves (human being), family, society and nature/existence.

2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4. Development of commitment and courage to act.

UNIT I Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 6 hours

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II Understanding Harmony in the Human Being - Harmony in Myself 6 hours

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health

UNIT III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship 6 hours

Understanding harmony in the Family- the basic unit of human interaction, Understanding values in a human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!.

UNIT IV Understanding Harmony in the Nature and Existence - Whole existence as Co-existence 6 hours

Understanding the harmony in Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT V Implications of the above Holistic Understanding of Harmony on Professional Ethics 6 hours

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for the transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

TOTAL: 30 HOURS

TEXT BOOKS:

T1: R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics Excel Books, New Delhi, 2010

References:

R1: Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA

R2: E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs,Britain.

R3: Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

R4: Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

Web Links:

W1: https://www.uhv.org.in/uhv2notes

W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAIC4003.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	**K2**
CO2:	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.	**K3**
CO3:	Describe the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society	**K2**
CO4:	Describe the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	**K3**
CO5:	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	3	3	2	3	1	-	3	2	-
CO2	-	-	-	-	-	3	2	2	3	1	-	3	2	-
CO3	-	-	-	-	-	3	3	2	3	1	-	3	2	-
CO4	-	-	-	-	-	3	2	2	3	1	-	3	2	-
CO5	-	-	-	-	-	3	3	3	3	**1**	-	3	2	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

SEMESTER III

22CBBM31	MATHEMATICS-III (Numerical Methods)	3	1	0	4

Course Objective:

Using appropriate numerical methods, determine approximate solutions to ordinary differential equations. Analyze the errors obtained in the numerical solution of problems.

UNIT I: Solution of Equations **12 hours**

Solution of algebraic and transcendental equations – Newton Raphson method –Regula falsi Method – Solution of linear system of equations- Gauss elimination method – Gauss-Jordon method–Gauss Seidel Method–Gauss Jacobi Method –Matrix Inversion by Gauss Jordon method.

UNIT II : Interpolation and Approximation **12 hours**

Interpolation with unequal intervals- Lagrange's interpolation –Inverse Lagrange's interpolation–Newton's divided difference interpolation– Interpolation with equal intervals– Newton's forward and backward difference formulae.

UNIT III : Numerical Differentiation and Integration **12 hours**

Numerical Differentiation: Approximation of derivatives using interpolation polynomials- Numerical integration: Trapezoidal–Simpson's 1/3 and 3/8 rule – Romberg's method – Double integral of Trapezoidal –Simpson's Rule.

UNIT IV: Initial Value Problems for Ordinary Differential Equations **12hours**

Single step methods: Taylor series method – Euler's method–Modified Euler's method– Second order Runge – Kutta method and Fourth order Runge – Kutta method for solving first order equations

UNIT V: Boundary Value Problems in Ordinary and Partial Differential Equations 12 hours

Finite difference methods for solving two-point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain

Total: 60 HOURS

TEXT BOOKS:

T1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science",9th Edition, Khanna Publishers, New Delhi, 2012.

T2. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson, Education, Asia, New Delhi, 2006.

T3. SivaramakrishnaDas.P and Vijayakumari.C, Numerical Analysis, 2014, Pearson Education, Limited in South Asia.

REFERENCE BOOKS:

R1: Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers",Tata McGraw-Hill, New Delhi, 5th Edition, 2007.

R2: Sankara Rao K, "Numerical Methods for Scientists and Engineers", Prentice Hall of India, New Delhi, 3rd Edition,2007 .

WEB LINKS:

W1: https://www.mathcity.org/_media/msc/notes/numerical-analysis-m-usman-hamid.pdf

W2: https://www.math.hkust.edu.hk/~machas/numerical-methods.pdf

COURSE OUTCOMES

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

CO1:	Apply numerical methods to obtain approximate solutions to mathematical problems.	**K3**
CO2:	Illustrate numerical methods for various mathematical interpolation problems.	**K2**
CO3:	Evaluate differentiation and integration solutions using numerical methods.	**K3**
CO4:	Describe the initial value problem for Ordinary differential Equations.	**K4**
CO5:	Explain the boundary value problem for Ordinary differential equations and Partial	**K4**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	1	2	2	-	-	-	-	-	3	3	3
CO 2	3	2	2	1	2	2	1	-	-	-	-	1	2	2
CO 3	3	2	1	1	1	3	-	-	-	-	-	1	2	1
CO 4	3	1	1	2	1	-	-	-	-	-	-	2	1	1
CO 5	2	1	1	1	1	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**

22CBBM32	ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3

Course Objectives

To help the student understand the basics of the principles of circuit analysis and design

- To understand the basic concepts and characteristics of the electronic devices and circuits.
- To impart a sound knowledge about the
  Basic Concepts of semiconductor devices – PN Junction Diode Characteristics and Field effect Transistors.
- To impart knowledge about the design of Rectifiers and Amplifiers.
- To study and design the applications of Oscillators and its Medical Applications.

UNIT I SEMICONDUCTOR DIODE 9 hours

Intrinsic and Extrinsic semiconductor, PN junction Diode: Construction, Working and VI Characteristics, Application of diode: Diode switch, Clipper, Clamper and Voltage multipliers - Zener diode - Zener voltage regulators.

UNIT II FIELD EFFECT TRANSISTORS 9 hours

JFET: Construction, Operation and Characteristics, Expression for pinch off voltage and drain current, MOSFET: Enhancement mode and Depletion mode MOSFET operation and characteristics, handling precautions of MOSFET, FET as VVR - Comparison of MOSFET and JFET - Comparison of BJT and JFET.

UNIT III RECTIFIERS AND POWER SUPPLIES 9 hours

Half Wave and Full Wave Rectifier, Bridge rectifier - performance measures of rectifiers, filters: Full Wave rectifier with inductive filter, capacitive filter, LC filter, Regulators-Shunt and series voltage regulators - Performance measures of regulators - Simple power supply circuits for medical instruments.

UNIT IV MULTISTAGE AMPLIFIERS AND POWER AMPLIFIERS 9 hours

Introduction to multistage amplifiers, Two stage RC Coupled amplifier, Darlington emitter follower amplifier, Bootstrap amplifier Introduction, Power Amplifiers: Class A Power Amplifier, Push Pull Principle, Class B push pull amplifier and complementary symmetry amplifier, Class C amplifier, Distortion in amplifiers - Medical applications.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9 hours

Effects of negative feedback, Voltage series, voltage shunt, current series and current shunt feedback amplifiers, Barkhausen Criterion for Oscillation, Construction and working of RC, Wein bridge oscillator, Hartley Oscillator, Colpitt's Oscillator, Crystal Oscillator - Medical applications.

TOTAL : 45 HOURS

Text Books:

T1. Robert L. Boystead and Louis Nashelky, Electronic Devices and Circuits, 8th Edition, PHI, 2005.
T2. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits, PPH, 2004.

Reference Books:

R1: Millman& Halkias, Integrated Electronics, McGraw Hill International Edition. 1991
R2: David A. Bell, Electronic Devices and Circuits, PHI.

Web Links:

W1: https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_ECE_EDC%20NOTES.pdf
W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SECA1306.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the Basics of electronic devices like diodes, transistors and amplifiers	**K 1**
CO2:	Develop knowledge about the principles, construction, characteristics and functioning of different semiconductor devices	**K 2**
CO3:	Determine a deep knowledge about the basic circuits in electronics	**K 3**
CO4:	Articulate knowledge about the special behavior of various devices	**K 3**
CO5:	Analyse and understand the design of electronic amplifiers.	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	1	-	-	-	-	3	3	3
CO2	1	2	2	2	2	2	-	-	-	-	-	1	2	2
CO3	2	2	1	2	2	3	1	-	-	-	-	1	2	1
CO4	2	1	1	2	1	-	1	-	-	-	-	2	1	1
CO5	1	2	2	1	2	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBM33	HUMAN ANATOMY AND PHYSIOLOGY	3	0	0	3

Course Objectives

The students will be able:

- To learn to appreciate the fascinating and ancient branch of science because it unfolds the mystery of complicated and functional aspects of individual organs of the body.
- The learning provides a solid foundation for understanding the structure and function of the human body. It also explains how body systems function to maintain homeostasis on day-to-day basis through the process of circulation, respiration, digestion, cellular metabolism, urinary functions and buffer systems.
- It is geared to preparing students for careers in health related professions.

UNIT I CARDIOVASCULAR SYSTEM 9 hours

Blood, Blood groups, Blood coagulation, structure and function of hemoglobin. Heart - Anatomy of heart; origin, conduction and regulation of heart beat, Cardiac cycle, Electrocardiogram, Blood pressure, regulation of blood pressure.

UNIT II DIGESTIVE AND EXCRETORY SYSTEM 9 hours

Overview of organs of digestive system-mouth, stomach, Small intestine, large intestine, Liver, Structure of Kidney, Physiology of urine formation, Role of the kidney in the regulation of water, salt and acid base balance.

UNIT III ENDOCRINE AND NERVOUS SYSTEM 9 hours

Endocrine System - Hormones - Pituitary Gland, Pineal Gland, Thyroid Gland, Pancreas, Adrenal Glands, Neuron, Organization of Nervous System - Brain and Spinal cord, Synapse, Reflex activity, Pain, EEG.

UNIT IV RESPIRATORY AND SENSORY SYSTEM 9 hours

Physiology of Respiration, Pulmonary Function tests, Exchange and transport of gases in the Blood, Regulation of respiration. Structure of eye and ear, physiology of vision, Mechanism of hearing.

UNIT V BONES AND MUSCLE PHYSIOLOGY 9 hours

Bones - types, formation, Development and growth of bone, Axial and Appendicular Skeleton, Joints of Skeleton, Types of muscles - Skeletal, Cardiac and Smooth muscle structure. Changes during muscular contraction. Structure of neuro muscular junction. Electromyogram.

TOTAL : 45 HOURS

TEXTBOOKS:

T1. Ross and Wilson, Anatomy and Physiology in Health and Illness, Churchill Livingstone, 9th Edition.2001

T2. Gerard. J. Tortora. Principles of Human Anatomy and physiology, Harper Collins College Publishers, 7th Edition.2005

T3. Arthur C. Guyton & John E. Hall, Text Book of Medical Physiology, W.B.Saunders Company, London, 12th Edition.1996.

REFERENCE BOOKS

R1: P. Saraswathi, Handbook of Anatomy for Nurses Jaypee Brothers Medical Publishers (P) Ltd, 1st Edition.2014.

R2: K Sembulingam and Prema Sembulingam, Essentials of Medical Physiology, Jaypee Brothers Medical Publishers P Ltd., 2nd Edition, 2001.

WEBLINKS:

W1: https://drnaitiktrivedi.com/index.php/notes/anatomy-physiology-notes/

COURSE OUTCOMES

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

CO1:	Analyse the various concepts of cell tissues of human body.	**K 4**
CO2:	Examine various parts of formation and analysis of human body.	**K 2**
CO3:	Illustrate the basic knowledge of human anatomy and physiology.	**K 3**
CO4:	Explain the various functions of the individual organs of the body.	**K 3**
CO5:	Explain about the structure and function of human body.	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	-	-	-	-	-	-	-	2	3	2
CO2	2	1	2	1	-	-	-	-	-	-	-	2	2	2
CO3	3	2	1	1	-	-	-	-	-	-	-	2	2	1
CO4	3	1	1	2	-	-	-	-	-	-	-	2	2	1
CO5	1	1	1	1	-	-	-	-	-	-	-	2	2	1

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBM34	BIOINSTRUMENTATION AND MEASUREMENTS	3	0	0	3

COURSE OBJECTIVES

The students will be able to learn:

- The purpose of learning the course onIntegrated circuit design for bioinstrumentation for biomedical engineering students is to enable the students to understand the fundamentals of linear integrated circuits and to implement and study in relation to the various medical related applications
- To study the static and dynamic behavior of analog and digital instruments and basic construction and working of AC and DC instruments for measurement of Voltage and Current.
- To obtain basic knowledge of digital instruments for measurement of voltage and current.
- To study signal generator and signal analysis. Also to study the different output devices analog and digital recorders.

UNIT I INTRODUCTION **9 hours**

Function elements of measuring instrument, Error in Measurement, Sources of Error, Static Characteristics: Accuracy, Sensitivity, Reproducibility, Drift, Static error types and Dead zone, Dynamic Characteristics: Speed of Response, Fidelity, Lag and Dynamic Error, Dynamic response of different order systems.

UNIT II BASICS OF ANALOG INSTRUMENTS **9 hours**

D'arsonval Galvanometer, Moving coil Instruments: Permanent magnet moving coil instrument, PMMC ammeter and PMMC voltmeter, Ohmmeter: Shunt type and Series type.Basic Electrodynamomter type instrument, Electrodynamometer type Ammeter and Electrodynamometer type voltmeter - Construction and working principle-Wheatstone's Bridge-Kirchoff's Law.

UNIT III BASICS OF DIGITAL INSTRUMENTS **9 hours**

Basic building block of a digital instrument, Ramp type digital voltmeter, Digital frequency meter, Digital phase meter and Digital storage oscilloscope, Comparison between analog and digital instruments.

UNIT IV SIGNAL GENERATION AND SIGNAL ANALYSIS **9 hours**

Standard signal generator, AF Sine and square wave generator, Function generator, RF generator, Basic Wave Analyzer, Heterodyne wave analyzer Spectrum analyzer and Harmonic distortion analyzer.

UNIT V DISPLAY DEVICES AND RECORDERS **9 hours**

Digital Display System and Indicators: Classification of display devices, DOT MATRIX display, LED Seven Segment display, LED matric display, LCD seven segment display, Recorders: Graphic Recorders - Strip chart recorders, Galvanometer type recorders and Self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders

TOTAL : 45 HOURS

Text Books:

T1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai sons, 1991.

T2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995

Reference Books

R1: W.D cooper and A. D. Helfrick, Electronic Instruments and Measurements Techniques, Prentice Hall of India-1991

R2: E. O. Doeblin, Measurement System - Application & Design, Mc Graw Hill, 1990.

Weblinks:

W1: https://www.vssut.ac.in/lecture_notes/lecture1620289351.pdf

W2: https://www.technicalsymposium.com/Biomedi_Sem3_149303NOL.pdf

COURSE OUTCOMES

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

CO1:	Explain the introduction and characteristics of instruments.	**K 1**
CO2:	Illustrate the basic working of Analog instruments and digital instrumenmts.	**K 2**
CO3:	Examine the basic characteristics of digital instruments uses and its advantages.	**K 3**
CO4:	Explain the working of devices and its applications.	**K 3**

CO5:	Explain the techniques of differentiating the analog and digital equipments.	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	-
CO2	2	1	2	2	1	-	-	-	-	-	-	-	3	2
CO3	3	2	3	3	2	-	-	-	-	-	-	-	3	2
CO4	3	1	2	2	2	-	-	-	-	-	-	-	3	2
CO5	2	1	2	2	2	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBM35	BIOCHEMISTRY (BLENDED LEARNING)	3	0	2	4

COURSE OBJECTIVE

The students will be able to

- Understand the insight into the chemical aspects of biological macromolecules and their importance
- Analyze the basics of biochemistry, i.e, synthesis and carbohydrates, lipids etc
- Understand the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzymes

UNIT 1CARBOHYDRATES **12 hours**

Introduction.Classification, Properties and Biological importance.Isomers, epimers, enantiomers, mutarotation, open chain and closed chain structures of glucose, carbohydrates test, Analysis of Glucose in blood,
Test the classification of biological molecules in a human body.

UNIT 2 AMINOACIDS AND PROTEINS **12 hours**

Aminoacids: classification- essential and non-essential amino acids, protein and non-protein amino acids, Zwitter ions. Proteins: Classification- based on i) shape and solubility and ii) increasing complexity of structure. Structure of proteins: primary, secondary, tertiary and quaternary, biological significance. Concept of isoelectric point and its significance, protein tests, Analysis of urine and urea.

UNIT 3 LIPIDS **12 hours**

Introduction, Classification, Properties and Biological importance. Fatty acid nomenclature and structure, Lipids in cell membrane Cholesterol and Steroids, Hormones - structure and function, Lipid and cholesterol tests.

UNIT 4 NUCLEIC ACIDS **12 hours**

Introduction- Nitrogeneous bases - Purines and Pyrimidines - Nucleosides and Nucleotides -- Structure of nucleic acids - DNA, RNA: m-RNA, t-RNA, r-RNA - Biological importance of nucleic acids. 16s rRNA and its significance, blood grouping, clotting and bleeding time.

UNIT 5 VITAMINS AND MINERALS **12 hours**

Vitamins: fat soluble and water-soluble vitamins. Minerals: Micro and Macrominerals. Biological importance of vitamin and minerals, deficiency symptoms

TOTAL: 60 HOURS

TEXTBOOKS

T1. Lehninger, Nelson and Cox, Principles of Biochemistry, W.H.Freeman, 4th Edition, 2005

T2. Donald Voet, Judith Voet and Charlotte Pratt, Principles of Biochemistry, John Wiley and Sons, 2008

REFERENCE BOOKS

R1: Pamela C.Champe, Richard A.Harvey and Denise R.Ferrier, Biochemistry, Lippincott's Illustrated reviews, 4th edition, 2007

R2: Stryer, L., Biochemsitry, 4th Edition, W.H. Freeman & Co., 2000.

WEBLINKS:

W1: **https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/medicalbiochemistry.pdf**

W2: **https://www.mednotes.in/2019/10/biochemistry.html**

COURSE OUTCOMES

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

CO1:	Describe the basics of carbohydrates and its tests	**K2**
CO2:	Describe the importance, analysis and types of amino acids	**K2**
CO3:	Illustrate the classification of lipid tests	**K3**
CO4:	Describe the importance of nucleic acids	**K3**
CO5:	Evaluate the importance of vitamins and minerals	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	1	1	-	-	-	-	-	-	-	3	2
CO2	3	2	3	2	2	-	-	-	-	-	-	-	3	3
CO3	2	3	3	3	3	-	-	2	-	-	-	-	3	3
CO4	2	3	3	3	3	-	-	2	-	-	-	-	3	3
CO5	2	3	3	3	3	-	-	2	1	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22PBBM31	HUMAN ANATOMY AND PHYSIOLOGY LAB	0	0	2	1

COURSE OBJECTIVE:

- To provide the students the exposure to the fundamentals in human anatomy and physiology.

LIST OF EXPERIMENTS

1. Identification and study of human eye
2. Identification and study of human brain
3.Identification and study of human heart
4.Identification and Study of Human Skull
5. Study of ECG.
6. Blood Pressure Monitoring.
7. Auscultation for Heart Sounds(Sthethescope)
8.Identification and study of human bones
a.Upper limb bones
b.Lower limb bones
9.Study and Identification of Human Skeleton System
10.Working of Galvanic Skin Resistance(GSR)
11.Measurement of Human Body Temperature

TOTAL : 30 HOURS

Text Books:

T1. Hole's Human Anatomy and Physiology textbook, 13th ed., by Shier, Butler, and Lewis, McGraw Hill, 2013. ISBN 978-0073378275

T2. Laboratory Manual to Accompany Hole's Human Anatomy and Physiology, 13th ed., by Martin, McGraw Hill, 2013. ISBN 978-0077390785

Reference Books

R1: W.D cooper and A. D. Helfrick, Electronic Instruments and Measurements Techniques, Prentice Hall of India-1991

R2: E. O. Doeblin, Measurement System - Application & Design, Mc Graw Hill, 1990.

Weblinks:

W1: https://www.vssut.ac.in/lecture_notes/lecture1620289351.pdf

W2: https://www.technicalsymposium.com/Biomedi_Sem3_149303NOL.pdf

COURSE OUTCOMES

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

CO1:	Analyse the various Anatomical and physiological structures	**K4**
CO2:	Examine various physiological functions and principles of human body	**K3**
CO3:	Determine various illustrations of human anatomical system and physiological parameters of the body	**K4**
CO4:	Distinguish various types of bones, organs, biochemical parameters and biosignals	**K5**
CO5:	Explain and understand the anatomy and physiology of the human system and its functions	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	-	-	-	-	-	-	3	2
CO2	3	2	2	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

Observation	Record	Model Exam	End Semester practical	Assignments	Case Studies
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22PBBM32	ELECTRONIC DEVICES&CIRCUITS LAB	0	0	2	1

COURSE OBJECTIVE:

The student should be able to

- Describe principles and applications of different ammeters and voltmeters
- Explain the types and working of watt meters and energy meters
- Learn the types, construction, and working of different types of amplifiers

LIST OF EXPERIMENTS

1. Rectifiers – HWR and FWR (with & without capacitor filter)
2. Zener diode as regulator
3. Study of biasing circuits a. i). Fixed bias, ii). Self bias, iii). collector to base bias
4. FET amplifier
5. Differential amp – CMRR and determination of Gain
6. Design of RC coupled amplifier
7. Design of Voltage series feedback amplifier
8. Design of Class A and Class B amplifier
9. Design of RC phase shift oscillator
10. Design of Hartley Oscillator
11. Design of Colpitts's oscillator
12. Study of pulse shaping circuits i). AstableMultivibrator ii). MonostableMultivibrator

TOTAL : 30 HOURS

Text Books:

T1. Robert L. Boystead and Louis Nashelky, Electronic Devices and Circuits, 8th Edition, PHI, 2005.
T2. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits, PPH, 2004.

Reference Books:

R1: Millman& Halkias, Integrated Electronics, McGraw Hill International Edition. 1991.
R2: David A. Bell, Electronic Devices and Circuits, PHI.

Web Links:

W1: https://www.iare.ac.in/sites/default/files/lab1/EDC%20LAB%20MANUAL%20--CHECKED-UPLOAD.pdf

COURSE OUTCOMES

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

CO1:	Articulate knowledge about the simple and basic circuits	**K3**
CO2:	Develop knowledge about responses and design of the basic electronic devices	**K3**
CO3:	Analyse and understand the basic design of electronic circuits	**K4**
CO4:	Categorise and define the designs and techniques for analysis of electronic devices and circuits	**K5**
CO5:	Analyse and determine the applications of electronic circuits	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	1	1	-	1	-	1	3	2
CO2	3	2	2	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	1	1	-	1	-	1	3	3
CO4	3	3	3	3	3	-	1	1	-	1	-	1	3	3
CO5	3	3	3	3	3	-	-	-	-	1	-	1	3	3

ASSESSMENT METHODS:

Observation	Record	Model Exam	End Semester practical	Assignments	Case Studies
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22SPUD31	PERSONALITY DEVELOPMENT I	2	0	0	2

COURSE OBJECTIVES:

- To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders

UNIT I SOFT SKILLS I 6 hours

Introduction to Personality Development – Meaning–Features of personality – Dimensions of Personality Determinants of Personality–Features and Traits– Components of self concept–Barriers–Self analysis

UNIT II SOFT SKILLS II 6 hours

Importance of Soft Skills – First impression–Work Place requirements–Discipline –Cleanliness Hygiene – general Appearance—Building Confidence—Concept of Thinking and Usage –Value of Time–Focus & Commitment.

UNIT III SOFT SKILLS IN ACTION 6 hours

Grooming – Attire – Understanding others– Stability & Maturity Development – Strength s – Weakness – Opportunities–threats – Merits of SWOT Analysis – Components – how to convert weakness into strengths – Goal settings

UNIT IV SELF AWARENESS AND SELF ESTEEM 6 hours

Definitions – Components of Self awareness – Developing Self awareness – Self esteem – meaning –Steps to improve self esteem.

UNIT V SELF MOTIVATION 6 hours

Motivation – Meaning –Techniques of self motivation–Motivation & goal setting – Motivation and emotion – Motivation at work.

TOTAL: 30 HOURS

TEXT BOOKS:

T1. Personality Development And Soft Skills Barun K Mitra, Oxford Publication
T2. Seven habits of Highly Effective people – Stephen R. covey

REFERENCE BOOKS:

R1: Emotion, motivation and Self regulation – Nathan C. Hall, McGill University, Canada Thomas Goetz, University of Konstanz, Germany http://www.emeraldgrouppublishing.com.
R2: Psychology of Self esteem – Nathaniel Branden, Nash (1st edition), Jossey – Bass (32 nd anniversary edition)

WEBLINKS:

W1: https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/BSS201%20-%20PERSONALITY.pdf

COURSE OUTCOMES

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

CO1:	Discuss the features, dimensions and determinants of personality	**K2**
CO2:	Make a good first impression in professional and other situations	**K3**
CO3:	Demonstrate confidence, punctuality and commitment as an engineer	**K3**
CO4:	Set goals for development using SWOT analysis	**K5**
CO5:	Develop self-awareness and improve self esteem	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	1	2	2	1	1	3	-	2	2	-
CO2	-	-	-	-	2	3	2	2	3	3	-	2	2	-
CO3	-	-	-	-	2	2	3	2	3	1	3	2	2	-
CO4	-	-	-	-	2	2	3	1	-	-	2	2	2	-
CO5	-	-	-	-	2	2	3	1	-	-	2	2	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

22MCMB31	BASIC LIFE SKILLS	2	0	0	0

COURSE OBJECTIVE:

1. To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

UNIT I PHYSICALHEALTH 6 hours

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.Yogasanas: Pranamasana – HasthaUttanasana - PadaHasthasana – AswaSanjalana Asana – ThuvipathaasvaSanjalana asana – AstangaNamaskara - Bhujangasana–AthaMukthaSavasana – AswaSanjalana Asana - PadaHasthasana–HasthaUttanasana - Pranamasana.Pranayama: Naddisuddi - Clearance Practice - Benefits.

UNIT II LIFE FORCE 6 hours

Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds).Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness. Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III MENTAL HEALTH 6 hours

Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits.
Shanthi Meditation explanation – Benefits - Thuriya Meditation explanation – Benefit.Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV VALUES 6 hours

Human Values Self-control - Self-confidence - Honesty Contentment - Humility – ModestyTolerance - Adjustment - Sacrifice – ForgivenessPurity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual puritySocial Values:Non-violence– ServicePatriotism – EqualityRespect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

UNIT V MORALITY (VIRTUES) 6 hours

Importance of Introspection - I - Mine (Ego, Possessiveness).Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.

TOTAL: 30 HOURS

TEXT BOOKS:

T1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
T2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
T3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
T4. Rev.Dr.G.U. Pope, 2016, Thirukkural, Giri Trading Agency,
T5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.

REFERENCE BOOKS:

R1: Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
R2: Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,
R3: K. R. Dhanalakshmi and N. S. Raghunathan, " Personality Enrichment, Margham Publications
R4: D.r V. M. Selvaraj, "Personality Development" Bhavani Publications
R5: R. S. Agarwal, "Quantitative Aptitude".
R6: A.K Gupta, "Logical and Analytical Reasoning (English)", 30th Edition.

WEBLINKS:

W1: https://ncert.nic.in/pdf/publication/otherpublications/tiyhwlups1.pdf
W2: https://aif.org/wp-content/uploads/2018/10/Lifeskills-2018a_MAST.pdf

COURSE OUTCOMES

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

CO1:	Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.	**K2**
CO2:	Demonstrate foundational standing, sitting, balance postures with proper alignment and maintain youthfulness through kaya kalpa practice.	**K3**
CO3:	Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them.	**K2**
CO4:	Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga to understand the human values.	**K3**
CO5:	Achieve a greater sense of awareness, wisdom, introspection, and a deeper sense of relaxation through meditation to keep up morality in life.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	3	-	-	3	2	-
CO2	-	-	-	-	-	3	2	2	3	-	-	3	2	-
CO3	-	-	-	-	-	3	3	2	3	-	-	3	2	-
CO4	-	-	-	-	-	3	2	2	3	-	-	3	2	-
CO5	-	-	-	-	-	3	3	3	3	-	-	3	2	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

SEMESTER IV

22CBBM41	SIGNALS AND SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

To have adequate knowledge basics of signals and systems which helps to understand the basic definition and classification of continuous time and discrete time signals and to study its analysis and its relevance to physiological signals.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9 hours

Continuous time signals (CT Signals) and Discrete time signals (DT Signals)- Step, Ramp, Pulse, Impulse, Exponential - Classification of CT and DT signals - Periodic, aperiodic and Random signals Real and complex signals - Energy and power signals - CT systems and DT systems - Linear time invariant systems - Basic properties of continuous-time systems - Linearity, Causality, Time invariance, Stability.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9 hours

Definition - Continuous time Fourier transform and Laplace transform analysis with examples - Decaying exponential - Rising exponential - Double exponential - Basic properties - Linearity - Parseval's relation - Convolution in time and frequency domain - Time shifting & Time reversal - Relation between Fourier transform and Laplace transform.

UNIT III ANALYSIS OF DISCRETE TIME SIGNALS 9 hours

Spectrum of DT signals, Sampling theorem – Graphical and analytical proof for Band Limited Signals, effect of under sampling – Aliasing - Basic principles of Z-Transform - Z-Transform definition - Region of convergence - Properties of ROC - Properties of Z- Transform - Poles and zeros - Inverse Z-Transform using contour integration

UNIT IV LINEAR TIME INVARIENT SYSTEMS 9 hours

Frequency response of LTI systems - Analysis and characterization of LTI systems using Laplace transform - computation of impulse response and transfer function using Laplace transform – Computation of Impulse response and Transfer function using Z-Transform. Random signal–relationship Between two random signals properties of autocorrelation and cross correlation functions

UNIT V MEDICAL APPLICATIONS OF SIGNAL ANALYSIS 9 hours

Introduction to Bio signals, Analysis of bio signals- Spatial and Frequency domain methods- Detailed Signals analysis of ECG, EMG, EEG

TOTAL : 45 HOURS

TEXT BOOKS:

T1. Allan V. Oppenheim et al., Signals and Systems, 2nd Edition, Prentice Hall of India Pvt. Ltd., 200

T2. Ramesh Babu P., Signals and Systems, 4th Edition, Scitech Publishers, 2011.

T3. Salivahanan S., Digital signal processing, 2nd Edition, Tata McGraw Hill, 2009

REFERENCES

R1. Signals and Systems 2nd Edition by Simon Haykin, WILEY INDIA,2018

R2. Michael Roberts, Govind Sharma, Fundamentals of Signals and Systems, McGraw Hill Education, 2017

R3. Chittode J.S., Signals & Systems, Technical Publication, 2021.

WEBLINKS:

W1: https://ceat.okstate.edu/che/site_files/docs/babatunde-a-ogunnaike.pdf

W2: https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/

W3: http://www.ws.binghamton.edu/fowler/Fowler%20Personal%20Page/EECE301%20-%20Flipped.htm

COURSE OUTCOMES

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

CO1:	Understand the basics of signals and systems.	**K2**
CO2:	Acquire knowledge in the types of signals and systems.	**K3**
CO3:	Apply the acquired knowledge in understanding the signal manipulations.	**K3**
CO4:	Analyse the various signals using different tools and techniques.	**K4**
CO5:	Develop the system to analyze the real-time biosignals	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	-	-	-	-	-	-	1	3	-
CO2	3	2	2	2	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	2	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓	✓	

22CBBM42	ANALOG AND DIGITAL INTEGRATED CIRCUITS	3	0	0	3

COURSE OBJECTIVE

The students will be able to learn:

- The prime objective of this course is to introduce to the students the fundamentals of Analog and Digital IC's
- The students will be equipped with the basic knowledge of Analog and Digital IC's interfacing and their applications.

UNIT I NUMBER SYSTEMS **9 hours**

Decimal, Binary, Octal and Hexadecimal Numbers.-Conversion between these number systems – Logic Gates-Truth tables-r's and (r-1)'s complements-subtraction using complements-Encoding numbers and characters using Binary digits –Binary coded Decimal –Gray code -Binary to Gray code conversion- Boolean laws and theorems- Solving Boolean expressions -The Karnaugh Map -Half adder-Full adder-Multiplexers-Demultiplexers-Encoders-Decoders.

UNIT II REGISTERS AND COUNTERS **9 hours**

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

UNIT III OPERATIONAL AMPLIFIERS **9 hours**

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth – equivalent circuit of an op-Amp – virtual ground concept – Linear applications of op-amp – inverting and noninverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter –Differential amplifiers –Instrumentation amplifier- differentiator and integrator. Nonlinear applications- comparator – Schmitt Triggers.

UNIT IV ACTIVE FILTERS AND SIGNAL GENERATOR **9 hours**

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

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

555 Timer (internal diagram) and its applications – monostable multivibrator, astable multivibrator. Phase locked Loo (565 - block diagram approach) and its applications - voltage to frequency and frequency to voltage converters. DAC · Binary weighted DAC and R-2R DAC- ADC – single and dual slope ADCs, successive approximation ADC.

TOTAL : 45 HOURS

TEXT BOOKS

T1. M. Morris Mano , ―Digital Logic and Computer design ― Prentice Hall 1994.
T2. Ramakant A. Gayakwad , ―Op-AMP and Linear Ics‖, Prince Hall, 1994
T3. John. F. Wakerly, ―Digital Design Principles and Practices‖, Fourth Edition, Pearson Education, 2007 .
T4. Charles H. Roth, Jr, ―Fundamentals of Logic Design‖, Fourth Edition, Jaico Books, 2002.

REFERENCE BOOKS:

R1. Robert B.Northrop, ―Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation‖, CRC Press, 2004.
R2. Sergio Franco, ―Design with Operational Amplifiers and analog Integrated circuits‖, McGraw- Hills, 2003.
R3. Millman J and Halkias .C., ―Integrated Electronics‖, TMH, 2007.

WEB LINKS:

W1: https://www.academia.edu/18978568/Analog_Electronics_Week1
W2: https://ajaybolar.weebly.com/analog-electronic-circuits.html
W3: https://www.lecturenotes.net/home/institute_courses3_ppt/analog-electronic-circuits/32/1674/4

COURSE OUTCOMES

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

CO1:	Simplify the mathematical expressions using Boolean Algebra and K-Map to design Combinational logic circuits.	**K3, K6**
CO2:	Understand the operation of Flip Flops and its application in the design of various Sequential circuits.	**K2, K6**
CO3:	Understand the Ideal characteristics of Operational Amplifier and its applications in various arithmetic circuits.	**K3**
CO4:	Analyze the working of Filtering and Signal Generating circuits designed using Operational Amplifier.	**K4**
CO5:	Implement and Analyze the working of Timer, PLL, A/D and D/A converter circuits constructed using Operational Amplifier.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	2	1	2	2	1	-	2	3	3
CO2	3	2	2	2	2	2	1	1	2	1	-	2	2	1
CO3	3	2	2	2	1	3	1	-	2	1	-	1	2	3
CO4	3	1	2	1	1	-	-	1	2	1	-	2	1	2
CO5	2	1	2	2	1	3	3	1	1	1	-	2	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓	✓	

22CBBM43	BIOSENSORS AND TRANSDUCERS	3	0	0	3

COURSE OBJECTIVES

- To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- To know about the types of transducers available and their applications in different fields.

UNIT I INTRODUCTION **9 hours**

General measurement system - purpose, structure and elements-Transducers - Definition, Classification. Resistance type- strain gauges, thermometers, potentiometers. Capacitive type, Inductive type- variable reluctance and LVDT. Biomedical Applications.

UNIT II TRANSDUCERS **9 hours**

Temperature transducers, Piezoelectric transducers, Piezoresistive transducers, Photoelectric transducers, Pressure transducers, Magneto strictive transducers Biomedical applications.

UNIT III BIO POTENTIAL ELECTRODES **9 hours**

Half cell potential (or) Electrode potential, Types of Electrodes - Micro electrodes, Depth and needle electrodes, Surface electrodes, and Chemical electrodes. Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

UNIT IV BIOMEMS & NANO SENSORS **9 hours**

Introduction, biological elements, immobilization of biological components. Micro machined biosensor - cantilever based chemical sensors - Biosensors for diabetes mellitus, FAB. Biochip - introduction, gene chip.

UNIT V APPLICATIONS OF BIOSENSORS **9 hours**

ISFET for glucose and urea. IMFET, MOSFET biosensors, affinity biosensor (catalytic biosensor), Enzyme electrodes, Ion exchange membrane electrodes.

TOTAL : 45 HOURS

TEXT BOOKS:

T1. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995.
T2. Brain R Eggins, Biosensors: An Introduction", John Wiley Publication.1996.
T3. A. K.Sawhney, A course in Electronic Measurements and Instruments, Dhapat Rai & sons, 1991

REFERENCE BOOKS:

R1: John G Webster, Medical Instrumentation: Application and design, John Wiley Publications.2007.
R2: John P Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education Asia, (2000 Indian reprint)
R3: Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

WEBLINKS:

W1: http://contents.kocw.or.kr/document/wcu/2009/23/01/01/23_01_01_04_Week4_Biosensors_28Sep2009_TransducersI.pdf
W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA1301.pdf

COURSE OUTCOMES

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

CO1:	Explain the introduction and characteristics of biosensors and transducers	**K 1**
CO2:	Illustrate the types of transducers used in biomedical field.	**K 2**
CO3:	Examine the basic characteristics of electrodes used in sensors and transducers.	**K 3**
CO4:	Explain the structure of biosensors and transducers in detail	**K 3**
CO5:	Explain the working and applications of Biosensors	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	-	-	-	-	2	2	-
CO2	1	1	2	2	3	-	-	-	-	-	-	2	3	-
CO3	3	2	2	3	3	-	-	-	-	-	-	2	3	2
CO4	2	1	2	3	3	-	-	-	-	-	-	2	3	3
CO5	2	1	2	2	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBM44	BIOMATERIALS AND BIOMECHANICS	3	0	0	3

COURSE OBJECTIVES

- To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- To know about the types of transducers available and their applications in different fields.

UNIT I BIOMECHANICS **9 hours**

Biomechanics- Definition and perspective, Fundamental Mechanical Concepts- Kinetics and Kinematics, Newton's Laws, Mechanical Properties -Stress, Strain, Elasticity, Shear, Tension, Forces, Compression, Plastic Deformation, Creep, and Fatigue. Mechanical testing of biomaterials.

UNIT II BIOMATERIALS **9 hours**

Biomaterials - Overview, Classification of biomaterials, Interfacial Phenomena and tissue response to biomaterials, Metals and alloys for orthopaedic implants-Stainless steel, Cobalt chromium alloy, Titanium and its alloys, Precious metal alloys, Other metal alloys. Dental implants - materials, types and designs.

UNIT III HUMAN LOCOMOTION **9 hours**

Anthropometric Characteristics of human body. Types of motion in humans, Gait analysis. Goniometry. Accelerometer, Foot Pressure Measurements-Pedobarographic-Force platform. Mechanics of foot.

UNIT IV ARTIFICIAL ORGANS & IMPLANTS **9 hours**

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants. Polymerization, polyamides, Acryrilic polymers, rubbers, high strength Thermoplastics, medical applications. Bio polymers: Collagen and Elastin. Medical Textiles: Silica, Chitosan, PLA composites, Sutures, wound dressings

UNIT V SPORTS MECHANICS **9 hours**

Application of biomechanics to neuromuscular fitness, gymnastics, Application of aerodynamics in sports, hydrodynamics in swimming. Analysis of throw and push patterns. Sports Medicine

TOTAL: 45 HOURS

TEXT BOOKS:

T1. Susan J Hall, Basic Biomechanics, Mc Graw Hill, 1999.
T2. Y. G. Fung, Biomechanics, Springer-verlag New York Inc, 1990

REFERENCE BOOKS :

R1: Ellen Kreighbaum, Barthels, Biomechanics - A qualitative approach for studying human movement, Macmillan,2nd Edition,1985.
R2: Joseph Bronzino Hand book of Biomedical Engineering, Springer,2nd Edition,2000.
R3: Buddy Ratner etal., Biomaterials Science - An Introduction to Materials in Medicine, Academic Press, San Diego, 1996.

WEBLINKS:

W1: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA1403.pdf
W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBM1304.pdf
W3: https://bme.lth.se/fileadmin/biomedicalengineering/Courses/Biomekanik/Lecture1_2015.pdf

COURSE OUTCOMES

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

CO1:	Describe the principles of mechanics and Mechanical testing of biomaterials	**K 2**
CO2:	Illustrate the uses and need of biomaterials.	**K 2**
CO3:	Explain the fundamentals of Human Locomotion and its measuring techniques	**K 3**
CO4:	Apply the knowledge of biomaterials used in various organs.	**K 3**
CO5:	Apply the principles of the mechanics in all fields	**K 3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	1	-	-	-	-	-	-	3	3	-
CO2	2	1	2	2	1	-	-	-	-	1	-	3	3	-
CO3	3	2	1	3	1	-	-	-	-	-	-	3	3	3
CO4	3	2	2	3	1	-	-	-	-	-	-	3	3	3
CO5	2	2	2	3	1	-	-	-	-	1	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBM45	BASICS OF PYTHON AND MATLAB SOFTWARE	3	0	2	4

COURSE OBJECTIVES

- To know the basics of algorithmic problem-solving in Python and MATLAB
- To read and write simple Python programs.

UNIT I BASICS OF PYTHON **9+6 Hours**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, Introduction to Python Programming, simple strategies for developing algorithms (iteration, recursion), Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, Basic arithmetic and logical functions using python, function definition and use, flow of execution, parameters and arguments; Illustrative programs

UNIT II CONTROL FLOW, FUNCTIONS **9+6 Hours**

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

UNIT III LISTS, TUPLES, DICTIONARIES **9+6 Hours**

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; Linear search and Binary search , Illustrative programs: First n prime numbers, selection sort, insertion sort, mergesort, histogram.

UNIT IV MATLAB – BASICS **9+6 Hours**

Introduction to MATLAB, Variables and Assignment Statements - Initializing, Selection sort, Insertion sort & merge sort , Incrementing, and Decrementing, Expressions, Multiply matrices, Characters and Encoding, Vectors and Matrices – creating rows, columns, matrix,

UNIT V MATLAB PROGRAMMING **9+6 Hours**

MATLAB Scripts, Input and output, Scripts to Produce and Customize Simple Plots, Introduction to File Input/Output (Load and Save), User-Defined Functions, Basic MATLAB programming, Selection Statements – if, else if, switch, menu. Looping – for, while, Vectorsing, Illustrative programs.

TOTAL : -- 75 HOURS

TEXT BOOKS.

T1: Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016

T2: Stromy Attaaway, “MATLAB: A Practical Introduction to Programming and Problem Solving”, Elsevier, 2009.

REFERENCE BOOKS

R1: Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.

R2: G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.

WEB LINKS:

W1:https://www.slideshare.net/sujithkumar9212301/introduction-to-python-36647807

W2:https://www.slideshare.net/SaifuddinKaijar/python-basic-76159731

W3:http://greenteapress.com/wp/thinkpython/

COURSE OUTCOMES

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

CO1:	Develop knowledge about basics of python	**K2**
CO2:	Determine knowledge about programs execute simple Python programs.	**K2**
CO3:	Analyse the various additional features in python	**K3**
CO4:	Determine and execute knowledge about MATLAB programming	**K3**
CO5:	Compare the knowledge of different versions of MATLAB	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	-	-	-	-	-	-	-	2	2	1
CO2	3	2	2	2	2	2	-	-	-	-	-	3	3	3
CO3	3	3	3	2	3	3	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22PBBM41	BIO SENSORS AND TRANSDUCERS LABORATORY	0	0	2	1

COURSE OBJECTIVE:

- To study and analyze the theory and practical characteristics of the various transducers for the measurement of the vital physiological signals.
- To get familiar with the various types of transducers and to study the compatibility for any clinical measurements.

LIST OF EXPERIMENTS

1. Characteristics of pressure transducer
2. Measurement of displacement capacitive transducer, LVDT and Inductive transducer
3. Characteristics of optical transducer for SpO2 measurement
4. Measurement of skin temperature by both contact and non-contact method
5. Study of the characteristics of capacitor level sensor for saline level measurement in a I-V set.
6. Data acquisition of physiological signals
7. Study of hot-wire anemometry
8. Study of amperometric sensor for blood glucose measurement
9. Electronic weighing machine for the measurement of chemical compounds
10. Non-invasive gas analyzer as an electronic nose.

TOTAL : 30 HOURS

TEXTBOOKS:

T1. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995.
T2. Brain R Eggins, Biosensors: An Introduction", John Wiley Publication.1996.
T3. A. K.Sawhney, A course in Electronic Measurements and Instruments, Dhapat Rai & sons, 1991

REFERENCE BOOKS:

R1: John G Webster, Medical Instrumentation: Application and design, John Wiley Publications.2007.
R2: John P Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education Asia, (2000 Indian reprint)
R3: Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

WEBLINKS:

W1:http://eie.sliet.ac.in/files/2021/03/LAB-MANUAL-TRANSDUCER-LAB-EE-222.pdf
W2:https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/Transducer-Manual-Print-engg-lab.pdf

COURSE OUTCOMES

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

CO1:	Analyze about various theory, practical characteristics and conversions of the various transducers	**K3**
CO2:	Evaluate the measurement of the parameters using different sensors and transducers	**K3**
CO3:	Analyze various types of transducers	**K4**
CO4:	Test compatibility for different measurement techniques	**K5**
CO5:	Apply and understand the biosensors in different measurement techniques	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	-	-	-	-	-	-	3	2
CO2	3	2	2	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

Observation	Record	ModelExam	End Semester practical	Assignments	Case Studies
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22PBBM42	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	0	0	2	1

Course Objective:

- To understand, study and experiment the working of Amplifiers, Filters and Timers

1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Active filter – first order LPF and HPF
4. Schmitt trigger using IC741
5. Instrumentation amplifier using IC741
6. Wein bridge oscillator
7. Multivibrator 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 flipflops
12. Design of mod-N counter

TOTAL : 45 HOURS

TEXT BOOKS

T1. M. Morris Mano , —Digital Logic and Computer design — Prentice Hall 1994.
T2. Ramakant A. Gayakwad , —Op-AMP and Linear Ics‖, Prince Hall, 1994
T3. John. F. Wakerly, —Digital Design Principles and Practices‖, Fourth Edition, Pearson Education, 2007 .
T4. Charles H. Roth, Jr, —Fundamentals of Logic Design‖, Fourth Edition, Jaico Books, 2002.

REFERENCE BOOKS:

R1. Robert B.Northrop, —Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation‖, CRC Press, 2004.
R2. Sergio Franco, —Design with Operational Amplifiers and analog Integrated circuits‖, McGraw- Hills, 2003.
R3. Millman J and Halkias .C., —Integrated Electronics‖, TMH, 2007.

WEB LINKS:

W1: https://www.academia.edu/18978568/Analog_Electronics_Week1
W2: https://ajaybolar.weebly.com/analog-electronic-circuits.html
W3: https://www.lecturenotes.net/home/institute_courses3_ppt/analog-electronic-circuits/32/1674/4

COURSE OUTCOMES

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

CO1:	Apply the analog circuits for amplifiers.	**K3**
CO2:	Evaluate the use of filters in various applications	**K3**
CO3:	Discriminate the Oscillators and Instrumentation Amplifier	**K4**
CO4:	Evaluate the characteristic use of Timers in circuits.	**K5**
CO5:	Evaluate the different digital circuits based on flip-flops and counters.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	3	-	-	-	-	-	-	3	2
CO2	3	3	2	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	2	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	2	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	2	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

Observation	**Record**	**Model Exam**	**End Semester practical**	**Assignments**	**Case Studies**
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22SUPD41	PERSONALITY DEVELOPMENT II	2	0	0	2

UNIT I SOFT SKILLS III 6 hours

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

UNIT II QUANTITATIVE APTITUDE I 6 hours

Percentage – Profit Loss –Discount – Ratio Proportion – Time & Work – Time, Speed & Distance. Problems relating to ages– Permutation & Combination–Probability

UNIT III QUANTITATIVE APTITUDE II 6 hours

Mensuration – Clocks and Calendars – Boats – Simple Interest – Compound Interest – Fractions and Decimals – Square roots – Functions.

UNIT IV ANALYTICAL PROBLEMS 6 hours

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

UNIT V LOGICAL PROBLEMS 6 hours

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

TOTAL: 30 HOURS

TEXT BOOKS:

T1. K. R. Dhanalakshmi and N S Raghunathan, Personality Enrichment, Margham Publications, 2012
T2. R. S. Agarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishers, 2017

REFERENCE BOOKS:

R1. D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021
R2. A.K Gupta, Logical and Analytical Reasoning (English), Ramesh Publishing House, 2022

WEBLINKS:

W1: https://www.griet.ac.in/cls/Personality%20Development.pdf

COURSE OUTCOMES

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

CO1:	Discuss the basic, email, business, telephone and meeting etiquettes.	**K2**
CO2:	Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance.	**K3**
CO3:	Work with fractions, decimals and square roots.	**K3**
CO4:	Analyze the cause, effect and course of action in logical problems.	**K4**
CO5:	Solve problems on the letter and symbol series.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	1	2	2	1	1	3	-	2	2	-
CO2	-	-	-	-	2	3	2	2	3	3	-	2	2	-
CO3	-	-	-	-	2	2	3	2	3	1	3	2	2	-
CO4	-	-	-	-	2	2	3	1	-	-	2	2	2	-
CO5	-	-	-	-	2	2	3	1	-	-	2	2	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

22CBBM46	ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	3

COURSE OBJECTIVE

- To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
- The student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.
- The role of government and non – governmental organization in environmental managements.

UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 9 hours

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem –Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, CharacteristicFeatures, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D)Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – 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 conservation of Biodiversity.Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 9 hours

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 9 hours

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9 hours

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9 hours

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of

Information Technology in Environment and Human Health – Case Studies.

Total: 45 HOURS

TEXT BOOKS

T1. De AK, Environmental Chemistry, Wiley Eastern Ltd.
T2. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.
T3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
T4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

REFERENCE BOOKS

R1: Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
R2: Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
R3: Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs.

WEB LINKS:

W1:https://vardhaman.org/wp-content/uploads/2021/03/ENVIRONMENTAL-SCIENCE-1.pdf

COURSE OUTCOMES

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

CO1:	Define the nature and facts about environment and implement scientific, technological, economic solutions to environmental problems.	**K 1**
CO2:	Illustrate the integrated themes and biodiversity, natural resources, pollution control and waste management.	**K 2**
CO3:	Analyze the importance of environment by assessing its impact on the human world.	**K 4**
CO4:	Determine the dynamic processes and understand the features of the earth's interior and surface and describe the role of an individual in Conservation of Natural Resources.	**K 3**
CO5:	Analyse the role of government in solving the environmental problems and also describe about Population Growth and variation among Nations	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	3	1	-	-	-	3	2	-
CO2	1	-	-	-	-	3	3	2	-	-	-	2	3	-
CO3	1	-	-	-	-	3	3	2	-	-	-	1	3	-
CO4	1	-	-	-	-	3	3	2	-	-	-	2	3	-
CO5	1	-	-	-	-	3	3	2	-	-	-	2	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22MCBM41	GENDER INSTITUTION AND SOCIETY	2	0	0	0

Course Objective: The course helps the student to understand concepts of social justice and gender justice. It provides the student with the knowledge of various institutions functioning worldwide which aim to eradicate discrimination against women. The course further aids students in understanding feminism and gender in relation to the society and to study the basic constitutional remedies available to women.

UNIT – I **6 hours**

Social Justice and Gender Justice – Theories relating to Social Justice – Theories relating to Gender Justice – Interrelationship between Gender justice and Social Justice

UNIT – II **6 hours**

International Conventions for protection of Women – Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) – National Commission for women – Constitutional remedies available for women under Indian Constitution.

UNIT – III **6 hours**

United Nations Entity for Gender Equality and the Empowerment of Women (UN Women) – Association for Women's Rights in Development (AWID) –Women kind worldwide – Centre for reproductive rights – Women's Environment and Development Organization (WEDO) – Global Fund for Women

UNIT – IV **6 hours**

International Center for Research on Women (ICRW) – European Institute for Gender Equality (EIGE) – Promundo – International Alliance of Women (IAW) – International Women's Development Agency (IWDA).

UNIT – V **6 hours**

World Health 92rganization – Sex and Gender – Feminism – Theories relating to Feminism – Gender and society

TOTAL: 30 HOURS

TEXT BOOKS

T1. Law relating to Women and children, Mamta Rao
T2. Gender, Politics and Institutions: Towards a Feminist Institutionalism, by Mona Lena krook and Fiano Mackay,2010
T3. Gender Justice and Feminist Jurisprudence, Dr.Sheetal Kanwal,2015
T4. Narain's Gender and society, P.Jain

REFERENCE BOOKS

R1: Gender Justice and feminist Jurisprudence by Dr.Ishitha Chatterjee
R2: Gender and Institutions, Moira Gatens and Alison Mackkinon

SUGGESTED READINGS:

R1: Women and Gender : Society and Community , Siddhartha Sarkar

WEBLINKS:

W1:https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/3/_PG_M.A._Socialogy.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the Concept of Social Justice and Gender Justice.	**K2**
CO2:	Learning the International Conventions and constitutional remedies available for women.	**K2**
CO3:	Identify the various gender Institutions and its functions for the development of women.	**K2**
CO4:	Assessing the International agencies.	**K3**
CO5:	Summarising the study on feminism and relation of gender and society.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2		PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-		-	-	-	3	2	2	-	-	-	2	3	-
CO2	-	-		-	-	-	3	2	2	-	-	-	3	3	-
CO3	-	-		-	-	-	3	2	2	1	-	-	3	3	-
CO4	-	-		-	-	-	3	2	2	1	-	-	3	3	-
CO5	-	-		-	-	-	3	3	2	1	-	-	3	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

SEMESTER V

22CBBM51	MICROPROCESSOR AND MICROCONTROLLER	3	0	0	3

COURSE OBJECTIVE

The students will be able to learn:

- The prime objective of this course is to introduce to the students the fundamentals of microprocessors and microcontroller.
- The students will be equipped with the basic knowledge of microprocessor and microcontroller interfacing and their applications.

UNIT I INTRODUCTION TO INTEL 8085 & 8086 **9 hours**

Evolution of Microprocessor - Architecture of 8085 - Instruction format - Addressing modes - Basic timing diagram of opcode fetch, memory read, memory write, I/O read and I/O write. Architecture of 8086, Addressing Modes, Assembly Language Programming, Procedure, Macros-Interrupts, and its applications. Example programming-8086.

UNIT II PERIPHERAL INTERFACING **9 hours**

Interfacing devices- 8255 Programmable Peripherals Interface- Architecture & various modes of operation - 8251 keyboard display controller (8279), ADC, DAC Interface, Programmable Timer Controller (8254).

UNIT III 8051 MICROCONTROLLER **9 hours**

Architecture of 8051 Microcontroller- Instruction Set – Assembly Language Programming – Branching, I/O and ALU Instructions. Programming 8051 - Timers, Serial Port, Interrupts. C programming for 8051. Application of microprocessors: Stepper Motor Control, Temperature control, TTL to RS232 Conversion - RS232 to TTL Conversion

UNIT IV ARM ARCHITECTURE **9 hours**

ARM architecture: Acron RISC Machine- Architectural inheritance- Programmers Model, ARM Assembly Language Programming, Data Processing Instructions- Data Transfer Instructions – Control flow instructions. ARM Organization and Implementation: 3-stage Pipeline- 5-stage – pipeline, ARM instruction execution

UNIT V ARM INTERFACE **9 hours**

ARM instruction set- Architectural support for High level Programming- Thumb Instruction set- Architectural Support for system development: ARM memory interface- AMBA interface- The ARMulator- JTAG Boundary-scan architecture- Embedded race

TOTAL: 45 HOURS

TEXTBOOKS

T1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 4th Edition, Penram International Publishing, New Delhi, 2000
T2. Kennith J. Ayala, 8051 Microcontroller, Thomson, 2005.
T3. Dougles V. Hall, Microprocessor and Interfacing, Tata MC Graw Hill Publication, 2nd Edition, 1992.
T4. Andrew N.Sloss, Dominic Symes, Chris Wright, ARM Systems Developer‘s Guide: Designing & Optimizing System Software, Elsevier, 2004.

REFERENCE BOOKS:

R1: Charless M. Gilmore, “Microprocessor Principle and application, McGraw Hill publication, 1995.
R2: A.NagoorKani, Microprocessor & Microcontroller, Tata Mc Graw Hill, 3rd Edition, 2012
R3: B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001
R4: William Hohl, ARM Assembly Language, Fundamentals and Techniques, Taylor & Francis, 2009

WEBLINKS:

W1: https://www.vssut.ac.in/lecture_notes/lecture1423813120.pdf
W2: https://iare.ac.in/sites/default/files/lecture_notes/IARE_MPMC_NOTES.pdf

COURSE OUTCOMES

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

CO1:	Determine the knowledge about fundamental concepts of Intel microprocessors	**K 2**
CO2:	Analyze the interfacing of the assembly language microprocessors	**K 2**
CO3:	Determine the basic concepts and applications of microcontroller	**K 3**
CO4:	Articulate the knowledge of basic concepts of ARM processor	**K 3**
CO5:	Apply and analyze the interfacing processes of the ARM processor	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	2	1	-	-	-	-	2	3	3
CO2	3	2	2	2	2	2	-	-	-	-	-	2	2	3
CO3	3	2	1	2	2	3	1	-	-	-	-	2	2	3
CO4	3	2	2	3	2	1	1	-	-	-	-	2	2	2
CO5	3	2	2	3	2	3	-	-	-	-	-	2	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
	✓		✓		

22PBBM51	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	0	0	2	1

COURSE OBJECTIVE:

The student should be made to:

- Learn the design aspects of I/O and Memory Interfacing circuits.
- Practically interface the communication and bus interfacing.

LIST OF EXPERIMENTS

Assembly Language Programming of 8085 /8086 based experiments

1. Programs for 16-bit Arithmetic, Sorting, Searching and String operations,
2. Interfacing and Programming 8279, 8259, and 8253.
3. Serial Communication between two Microprocessor Kits using 8251.
4. Interfacing and Programming of Stepper Motor and DC Motor Speed Control and Parallel Communication between two Microprocessor Kits using Mode 1 and Mode 2 of 8255.

Programming for 8051 & ARM Processor based experiments

1. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051 microcontrollers.
2. Programming and verifying Timer, Interrupts, and UART operations in 8051 microcontrollers.
3. Interfacing – traffic light control and stepper motor
4. Programming using Arithmetic, sorting, and string operations of ARM Processor
5. Interfacing and Programming using Stepper motor, LED, and LCD of ARM Processor

TOTAL: 30 HOURS

TEXTBOOKS

T1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 4 th Edition, Penram International Publishing, New Delhi, 2000

T2. Kenneth J. Ayala, 8051 Microcontroller, Thomson, 2005.

T3. Douglas V. Hall, Microprocessor and Interfacing, Tata MC Graw Hill Publication, 2nd Edition, 1992.

T4. Muhammad Tahir and Kashif Javed, ARM Microprocessor Systems Cortex-M Architecture, Programming, and Interfacing, CRC Press Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742 © 2017.

REFERENCE BOOKS:

R1: Charles M. Gilmore, "Microprocessor Principle and application, McGraw Hill publication, 1995.

R2: A.NagoorKani, Microprocessor & Microcontroller, Tata Mc Graw Hill, 3rd Edition, 2012

R3: B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001

WEBLINKS:

W1: https://www.scribd.com/document/521053263/MPMC-lab-manual-For-20-21-Final#

W2: https://iare.ac.in/sites/default/files/lecture_notes/IARE_MPMC_NOTES.pdf

W3: https://www.vsmit.ac.in/files/downloads/ec/6th_SEM_EC_Lab_Manual%20%5B17EC67%5D.pdf

COURSE OUTCOMES

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

CO1:	Design and implement programming in Microprocessor and microcontroller	**K3**
CO2:	Analyse and implement operational functions of the Microprocessor and microcontroller	**K3**
CO3:	Design and analyze the assembly languages of Microprocessor and microcontroller	**K4**
CO4:	Design and implement the instruction sets of the Microprocessor and microcontroller	**K5**
CO5:	Illustrate and implement the use of advanced Processors	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	-	-	-	-	-	1	3	2
CO2	3	2	2	3	3	1	-	-	-	-	-	2	3	2
CO3	3	3	3	3	3	1	-	-	-	-	-	1	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	3	1	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

Observation	Record	Model Exam	End Semester practical	Assignments	Case Studies
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22CBBM52	BIO SIGNAL PROCESSING	3	0	0	3

Course Objectives

Students should be made to

- Illustrates a solid foundation in signal processing and systems including advancements in the field.
- Define the basic analysis and use of spectral estimation in signal processing
- Demonstrate processing, validation, optimization, and analysis of different biomedical signals.
- Illustrate the biosignal classification and detection techniques

UNIT I INTRODUCTION TO BIOSIGNAL PROCESSING 9 hours

Representation and Characteristics of Basic Biomedical Signals – Bioelectric, Bio acoustic, Bioimpedance and Biomechanical signals. Noises - Random and Structured Noise, Noises and Artifacts- Muscle noise, Baseline Wandering, Power line interference, Physiological Interference. Sampling and Aliasing of Bio signals.

UNIT II FILTERING OF BIOSIGNALS 9 hours

FIR – Hanning, Hamming, Blackmann, IIR –Butterworth, Chebyshev filters, moving Average filters, Removal of noises in ECG and EEG, Adaptive filtering - LMS and adaptive noise cancelling in ECG and EEG signals, Adaptive filters for removal of interference, improved adaptive filtering in FECG.

UNIT III TIME SERIES AND SPECTRUM ANALYSIS OF BIOSIGNALS 9 hours

Time series analysis – Linear prediction models – Fixed segmentation – Adaptive segmentation, Estimation of R-R Interval – Time-varying analysis of Heart-rate variability, Time domain analysis in EEG signals. Spectral Analysis - Power Spectral Density function –Cross Spectral Density and Coherence function – Cepstrum, Spectral Analysis of ECG and EEG.

UNIT IV TIME-FREQUENCY AND MULTIVARIATE ANALYSIS OF BIOSIGNALS 9 hours

Spectrogram – Time-Scale representation – Scalogram – Data reduction techniques – ECG data compression – ECG characterization – Feature extraction – Estimation of the mean of finite time signals. Multivariate component analysis –PCA – ICA. Applications in Multivariate Analysis in EEG.

UNIT V DETECTION AND CLASSIFICATION OF BIOSIGNALS 9 hours

Waves and Transients, Wavelet detection in ECG – Structural features – Matched filtering – Adaptive wavelet detection - Detection of P, Q, R, S, and T Waves in ECG, EEG Rhythms. EMG-Intramuscular signal decomposition- fractal analysis of EMG signals. Signal classification and recognition – Statistical signal classification and linear discriminant function.

TOTAL: 45 HOURS

TEXT BOOKS:

T1. Rangaraj M. Rangayyan, " Biomedical Signal Processing " 2014 1st edition, IEEE press, New York
T2. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
T3. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal Processing- A Practical Approach" Pearson education Ltd., 2002
T4. P. Ramesh Babu, ―Digital Signal Processing‖, Sixth Edition, Scitech publications, Chennai, 2014.

REFERENCE BOOKS:

R1: Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
R2: Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach", Wiley, IEEE Press, 2015.
R3: Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
R4: N Vyas "Biomedical Signal Processing" 2011 1st edition, University Science Press, New Delhi

WEB LINKS:

W1: https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/bsp.pdf
W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA5202.pdf

COURSE OUTCOMES

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

CO1:	Determine the basic knowledge about biosignals and different noises	**K 2**
CO2:	Apply different filters on bio signals and analyse filter performance	**K 3**
CO3:	Compute the time series variability and spectral analysis of bio signals	**K 4**
CO4:	Analyse the application of time-frequency analysis of biosignals	**K 4**
CO5:	Compute techniques for the detection and classification of biosignals	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	-	3	-
CO2	3	3	3	2	3	2	-	-	-	-	-	2	3	3
CO3	3	3	3	3	3	2	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	2	-	-	-	1	1	2	3	3
CO5	3	3	3	3	3	2	-	-	-	1	1	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
	✓	✓	√	√	

22PBBM52	BIOSIGNAL PROCESSING LABORATORY	0	0	2	1

COURSE OBJECTIVES

Students should be made to

- Understand the basics of instrumentation, biopotentials and bio amplifiers
- Illustrate the devices described for the diagnosis of cardiac and muscular abnormalities
- Learn about the neurological devices for analysis and diagnosis
- Describe the measurement techniques for non-electrical parameters.
- Illustrates the recent advancements in the field of diagnostic devices.

LIST OF EXPERIMENTS

1. Generation of sequences (functional & random) & correlation
2. Linear and Circular Convolutions
3. FIR and IIR filter design
4. Equalization
5. Filtering of Bio signals for Analysis (ECG,EEG)
6. Spectrum Analysis for Medical signals (PSD,CSD, Coherence)
7. Transforms (Walsh, Hadamard, Haar)
8. Spectrogram Analysis of Bio signals
9. Data Compression in Bio signal Processing
10. Wavelet detection in ECG

TOTAL: 30 HOURS

TEXT BOOKS:

T1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.

T2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach" Pearson education Ltd., 2002

T3. P.Ramesh Babu, ―Digital Signal Processing‖, Sixth Edition, Scitech publications, Chennai, 2014.

Reference Books:

R1: Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000

R2: Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach", Wiley, IEEE Press, 2015.

R3: Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

Web Links:

W1: https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/bsp.pdf

W2: https://www.avit.ac.in/lab/Digital_signal_processing_lab/download/17BMCC84/lab_manual.pdf

COURSE OUTCOMES

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

CO1:	Explain the vital parameters behind signal acquisition and processing	**K3**
CO2:	Understand various techniques for signal analysis and filtering	**K3**
CO3:	Apply transforms for bio signals for useful applications	**K4**
CO4:	Analyze signals with various spectrum and compression patterns	**K4**
CO5:	Evaluate the principles of signal processing and wavelet detection.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	-	-	-	-	3	-
CO2	3	2	2	2	2	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

Observation	**Record**	**Model Exam**	**End Semester practical**	**Assignments**	**Case Studies**
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22CBBM53	BIOCONTROL SYSTEMS	3	0	2	4

COURSE OBJECTIVES:

- To study concept and different mathematical techniques applied in analyzing any given system
- To learn to do the analysis of given system in time domain and frequency domain
- To study the techniques of plotting the responses in both domain analysis
- To study techniques of modeling the physiological systems

UNIT I CONTROL SYSTEM MODELLING 9+6 hours

Terminology and basic structure of control system, example of a closed loop system, transfer functions, modeling of electrical systems, translational and rotational mechanical systems, electromechanical systems, block diagram and signal flow graph representation of systems, conversion of block diagram to signal flow graph, reduction of block diagram and signal flow graph.

UNIT II TIME RESPONSE ANALYSIS 9+6 hours

Step and Impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses. definition of steady state error constants and its computation, definition of stability, Routh-Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability .

UNIT III FREQUENCY RESPONSE ANALYSIS 9+6 hours

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, definition of gain margin and phase margin, Bode plot, determination of gain margin and phase margin using Bode plot, use of Nichol's chart to compute resonance frequency and band width.

UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS 9+6 hours

Block diagram representation of the muscle stretch reflex, the difference between engineering and physiological control systems, generalized system properties, models with combination of system elements. Introduction to simulation, physiological Modelling using Simulink.

UNIT V PHYSIOLOGICAL SYSTEM MODELING 9+6 hours

Linear model of respiratory mechanics, model of chemical regulation of ventilation, linear model of muscle mechanics, model of regulation of cardiac output, model of Neuromuscular reflex motion.

TOTAL : 75 HOURS

TEXT BOOKS:

T1. M. Gopal "Control Systems Principles and design", Tata McGraw Hill ,2002
T2. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 1995
T3. Michael C K Khoo, "Physiological control systems", IEEE press, Prentice –Hall of India, 2001.

REFERENCES

R1: John Enderle, Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering" second edition, Academic Press, 2005.
R2: Richard C. Dorf, Robert H. Bishop," Modern control systems",Pearson, 2004

WEBLINKS:

W1: https://ceat.okstate.edu/che/site_files/docs/babatunde-a-ogunnaike.pdf

COURSE OUTCOMES

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

CO1:	Make use mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems	**K 1**
CO2:	Analyze the time response of various systems and discuss the concept of system stability	**K 2**

CO3:	Analyze the response characteristics of various systems using different charts	**K 3**
CO4:	Apply the concept of modeling basic engineering systems in time domain and frequency domain	**K 3**
CO5:	Comprehend the application aspects of time and frequency response analysis in physiological control systems.	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	-	-	-	-	-	-	1	3	-
CO2	3	2	2	2	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	2	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

22SUPD51	PERSONALITY DEVELOPMENT III	2	0	0	2

COURSE OBJECTIVE:

- To enhance the communication, interpersonal, group skills.

UNIT I VERBAL APPTITUDE I 6 hours

Phonetics / Neutral Accent / Pronunciation – Speech Mechanism / Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

UNIT II VERBAL APTITUDE II 6hours

Singular/plural – present tense / past tense – genders Prepositions – conjunctions – Choice of words –simple sentences – compound sentences – summarizing phrases Synonyms – Antonyms – Analogies –Similar Words.

UNIT III SOFT SKILLS 6 hours

Attitude – Meaning–Features of attitude – Formation – Personality Factors –Types of attitude – change in attitude – developing Positive attitude.

UNIT IV TIME MANAGEMENT 6 hours

Definition – Meaning–Importance, Value of time as an important resource – comparison of Time and Money – Circle of influence and circle of control – Definition of URGENT and IMPORTANT – Time Wasters and how to reduce – Procrastination – meaning and impact – 4 Quadrants.

UNIT V TEAM BUILDING 6 hours

Meaning – Aspects of team building – Process of team building – Types of Teams – Team Ethics and Understanding – Team trust and commitment.

TOTAL: 30 HOURS

TEXT/REFERENCE BOOKS:

T1. B N Ghosh, Managing Soft Skills and Personality, Mc graw Hill Publications
T2. Shejwalkar and Ghanekar,Principles and Practices of Management,Mc Graw Hill Latest.
T3. Roberta Roesch ,Time management for Busy people, Tata McGraw–Hill Edition

REFERENCE BOOKS:

R1: D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021
R2: Dr V M Selvaraj, Personality Development, Bhavani Publications

WEB LINKS:

W1: https://www.rccmindore.com/wp-content/uploads/2023/02/Personality-Development-Notes.pdf
W2: https://acs.dypvp.edu.in/NAAC/Personality-Development-Vishal-Gaikwad-BBA.pdf

COURSE OUTCOMES

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

CO1:	Articulate by understanding the rate and flow of speech.	**K3**
CO2:	Choose words and phrases appropriately for any verbal communication.	**K3**
CO3:	Develop a positive attitude in handling diverse situations.	**K4**
CO4:	Prioritize important and urgent tasks using the four quadrants method.	**K4**
CO5:	Practice team ethics and understanding when working with teams.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	2	-
CO2	-	-	-	-	2	-	-	-	3	3	-	3	2	-
CO3	2	-	-	-	2	-	-	-	3	3	-	2	3	-
CO4	2	-	-	-	2	-	-	-	3	3	-	2	3	-
CO5	-	-	-	-	2	-	-	-	3	3	-	2	3	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

22PBBM53	**Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/Coursera/ Mathworks) - Minimum 4 weeks**	**0**	**0**	**4**	**2**

Course Objectives

- To identify a specific course/ project/ training program to meet the current needs of the society as a Biomedical Engineer
- To study and understand basic industrial needs through courses on different platforms

The student individually undergoes industrial training and studies a few courses in different platforms like NPTEL, SWAYAM, Coursera, and Mathworks for a period of a minimum of 4 weeks. Faculty members are assigned to the student for guidance and support. The student submits the report regarding the industrial training and certificate of the course to the faculty for assessment.

TOTAL: 60 HOURS

COURSE OUTCOMES

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

CO1:	Describe the industrial need of the society	**K2**
CO2:	Compute and identify the course of study/ project	**K3**
CO3:	Discriminate the methodologies and Implementation process	**K4**
CO4:	Evaluate the process of meeting the industrial needs	**K5**
CO5:	Design a solution to the needs of the society as Biomedical Engineer	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	2	-	2	-	2	1	-	3	3	3
CO2	3	2	2	2	2	2	-	-	2	2	2	3	3	3
CO3	3	3	3	3	3	2	2	-	2	3	-	3	2	3
CO4	3	3	3	3	3	2	3	-	3	3	2	2	2	3
CO5	3	3	3	3	3	2	3	-	3	3	3	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams/ viva voce**	**Assignments**	**Case Studies**
			✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
		✓		✓	

SEMESTER VI

22CBBM61	DIAGNOSTIC INSTRUMENTATION	3	1	0	4

Students should be made to

- Understand the basics of instrumentation, bio potentials and bio amplifiers
- Illustrate the devices described for the diagnosis of cardiac and muscular abnormalities
- Learn about the neurological devices for analysis and diagnosis
- Describe the measurement techniques for non-electrical parameters.
- Illustrates the recent advancements in the field of diagnostic devices.

UNIT I BASICS OF INSTRUMENTATION 12 hours

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – non-polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference

UNIT II CARDIAC AND MUSCULAR EQUIPMENT 12 hours

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system.Patient Monitoring system.ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit. Generation, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, EMG Bio Feedback Instrumentation

UNIT III NEUROLOGICAL EQUIPMENT 12 hours

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

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 12 hours

Temperature, respiration rate and pulse rate measurements. Blood Pressure measurement, Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement, Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description)

UNIT V RECENT TRENDS 12 hours

Principles and application of thermography, Principles of cryogenic Technique and application, Endoscopy, Laparoscopy, ophthalmic equipment's- slit Lamp, Tonometer , Retinal response Plotter, principles of Bio telemetry, principles of Lithotripsy.

TOTAL : 60 HOURS

TEXT BOOKS:

T1: John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.

T2: Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.

REFERENCE BOOKS:

R1: Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.

R2: Myer Kutz, "Standard Handbook of Biomedical Engineering and Design"

R3: Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

WEB LINKS:

W1: https://kanchiuniv.ac.in/coursematerials/Biomedical%20instrumentation.pdf

W2: https://www.robots.ox.ac.uk/~gari/teaching/b18/lecture_slides/B18_LectureA.pdf

COURSE OUTCOMES

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

CO1:	Identify and Distinguish the basics of instrumentation, bio potentials	**K 2**
CO2:	Illustrate and application of recent trends in diagnostic instrumentation	**K 3**
CO3:	Illustrate, Apply and identify the normal and abnormalities in neurologic and cardio vascular waveforms	**K 4**
CO4:	Apply the instrumentation in design of Bio amplifiers	**K 4**
CO5:	Analyze and Illustrate the various vital parameters of the body	**K 4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

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

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			√	√	

22PBBM61	DIAGNOSTIC INSTRUMENTATION LABORATORY	0	0	2	1

COURSE OBJECTIVES

Students should be made to

- Understand the basics of pre-amplifiers and bio amplifiers
- Demonstrate the measurements of non-electrical parameters.
- Illustrates the recording of bio signals and blood flow.

LIST OF EXPERIMENTS:

1. Design a right leg driven ECG amplifier
2. Design of EMG Amplifier
3. Study of frequency response of electrode contact impedance.
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Measurement of pulse-rate using Photo transducer.
6. Recording of Audiogram
7. Measurement of pH and conductivity.
8. Measurement and recording of peripheral blood flow
9. Measurement of respiratory parameter using spirometer
10. Measurement of drug delivery System by using syringe pump

TOTAL: 45 HOURS

TEXT BOOKS:

T1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.

T2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.

REFERENCE BOOKS:

R1: Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.

R2: Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

WEB LINKS:

W1: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBM1301.pdf

W2: https://www.robots.ox.ac.uk/~gari/teaching/b18/lecture_slides/B18_LectureA.pdf

W3: https://srmvalliammai.ac.in/wp-content/uploads/2022/11/1910506-medical-instrumentation-laboratory-manual.pdf

COURSE OUTCOMES

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

CO1:	Understand the basics of Instrumentation in diagnostic techniques	**K3**
CO2:	Illustrate the circuits and operations of the different diagnostic instruments	**K3**
CO3:	Demonstrate the measurements of biosignals and parameters used in diagnosis.	**K4**
CO4:	Illustrates the recording of bio signals and various physiological parameters	**K5**
CO5:	Illustrates the functioning of the diagnostic instrumentation	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	-	-	-	-	3	-
CO2	3	2	2	2	2	-	-	-	-	-	-	2	3	3

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

ASSESSMENT METHODS:

Observation	**Record**	**Model Exam**	**End Semester practical**	**Assignments**	**Case Studies**
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22CBBM62	MEDICAL IMAGE PROCESSING	3	0	0	3

COURSE OBJECTIVES

Students should be made to

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- Learn to restore and reconstruct the medical images

UNIT I FUNDAMENTALS OF DIGITAL IMAGE AND TRANSFORMS 9 hours

Anatomy of Human Eye- Elements of Visual perception, Image sampling and quantization, Neighborhood pixel Relationships – Basic Image operations – Arithmetic, Geometric and Morphological. Image transform: 2D DFT-Discrete cosine-, Sine-, Haar-, and Hadamard- transform.

UNIT II IMAGE ENHANCEMENT 9 hours

Basic gray level transformation, Histogram processing ,Smoothening by spatial filters - Sharpening by spatial filters ,Smoothening- frequency domain filters, Sharpening- frequency domain filters ,Color image Processing- color models- Pseudo color image processing– Color Image Transformation – Smoothening - Sharpening.

UNIT III IMAGE SEGMENTATION AND OBJECT RECOGNITION 9 hours

Edge detection- Marr Hidreth edge detector - Canny edge detector, Thresholding foundation- Basic global thresholding - Basic Adaptive thresholding, Region Based segmentation, Watershed segmentation algorithm, Patterns and pattern classes, Recognition based on decision theoretic methods-matching, Optimum statistical classifiers.

UNIT IV IMAGE COMPRESSION 9 hours

Image compression- Fundamentals - Image compression standards- Coding: Run length-, Huffman- Arithmetic-, Bit plane-, Transform- and Lossy- and lossless predictive coding.

UNIT V IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGES 9 hours

Image degradation models, Algebraic approach to restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms - Filter back projection algorithm – Fourier reconstruction of MRI Images, Image Registration

TOTAL: 45 HOURS

TEXTBOOKS:

T1. Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing",Pearson Education Asia, Third Edition, 2007.

T2. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2nd edition 1997.

REFERENCES:

R1: William K Pratt, "Digital Image Processing", John Wiley NJ, 4th Edition, 2007.

R2: Albert Macouski, "Medical Imaging Systems", Prentice Hall, New Jersey 2nd edition 1997.

WEBLINKS:

W1: https://iare.ac.in/sites/default/files/IARE_IMAGE_PROCESSING_LECTURE_NOTES.pdf

W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBM1308.pdf

COURSE OUTCOMES

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

CO1:	Explain the basics of digitization and transforms.	**K2**
CO2:	Illustrate the various image processing transforms.	**K2**

CO3:	Categorize the image segmentation and various image processing techniques	**K3**
CO4:	Discriminate the techniques of image compression	**K3**
CO5:	Analyze the principles of image preprocessing and processing techniques	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	-	-	-	-	-	-	-	1	2	2
CO2	2	2	3	3	2	-	-	-	-	-	-	2	2	3
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	2	3	3	3	2	-	-	-	-	-	-	2	3	3
CO5	1	2	3	3	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22PBBM62	MEDICAL IMAGE PROCESSING LABORATORY	0	0	3	2

COURSE OBJECTIVES

Students should be made to

- Learn about the basics and fundamentals of image processing
- Illustrate applications of different transforms
- Demonstrate the different enhancement techniques
- Describe the applications of image segmentation process
- Illustrates the advancements and formatting in image processing

LIST OF EXPERIMENTS

1. Medical Image sampling and quantization
2. Analysis of spatial and intensity resolution of medical images.
3. Intensity transformation of medical images.
4. DFT analysis of medical images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Medical Image Enhancement-Spatial filtering
8. Medical Image Enhancement- Filtering in frequency domain
9. Medical Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Region based Segmentation in medical images
12. Segmentation using watershed transformation
13. Analysis of medical images with different color models.
14. Study of DICOM standards
15. Medical Image compression techniques
16. Medical Image restoration

TOTAL: 45 HOURS

TEXTBOOKS:

T1. Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing",Pearson Education Asia, Third Edition, 2007.

T2. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2nd edition 1997.

REFERENCES:

R1: William K Pratt, "Digital Image Processing", John Wiley NJ, 4th Edition, 2007.

R2: Albert Macouski, "Medical Imaging Systems", Prentice Hall, New Jersey 2nd edition 1997.

WEBLINKS:

W1: https://srmvalliammai.ac.in/wp-content/uploads/2022/11/1910706-digital-image-processing-laboratory-manual.pdf

W2: https://coeosmanabad.ac.in/wp-content/uploads/2020/03/BE-DIP-Lab-Manual.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the basic processing of images	**K2**
CO2:	Analyze the various techniques implemented in image processing	**K4**
CO3:	Discriminate the analysis techniques in image processing	**K4**
CO4:	Evaluate the processes and techniques of image processing	**K5**
CO5:	Develop the skills in analyzing and processing the digital images	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	-	-	-	-	3	-
CO2	3	2	2	2	2	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

Observation	**Record**	**Model Exam**	**End Semester practical**	**Assignments**	**Case Studies**
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22SUPD61	PERSONALITY DEVELOPMENT IV	2	0	0	2

COURSE OBJECTIVES:

- To develop awareness of different job search techniques, including how to employ practical networking techniques
- To begin to recognize the skills developed during research and analyse how to present these effectively in written applications
- To critique the strengths and weaknesses of their own and colleagues' current CVs
- To understand interview processes and practice being interviewed in a supportive environment.

UNIT I SOFT SKILLS **6 hours**

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication – Merits – forms of assertion – Causes of misunderstanding

UNIT II COMMUNICATION SKILLS **6 hours**

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

UNIT III PRESENTATION SKILLS I **6 hours**

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience – Types of presentations – How to make effective presentation.

UNIT IV PRESENTATION SKILLS II **6 hours**

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences – Steps to eliminate Stage fear.

UNIT V CHANGE MANAGEMENT **6 hours**

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

TOTAL: 30 HOURS

TEXT BOOKS:

T1. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.

T2. Business Communication Today: Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. Tenth Edition. New Jersey: Prentice Hall, 2010.

REFERENCE BOOKS:

R1: Helping employees embrace change – LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.

R2: Who Moved My Cheese by Spencer Johnson published by vermilion first edition

WEBLINKS:

W1: https://www.jaincollege.ac.in/jecvvp/pdf/IV-Sem-Personality-Development.pdf

COURSE OUTCOMES

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

CO1:	Be assertive in their communication.	**K3**
CO2:	Differentiate the principles of formal and informal communication.	**K4**
CO3:	Make an effective presentation by understanding the audience.	**K3**
CO4:	Practice the rules of presentation using slides, PPT's and visuals.	**K3**
CO5:	Discuss the principles of change management.	**K2**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	2	-
CO2	-	-	-	-	2	-	-	-	3	3	-	3	2	-
CO3	2	-	-	-	2	-	-	-	3	3	-	2	3	-
CO4	2	-	-	-	2	-	-	-	3	3	-	2	3	-
CO5	-	-	-	-	2	-	-	-	3	3	-	2	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

22IBBM61	SUMMER INETRNSHIP	0	0	4	2

COURSE OBJECTIVES

- To get real time experience in the field of Biomedical Engineering
- To develop the problem-solving skills
- To train students in preparing real time projects

Syllabus

The Industrial / Practical Training shall carry 100 marks. At the end of the Industrial / Practical training / internship / Summer Project, the student shall submit a certificate from the organization where the student has undergone training and a brief report about the training. The evaluation will be made based on this report, presentation and a Viva-Voce Examination conducted internally by a three-member Departmental Committee consisting of one coordinator and two members constituted by the Head of the Department.

TOTAL: 60 HOURS

COURSE OUTCOMES

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

CO1:	Express the technical ideas, strategies, solutions and methodologies.	**K3**
CO2:	Analyse the real time problem and implement problem solving ideas.	**K4**
CO3:	Compare the knowledge on Engineering tools, solutions to problems, skill development	**K4**
CO4:	Evaluate and solve the real time Engineering problems	**K5**
CO5:	Develop the solutions real time Engineering problems and solutions	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	2	1	2	3	3	3	3	3	3
CO3	3	3	3	3	3	-	2	2	3	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	3	3	3	3	3	3
CO5	3	3	3	3	3	-	3	2	3	2	3	3	3	3

ASSESSMENT METHODS:

Report	Certificate	Model Exam	End Semester practical/ oral presentation	Assignments	Case Studies
✓	✓		✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

SEMESTER VII

22CBBM71	THERAPEUTIC EQUIPMENTS	3	0	0	3

COURSE OBJECTIVES

Students should be made to

- Understand the use of cardiac care devices and safety issues
- Illustrate the devices in the field of physiotherapy and applications of diathermy
- Learn about ventilators and applications of anaesthetic systems.
- Describe the extra corporeal devices and safety measures applied for patients.

UNIT I CARDIAC CARE UNITS **9 hours**

Pacemakers – Need for pacemaker, different types and their comparison, batteries for pacemakers. Defibrillator-Need, AC defibrillators and demerits, DC Defibrillator, asynchronous and synchronous DC defibrillators, Hazards and safety issues.

UNIT II PHYSIOTHERAPY AND DIATHERMY EQUIPMENT **9 hours**

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, different types of lasers in medicine, Laser Therapy

UNIT III VENTILATORS & ANAESTHETIC SYSTEM **9 hours**

Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, different ventilatory adjuncts, neonatal ventilators, p-based ventilator, ventilator testing. Anaesthesia: Need of anaesthesia, gas used and their sources, gas blending and vaporizers, anaesthesia delivery system.

UNIT IV EXTRA CORPOREAL DEVICES AND ELECTRICAL STIMULATORS **9 hours**

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameters. Hemo Dialyser unit. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain and relief, Robot- assisted surgery

UNIT V PATIENT SAFETY **9 hours**

Physiological effects of electricity – important susceptibility parameters – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, GFI units, Earthing Scheme, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

TOTAL: 45 HOURS

TEXT BOOK:

T1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

R1: 1. John Webster. Medical Instrumentation - Application and Design. John Wiley and Sons. Inc., New York. Third edition 2003.
R2: Cromwell Leslie, Fred Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New
R3: Delhi 2000
R4: 3. Wolbasrsht . M. L, Laser Application in Medicine and Biology plenum press NewYork 1989.
R5: 4. Bronzino, Joseph; Handbook of Biomedical Engineering. 2nd edition, CRC Press, 2000.
R6: Welkowitz, Walter & Others Bio-Medical Instruments Theory & Design., 2nd Edition, Academic Press, 1999

WEBLINKS:

W1: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBM1403.pdf

COURSE OUTCOMES

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

CO1:	Explain the basics principles of the instrumentation of therapeutic devices	**K2**
CO2:	Determine the analysis of bio signals and basic therapeutic equipments	**K2**
CO3:	Analyze the working and functioning of different therapeutic equipments	**K3**
CO4:	Categorise the working principles of different therapeutic devices	**K3**
CO5:	Analyse and determine the use of therapeutic devices	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	1	2	2
CO2	2	2	3	3	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	2	3	3	3	2	-	-	-	-	-	-	2	3	3
CO5	1	2	3	3	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22PBBM71	THERAPEUTIC EQUIPMENTS LABORATORY	0	0	2	1

COURSE OBJECTIVES

Students should be made to

- Understand the basics measurements of bio signals
- Illustrate the therapeutic and telemetric devices
- Learn about the medical stimulators and surgical units
- Describe the recording of audiogram and electrical safety measures
- Study the functioning of different therapeutic devices.

LIST OF EXPERIMENTS:

1. Measurement of visually evoked potential
2. Galvanic skin resistance (GSR) measurement
3. Study of shortwave diathermy
4. Study of ultrasonic diathermy
5. Electrical safety measurements
6. Study of medical stimulator
7. Analyze the working of ESU – cutting and coagulation modes
8. Study the working of Defibrillator
9. Study the working of pacemakers
10. Study of ventilator and its various parameters

HOSPITAL VISIT

Hospital visit is necessary for the students to visualize high tech and advanced equipment's used in the hospitals for the diagnostic and treatment of the patients. Real time functioning of the equipment's can be analysed.

TEXT BOOK:

T1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

R1: 1. John Webster. Medical Instrumentation.- Application and Design. John Wiley and Sons. Inc., New York. Third edition 2003.

R2: Cromwell Leslie, Fred Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall, New Delhi 2000

WEBLINKS:

W1: https://www.avit.ac.in/lab/biomedical_instrumentation_lab/download/17BMCC85/lab_manual.pdf

W2: https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/bmi.pdf

TOTAL: 30 HOURS

COURSE OUTCOMES

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

CO1:	Explain the basics principles of the instrumentation of therapeutic devices.	**K2**
CO2:	Understand the analysis of bio signals and basic therapeutic equipments	**K2**
CO3:	Analyze the working and functioning of different therapeutic equipments	**K3**
CO4:	Apply the working principles of different therapeutic devices	**K4**
CO5:	Describe about the use of therapeutic devices	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO2	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

Observation	**Record**	**Model Exam**	**End Semester practical**	**Assignments**	**Case Studies**
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22PBBM72	BIOSIMULATION LABORATORY	0	0	3	2

Course Objectives

- To impart adequate knowledge in the simulation of basic operations and functions.
- To impart knowledge on various analysis tools for bio simulation.

LIST OF EXPERIMENTS

1. Basic arithmetic operations using Simulink
2. Design of simple model using Simulink
3. Design of signal analysis system
4. Segmentation of two signals in Simulink
5. Design of image analysis system in Simulink
6. Thermal conduction analysis
7. Design of Defibrillator (using Simulink)
8. Simulate and analyze the statistical features
9. Design an Artificial neural network
10. Design of Simple GUI for analysis
11. Introduction to HDL coder in MATLAB
12. Design an application using MATLAB

TOTAL : 45 HOURS

TEXT BOOKS:

T1. Modeling and Simulation Using MATLAB – Simulink, **Shailendra Jain**, *Maulana Azad National Institute of Technology,* **Dr. Sanjeevan Kapshe**

REFERENCE BOOKS:

R1: Katsuhiko Ogata "Modern Control Engineering" Prentice Hall of India Pvt. Ltd., 3rd edition, 1998

R2: R2 : N.K.Sinha, "Control Systems" New Age International (P) Limited Publishers, 3rd Edition,1998.

WEB LINKS:

W1: https://ece.anits.edu.in/SIMULATION%20LABORATORY-2.pdf

W2: https://people.eecs.berkeley.edu/~sojoudi/lab1.pdf

W3: https://nps.edu/documents/105873337/0/ECP+Lab1+Simulink+Intro+r4.pdf/46d373db-8b85-4345-af6c-ef7f455e88df

COURSE OUTCOMES

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

CO1:	Illustrate the basic functions in the biosimulation process	**K2**
CO2:	Apply and develop knowledge about the different biosimulation techniques	**K3**
CO3:	Distinguishing the simulation techniques and processes.	**K4**
CO4:	Compare and evaluate the simulation process for various applications	**K5**
CO5:	Summarize the functional skill and knowledge of biosimulation techniques	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	-	-	-	-	-	-	3	2

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

ASSESSMENT METHODS:

Observation	**Record**	**Model Exam**	**End Semester practical**	**Assignments**	**Case Studies**
✓	✓	✓	✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
				✓	

22RBBM71	PROJECT PHASE -I	0	0	10	5

Course Objectives

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To develop skills to analyse and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 60 HOURS

COURSE OUTCOMES

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

CO1:	Describe the problem or need of the work	**K2**
CO2:	Compute and identify the literature of the problem	**K3**
CO3:	Discriminate the methodologies and Implementation process	**K4**
CO4:	Evaluate the results and outcomes	**K5**
CO5:	Design a solution to the problem or need	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2	-	2	-	2	1	-	3	3	3
CO2	2	2	2	2	2	-	-	-	2	2	2	3	3	3
CO3	2	3	3	3	3	-	2	-	2	3	-	3	2	3
CO4	3	3	3	3	3	-	3	-	3	3	2	2	2	3
CO5	3	3	3	3	3	-	3	-	3	3	3	2	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams/ viva voce	Assignments	Case Studies
			✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
		✓		✓	

SEMESTER VIII

22RBBM81	PROJECT PHASE -II	0	0	20	10

Course Objectives

- To identify a specific problem for the current need of the society and collect information related to the same through a detailed review of the literature.
- To develop the methodology to solve the identified problem.
- To develop skills to analyze and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examinations.

The student individually works on a specific topic approved by a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization in the program. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, a detailed literature review related to the area of work, and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 60 HOURS

COURSE OUTCOMES

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

CO1:	Analyze a real-world problem, identify the requirement and develop the design solutions.	**K4**
CO2:	Evaluate the technical ideas, strategies and methodologies.	**K5**
CO3:	Design the new tools, algorithms, techniques that contribute to obtain the solution of the project.	**K6**
CO4:	Estimate and validate through conformance of the developed prototype and analysis the cost Effectiveness.	**K5**
CO5:	Evaluate and present the results and outcomes	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	-	2	-	2	2	-	2	3	3
CO2	2	3	3	3	3	-	3	-	3	3	3	3	3	3
CO3	3	3	3	3	3	-	3	-	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	-	3	3	3	3	3	3
CO5	3	3	3	3	3	-	3	-	3	3	3	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams/ viva voce	Assignments	Case Studies
			✓		
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
		✓		✓	

PROFESSIONAL ELECTIVE COURSES

S.NO	COURSE TITLE	LECTURE	TUTORIAL	PRACTICAL	CREDITS
PEC-1	Medical Physics	3	-	-	3
PEC-2	Tissue Engineering	3	-	-	3
PEC-3	Medical Optics	3	-	-	3
PEC-4	Enterpreneurship for Biomedical Engineers	3	-	-	3
PEC-5	Effects of Radiation and Radiation safety	3	-	-	3
PEC-6	Rehabilitation Engineering	3	-	-	3
PEC-7	Wearable Medical Systems	3	-	-	3
PEC-8	Biomems and Nanotechnology	3	-	-	3
PEC-9	Biomedical informatics	3	-	-	3
PEC-10	Hospital Management	3	-	-	3
PEC-11	Pathology and Microbiology	3	-	2	4
PEC-12	Robotics in medicine	3	-	2	4
PEC-13	Pattern Recognition and Neural Networks	3	-	2	4
PEC-14	Internet of Medical Things	3	-	2	4
PEC-15	Analog and Digital Communications	3	-	2	4
PEC-16	Human Assist Devices	3	-	-	3
PEC-17	Neuroscience for Biomedical Applications	3	-	-	3
PEC-18	Telehealth Technology	3	-	-	3
PEC-19	Medical Waste Management	3	-	-	3
PEC-20	Radiological Equipments	3	-	-	3
PEC-21	Artificial Intelligence and Deep learning	3	-	2	4
PEC-22	Virtual Instrumentation in medicine	3	-	2	4
PEC-23	Troubleshooting of medical Equipments	3	-	2	4
PEC-24	Principles of 3D Printing Technology in Healthcare	3	-	2	4
PEC-25	Real time signal Acquisition and Analysis	3	-	2	4
PEC-26	Physiological Modelling and Simulation	3	-	-	3
PEC-27	Brain Computer Interface	3	-	-	3
PEC-28	Regulatory Aspects in bioscience	3	-	-	3
PEC-29	Advanced Bioanalytical and Therapeutic Techniques	3	-	-	3
PEC-30	Body Area Networks	3	-	-	3

22CBBMXX	MEDICAL PHYSICS	3	0	0	3

COURSE OBJECTIVES

The student should be made to:

- To study principles and effects of ionizing and non-ionizing radiation in human body
- To discuss the physics of the senses
- To explore the effects of radiation in matter and how isotopes are produced
- To understand various detectors for detecting the presence of ionizing radiation

UNIT I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS 9 hours

Introduction and objectives - Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole–Cole model, 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

UNIT II PHYSICS OF THE SENSES 7 hours

Introduction and objectives - Cutaneous sensation - The chemical senses – Audition –Vision - Psychophysics

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES 10 hours

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 Radionuclides, radionuclide Generator-Technetium generator.

UNIT IV RADIOACTIVE DECAY AND INTERACTION OF RADIATION WITH MATTER 11 hours

Spontaneous Fission- Isomeric Transition-Alpha Decay-Beta Decay-Positron Decay-Electron Capture-Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

UNIT V SCINTILLATION, SEMICONDUCTOR AND GAS FILLED DETECTORS 8 hours

Scintillation Detectors - Solid Scintillation Counters - Gamma-Ray Spectrometry-Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Thyroid Probe-Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Müller Counters

TOTAL: 45 HOURS

TEXT BOOKS:

T1: Gopal B. Saha, ―Physics and Radiobiology of Nuclear Medicine‖, 4th Edition, Springer, 2013.

T2: 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.

REFERENCES:

R1: S.Webb ― The Physics of Medical Imaging‖, Taylor and Francis, 1988

R2: J.P.Woodcock, ―Ultrasonic,Medical Physics Handbook series 1‖, Adam Hilger, Bristol, 2002

R3: HyltonB.Meire and Pat Farrant ―Basic Ultrasound‖ John Wiley & Sons, 19.

WEBLINKS:

W1: https://openlearning.mit.edu/

W2: https://www.youtube.com/user/nptelhrd

W3: https://www.swayamprabha.gov.in/index.php/program/current_he/8

COURSE OUTCOMES

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

CO1:	Interpret different structures and systems related to medical physics	**K2**
CO2:	Illustrate the principles and use of various devices used in hospitals	**K2**
CO3:	Explain the principles and techniques of various equipment's	**K3**
CO4:	Compare interaction of various radiations	**K3**
CO5:	Evaluate various radiation quantities and study the activities of radio nucleotides	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	2	-	-	-	-	-	3	3	3
CO2	2	1	2	1	2	2	-	-	-	-	-	1	2	2
CO3	3	2	1	1	1	3	-	-	-	-	-	1	2	1
CO4	2	1	1	2	1	-	-	-	-	-	-	2	1	1
CO5	2	1	1	1	1	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBMXX	TISSUE ENGINEERING	3 0 0 3

COURSE OBJECTIVES:

- To learn about the basic mechanics of Tissue Engineering, model of artificial organs and it process.
- To have a clear view about tissue growth mechanism
- To learn in detail about implants

UNIT 1 FUNDAMENTAL OF TISSUE ENGINEERING **9 hours**

Introduction and objectives of Tissue engineering,Tissue Exchange and Tissue Development, Element of Tissue development.

UNIT 2 CELLULAR STUDIES **9 hours**

Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.

UNIT 3 TISSUE BARRIERS TO MOLECULAR AND CELLULAR TRANSPORT **9 hours**

Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space.

UNIT 4 TISSUE REPLACEMENT IMPLANTS **9 hours**

Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

UNIT 5 CLINICAL APPLICATIONS **9 hours**

Stem cell therapy, Molecular therapy, In vitro organogenesis, neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, Preservation – freezing and drying. Patent protection and regulation of tissue-engineered products, ethical issues.

TOTAL: 45 HOURS

COURSE OUTCOMES

At the end of the course, the students would

CO1:	Examine the fundamentals of tissue engineering	**K2**
CO2:	Describe cellular studies in detail	**K2**
CO3:	Explain tissue barriers to molecular and cellular transport	**K2**
CO4:	Explain in detail about applications of tissue replacements	**K3**
CO5:	Explain in detail about artificial organs	**K3**

TEXTBOOKS:

T1. PARK J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.

T2. W Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press Inc New York 2004.

REFERENCE BOOKS:

R1. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.

WEBLINKS:

W1: **https://www.lehigh.edu/~inbios21/PDF/Fall2015/Chow_10302015.pdf**

W2: **https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Tissue%20Engineering.pdf**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	2	-	-	-		-	-	-	-	-	3	2
CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBMXX	MEDICAL OPTICS	3	0	0	3

COURSE OBJECTIVES

Students should be made to

- Understand the optical properties and interaction of the light with tissue
- Illustrate the photonics devices and detectors used for optical analysis
- Learn about the applications of laser in surgery
- Describe the applications of laser in non-thermal diagnosis
- Illustrates the photodynamic and other therapeutic applications of laser.

UNIT I OPTICAL PROPERTIES OF THE TISSUES **9 hours**

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal- Electromechanical – Photoabalative processes.

UNIT II INSTRUMENTATION IN PHOTONICS **9 hours**

Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors – Time resolved and phase resolved detectors.

UNIT III SURGICAL APPLICATIONS OF LASERS **9 hours**

Lasers in ophthalmology- Dermatology –Dentistry-Urology-Otolaryngology - Tissue welding.

UNIT IV NON THERMAL DIAGNOSTIC APPLICATIONS **9 hours**

Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM, Raman Spectroscopy and Imaging, FLIM – Holographic and speckle application of lasers in biology and medicine.

UNIT V THERAPEUTIC APPLICATIONS **9 hours**

Phototherapy, Photodynamic therapy (PDT) - Principle and Mechanism - Oncological and non-oncological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

TOTAL: 45 HOURS

TEXT BOOKS:

T1: Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007.

T2: Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and Sons, Inc. Publications, 2003.

REFERENCES:

R1: Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Pres LC, 2003.

R2: Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.

R3: R. Splinter and B.A. Hoper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007

WEB LINKS:

W1: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBM1602.pdf

W2: http://biomedikal.in/2011/02/lecture-notes-on-fiber-optics-laser-in-medicine-for-biomedical-engineers/

COURSE OUTCOMES

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

CO1:	Describe the basic properties of light in tissue.	**K2**
CO2:	Illustrate about the Instruments used in optics	**K2**
CO3:	Explain the applications of LASER	**K3**
CO4:	Apply the knowledge about Lasers for therapeutic and diagnostic applications	**K3**
CO5:	Explain the application of lasers in therapy	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	2	-	-	-	-	-	3	3	3
CO2	1	1	2	1	2	2	-	-	-	-	-	1	2	2
CO3	2	2	1	1	1	3	-	-	-	-	-	1	2	1
CO4	2	1	1	2	1	-	-	-	-	-	-	2	1	1
CO5	1	1	1	1	1	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBMXX	ENTREPRENEURSHIP FOR BIOMEDICAL ENGINEERS	3	0	0	3

COURSE OBJECTIVE

- To learn fundamentals of entrepreneurship
- To apply the methods of entrepreneurship in medical field
- To evaluate the medical devices and market trends

UNIT 1 BIOMEDICAL INDUSTRY **9 hours**

Challenges & Opportunities – Medical Technology – Pharmaceutical Industry – Innovations in Medical Technology - Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Artificial intelligence in innovation of medical devices.

UNIT 2 VENTURE **9 hours**

Assessing the venture, Establish venture invention, market research, presenting the business plan, case study. Data analytics in market research, Forming the Company: Organizational Structure – Capitals required for the Company's Operation – Company Registration – Share Distribution – Exit Strategy.

UNIT 3 BUILDING UP THE ENTERPRISE **9 hours**

Financing & Accounting: Account Management – Budgeting – Financial Projections, Negotiating Process, Manufacturing the Product: Procurement & Outsourcing – Current Good Management Practice (cGMP) – Accountability – Risk Management – Lifecycle Management for Maximum Value

UNIT 4 MARKETING, EXPANDING AND GLOBALIZING THE BUSINESS **9 hours**

Marketing & Sales: Know the Customers – Market Characteristics of Medical Devices – Customer Relationship Management (CRM) – Marketing Ethics and Legal Compliance, Expanding & Globalizing the Business: World Prevalence of Diseases – Healthcare in UK/Germany/France/Italy – Healthcare Systems and Biomedical Industry in China – Global Markets of Medical Devices – Challenges of Global Marketing.

UNIT 5 CASE STUDIES ON BIOMEDICAL APPLICATIONS **9 hours**

Impact of MedTech innovations on Healthcare, Covid-19 Pandemic Assistive Devices - Inventions in various fields of Biomedical Engineering – Devices Developed.

TOTAL: 45 HOURS

TEXT BOOKS

T1: Jen-shih Lee, "Being A Biomedical Entrepreneur - Growth of The Biomedical Industry", World Scientific Publication Co. Pvt. Ltd., 2019.

T2: Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy, 2016

REFERENCE BOOKS:

R1. B Riadh Habash, "Green Engineering: Innovation, Entrepreneurship and Design", CRC Press, Taylor & Francis Group, 2017

R2. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organization", Harvard Business Press, Boston, 2014.

WEBLINKS:

W1: https://wctgroup.eng.uci.edu/publications/journal/J030-2019-Technology-and-Innovation_King.pdf

COURSE OUTCOMES

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

CO1:	Understand the concepts of Entrepreneurship	**K2**
CO2:	Interpret the background for biomedical engineers in entrepreneurship	**K2**
CO3:	Acquire the skills and techniques required towards innovation	**K3**
CO4:	Familiarise Marketing and Business Globalization	**K3**
CO5:	Apply the concepts of Biomedical Engineering for inventions and device development	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	1	1	2	-	2	-	2	-	3	3	2
CO2	3	2	2	2	2	2	-	2	2	2	-	3	3	3

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

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBM5X	EFFECTS OF RADIATION AND RADIATION SAFETY	3	0	0	3

Course Objectives

- To provide a broad knowledge on the interaction of Non-Ionizing radiation
- To learn about affects of ultrasound in tissues and their use in medicine.
- To have a better understanding about radiation monitoring instruments

UNIT I REVIEW OF NONIONISING RADIATIONPHYSICS IN MEDICINE **9 hours**

Different sources of Non Ionising radiation-their physical; properties-first law of photochemistry-Law of reciprocity- - Electrical Impedance and Biological Impedance - Principle and theory of thermography - applications

UNIT 2 TISSUE OPTICS **9 hours**

Various types of optical radiations - UV, visible and IR sources - Lasers: Theory and mechanism- Laser Surgical Systems-Measurement of fluence from optical sources - Optical properties of tissues – theory and experimental techniques-interaction of laser radiation with tissues – photothermal -photochemical – photoablation – electromechanical effect

UNIT 3 PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS **9 hours**

Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors – Ion chamber dosimetry systems - free air ion chamber – parallel plate chamber - ionization chamber – proportional chamber - GM counter – condenser type chambers and thimble chambers working and different applications – film dosimeteryLuminescence dosimetry – semiconductor dosimetry – Gel dosimetry - – radiographic and radiochromic films – scintillation detections.

UNIT 4 RADIATION MONITORING INSTRUMENTS **9 hours**

Introduction – operational quantities for Radiation monitoring – Area survey meters – Ionization chambers – proportional counters – neutron area survey meters – GM survey meters – scintillation detectors – Personal monitoring – film badge – TLD – Properties of personal monitors - Radiophtoluminesce glass dosimetry system – OSLD

UNIT 5 RADIATION TREATMENT PLANNING PARAMETERS **9 hours**

Build-up, central axis depth doses for different energies and their determination - Tissue Air Ratio, Tissue Maximum Ratio and Tissue Phantom Ratio - their relationship - back scatter factor –phantom scatter factor – collimator scatter factor - source to surface distance –dependence of SSD

TOTAL : 45 HOURS

TEXTBOOKS:

T1: F M Khan-Physics of Radiation Therapy, 3rd Edition,Liippincott Williams & Wilkins,USA, 2003.
T2: W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.

REFERENCE BOOKS:

R1: Radiation oncology physics : A Handbook for teachers and students. IAEA publications 2005.
R2: 4F.M.Khan,The Physics of Radiation Therapy,Third Edition,Lippincott Williams and Wilkins,U.S.A.,2003.

WEB LINKS:

W1: https://www.slideshare.net/RubiSapkota/radiation-protection-and-personnel-monitoring-devices
W2: https://www.slideshare.net/jdtomines/radiation-therapy

COURSE OUTCOMES

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

CO1:	Explain the understanding of radiation physics in medicine	**K2**
CO2:	Explain the applications of optics	**K2**
CO3:	Describe the radiation detection system and its applications	**K3**
CO4:	Explain the radiation monitoring system and the treatment planning	**K3**
CO5:	Analyse the applications of radiation in therapeutic systems	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	-	3	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	3	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	3	3
CO4	2	2	3	3	2	-	-	-	-	-	-	-	3	3
CO5	2	2	3	3	2	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBM6X	REHABILITATION ENGINEERING	3	0	0	3

Course Objectives

- Understand the basics of rehabilitation engineering
- Illustrate the devices described for mobility functions
- Learn about the orthotic and prosthetic devices
- Describe the technology assistance for vision and hearing impairments
- Illustrates the advancements in the field of rehabilitation

UNIT- I INTRODUCTION TO REHABILITATION ENGINEERING 9 hours

Introduction to Rehabilitation Engineering - PHAATE model - Clinical practice of rehabilitation Engineering - Low technology tools - Service delivery – Universal design - Design based on human ability - Standards for assistive technology - Test for best design.

UNIT- II MOBILITY AIDS 9 hours

Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Polarized Ultrasonic Travel aids.Seating Assessment - Interventions in seating system - Biological aspects of tissue health - Support surface classification - Manual wheelchairs – Electric power wheelchairs - Power assisted wheelchairs - Wheel chair standards & tests - Wheel chair transportation.

UNIT - III ORTHOTIC & PROSTHETIC DEVICES 9 hours

Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription - Components of upper limb prosthesis - Fabrication of prosthesis - Components of lower limb prosthesis – Orthoses: need and types - Lower extremity- and upper extremity- orthoses - Slints – materials used

UNIT- IV ASSISTIVE TECHNOLOGY FOR VISION & HEARING 9 hours

Anatomy of eye, Categories of visual impairment - Cortical & retinal implants - Auditory Information Display - Blind mobility aids – reading writing & graphics access, Orientation & navigation Aids - Anatomy of ear – hearing functional assessment - Surgical and non surgical hearing aids - Assistive technologysolutions for hearing Tactile - Information Display.

UNIT -V ADVANCED APPLICATIONS 9 hours

Functional Electrical stimulation - Robots in rehabilitation - Rehabilitation in sports -Daily living aids - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering - Role of biomedical engineering in rehabilitation.

TOTAL : -- 45 HOURS

TEXTBOOKS:

T1: Rory A, Cooper, Hisaichi Ohnabe, Douglas A, Hodson, “An Introduction to Rehabilitation Engineering”, CRC Press, First edition, 2006.

REFERENCES:

R1: Marion A Hersh, Michael A, Johnson, “Assistive Technology for Visuallyimpaired and blind people”, Springer Publications, First edition, 2008.

R2: Suzanne Robitaille, “The illustrated guide to Assistive technology and devices–Tools and gadgets for living independently”, Demos Health Newyork, First edition, 2010

Web Links:

W1: https://www.slideshare.net/amitmallik/mobility-aids-44750011

W2: https://www.slideshare.net/AsirJohnSamuel/functional-electrical-stimulation-in-spinal-cord-injury-rehabilitation

COURSE OUTCOMES

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

CO1:	Explain the introduction and importance of rehabilitation engineering	**K2**
CO2:	Illustrate the principle and working of assistive aids	**K2**
CO3:	Examine the basic fundamentals and working of orthotic and prosthetic devices	**K3**
CO4:	Compare the assistive devices for various parts of human body	**K3**
CO5:	Evaluate the applications of Rehabilitation engineering	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	-	-	-	-	-	-	-	-	2	1
CO2	2	2	2	2	2	-	-	-	-	-	-	-	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBM5X	WEARABLE MEDICAL SYSTEMS	3	0	0	3

COURSE OBJECTIVE

- To Learn about challenges and research issues related to wearable sensors
- To design wireless sensor networks
- To learn about Humanistic intelligence
- To have an understanding about IoT
-

UNIT 1 – FUNDAMENTALS OF SENSOR NETWORKS **9 hours**

Introduction to computer and wireless sensor networks and Overview of the syllabus ,Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints - node architecture-sensing subsystem, processor subsystem communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

UNIT 2- COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS 9 hours

Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time SynchronizationClock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols - Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization

UNIT 3 - CYBERNETICS AND HUMANISTIC INTELLIGENCE **9 hours**

Wearables - Augmented Reality – Mixed Reality.Case studies, Oculus Rift , AR versus VR - IoT and Wearables: Smart Cites and Wearable Computing as a form of urban design - Advanced I/O – open Frameworks:Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, sqLite, XML, PHP/Web) - Arduino:Wired/Wireless Networking (hardware vs. USB proxy) - Software serial (RS-232) talking to other devices - Advanced sensor/device communication SPI - Advance IC interfacing / Bitbanging (bitwise operators) - Linux – GPIO

UNIT 4 - THE WORLD OF THE FUTURE – INTERNET OF EVERYTHING **9 hours**

Humanistic Intelligence,. Wearable Computing and IoT (Internet of Things) The scalespace theory; sur/sousveillance; integrity; VeillanceContract; Humanistic Intelligence; MedialityAxis , Overview of Mobile and Wearable Computing, Augmented Reality, and Internet of Things. The fundamental axes of the Wearables + IoT + AR space - Freeroaming AR: Wearable Computing, Wireless, Sensing, and Metasensing with light bulbs Phenomenal Augmented Reality: Real world physical phenomena as the fundamental basis of mobile and wearable AR.

UNIT 5 - FUTURE AND PERSPECTIVES **9 hours**

Internet of Everything – The Future and perspectives – Challenges, Case studies

TOTAL: 45 HOURS

TEXTBOOKS

T1: “Practical Electronics for Inventors, Third Edition,” by Paul ScherzandSimon Monk. 2016

T2: Intel Galileo and Intel Galileo Gen 2API Features and Arduino Projects for Linux Programmers, Ramon, Manoel 2014 (Open Access)

REFERENCES

R1: Fundamentals of Wearable Computers and Augmented Reality, Second Edition by Woodrow Barfield 2015

R2: Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design By OmeshTickoo, Ravi Iyer 2016

R3: Programming Interactivity, Second Edition By Josha Noble, 2012

R4: Programming the Raspberry Pi: Getting Started with Python 2E, 2016

WEB LINKS:

W1: https://ieeexplore.ieee.org/document/8094096

COURSE OUTCOMES

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

CO1:	Develop knowledge about the sensor networks in advanced and emerging technologies	**K2**
CO2:	Explain the mechanisms and characteristics of communication systems	**K2**
CO3:	Categorize the equipment that can be integrated with wearable systems	**K3**
CO4:	Differentiate the wearable technology and illustrates knowledge about internet of things	**K3**
CO5:	Apply and illustrate the future challenges	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	3	3	-	-	-	-	-	1	2	3
CO2	3	3	2	3	3	2	-	-	-	-	-	2	2	3
CO3	2	3	2	3	3	3	-	-	-	-	-	1	3	3
CO4	3	3	2	2	3	3	-	-	-	-	-	1	3	3
CO5	2	2	2	3	2	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	BIO MEMS AND NANOTECHNOLOGY	3	0	0	3

Course Objectives

The students should be made to

Acquire knowledge about the principles of BioMEMS & Biomedical Nanotechnology.
Understand the working principle of MEMS & Microsystems.
Understand the application of BioMEMS

UNIT I MEMS & MICROSYSTEM 9 hours

MEMS and Microsystems- Introduction - Typical MEMS and Microsystem Products - Application of Micro-system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation - MEMS with Microactuation – Micro-accelerators & Micro-fluidics - Materials for MEMS & Microsystems

UNIT II MICRO-OPTO ELECTROMECHANICAL SYSTEMS & MICROFLUIDICS 9 hours

Fundamental principle of MOEMS Technology - Light Modulators, Beam splitter – Microlens, Micro-mirrors - Digital Micro-mirror Device, Light detectors - Important Consideration on Micro-scale fluid, Properties of fluid - Fluid Actuation Methods – Micro-pumps – Typical Micro-fluidic Channel, Micro-fluid Dispenser.

UNIT III BIOMEMS 9 hours

BIOMEMS-Introduction, the driving force behind the biomedical Application - Principle of Biosensor, Ampero-metric Biosensor - Multi-analyte measurement, Micro-dialysis - BioMEMS for Clinical Monitoring - Multi-parameter monitoring - Monitoring of Glucose & Lactate with a micro-dialysis probe – Ammonia Monitoring - Electronic Nose, DNA Sensors.

UNIT IV DNA BASED BIOMEMS 9 hours

Introduction, Unique features of Nucleic Acids,Lab on the Chip, Electrophoresis, Polymerase Chain Reaction (PCR), Biochemical reaction chains for integration: Biosensors & the "lab biochip", Typical Microarray experiment, Manufacturing of Microarrays, Synthesis on the chip, Spotting Techniques, PCR on the chip, Microchamber Chips, Micro-fluidics Chips, Emerging BioMEMS Technology

UNIT V BIOMEDICAL NANOTECHNOLOGY 9 hours

Introduction to nanoscale phenomena, Nanoparticles- Nanomaterial characterization – XRD, SAXS, TEM, SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MR Imaging, Nano-devices in biomedical applications.

TOTAL : 45 HOURS

TEXT BOOKS:

T1: Steven S, Saliterman, "Fundamentals of BioMEMS & Medical Microdevices*"*,International Society for Optical Engineering, First Edition 2006.
T2: Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill, 2nd Reprint 2008.
T3: Wanjun Wang & Steven A.Soper , "BioMEMS- Technologies and applications", CRC Press, First edition 2007.

REFERENCE BOOKS:

R1: Tai-Ran Hsu, "MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering*"*, John Wiley & Sons, 2nd Edition 2008.
R2: Gerald A Urban, "BioMEMS*",* Springer, First Edition 2006.
R3: Abraham P. Lee and James L. Lee, "BioMEMS and Biomedical Nanotechnology",Volume I, Springer, First Edition 2006.
R4: Paul C.H. Li, "Introduction to Microfluids and BioMEMS: A Design and Problem-
R5: SolvingTextbook", CRC Press, First Edition 2009.
R6: Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, First Edition 2002.
R7: 6. Guozhong Cao & Ying Wang, "Nanostructures and Nanomaterials-Synthesis, Propertiesand Applications*",* World Scientific, 2nd Edition 2011.

WEB LINKS:

W1:https://nanohub.org/resources/992/download/2005.02.07-Bashir1.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the knowledge to design solutions to probe biomedical and biology systems	**K2**
CO2:	Apply the integration of mechanical and electrical elements and also the techniques involved in the fabrication of biomems and nanotechnology Examine the basic design and operation of BioMEMS sensors and transducers, and Biochips	**K2**
CO3:	Analyse the fabrication of microfluidic devices, surface functionalization and the limitations of surface micromachining.	**K4**
CO4:	Demonstrate a detailed understanding of the fundamental principles of nanotechnology and their application to biomedical engineering.	**K3**
CO5:	Evaluate and employ electrical measurements for MEMS mechanical structure characterization, understanding possible problems encountered in living systems.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	1	-	2	-	-	-	-	-	3	3	2
CO2	3	1	-	1	2	2	-	3	2	-	-	-	2	2
CO3	1	1	1	1	-	3	-	-	2	1	-	-	-	2
CO4	2	-	1	2	2	-	-	3	2	1	-	-	2	1
CO5	1	1	-	1	-	3	-	3	2	1	-	2	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22CBBMXX	BIOMEDICAL INFORMATICS	3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- Learn ICT applications in medicine
- Learn health informatics.
- Understand the theories and practices adopted in Hospital Information Systems in the light of medical standards,
- Understand medical data formats and recent trends in Hospital Information Systems.

UNIT I MEDICAL INFORMATICS **9 hours**

Introduction – Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics – Functional capabilities of Hospital Information System - On-line services and Off – line services - Dialogue with the computer

UNIT II MEDICAL STANDARDS **9 hours**

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA –Electronics Patient Records – Healthcare Standard Organizations – JCAHO (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT III MEDICAL DATA STORAGE AND AUTOMATION **9 hours**

Representation of Data, Data modeling Techniques, Relational Hierarchical and network Approach, Normalization techniques for Data handling - Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface – Medical Data formats – Signal, Image and Video Formats –Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System –PACS.

UNIT IV HEALTH INFORMATICS **9 hours**

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS **9 hours**

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

TOTAL: 45 PERIODS

TEXT BOOKS:

T1: R.D.Lele, "Computers in medicine progress in medical informatics", Tata McGraw Hill Publishing Ltd, 2005 (Units I, III & IV).

T2: Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Ltd, 2003 (Units II, IV & V).

REFERENCES:

R1. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007.

R2. Yi Ping Phoebe Chen, "Bioinformatics Technologies", Springer International Edition, New Delhi, 2007.

WEBLINKS:

W1: https://drive.uqu.edu.sa/_/maatia/files/Biomedical%20Informatics.pdf

COURSE OUTCOMES

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

CO1:	Discuss about health informatics.	**K2**
CO2:	Discuss the different ICT applications in medicine.	**K3**
CO3:	Explain the function of Hospital Information Systems	**K2**
CO4:	Analyze medical standards	**K3**

CO5:	Explain recent trends in Hospital Information Systems	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	2	1	-	-	-	-	-	3	-
CO2	1	1	1	1	-	2	1	3	2	-	-	-	2	3
CO3	3	2	-	1	-	1	1	-	2	1	-	-	-	-
CO4	3	1	1	1	-	1	2	3	2	-	-	-	2	3
CO5	2	2	1	1	-	1	1	3	2	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22EBBMXX	HOSPITAL MANAGEMENT	3	0	0	3

Course Objectives

The students should be made to

Understand the fundamentals of hospital administration and management.

Know the market related research process

Explore various information management systems and relative supportive services.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9 hours

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 IN HOSPITAL 9 hours

Principle of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication

UNIT III MARKETING RESEARCH PROCESS 9 hours

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 - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9 hours

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 hours

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. 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 HOURS

TEXT BOOKS:

T1: R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.

T2: G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

Reference Books:

R1: Cesar A.Caceres and Albert Zara, ―The Practice of Clinical Engineering, Academic Press, New York, 1977.

R2: Norman Metzger, ―Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.

R3: Peter Berman ―Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.

R4: William A. Reinke ―Health Planning For Effective Management‖ - Oxford University Press.1988

Web Links:

W1: https://onlinecourses.swayam2.ac.in/aic20_ge08

W2: https://www.measureevaluation.org/resources/training/capacity-building-resources/health-management-information-systems-hmis-1

COURSE OUTCOMES

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

CO1:	Illustrate the functions of management and administration of hospitals.	**K2**
CO2:	Apply various principles of planning and management in implementing health projects and programs	**K3**
CO3:	Determine the various components of the health care delivery system in India.	**K2**
CO4:	Compute healthcare ethics with business and industry knowledge.	**K3**
CO5:	Evaluate the knowledge and understanding of concepts, theories, laws, tools, and practices in Budgeting, financial reporting and control, Management and organization	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	-	3	1	-	-	-	-	-	3	-
CO2	1	1	1	1	-	3	1	3	2	-	-	-	2	3
CO3	3	2	-	1	-	3	1	-	2	1	-	-	-	-
CO4	3	1	1	1	-	3	2	3	2	-	-	-	2	3
CO5	2	2	1	1	-	3	1	3	2	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22CBBMXX	PATHOLOGY AND MICROBIOLOGY	3	0	2	4

Course Objectives

The student should be made to:

- Gain a knowledge on the structural and functional aspects of living organisms.
- Gain a knowledge on fluids and disorders.
- Know the etiology and remedy in treating the pathological diseases.
- Empower the importance of public health.

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA **9+6 Hours**

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood) , cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Histopathological slides of benign and malignant tumours., Neoplasia, Study of parts of compound microscope , Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS **9+6 Hours**

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders-Bleeding disorders, Leukaemias, Manual paraffin tissue processing and section c utting (demonstration) , Lymphomas Haemorrhage.

UNIT III MICROBIOLOGY **9+6 Hours**

Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria, culture media and its types , Bleeding time and clotting time. , culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

UNIT IV MICROSCOPES **9+6 Hours**

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple, Special stains – Cresyl Fast Blue (CFV)- Trichrome – oil red O – PAS , gram staining and AFB staining. Gram stain. ., AFB stain.

UNIT V IMMUNOPATHOLOGY **9+6 Hours**

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE. Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, Basic staining – Hematoxylin and eosin staining. immuno electrophoresis, RIA and ELISA, monoclonal antibodies. Simple stain.

TOTAL : 75 HOURS

TEXT BOOKS:

T1: Robbins S.L & Ramzi S.C, “Pathologic Basis of Diseases’, W.B. Saunders Co. 1999Anatha

T2: Narayanan.R & Jayaram Panicker C.R, ‘Text Book of Microbiology, Orient Laongman’ 1998

REFERENCES:

R1: Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.

R2: Dubey RC and Maheswari DK. “A Text Book of Microbiology” Chand & Company Ltd, 2007

Web Links:

W1: https://www.slideshare.net/NehaMahajan9/cell-injury-and-degenerations

W1: https://www.slideshare.net/hmirzaeee/immunopathology

COURSE OUTCOMES

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

CO1:	Explain the knowledge about adaptation of cells for the pathology	**K2**
CO2:	Illustrate the body fluid derangements and blood related disorders	**K2**
CO3:	Examine the working of various types of microscopes and sample preparation techniques.	**K3**
CO4:	Explain the tests and analysis of the bacteria	**K4**
CO5:	Examine the body immune responses and immunological techniques.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	-	-	-	-	-	-	-	1	2	-
CO2	2	2	3	2	-	-	-	-	-	-	-	1	2	-
CO3	2	2	3	2	1	-	-	-	-	-	-	3	2	3
CO4	2	2	3	2	2	-	-	-	-	-	-	3	3	3
CO5	2	2	3	2	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBMXX	ROBOTICS IN MEDICINE	3	0	2	4

COURSE OBJECTIVES

The student should be made to

- Understand the basics of Robotics, Kinematics.
- Understand the basics of Inverse Kinematics.
- Explore various kinematic motion planning solutions for various Robotic configurations.
- Explore various applications of Robots in Medicine.

UNIT – I BASIC CONCEPTS **9+6 Hours**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT – II POWER SOURCES AND SENSORS **9+6 Hours**

Hydraulic, pneumatic and electric drives determination of HP of motor and gearing ratio variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT – III MANIPULATORS, ACTUATORS AND GRIPPERS **9+6 Hours**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – various types of grippers – design considerations.

UNIT- IV POWER SOURCES AND SENSORS **9+6 Hours**

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, variable speed arrangements, Path determination - Machinery vision, Ranging Laser- Acoustic, Magnetic fiber optic and Tactile sensor.

UNIT - V ROBOTICS IN MEDICINE **9+6 hours**

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric-, and General- Surgery, Gynecologic Surgery, General Surgery and Nano robotics.

TOTAL: 75 HOURS

TEXT BOOK:

T1: Niku Saeed B, Introduction to Robotics: Analysis, System, Applications, PHI Publishers.
T2: Tony Hyland, Scientific and Medical Robotics, Smart Apple Media Publishers, 2007.
T3: Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

REFERENCES:

R1: Staugaard, Andrew C,—Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning, Prentice Hall Of India, 1987
R2: Grover, Wiess, Nagel, Oderey, —Industrial Robotics: Technology, Programming and Applications‖, McGraw Hill, 1986.
R3: Wolfram Stadler, —Analytical Robotics and Mechatronics‖, McGraw Hill, 1995.
R4: Saeed B. Niku, —Introduction to Robotics: Analysis, Systems, Applications‖, Prentice Hall, 2001.
R5: K. S. Fu, R. C. Gonzales and C. S. G. Lee, —Robotics‖, McGraw Hill, 2008.

WEBLINKS:

W1: https://web.stanford.edu/class/me328/lectures/lecture1-intro.pdf
W2: http://www.cs.columbia.edu/~allen/F17/NOTES/Medical_Robotics_updated.pdf

COURSE OUTCOMES

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

CO1:	Describe the basic knowledge on robotics	**K2**
CO2:	Illustrate the basic concept of robots and its types	**K2**
CO3:	Articulate the information about robots and its kinematics	**K3**
CO4:	Explain the various types of equipments that can be integrated with robotics	**K4**
CO5:	Categorise the applications of robots along with the advantages and disadvantages	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO2	3	3	2	2	3	-	1	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	3	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	3	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	3	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBMXX	PATTERN RECOGNITION AND NEURAL NETWORKS	3	0	2	4

Course Objectives

The student should be made to:

- The course will introduce the student to the fundamentals of pattern recognition and its application.
- The course will discuss several supervised and unsupervised algorithms suitable for pattern classification
- Particular emphasis will be given to computational methods such as linear discriminant functions and nearest neighbor rule.
- The course also covers basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision.
- The major focus of this course will be on the use of Pattern and Neural Classifiers for classification applications.

UNIT I INTRODUCTION AND SUPERVISED LEARNING **9+6 Hours**

Overview of Pattern recognition, Types of Pattern recognition, To Design and train a perceptron for AND Gate, Parametric and Nonparametric approach, Bayesian classifier, To design and train a perceptron training for OR gate, Discriminant function, non parametric density estimation, histograms, kernels, window estimators, k- nearest neighbor classifier, estimation of error rates.

UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS **9+6 Hours**

Unsupervised learning- Hierarchial clustering- Single-linkage Algorithm, To design and train a perceptron training for EX-OR gate, Complete – linkage Algorithm, To design and train a perceptron for NOT gate, Average-linkage algorithm and Ward's method. Partitional clustering- Forgy's Algorithm, k-means algorithm and Isodata Algorithm

UNIT III INTRODUCTION AND SIMPLE NEURAL NET **9+6 Hours**

Elementary neurophysiology and biological neural network- Artificial neural network-Architecture, To design KNN classifier for classification of data , biases and thresholds, To design and train a perceptron for identifying ODD and EVEN number. , To design BPN network for classification , Hebb net, To create a Bi-directional Associative Memory (BAM) for ID and telephone number. , Perceptron, Adaline and Madaline.

UNIT IV BACK PROPAGATION AND ASSOCIATIVE MEMORY **9+6 Hours**

Back propagation network, generalized delta rule, Bidirectional Associative memory Hopfield Network

UNIT V NEURAL NETWORKS BASED ON COMPETITION **9+6 Hours**

Kohonen Self organizing map, Learning Vector Quantisation, To design and train the Hopfield net to map the input vector with the stored vector and correct them , Counter Propagation network

TOTAL : -- 75 HOURS

TEXT BOOKS:

T1: Duda R.O. Hart P.G, "Pattern Classification and scene analysis", Wiley Edition 2000 .

T2: Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002.

REFERENCES:

R1: Freeman J.A., and Skapura B.M, "Neural Networks, Algorithms, Applications and Programming Techniques", Addison - Wesley, 2003.

R2: Earl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1999.

R3: Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.

R4: Laurene Fausett, "Fundamentals of neural networks- Architectures, algorithms and applications",Prentice Hall, 1994

Web Links:

W1: https://www.slideshare.net/Ahmed_hashmi/neural-network-its-applications

W2: https://www.slideshare.net/MohammedBennamoun/artificial-neural-networks-lect7-neural-networks-based-on-competition

COURSE OUTCOMES

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

CO1:	Determine the basic concepts in pattern recognition.	**K2**
CO2:	Utilize Unsupervised learning algorithms to solve problems.	**K2**
CO3:	Apply the concepts and techniques of neural networks	**K3**
CO4:	Construct and develop neural network systems	**K4**
CO5:	Compare neural network and patterns based on competition.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	-	-	-	-	2	3	2
CO2	3	2	2	2	2	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBMXX	INTERNET OF MEDICAL THINGS	3	0	2	4

COURSE OBJECTIVES

- To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- To know about the types of transducers available and their applications in different fields.

UNIT I INTRODUCTION 9+6 hours

Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device- Study and introduction of IoT platform

UNIT II IoT SENSORS 9+6 hours

Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics– Polytronics Systems – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap - Execution of a medical parameter using think speak module

UNIT III NETWORK& COMMUNICATION ASPECTS 9+6 hours

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination - Study of Data logging in think speak and Beagle bone black, Study of Data logging in think speak and Beagle bone black

UNIT IV CHALLENGES IN IOT 9+6 hours

Design challenges, Development challenges, Security challenges, Other challenges, Study and execution of applications using Online Cloud Platforms.

UNIT V APPLICATIONS OF IoMT 9+6 hours

Chronic disease management, Remote assisted living (Tele health), Wellness and preventive care (Lifestyle assessment), Remote intervention, Improved drug management, Study and uses of Biomedical Engineering.

TOTAL : 75 HOURS

TEXTBOOKS:

T1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence Press, 2014.

T2. Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons, 2018.

T3. Hassan, Qusay F., ed. Internet of Things A to Z: technologies and applications. John Wiley & Sons, 2018.

REFERENCE BOOKS

R1: Holler, Jan, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, and David Boyle. Internet of Things. Academic Press, 2014.

R2: Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011. 6 Bernd Scholz- -3-642-19156-5 e-ISBN Architecting the Internet of Things, ISBN 978-3-642-19156-5, 978-3- 642-19157-2, Springer

WEBLINKS:

W1: https://www.aranca.com/assets/uploads/resources/special-reports/Internet-of-Medical-Things-IoMT_Aranca-Special-Report.pdf

W2: https://www.scirp.org/pdf/jcc_2022082515323190.pdf

COURSE OUTCOMES

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

CO1:	Explain the introduction and importance of internet of things	**K 2**
CO2:	Illustrate the principle and significance of iot sensors	**K 2**

CO3:	Examine the basic fundamentals and working of networking and communication aspects	**K 3**
CO4:	Explain and analyse the significance of IoT	**K 4**
CO5:	Explain advanced applications of IoMT in various fields.	**K 5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	2	1	2	2	-	1	3	3	2
CO2	2	1	2	2	2	2	1	1	2	1	1	2	2	2
CO3	3	2	2	2	2	3	1	-	2	-	1	1	3	3
CO4	3	1	2	2	2	-	-	1	2	-	1	2	2	2
CO5	2	1	1	2	2	3	3	1	1	1	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBMXX	ANALOG AND DIGITAL COMMUNICATION	3	0	2	4

COURSE OBJECTIVES:

The student should be made to:

- Understand analog communication techniques.
- Learn data and pulse communication techniques.
- Learn basics digital communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

UNIT I ANALOG COMMUNICATION **9+6 hours**

Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II PULSE AND DATA COMMUNICATION **9+6 hours**

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

UNIT III DIGITAL COMMUNICATION **9+6 hours**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV SOURCE AND ERROR CONTROL CODING **9+6 hours**

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes - ARQ Techniques.

UNIT V MULTI-USER RADIO COMMUNICATION **9+6 hours**

Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TOTAL: 75 HOURS

TEXT BOOK:

T1: Wayne Tomasi, ―Advanced Electronic Communication Systems‖, 6th Edition, Pearson Education, 2009.

REFERENCES:

R1: Simon Haykin, ―Communication Systems‖, 4th Edition, John Wiley & Sons, 2004
R2: Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
R3: H.Taub, D L Schilling and G Saha, ―Principles of Communication‖, 3rd Edition, Pearson Education, 2007.
R4: B. P.Lathi, ―Modern Analog and Digital Communication Systems‖, 3rd Edition, Oxford University Press, 2007.

WEB LINKS:

W1: https://www.tutorialspoint.com/digital_communication/digital_communication_analog_to_digital.htm

COURSE OUTCOMES

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

CO1:	Describe the various analog and digital communication techniques.	**K2**
CO2:	Illustrate the advanced analog and digital communication techniques.	**K2**
CO3:	Examine and determine the basics of analog and digital communication techniques.	**K3**

CO4:	Apply the knowledge of communication in coding theorems.	**K3**
CO5:	Categorise the knowledge about techniques of analog and digital communication	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	-	-	-	-	1	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22CBBMXX	HUMAN ASSIST DEVICES	3	0	0	3

Course Objectives

- Learn the functioning of the assistive technological devices.
- Understand the tests to assess and development of electronic devices to compensate for the loss.
- Understand electrical stimulation techniques used in clinical applications.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9 hours

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, Mock test setup for assessing its Functions

UNIT II CARDIAC ASSIST DEVICES 9 hours

Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra-Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNITIII ARTIFICIAL KIDNEY 9 hours

Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV PROSTHETIC AND ORTHOTIC DEVICES 9 hours

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices.

UNIT V RESPIRATORY AND HEARING AIDS 9 hours

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, Construction and Functional Characteristics, audiogram

TOTAL : 45 HOURS

Text Books:

T1. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.
T2. Andreas.F.Von racum, Handbook of biomaterial evaluation, Mc-Millan publishers, 1980.
T3. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey,1982

Reference Books:

R1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
R2. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.

Web Links:

W1: https://www.slideshare.net/sivanandareddy52/ambulatory-devices
W2: https://slideplayer.com/slide/12787794/

COURSE OUTCOMES

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

CO1:	Explain all types of assist devices and its operations.	**K2**
CO2:	Determine the properties and classification of different types of assistive materials	**K3**
CO3:	Distinguish the functioning and working of all assistive devices and technologies	**K3**
CO4:	Apply the designing of assistive devices to overcome loss in human system	**K3**
CO5:	Analyze about tests to assess the development of assistive devices	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	-	-	-	-	-	-	-	-	2	1
CO2	2	2	2	2	2	-	-	-	-	-	-	-	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓				✓	

22EBBMXX	NEUROSCIENCE FOR BIOMEDICAL APPLICATIONS	3	0	0	3

Course Objectives

The students should be made to

This course encompasses a scientific study of human nervous system.

It Includes different approaches to study the molecular, cellular, developmental, structural, functional, evolutionary, and medical aspects of nervous system

It addresses the mechanisms of how neurons process signals physiologically and electrochemically.

UNIT I INTRODUCTION TO NEUROSCIENCE. 9 hours

An overview of neuroscience, Applications of neuroscience, Neurons and Neuroglia, Neurotransmitters

UNIT II NERVOUS SYSTEM 9 hours

Nervous system: central nervous system, peripheral nervous system, autonomic nervous system; anatomical organization of the nervous system, functional organization of the nervous system, neurons-the nerve cell, CSF

UNIT III ELECTRICAL PROPERTIES OF NERVOUS SYSTEM 9 hours

Electrolytes within our neurons; Ion channels, Local signaling, Signal propagation - Action potential, Synapse, Synaptic integration, Modulation of synaptic transmission, Nerve-Muscle interaction

UNIT IV NEURAL NETWORKS 9 hours

Current flow in neurons, Introduction to electro diagnostic signals and their measurement, nerve conduction study, evoked potentials and EEG

UNIT V CHALLENGES 9 hours

Neuroscience methods and techniques to understand the functions of nervous system – Pathology of Nervous system – Molecular and cellular mechanisms of Parkinson's, Huntington's, Stroke and Alzheimer's diseases.

TOTAL : 45 HOURS

TEXT BOOKS:

T1: Richard S Snell, Clinical Neuro Anatomy, Lippincott Williams & Wikkins,2006

T2: W.F Ganang Review of Medical Physiology, Mc Graw Hill Professional, 21st Edition, 2003

REFERENCE BOOKS:

R1: A Krishnamurti Notes on Nervous System, Janagam Offset Printers, 1999

R2: Eric R Sandel, Principles of Neural Science, Elsevier, 4th Edition,2000

R3: U.K.Misra, Clinical neurophysiology, Elsevier Health Science, 2006 6. James D Fix, Neuroanatomy, William and Wilkins, 2nd Edition, 1995

WEB LINKS:

W1:https://onlinecourses.nptel.ac.in/noc20_ee95/preview

COURSE OUTCOMES

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

CO1:	Determine the understanding the basics of neuroscienc	**K2**
CO2:	Illustrate about the nervous system	**K2**
CO3:	Appreciation of how physiological signals can help us to understand motor and sensory systems	**K4**
CO4:	Knowledge of the current level of development of the field of Neuroscience	**K3**
CO5:	Analyse the challenges and mechanisms of different neurological disorders	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	1	-	-	-	-	-	3	-
CO2	1	1	1	1	-	-	1	-	2	-	-	-	2	3
CO3	2	2	1	1	-	-	1	-	2	1	-	-	-	-
CO4	-	1	1	1	-	3	2	3	2	1	-	-	2	3

CO5	2	2	1	1	-	3	1	3	2	1	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22EBBMXX	TELEHEALTH TECHNOLOGY	3	0	0	3

Course Objectives

The students should be made to

- Learn the key principles for telemedicine and health
- Understand telemedical technology.
- Understand ethical and legal aspects of Telemedicine.
- Know telemedical standards, mobile telemedicine and it applications.

UNIT I FUNDAMENTALS OF TELEMEDICINE **9 Hours**

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

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE **9 Hours**

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

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE **9 Hours**

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

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM **9 Hours**

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE **9 Hours**

Geriatric Care, Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine.

TOTAL : 45 HOURS

TEXTBOOKS:

T1: Norris A C, ―Essentials of Telemedicine and Telecare‖, John Wiley, New York, 2002.

T2: H K Huang, ―PACS and Imaging Informatics: Basic Principles and Applications‖ Wiley, New Jersey, 2010.

REFERENCES:

R1: Olga Ferrer Roca, Marcelo Sosa Iudicissa, ―Handbook of Telemedicine‖, IOS Press, Netherland, 2002. 2. Khandpur R S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 2003.

R2: Keith J Dreyer, Amit Mehta, James H Thrall, ―Pacs: A Guide to the Digital Revolution‖, Springer, New York, 2002.

R3: Khandpur R S, ―TELEMEDICINE – Technology and Applications‖, PHI Learning Pvt Ltd., New Delhi, 2017.

Web Links:

W1: https://www.slideshare.net/AdityaMaduriya/telemedicine-63767663#:~:text=Telemedicine,User%20Agreement%20and%20Privacy%20Policy

W2: https://www.slideshare.net/DrPreetiTiwari/telemedicine-and-its-application-in-public-health

COURSE OUTCOMES

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

CO1:	Explain about the communication system and its work flow	**K2**
CO2:	Explain the various aspects based on which communication is done	**K3**
CO3:	Describe the communication system	**K3**

CO4:	Describe the applications of telehealth technology	**K3**
CO5:	Analyse the applications of telehealth systems	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	-	1	-	2	-	-	-	-	-	3	3	2
CO2	3	1	-	1	2	2	-	3	2	-	-	-	2	2
CO3	1	1	1	1	-	3	-	-	2	1	-	-	-	2
CO4	2	-	1	2	2	-	-	3	2	1	-	-	2	1
CO5	1	1	-	1	-	3	-	3	2	1	-	2	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	MEDICAL WASTE MANAGEMENT	3	0	0	3

Course Objectives

The students should be made to

- Understand the hazardous materials used in hospital and its impact on health
- Understand various waste disposal procedures and management.

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9 hours

Healthcare Hazard Control : Introduction, Hazard Control and Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Analysis, Personal Protective Equipment, Hazard Control Evaluation, 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 hours

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazards 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 hours

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 hours

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 hours

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 HOURS

TEXT BOOKS:

T1: Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

T2: Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).,

REFERENCE BOOKS:

R1: R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006.

R2: V.J. Landrum, "Medical Waste Management and disposal", Elsevier, 1991

WEB LINKS:

W1: https://ucms.ac.in/Lectures-C-2020/BSc%20Biological%20effects%20of%20Radiation.pdf

COURSE OUTCOMES

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

CO1:	Analyse various hazards, accidents and its control	**K2**
CO2:	Design waste disposal procedures for different biowastes	**K4**
CO3:	Categorise different biowastes based on its properties	**K3**
CO4:	Design different safety facility in hospitals	**K4**
CO5:	Propose various regulations and safety norms	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	2	-	-	-	-	-	3	3	3
CO2	2	1	2	1	2	2	-	-	-	-	-	1	2	2
CO3	3	2	1	1	1	3	-	-	-	-	-	1	2	1
CO4	2	1	1	2	1	-	-	-	-	-	-	2	1	1
CO5	2	1	1	1	1	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22EBBMXX	RADIOLOGICAL EQUIPMENTS	3	0	0	3

COURSE OBJECTIVE

Students should be made to

- Understand generation of x-rays and its uses in imaging.
- Learn different types of radio diagnostic techniques.
- Know techniques used for visualizing different sections of the body using resonance imaging
- Illustrate the nuclear medicine system in the field of radiology.
- Learn radiation therapy methodologies and the radiation safety.

UNIT- I MEDICAL X-RAY EQUIPMENT **9 hours**

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

UNIT- II COMPUTED TOMOGRAPHY **9 hours**

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

UNIT- III MAGNETIC RESONANCE IMAGING **9 hours**

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

UNIT- IV NUCLEAR MEDICINE SYSTEM **9 hours**

Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT- V RADIATION THERAPY AND RADIATION SAFETY **9 hours**

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 HOURS

TEXT BOOKS:

T1. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 1988 (Units I, II, III & IV).
T2. R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss, 2002.

REFERENCES:

R1. Gopal B. Saha “Physics and Radiobiology of Nuclear Medicine”- Third edition Springer, 2006.
R2. B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C Barber, “Medical physics and biomedical Engineering”, - CRC Press, 1999.
R3. Myer Kutz, “Standard handbook of Biomedical Engineering and design”, McGraw Hill, 2003.
R4. P.Ragunathan, “Magnetic Resonance Imaging and Spectroscopy in Medicine.

WEBLINKS:

W1. https://www.slideshare.net/raejshwari/unit-1-ppt-notes-bm8702-radiological-equipments

COURSE OUTCOMES

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

CO1:	Explain the generation of X-rays and its applications.	**K2**
CO2:	Illustrate the principle and working of CT Scan in detail	**K2**
CO3:	Examine the basic fundamentals and working of MRI scan in detail	**K2**
CO4:	Explain the structure of nuclear medicine system	**K4**
CO5:	Explain radiotherapy and radiation safety in detail	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	3	-	-	-	-	-	1	2	3
CO2	3	3	2	3	3	2	-	-	-	-	-	2	2	3
CO3	2	3	2	3	3	3	-	-	-	-	-	1	3	3
CO4	3	3	2	2	3	3	-	-	-	-	-	1	3	3
CO5	2	2	2	3	2	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22EBBMXX	ARTIFICIAL INTELLIGENCE AND DEEP LEARNING	3	0	2	4

COURSE OBJECTIVES:

The student should be made to:

- Study the basic concepts and implementation of AI and Deep learning
- Understand the techniques and applications of AI and Deep learning

UNIT -I BASICS OF AI **9+6 hours**

General AI Goal, Study of AI, Engineering based AI Goal, Science-based AI Goal. Techniques that make system to behave as Intelligent, Describe and match, Goal reduction, Constraint satisfaction, Tree Searching, Generate and test, Rule based systems, Biology-inspired AI techniques, Neural Networks, Genetic Algorithms, Reinforcement learning.

UNIT -II BRANCHES OF AI **9+6 hours**

Logical AI, Search in AI, Pattern Recognition, Knowledge Representation, Inference, Commonsense knowledge and reasoning, Learning, Planning, Epistemology, Ontology, Heuristics, Genetic programming.

UNIT-III APPLICATIONS OF AI **9+6 hours**

Game playing, Speech Recognition, Understanding Natural Language, Computer Vision, Expert Systems, Biomedical data using deep learning.

UNIT IV DEEP NETWORKS BASICS **9+6 hours**

Linear Algebra: Scalars -- Vectors -- Matrices and tensors; Probability Distributions – Gradient based Optimization – Machine Learning Basics: Capacity -- Overfitting and underfitting -- Hyperparameters and validation sets -- Estimators -- Bias and variance -- Stochastic gradient descent -- Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization -- Optimization.

UNIT V CONVOLUTIONAL NEURAL NETWORKS **9+6 hours**

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers -- Gradient Computation, CNN implementation of basic data, Character and digit recognition using ANN.

TOTAL:75 HOURS

TEXT BOOKS

T1. S. Russell, P. Norvig , Artificial Intelligence,Prentice Hall

T2. E.Rich, K. Knight, Artificial Intelligence, McGraw Hill

T3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016

T4. Stone, James. (2019). Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning, Sebtel Press, United States, 2019.

REFERENCE BOOKS:

R1. David Poole, Alan Mackworth, Randy Goebel, ”Computational Intelligence : a logical approach”, Oxford University Press.

R2. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problemsolving”, Fourth Edition, Pearson Education.

R3. J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers

WEBLINKS:

W1:https://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the basic concepts of AI and deep learning.	**K2**
CO2:	Determine the functioning of different forms of AI and deep learning	**K3**
CO3:	Analyse the approaches and techniques in AI and deep learning	**K4**
CO4:	Examine the implementation and analysis of AI and deep learning	**K4**

CO5:	Explain the applications and networks for AI and deep learning	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	-	-	-	1	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	3	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22EBBMXX	VIRTUAL INSTRUMENTATION IN MEDICINE	3	0	2	4

COURSE OBJECTIVES:

The student should be made to:

- Impart adequate knowledge on Virtual Instrumentation for acquisition and analysis of signals in medical system.
- Educate about the Basic concepts of VI,programming concepts of VI
- Enable to implement VI in medical systems

UNIT I - INTRODUCTION TO VIRTUAL INSTRUMENTATION **9+6 hours**

Virtual instrumentation (VI): Evolution, Definition, Architecture- Conventional-, and, Comparison of VI with traditional Instruments, Need of VI, advantages, block diagram, data flow techniques, graphical programming, Comparison between graphical programming and conventional programming.

UNIT II - PROGRAMMING MODES IN VI **9+6 hours**

front panel, Block diagram, LABVIEW Environment: Startup-, Shortcut-, and Pull down menu, Palletes, Control structures: FOR loop, WHILE loop, Shift Registers, feedback nodes, Selection Structures: Case and sequence structures, Formulae nodes, Arrays, Clusters, Waveform Chart and graph, XY Graph, Strings, Tables, File I/O functions.

UNIT III - HARDWARE ASPECTS OF VI SYSTEM **9+6 hours**

Digital I/O Techniques: pull-up and pull down resistors, TTL to solid state Relays, Voltage dividers, data acquisition in LABVIEW, hardware installation and configuration, Data acquisition (DAQ): Components, Accessories, Hardware, and Software.

UNIT IV - COMMON INSTRUMENT INTERFACE **9+6 hours**

Current loop:4-20mA,60mA, RS232, RS422, RS485, General purpose interface bus(GIPB) ,Virtual Instrument Software Architecture (VISA), Universal serial port bus(USB), Peripheral computer interface (PCI), VME extensions for instrumentation (VXI), PCI extensions for Instrumentation (PXI), Personal Computer Memory Card International Association (PCMCIA), Signal conditioning extension for instrumentation (SCXI).

UNIT V - ANALYSIS TOOLS AND APPLICATIONS OF VI **9+6 hours**

Fourier transform, Power spectrum, Correlation, Windowing, filtering, Oscilloscope, Waveform generator, Multi-channel data acquisition using LABVIEW, Biomedical applications.

TOTAL: 75 HOURS

TEXT BOOKS

T1. Gary Jonson, “Labview Graphical Programming”, Second Edition, McGraw Hill, New York, Fourth edition 2006.

T2. Lisa K. wells & Jeffrey Travis, “Labview for everyone”, Prentice Hall Inc., New Jersey;First edition 1997.

REFERENCES

R1. Gupta S, Gupta J P, “PC interfacing for Data Acquisition & Process Control”, Instrument Society of America, Second Edition, 1994

R2. Technical Manuals for DAS Modules of Advantech and National Instruments

WEB LINKS:

W1: https://kanchiuniv.ac.in/coursematerials/Virtual_Instrumentation_Janani%20R.pdf

COURSE OUTCOMES

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

CO1:	Explain about the basic concepts involved in Virtual instrumentation	**K2**
CO2:	Articulate the different modes in VI	**K3**
CO3:	Examine about the concepts of Virtual Instrumentation	**K3**
CO4:	Explain about the interface and programming of VI	**K4**
CO5:	Experiment the principles and applications of VI	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO2	3	2	2	3	2	-	-	-	-	-	-	3	3	2
CO3	3	3	2	2	3	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22EBBMXX	TROUBLESHOOTING OF MEDICAL INSTRUMENTS	3	0	2	4

Course Objectives

Students should be made to

- To provide knowledge to students to enable them to troubleshoot the various equipment's used in hospitals.
- To provide adequate technical information on operating principles of medical instruments
- To attain mastery in fault detection and corrective measures.

UNIT I FUNDAMENTAL TROUBLESHOOTING PROCEDURES 9+6 hours

Making of an Electronic Equipment, causes of Equipment Failure, Troubleshooting Process & Fault finding Aids, Troubleshooting Techniques, Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and Correction Action to repair the Equipment, Power supply unit and troubleshooting

UNIT II TESTING OF PASSIVE COMPONENTS & SEMICONDUCTOR DEVICES 9+6 hours

Testing: resistors, capacitors & inductors, causes of failure for electronic components, testing procedure for semiconductor devices: special diodes, bipolar transistors, field effect transistor (FET), and thyristor, Troubleshooting semiconductors.

UNIT III FAULT DIAGNOSIS IN ANALOG& DIGITAL INTEGRATED CIRCUITS 9+6 hours

Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

UNIT IV BIOMEDICAL EQUIPMENT TROUBLESHOOTING –I 9+6 hours

Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anesthesia machine, Autoclaves & sterilizers, Endoscope.

UNIT V BIOMEDICAL EQUIPMENT TROUBLESHOOTING –II 9+6 hours

Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators, Oxygen cylinders & flow meters, Pulse Oximeter, Sphygmomanometers, Suction Machine, X-Ray Machine

TOTAL : 75 HOURS

TEXT BOOKS:

T1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair &Maintenance", Tata McGraw-Hill, Second Edition 2009.

T2. Dan Tomal& Neal Widmer, "ElectronicTroubleshooting", McGraw Hill, 3rd Edition 2004.

REFERENCES:

R1: Nicholas Cram & Selby Holder, "Basic Electronic Troubleshooting forBiomedical Technicians", TSTC Publishing, 2nd Edition 2010.

R2: World Health Organisation, "Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment", Geneva,1994.

R3: Ian R, McClelland , "X-ray Equipment maintenance & repairs workbook for Radiographers& Radiological Technologists", World Health Organisation, Geneva, 2004.

R4: Ministry of Health & Family Welfare, "Medical Equipment Maintenance Manual- A first line maintenance guide for end users", New Delhi, October 2010.

R5: Joseph.J, Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment", Charles C Thomas Publisher Ltd, 2nd Edition 2005.

WEB LINKS:

W1: https://bmet.ewh.org/bitstream/handle/20.500.12091/79/Medical%20Equipment%20Troubleshooting%20Handbook%20Vol.%206.pdf?sequence=1&isAllowed=y

W2: https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA3001.pdf

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

CO1:	Explain and Understand the basic equipment failure and troubleshooting techniques	**K 2**
CO2:	Apply knowledge about the concept of resistor, capacitor, inductor, semi-conductor troubleshooting.	**K 3**
CO3:	Apply and Analyze Digital IC troubleshooting	**K 4**
CO4:	Design protocol and manual for Biomedical Instruments Troubleshooting	**K 6**
CO5:	Incorporate the solutions to failures & evaluating the procedure for troubleshooting of biomedical instruments.	**K 6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

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

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22EBBMXX	PRINCIPLES OF 3D PRINTING TECHNOLOGY	3	0	2	4

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COURSE OBJECTIVES:

The student should be made to:

- Understand the basic principles and concepts in 3D printing
- Learn the design and implementation skills of 3D printing.

UNIT I 3D PRINTING – INTRODUCTION **9+6 hours**

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT II PRINCIPLE AND APPLICATION OF 3D PRINTING **9+6 hours**

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials – Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection – Processes, applications, limitations; Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Opensource; Future trends

UNIT - III BIOMODELLING **9+6 hours**

Introduction, Surgical Applications of Real Virtuality - Cranio-maxillofacial biomodelling, Use of real virtuality in customized cranio-maxillofacial prosthetics, Biomodel-guided stereotaxy, Vascular biomodelling, Skull-base tumor surgery, Spinal surgery, Orthopaedic biomodelling.

UNIT–IV BIOBUILD SOFTWARE FOR MEDICAL DATA TRANSFER **9+6 hours**

Introduction, Medical Imaging: from Medical Scanner to 3D Model, Computer Approach in Dental Implantology. BioBuild Paradigm - Importing a dataset, Volume reduction, Anatomical orientation confirmation, Volume editing, Image processing, Build orientation optimization, 3D visualization, RP file generation, Future Enhancements.

UNIT–V MEDICAL APPLICATIONS FOR 3D PRINTING **9+6 hours**

Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications.

TOTAL:75 HOURS

TEXT BOOK

T1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010

REFERENCES

R1. D.T. Pham and S.S. Dimov, “Rapid Manufacturing”, Springer, 2001 3. Terry Wohlers, “ Wholers Report 2000”, Wohlers Associates, 2000

R2. Paul F. Jacobs, “ Rapid Prototyping and Manufacturing”–, ASME Press, 1996

R3. Ian Gibson, Davin Rosen, Brent Stucker “Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

WEB LINKS:

W1:https://education.gov.mt/en/resources/News/Documents/Youth%20Guarantee/3D%20Printing.pdf

COURSE OUTCOMES

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

CO1:	Illustrate the basics and concepts of 3D printing	**K2**
CO2:	Determine the principles and techniques in 3D printing	**K3**
CO3:	Distinguish the functioning of biosystems in 3D printing	**K3**
CO4:	Analyse the data analysis and study in 3D analysis	**K4**
CO5:	Experiment and determine the applications of 3D printing	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	2	-	-	-	-	-	-	1	2	2
CO2	2	1	3	2	2	-	3	-	-	-	-	1	3	3
CO3	3	2	3	3	3	-	3	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	3	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22EBBM7X-05	REAL-TIME SIGNAL ACQUISITION AND ANALYSIS	3	0	2	4

COURSE OBJECTIVES:

The student should be made to:

- To learn the basics of real-time signal acquisition and analysis
- Learn the design and implementation skills of real-time processing.

UNIT -I INTRODUCTION TO REAL-TIME COMPUTATION **9+6 hours**

Data Acquisition system, Data converters (A/D, D/A), machine architecture, software considerations. Sampling theorem, aliasing, quantization, sampled data systems, cardinal (Whitaker) reconstruction, zero-, first-, second-order hold reconstructors, interpolators, non-resetting reconstructors, matched filtering. Interpolation and decimation.

UNIT -II DISCRETE SPECTRAL ANALYSIS **9+6 hours**

The DFT and its relationship to the continuous FT, the FFT, and implementations (decimation in time and frequency), radix-2 implementation, and spectral analysis. Introduction to PSoC 3/5, PSoC 3/5 Architecture – Block Diagram, System Wide Resources, I/O Interfaces, CPU Subsystem, Memory Organization, Digital Subsystems, Analog Subsystems, BIOPAC, Bitlanio.

UNIT -III REAL-TIME SIMULATION METHODS USING DIFFERENCE EQUATIONS **9+6 hours**

Real-Time Simulation and Testing, Parameter Tuning and Data Logging, Impulse-, step-, ramp-invariant simulations. Tustin's method, matched poles/zeros, bilinear transform methods. Error analysis.

UNIT- IV FILTER DESIGN — CONTINUOUS AND DISCRETE **9+6 hours**

Butterworth, elliptic, Chebyshev low-pass filters. Low-pass design methods based on continuous prototypes. Realizations. Conversion to high-pass, band-pass, band-stop filters. Discrete-time filters: IIR and FIR. Linear phase filters. Frequency sampling filters.

UNIT-V STATISTICAL SIGNAL PROCESSING **9+6 hours**

Linear prediction, adaptive filters (LMS), recursive least-squares statistical analysis of bio signals.

TOTAL:75 HOURS

TEXTBOOKS

T1: Proakis, John G., and Dmitris K. Manolakis. Digital Signal Processing. 4th ed. Upper Saddle River, NJ: Prentice Hall, 2006. ISBN: 9780131873742.

REFERENCE BOOKS

R1: Oppenheim, Alan V., Ronald W. Schafer, and John R. Buck. Discrete-Time Signal Processing. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1999. ISBN: 9780137549207.

WEB LINKS:

W1: https://www.researchgate.net/publication/305751751_Real_time_acquisition_and_analysis_of_ECG_signal_using_MATLAB

COURSE OUTCOMES

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

CO1:	Describe the concepts in real time signal acquisition and analysis	**K2**
CO2:	Illustrate the computation of real time signals	**K3**
CO3:	Determine the techniques for analysis of real time signals	**K3**
CO4:	Apply the simulation and acquisition process of real time signals	**K3**
CO5:	Analyze the real time signals using various mathematical descriptions	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	-	-	-	-	-	-	2	3	2
CO2	3	3	2	2	3	-	-	1	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	1	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3

CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓		✓	✓	✓	
Quiz	**MCQ**	**Projects**	**observation**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

22EBBMXX	PHYSIOLOGICAL MODELING AND SIMULATION	3	0	0	3

Course Objectives

The students should be made to

- To explain the application of Physiological models and vital organs.
- To Formulate the methods and techniques for analysis and synthesis of dynamic models
- To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.
- To describe nonlinear models of physiological systems
- To compute the Simulation of physiological systems

UNIT I INTRODUCTION TO PHYSIOLOGICAL MODELING 9 hours

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling 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 hours

Dynamic systems and their control, modeling 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 hours

Nonparametric Modeling-Volterra Models.Wiener Models. Efficient Volterra Kernel Estimation.Parametric Modeling- Basic Parametric Model Forms and Estimation ProceduresVolterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.

UNIT IV COMPARTMENTENTAL PHYSIOLOGICAL MODEL 9 hours

Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.Mathematical modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

UNIT V SIMULATION OF PHYSIOLOGICALSYSTEMS 9 hours

Simulation of physiologicalsystemsusing 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 HOURS

TEXT BOOKS:

T1: Michel C Khoo, ―Physiological Control Systems -Analysis, simulation and estimation‖, Prentice Hall of India, 2001.

T2: Marmarelis, ―Nonlinear Dynamic Modeling of Physiological Systems‖, Wiley-IEEE Press,200**4.**

REFERENCE BOOKS:

R1. Benjamin C Kuo, ―Automatic control systems‖, Tenth Edition, McGraw-Hill Education, 2017.

R2. DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, WileyIEEE Press, 2003.

R3. V.Z. Marmarelis, ―Advanced methods of physiological modeling‖ , Springer, 1989

R4. L.Stark,‖ Neurological Control System, Plenum Press‖,1968. 5. John H Milsum , ―Biological control systems‖, McGraw Hill 1966

R5. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,―Advanced Computational Methods in Life System Modeling and Simulation‖, Springer,2017 BM

WEB LINKS:

W1: http://www.eee.metu.edu.tr/~ngencer/ee518/Lecture%20Notes/2013/Chapter%201/Chapter%201.pdf

COURSE OUTCOMES

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

CO1:	Explain the application of Physiological models	**K2**
CO2:	Describe the methods and techniques for analysis and synthesis of Linear and dynamic system	**K2**
CO3:	Describe the methods and techniques for analysis and synthesis of Non linear models	**K2**
CO4:	Discuss the differential equations to describe the compartmental physiological model	**K2**
CO5:	Develop simulation model using heuristic methods	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	-	-	-	-	-	3	1	3
CO2	3	3	3	3	3	3	-	-	-	-	-	2	2	3
CO3	2	3	3	3	3	3	-	-	-	-	-	3	2	3
CO4	3	3	3	2	3	3	-	-	-	-	-	2	1	3
CO5	2	3	2	3	3	3	-	-	-	-	-	3	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22CBBMXX	BRAIN-COMPUTER INTERFACE	3 0 0 3

COURSE OBJECTIVE

- To learn the basics of brain computer interfacing and to study different BCI approach methods with basic examples.
- To study the EEG feature extraction and transformation.
- To help acquire Having knowledge about MATLAB tools for BCI.

UNIT 1 INTRODUCTION TO BCI **9 hours**

Introduction to Brain computer interfaces, The Evolution of BCIs, Brain signals for BCIs: Neuronal Activity in motor cortex and related areas, Electrical and Magnetic fields produced by the brain, Signals reflecting brain metabolic activity, Concept of BCI, Invasive and Non-invasive Types, EEG Standards, Signal Features, Spectral Components, EEG Data Acquisition, Pre-processing, Hardware and Software , Artifacts, Methods to Remove , Near Infrared BCI.

UNIT 2 BCI APPROACH METHODS **9 hours**

Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

UNIT 3 EEG FEATURE EXTRACTION METHODS **9 hours**

Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering PCA – Laplacian Filters – Linear and Non-linear Features.

UNIT 4 EEG FEATURE TRANSLATION METHODS **9 hours**

LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

UNIT 5 MATLAB-BASED TOOLS FOR BCI **9 hours**

Introduction, Data Streaming: Field Trip, DataSuite: DataRiver and MatRiver, EEGLAB Online Data Processing: A minimalistic BCI script using native MATLAB code, Other MATLAB BCI Classification tools, BCILAB

TOTAL: 45 HOURS

TEXT BOOKS

T1. Jonathan R. Wolpaw, Elizabeth Winter Wolpaw, Brain computer interfaces principles and practice, Oxford University Press-2012.
T2. Desney S, Tan & Anton Nijholt, Brain Computer interfaces: Applying our minds to human computer interaction, Springer Science and Business Media, 2010.

REFERENCE BOOKS

R1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, Brain computer interfaces Revolutionizing Human – Computer interaction, Springer-2010.
R2. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
R3. Andrew Webb, Statistical Pattern Recognition, Wiley International, Second Edition, 2002. 6. R.Spehlmann, EEG Primer, Elsevier Biomedical Press, 1981.

WEBLINKS

W1: https://www.slideshare.net/pavanireddy86/brain-computer-interfaces-114401273
W2: https://slideplayer.com/slide/10445941/

COURSE OUTCOMES

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

CO1:	Determine knowledge about the introduction of brain computer interface	**K2**
CO2:	Explain the BCI approach methods	**K2**

CO3:	Describe in detail about BCI approach methods	**K3**
CO4:	Describe in detail about BCI approach methods	**K3**
CO5:	Describe the mat lab-based tools for brain-computer interface	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	2	2	-	2	-	-	-	-	3	2
CO3	3	3	3	3	2	2	-	2	-	-	-	-	3	2
CO4	3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO5	3	3	3	3	2	2	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	REGULATORY ASPECTS IN BIOSCIENCES	3	0	0	3

Course Objective: To provide the ability to gain knowledge of different regulatory aspects in biosciences. To make them understand the regulations of Food and Drug Administration and impart the knowledge about Legal issues and Health policies related to Biosciences.

UNIT- I
INDIVIDUAL AND INSTITUTIONAL RESPONSIBILITY & REGULATION BY FDA & CE

9hours

Researching a bioethical question, Individual and institutional responsibility, Institutional review boards, Role of independent institutional review boards, The regulation of drugs and biological products by the food and drug administration, CE, MDR regulations, CDSCO, ISO standards -14971, 10993, 62304, 17025 and 13485

UNIT- II LEGAL ISSUES AND HEALTH POLICY

9hours

Data and safety monitoring, Legal issues, rules to prevent conflict of interest on human subjects, National institutes of health policy on the Inclusion of women and minorities as subjects, Role and importance of trial registries and results databases.

UNIT- III ETHICAL AND REGULATORY GUIDANCE **9 hours**

Immobilization, The Nurenberg code, Declaration of Helsinki: Ethical principles of medical research involving human subjects, The Belmont report: Ethical principles and guidelines for the protection of human subjects, The common rule, Code of federal regulations.

UNIT- IV DISTINCTION BETWEEN RESEARCH AND TREATMENT & THE ETHICS OF RANDOMIZED CLINICAL TRIALS **9 hours**

Research and Practice, Demarcating Research and Treatment: A Systematic Approach, The ethics of randomized clinical trials: Problems of the randomized clinical trial, Equipoise and the ethics of clinical research, Randomized controlled trials: Lessons from ECMO.

UNIT- V ROLE OF PLACEBOS IN CLINICAL RESEARCH & CHANGING LANDSCAPE OF HUMAN EXPERIMENTATION

9 hours

The continuing unethical use of placebo controls, Placebo-controlled trials and the logic of clinical purpose, Active control trials in the evaluation of new treatments, The changing landscape of human experimentation.

TOTAL: 45 HOURS

TEXTBOOKS:

T1: John I, Gallin, Frederick P, Ognibene "Principles and Practice of Clinical Research", Academic Press, Third Edition, 2012.

T2: Ezekiel J, Emanuel, Robert A Crouch, John D Arras, Jonathan D Moreno, Christine Grady, "Ethical and Regulatory Aspects of Clinical Research", Johns Hopkins University Press, First Edition, 2003.

REFERENCES:

R1. Michael A, Santoro, Thomas M. Gorrie, "Ethics and the Pharmaceutical Industry", Cambridge University Press, First Edition, 2005.

R2. Susan E, Lederer, "Subjected To Science: Human Experimentation in America before the Second World War", Johns Hopkins University Press, First Edition, 1995.

WEBLINKS:

W1: https://atecentral.net/downloads/5417/

W2: https://nhm.gov.in/New_Updates_2018/NHM_Components/Health_System_Stregthening/BEMMP/Biomedical_Equipment_Revised_Guidelines.pdf

COURSE OUTCOMES

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

CO1:	Determine the FDA, ethical regulations in an institute	**K2**
CO2:	Illustrate the legal issues and the health policies in bioscience	**K2**
CO3:	Determine the different codes, reports involved in medical research	**K3**
CO4:	Apply the difference between research and treatment in clinical trials	**K3**
CO5:	Analyse the make and use of clinical trials	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	-	-	3	3	2	1	1	-	1	3	-
CO2	1	1	2	-	-	3	3	2	2	2	-	3	3	-
CO3	2	2	2	1	-	3	3	3	2	3	-	3	3	3
CO4	2	2	2	1	-	3	3	3	2	3	-	3	3	3
CO5	2	2	2	1	-	3	3	3	2	3	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	**ADVANCED BIOANALYTICAL AND THERAPEUTIC TECHNIQUES**	**3**	**0**	**0**	**3**

Course Objectives

The students should be made to

- Gain knowledge about the Light spectrum, Absoprtion, Fluorescence,
- Gain knowledge about the NMR, Mass spectroscopy
- Gain knowledge on the different chromotographic methods for separation of biological products..

UNIT I INTRODUCTION TO SPECTROMETRY 9 hours

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9 hours

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law– Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation– Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications –Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9 hours

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

UNIT IV SEPARATION METHODS 9 hours

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatographyprinciples of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9 hours

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry –Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL : 45 HOURS

TEXT BOOKS:

T1: Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". Cengage Learning , 2007.

REFERENCE BOOKS:

R1. Analytical techniques in biochemistry and molecular biology R. Katoch Springer, New York, 2011

R2. Biological spectroscopy I. D. Campbell Benjamin/Cummings Pub. Co 1984

R3. Separation Processes in Biotechnology Asenjo, Juan A. CRC / Taylor & Francis 1990

WEB LINKS:

W1: https://www.askiitians.com/iit-jee-dual-nature-of-matter-and-x-rays/x-rays

W2: https://www.radiologycafe.com/radiology-trainees/frcr-physics-notes

COURSE OUTCOMES

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

CO1:	Explain the introduction and importance of spectrometry	**K2**
CO2:	Illustrate the principle and working of molecular spectroscopy	**K2**
CO3:	Explain the basic fundamentals and working of magnetic resonance spectroscopy and mass spectroscopy	**K3**
CO4:	Explain the separation methods of chromatography	**K3**
CO5:	Explain the skills to understand the theory and practice of bio analytical techniques.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	2	3
CO3	3	3	3	2	2	3	-	-	-	-	-	-	3	2
CO4	2	3	3	3	3	3	-	-	-	-	-	-	2	2
CO5	3	3	3	3	2	3	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

22EBBMXX	BODY AREA NETWORKS	3	0	0	3

Course Objectives

The students should be made to

- Learn about body area networks' and different hardwares related to it
- Learn about wireless communication
- Provide knowledge in the applications of Body Area Networks.

UNIT I INTRODUCTION **9 hours**

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture –Introduction

UNIT II HARDWARE FOR BAN **9 hours**

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 hours**

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 hours**

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 hours**

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill

TOTAL : 45 HOURS

TEXT BOOKS:

T1: Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.(Unit I, II, III & V).

T2: Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013. (Unit IV).

REFERENCE BOOKS:

R1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems",Springer, 2013.

R2. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006.

Web Links:

W1: https://www.sciencedirect.com/science/article/pii/S0378512218302330

W2: https://www.sciencedirect.com/topics/computer-science/wearable-technology

W3: https://www.coursera.org/lecture/iot-cyber-security/module-overview-zu1oq

COURSE OUTCOMES

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

CO1:	Comprehend technical information and challenges in body area networks (BAN)	**K3**
CO2:	Describe the hardware requirements of BAN	**K2**
CO3:	Illustrate the network topologies, protocols and standards used for BAN	**K3**
CO4:	Describe and analyse the Hardware for BAN	**K4**
CO5:	Discuss various applications of BAN.	**K2**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	2	2	2	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	2	2	2	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
√	√	√	√	√	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

OPEN ELECTIVE COURSES

22EBBMXX	FIBER OPTICS AND LASERS IN MEDICINE	3	0	0	3

Course Objectives

The students should be made to

- To enable the student to understand the basics of tissue properties, instrumentation principles in medical optics and the the therapeutic applications.
- Explain the principles of light emission in LED and LASER
- Learn the surgical applications of LASER
- Basics of holography and its applications

UNIT I TYPES OF LASERS AND DISPLAY DEVICES 9 hours

Lasers-Definition-Types-Working-Helium Neon Laser-Argon Laser-Ruby Laser-Nd:Yag Laser-Semiconductor Laser Diode-LCD display: --liquid crystals, construction and types.

UNIT II OPTICAL PROPERTIES OF THE TISSUES 9 hours

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

UNIT III SURGICAL APPLICATIONS OF LASERS 9 hours

Lasers in ophthalmology- Dermatology – Types of lasers used in dermatology – Dentistry- Types of Dental lasers - Urology – Surgical Laser therapy in urology - Otolaryngology - Tissue welding – Specifications Laser in tissue welding,lasers in ophthalmology.

UNIT IV OPTICAL HOLOGRAPHY &NON THERMAL DIAGNOSTIC APPLICATIONS 9 hours

Wave fronts, interference patterns, principle of hologram, optical hologram, applications,Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and speckle application of lasers in biology and medicine.

UNIT V THERAPEUTIC APP LICATIONS 9 hours

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non oncological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

TOTAL : 45 HOURS

TEXT BOOKS:

T1. Leon Goldman, M.D., &R.James Rockwell, Jr., “Lasers in Medicine”, Gordon and Breach, Science PublishersInc., 1975.

T2. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic Press Edition,1998.

REFERENCE BOOKS:

R1. Tuan Vo Dirh, “Biomedical Photonics – Handbook”, CRC Press, Bocaraton,2003 (Unit I – III, V)

R2. Glasser, O., “Medical Physics -- Vol 1, 2, 3 “Adam HilgarBrustolInc, 1987.

R3. G.David Baxter “Therapeutic Lasers – Theory and practice”, Churchill Livingstone Publications Edition- 2001.

WEB LINKS:

W1: https://onlinecourses.nptel.ac.in/noc20_ph07/preview

COURSE OUTCOMES

CO1:	Describe the laser radiation characteristics and interaction of lasers with tissues	**K2**
CO2:	Illustrate the types, construction and operation of different laser systems	**K2**
CO3:	Associate the role of different types of laser systems used for biomedical applications	**K3**
CO4:	Determine the applications of laser in ophthalmology, dermatology, urology, gynecology and neurology	**K3**
CO5:	Discriminate the knowledge on applications of laser and precautionary methods in laser safety.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	-	3	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	3	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	3	3
CO4	2	2	3	3	2	-	-	-	-	-	-	-	3	3
CO5	2	2	3	3	2	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22CBBMXX	CLINICAL ENGINEERING	3	0	0	3

Course Objectives

- To understand the essentials of basic biological principles
- To learn about Hospital Organization and the Role of Clinical Engineering
- To learn about Clinical Engineering Programs
- To clear view of The Health Care Delivery System, Strategic Technology Planning, Technology Assessment,
- To learn about Quality Improvement, Standard Database, Measurement Indicators

UNIT 1 CLINICAL ENGINEER **9 Hours**

Definition, Evolution of Clinical Engineering – interactions of a clinical engineer , Hospital Organization and the Role of Clinical Engineering, Clinical Engineering Programs

UNIT -2 MANAGEMENT AND ASSESSMENT OF MEDICAL TECHNOLOGY AND RISK FACTORS **9 Hours**

The Health Care Delivery System, Strategic Technology Planning, Technology Assessment, Equipment Assets Management. Risk Management – Strategies, Risk Management: Application

UNIT -3 QUALITY OF IMPROVEMENT AND TEAM BUILDING **9 Hours**

Deming's 14 Points, Zero Defects, TQM (Total Quality Management) and Tools Used for Quality Improvement, Standard Database, Measurement Indicators.

UNIT -4 CLINICAL STANDARDS **9 Hours**

Standards Regulatory and Assessment Agencies, Standards for clinical Engineers, Regulatory Agnecies, Technology Assessment Agencies

UNIT -5 APPLICATIONS OFVIRTUAL INSTRUMENTS IN HEALTH CARE **9 Hours**

Application with Examples , Trending, Relationships, and Interactive Alarms, Data Modeling,0 Medical Equipment Risk Criteria, Peer Performance Reviews

TOTAL : -- 45 HOURS

TEXTBOOKS:

T1: Ernesto Iadanza Clinical Engineering Handbook, 2nd Edition, Editor, Elsevier, Academic Press, November 2019, ISBN 9780128134672

T2: Les Atles, A Practicum for Healthcare Technology Management, Association for the Advancement of Medical Instrumentation (AAMI),2nd Edition, June 2015

REFERENCES:

R1: Taktak, et al,Clinical Engineering: A Handbook for Clinical and Biomedical Engineers, Elsevier, 2014.

Web Links:

W1: https://www.elsevier.com/books/clinical-engineering-handbook/iadanza/978-0-12- 813467-2

W2: https://www.slideshare.net/abenedicto/clinical-practice-guidelines

W3: https://www.slideshare.net/MohamedElsaied6/clinical-engineering-85797832

COURSE OUTCOMES

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

CO1:	Explain about role of clinical engineering	**K2**
CO2:	Illustrate on the health care system and hospital organization	**K2**
CO3:	Interpret tools in clinical engineering	**K3**
CO4:	Categorize various health care delivery system based on asesssment	**K3**
CO5:	Apply the recent trends of clinical Engineering in health care	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	2	-	-	-	3	-	-	2	-	3	-
CO2	2	2	3	2	-	3	-	2	-	-	2	-	3	2
CO3	3	2	3	3	-	2	-	1	-	-	3	-	3	3
CO4	3	2	3	3	-	2	-	2	-	-	3	-	3	3
CO5	3	2	3	3	-	3	-	1	-	-	3	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	ELECTRONICS IN HEALTH CARE INDUSTRY	3	0	0	3

Course Objectives

The students should be made to

- Illustrate diverse applications of electronics in cardiology
- Explain about the electronic equipments used in diagnosis and treatment
- Infer the role of electronics in various health care industry
- Identify technologies in medical instruments in health care Industry.

UNIT I ELECTRONICS IN CARDIOLOGY 9 hours

Physiology of Heart and its abnormalities, Cardiac Monitoring and Recording Devices- ECG, Pacemaker, Defibrillators, Counter pulsation technique, Intra aortic balloon pumping and prosthetic heart valves and Imaging for cardiovascular system.

UNIT II ELECTRONICS IN NEUROLOGY 9 hours

Neurons and its abnormalities, EEG, Evoked response – Auditory and Visual sensory, Polysomnography, nerve stimulator and Imaging for brain disorders.

UNIT III ELECTRONICS IN NEPHROLOGY 9 hours

Nephrons and its abnormalities, Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Artificial kidney, Lithotripsy.

UNIT IV ELECTRONICS IN CIRCULATORY SYSTEM 9 hours

Interrelationships among Pressure, Flow, and Resistance, Blood and blood components, blood cell counters, Methods for blood flow meter, EM and ultrasonic blood flow meters, Blood Pressure, Plethysmography technique, Heart Lung machine, Respiration rate, Respiratory volume measurement, spirometer, Ventilators.

UNIT V ELECTRONICS IN VISUAL AND AUDITORY SYSTEM 9 hours

Anatomy of eye and its abnormalities, Laser in ophthalmology, Ear and it abnormalities Types of Deafness, Audiometer, Hearing Aids and cochlear implants.

TOTAL : 45 HOURS

TEXT BOOKS:

T1. Guyton, Arthur C & John E. Hall, Text book of Medical Physiology – WB Jaunder company Philadelphia –11th edition 2006.

T2. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 4th edition2010.

T3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 3rdedition 2014.

REFERENCE BOOKS:

R1. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology

WEB LINKS:

W1: www.electronics-notes.com/

COURSE OUTCOMES

CO1:	Describe the usage of Electronic Health Care in a medical office.	**K2**
CO2:	Illustrate the application of electronics in the field of diagnosis and treatment	**K2**
CO3:	Distinguish the role of technology in cardiology, neurology, nephrology	**K3**
CO4:	Explain the knowledge about instruments involved for health care management.	**K3**
CO5:	Analyse and Incorporate knowledge Electronics in Health Care into their personal health care decisions.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	2	3	3	-	-	-	-	-	-	-	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	BASICS OF BIOMEDICAL ENGINEERS	3 0 0 3

COURSE OBJECTIVES

- To acquire the knowledge related to bio-electric potentials.
- To design bio-amplifiers
- To study the physiological functions of the human body

UNIT 1: BASICS OF BIOMEDICAL ENGINEERING **9 hours**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – non-polarizable electrodes. Types of electrodes – surface, needle and micro electrodes and their equivalent circuits.

UNIT 2: PHYSIOLOGICAL SIGNALS AND ITS CHARACTERISTICS **9 hours**

Physiological systems of the body: cardiovascular system, respiratory system and nervous system, Sources of biomedical signals, medical instrumentation system, Origin of bioelectric signals: ECG, EEG and EMG, Electrode-tissue interface, Electrodes for ECG: Limb, floating, disposable, EEG, EMG, Pressure transducer, thermistor, photoelectric transducer , optical fiber sensors ,Biosensor and smart sensor

UNIT 3: MEDICAL IMAGING SYSTEMS AND BIOMEDICAL TELEMETRY **9 hours**

Nature of X-rays, stationary anode tube and X-ray machine, Digital Radiography and computed tomography, Emission computed tomography, Principle of NMR and its imaging system, Single channel ECG telemetry system, obstetrical telemetry system

UNIT 4: THERAPEUTIC EQUIPMENTS **9 hours**

Basic principle of lasers and its application in medicine, Electrotherapy equipments: short wave diathermy and microwave diathermy, Electro-diagnostic therapeutic stimulator

UNIT 5: INSTRUMENTS FOR SURGERY AND PATIENT SAFETY **9 hours**

Principle of surgical diathermy machine and safety aspects in ESU, Surgical diathermy analyzer, Electric shock hazards, micro and macro shock, Leakage current and its types. Safety codes for electro medical equipment and electrical safety analyzer, Testing of biomedical equipment

TOTAL : 45 HOURS

TEXT BOOKS

T1. Khandpur R.S, “Hand-book of Biomedical Instrumentation”, McGraw Hill Education, 3rd edition, 2014.

T2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Prentice-Hall India, 2nd edition, 2007.

T3. Joseph J Carr and John M Brown., “Introduction to Biomedical equipment technology”, Pearson education, New Delhi, 4th edition, 2004.

REFERENCE BOOKS:

R1. Arumugam.M, Textbook of Biomedical Instrumentation,2003.

R2. Richard A. Norman “Principles of Biomedical Instrumentation” John Wiley and sons. New York.1988.

R3. Scott / Mathur “Textbook of Biomedical Instrumentation” CBS Publishers. Chennai 2007.

Web Links:

W1: http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html

COURSE OUTCOMES

CO1:	Describe the knowledge about the basics of biomedical engineering	**K2**
CO2:	Differentiate various concepts and fundamental techniques of biomedical engineers	**K2**
CO3:	Distinguish the tools and equipments used in the field of Biomedical Engineering	**K3**
CO4:	Analyse the different illustrations in the field of Biomedical Engineering	**K4**
CO5:	Evaluate the techniques and concepts as a Biomedical Engineer.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	1	1	-	-	-	-	-	-	-	3	2
CO2	3	2	3	2	2	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	2	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	2	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	2	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

22EBBMXX	HEALTH POLICY AND EQUIPMENT MANAGEMENT	3	0	0	3

Course Objectives

The students should be made to

- Expose the students for planning and operation of hospitals in a detailed manner which will include all facts of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.
- Introduce the equipment maintenance management skills and how to protect equipment from electromagnetic interferences.

UNIT I HEALTH SYSTEM 9 hours

Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system.

UNIT II NATIONAL HEALTH POLICY 9 hours

Need for evaluating a health policy, need for providing primary health care, health education, health insurance, health legislation, inter-sectoral cooperation.

UNIT III EQUIPMENT MAINTENANCE MANAGEMENT 9 hours

Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of the equipment and operating instructions. Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT IV LOGISTIC SUPPORT & RELIABILITY 9 hours

Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials. Reliability fundamentals

UNIT V EMI AND EMC TO HOSPITAL EQUIPMENT 9 hours

Principles of EMI and EMC, computation of EMI and EMC, Method of suppressing and isolating the unit from interference

TOTAL: 45 HOURS

TEXTBOOKS:

T1. Antony Kelly, `Maintenance Planning & control' Butterworth, London 1984.
T2. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

REFERENCE BOOKS:

R1. Hans Pleiff veradammann (ed) `Hospital Engineering in developing countries, GTZ report Eschborn, 1986.

Web Links:

W1: http://www.scribd.com/doc/18278414/Hospital-management#scribd

COURSE OUTCOMES

CO1:	Develop understanding of the various health organisations and policies	**K2**
CO2:	Explain the Planning activities at health care centers.	**K2**
CO3:	Describe the healthcare Equipment installation, service and calibration needs	**K3**
CO4:	Analyse the logistics of equipments and tools for maintenance.	**K4**
CO5:	Evaluate the principles, computation and methods of EMI.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	2	-	-	-	3	-	-	2	-	3	-
CO2	2	2	3	2	-	3	-	2	-	-	2	-	3	2
CO3	2	2	3	3	-	2	-	1	-	-	3	-	3	3
CO4	3	2	3	3	-	2	-	2	-	-	3	-	3	3
CO5	3	2	3	3	-	3	-	1	-	-	3	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	