



SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.
BIOMEDICAL ENGINEERING

ACADEMIC REGULATIONS 2023
(R-2023)

CURRICULUM AND SYLLABI



COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1: Quality Education

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

To provide quality education in Biomedical Engineering focused on promoting continuous enrichment in the relevant research field and innovations in medical diagnosis for human health care.

Mission

M1: Medical science Engineering

To provide quality Biomedical Engineering education that integrates engineering principles with biomedical sciences.

M2: Research and Development

To develop Biomedical engineers to apply innovative strategies for the design and development of medical equipment.

M3: Industrial Intelligence

To incorporate novel technologies towards the healthcare industrial needs for medical applications and to become an entrepreneur.

M4: Ethical Responsibilities

To impart the desirable skill sets to become globally competent ethical professional.



PROGRAM OUTCOMES (POs)**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.



PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**PEO1: Professional Skills**

To become outstanding professionals to demonstrate their skills in solving challenges for healthcare diagnosis.

PEO2: Higher Education and Research

To work successfully in multi-disciplinary environments or pursue higher studies.

PEO3: Entrepreneurial Competencies

To address the challenges in biomedical engineering that supports employment and entrepreneurship to serve the society.

PEO4: Leadership Quality

To enable the graduates to exhibit leadership, make decisions with ethical responsibilities.

PROGRAM SPECIFIC OUTCOMES (PSOs)**PSO1: Knowledge in Biomedical Engineering**

Comprehending fundamental concepts in Biomedical Engineering to meet the emerging trends.

PSO2: Problem Solving in Medical Diagnosis

Apply Bio Signal and Image processing techniques to solve real time problems in medical field.

PSO3: Troubleshooting of Medical Equipment

Troubleshoot the faulty medical Equipment used in health care industry.



STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl.No.	Course Category	Breakdown of Credits
1	Humanities and Social Sciences including Management courses (HS)	15
2	Basic Science Courses (BS)	24
3	Engineering Science including workshop, drawing, basics of electrical / mechanical / computer etc. (ES)	25
4	Professional Core Courses (PC)	65
5	Professional Electives Courses (PE)	18
6	Open Electives Courses (OE)	9
7	Project Work and Internship (PA)	13
8	Ability Enhancement Courses (AEC*)	-
9	Mandatory Courses (MC*)	-
Total		169

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No.	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management courses (HS)	3	5	1	1	2	-	-	3	15
2	Basic Sciences(BS)	11	4	5	4	-	-	-	-	24
3	Engineering Sciences (ES)	8	5	4	4	4				25
4	Professional Core (PC)	-	8	13	10	8	15	11	-	65
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	-	3	3	3	-	9
7	Project Work (PA)	-	-	-	-	1	1	2	8	12
8	Internship (PA)	-	-	-	-	-	-	1	-	1
9	Ability Enhancement Courses (AEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		22	22	23	22	21	22	20	17	169

* AEC and MC credits are not included for CGPA calculation

HONOURS / MINOR DEGREE PROGRAMME:

The student is permitted to opt for earning an honours / Minor degree in the same discipline of engineering in addition to the degree in his/her own discipline. To earn an honours / Minor degree the student is required to earn an additional 18 - 20 credits (over and above the total 169 credits prescribed in the curriculum) starting from fourth semester onwards by completing 5 additional courses offered in respective



semesters. A student is eligible to exercise this option if he/she has passed all the courses offered upto third semester in the first attempt itself and has earned a CGPA / GPA* (*for lateral entry) of not less than 8.0. The prescribed courses offered for Honours / Minor degree are given in **Annexure – V**

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC01	Engineering Mathematics – I	BS	3	1	0	4	25	75	100
2	U23BSTC01	Physical Science for Engineers	BS	3	0	0	3	25	75	100
3	U23BMT101	Human Anatomy and Physiology	BS	3	0	0	3	25	75	100
4	U23BMT102	Basic Electrical Circuits	ES	3	0	0	3	25	75	100
5	U23ESTC01	Basics of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ENBC01	Communicative English - I	HS	2	0	2	3	50	50	100
Practical										
7	U23BMP101	Physiology Laboratory	BS	0	0	2	1	50	50	100
8	U23BMP102	Basic Electrical Circuits Laboratory	ES	0	0	2	1	50	50	100
9	U23ESPC02	Design Thinking and IDEA Lab	ES	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23BMC1XX	Certification Course - I**	AEC	0	0	4	-	100	-	100
Mandatory Course										
11	U23BMM101	Induction Programme	MC	2 weeks			-	-	-	-
							22	425	575	1000

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC02	Engineering Mathematics – II	BS	3	1	0	4	25	75	100
2	U23CSTC01	Programming in C	ES	3	0	0	3	25	75	100
3	U23BMTC01	Electron Devices and Circuits	PC	3	0	0	3	25	75	100
4	U23BMT203	Biosensors and Transducers	PC	3	0	0	3	25	75	100
5	U23HSTC01	Universal Human Values II	HS	2	0	0	2	25	75	100
Theory cum Practical										
6	U23ENBC02	Communicative English - II	HS	2	0	2	3	50	50	100
Practical										
7	U23ESPC03	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100

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8	U23CSPC01	Programming in C Laboratory	ES	0	0	2	1	50	50	100
9	U23BMPC01	Electron Devices and Circuits Laboratory	PC	0	0	2	1	50	50	100
10	U23BMP203	Biosensors and Transducers Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23BMC2XX	Certification Course - II**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23BMM202	Sports Yoga and NSS	MC	0	0	2	-	100	-	100
							22	575	625	1200

**** Certification courses are to be selected from the list given in Annexure III**

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC03	Probability and Statistics	BS	3	1	0	4	25	75	100
2	U23ADTC01	Programming in Python	ES	3	0	0	3	25	75	100
3	U23BMT304	Biosignals and Systems	PC	2	1	0	3	25	75	100
4	U23ICTC01	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U23ICTC02	Digital Logic Circuits	PC	2	1	0	3	25	75	100
Theory cum Practical										
6	U23BMB301	Pathology and Microbiology	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPC01	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U23MAPC01	Engineering Mathematics Laboratory	BS	0	0	2	1	50	50	100
9	U23ADPC01	Programming in Python Laboratory	ES	0	0	2	1	50	50	100
10	U23ICPC01	Linear and Digital Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23BMC3XX	Certification Course – III**	AEC	0	0	4	-	100	-	100
12	U23BMS301	Skill Enhancement Course-1*	AEC	0	0	2	-	100	-	100
Mandatory Course										
13	U23BMM303	Climate Change	MC	2	0	0	-	100	-	100
							23	675	625	1300

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC04	Numerical Methods and Optimization	BS	3	1	0	4	25	75	100
2	U23CSTC03	Data Structures	ES	3	0	0	3	25	75	100
3	U23BMT405	Biomechanics	PC	3	0	0	3	25	75	100
4	U23BMT406	Biomedical Instrumentation	PC	3	0	0	3	25	75	100

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5	U23BME4XX	Professional Elective – I [#]	PE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23BMB401	Biosignal Processing	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPC02	General Proficiency - II	HS	0	0	2	1	50	50	100
8	U23CSPC02	Data Structures Laboratory	ES	0	0	2	1	50	50	100
9	U23BMP404	Biomedical Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23BMC4XX	Certification Course - IV**	AEC	0	0	4	-	100	-	100
11	U23BMS402	Skill Enhancement Course-2*	AEC	0	0	2	-	100	-	100
Mandatory Course										
12	U23BMM404	Right to Information and Good Governance	MC	2	0	0	-	100	-	100
							22	625	575	1200

[#] Professional Electives are to be selected from the list given in Annexure I

** Skill Enhancement Courses (1 and 2) are to be selected from the list given in Annexure IV*

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P			CAM	ESM
Theory										
1	U23HSTC02	Research Methodology	HS	2	0	0	2	25	75	100
2	U23ITTC02	Programming in Java	ES	3	0	0	3	25	75	100
3	U23BMT507	Microcontroller and its Medical Applications	PC	3	0	0	3	25	75	100
4	U23BME5XX	Professional Elective – II [#]	PE	3	0	0	3	25	75	100
5	U23XX05XX	Open Elective – I ^{\$}	OE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23BMB502	Biocontrol Systems	PC	2	0	2	3	50	50	100
Practical										
7	U23ITPC02	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U23BMP505	Microcontroller and its Medical Applications Laboratory	PC	0	0	2	1	50	50	100
9	U23BMP506	Hospital Training	PC	0	0	2	1	50	50	100
Project Work										
10	U23BMW501	Micro Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23BMC5XX	Certification Course – V**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23BMM505	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	625	575	1200

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SEMESTER – VI										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23BMT608	Diagnostic and Therapeutic Equipment	PC	3	0	0	3	25	75	100
2	U23BMT609	Embedded Systems for Healthcare	PC	3	0	0	3	25	75	100
3	U23BMT610	Medical Internet of Things	PC	3	0	0	3	25	75	100
4	U23BMT611	Artificial Intelligence and Machine learning in Healthcare	PC	3	0	0	3	25	75	100
5	U23BME6XX	Professional Elective – III [#]	PE	3	0	0	3	25	75	100
6	U23XX06XX	Open Elective – II [§]	OE	3	0	0	3	25	75	100
Practical										
7	U23BMP607	Diagnostic and Therapeutic Equipment Laboratory	PC	0	0	2	1	50	50	100
8	U23BMP608	Embedded Systems for Healthcare Laboratory	PC	0	0	2	1	50	50	100
9	U23BMP609	Medical Internet of Things Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23BMW602	Mini Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23BMC6XX	Certification Course – VI ^{**}	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23BMM606	Gender Equality	MC	2	0	0	-	100	-	100
							22	600	600	1200

[§] Open electives are to be selected from the list given in Annexure II

SEMESTER – VII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23BMT712	Biomaterials and Artificial Organs	PC	3	0	0	3	25	75	100
2	U23BMT713	Rehabilitation Engineering	PC	3	0	0	3	25	75	100
3	U23BMT714	Medical image processing	PC	3	0	0	3	25	75	100
4	U23BME7XX	Professional Elective – IV#	PE	3	0	0	3	25	75	100
5	U23XXO7XX	Open Elective III	OE	3	0	0	3	25	75	100
Practical										
6	U23BMP710	3D Printing in Biomedical Applications Laboratory	PC	0	0	2	1	50	50	100
7	U23BMP711	Medical Image Processing Laboratory	PC	0	0	2	1	50	50	100
Project Work										
8	U23BMW703	Project Phase – I	PA	0	0	4	2	50	50	100
9	U23BMW704	Internship/Inplant Training	PA	0	0	2	1	100	-	100
							20	375	525	900

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SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC03	Entrepreneurship and Business Management	HS	3	0	0	3	25	75	100
2	U23BME8XX	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U23BME8XX	Professional Elective – VI#	PE	3	0	0	3	25	75	100
Project Work										
4	U23BMW805	Project Phase - II	PA	0	0	16	8	50	100	150
							17	125	325	450



Annexure – I**PROFESSIONAL ELECTIVE COURSES**

Professional Elective – I (Offered in Semester IV)		
Sl. No.	Course Code	Course Title
1	U23BME401	Medical Physics
2	U23BME402	Environmental Biotechnology
3	U23BME403	Biometric Recognition Systems
4	U23BME404	Hospital Equipment Safety and Management
5	U23BMEC01	Communication Systems
Professional Elective – II (Offered in Semester V)		
Sl. No.	Course Code	Course Title
1	U23BME505	Laser and Fiber Optics in Medicine
2	U23BME506	Computers in Medicine
3	U23BME507	Transportation in Living Systems
4	U23BME508	Medical Informatics
5	U23BME509	VLSI Systems
Professional Elective – III (Offered in Semester VI)		
Sl. No.	Course Code	Course Title
1	U23BME610	Troubleshooting and Quality Control in Medical Equipment
2	U23ICEC02	Soft Computing Techniques
3	U23BME611	Physiological System Modeling
4	U23BME612	Hospital Engineering and Information Systems
5	U23BME613	Biotelemetry and Telemedicine
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	Course Code	Course Title
1	U23BME714	Virtual Bioinstrumentation
2	U23BME715	Nanotechnology in Medicine
3	U23BME716	Dynamics of Biofluids
4	U23BME717	Medical Safety and Standards
5	U23BME718	Cryptography and Network Security



Professional Elective – V (Offered in Semester VIII)		
Sl. No.	Course Code	Course Title
1	U23BME819	Modeling and Designing of implants
2	U23BMEC02	Wearable Technology
3	U23BME820	Tissue Engineering
4	U23BME821	Pattern Recognition and Expert System in Medicine
5	U23BME822	Bio MEMS
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	Course Code	Course Title
1	U23BME823	Clinical Engineering
2	U23BME824	Virtual Reality in Medicine
3	U23BME825	Brain Computer Interface and Applications
4	U23BME826	Medical Ethics and Intellectual Property rights
5	U23BME827	Acoustics and Optical Imaging

Annexure – II

OPEN ELECTIVE COURSES

S.No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I/ Open Elective – II (Offered in Semester V for CSE, IT, MECH, Mechatronics, AI&DS) (Offered in Semester VI for EEE, ECE, ICE, CIVIL, CCE, CSBS/CSEBS)				
1	U23BMOC01	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, Mechatronics, AI&DS, CCE, CSBS/CSEBS
2	U23BMOC02	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, Mechatronics, AI&DS, CCE, CSBS/CSEBS
Open Elective – III (Offered in Semester VII)				
3	U23BMOC03	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CIVIL, AI&DS, CCE, CSBS/CSEBS
4	U23BMOC04	Telehealth Technology	BME	EEE, ECE, CSE, IT, ICE, CIVIL, AI&DS, CCE, CSBS/CSEBS



Annexure – III
ABILITY ENHANCEMENT COURSES – (A) CERTIFICATION COURSES

S. No.	Course Code	Course Title	Certified By
1	U23XXCX01	Adobe Photoshop	Adobe
2	U23XXCX02	Adobe Animate	Adobe
3	U23XXCX03	Adobe Dreamweaver	Adobe
4	U23XXCX04	Adobe After Effects	Adobe
5	U23XXCX05	Adobe Illustrator	Adobe
6	U23XXCX06	Adobe InDesign	Adobe
7	U23XXCX07	Autodesk AutoCAD -ACU	Autodesk
8	U23XXCX08	Autodesk Inventor - ACU	Autodesk
9	U23XXCX09	Autodesk Revit - ACU	Autodesk
10	U23XXCX10	Autodesk Fusion 360 - ACU	Autodesk
11	U23XXCX11	Autodesk 3ds Max - ACU	Autodesk
12	U23XXCX12	Autodesk Maya - ACU	Autodesk
13	U23XXCX13	Cloud Security Foundations	AWS
14	U23XXCX14	Cloud Computing Architecture	AWS
15	U23XXCX15	Cloud Foundation	AWS
16	U23XXCX16	Cloud Practitioner	AWS
17	U23XXCX17	Cloud Solution Architect	AWS
18	U23XXCX18	Data Engineering	AWS
19	U23XXCX19	Machine Learning Foundation	AWS
20	U23XXCX20	Robotic Process Automation / Medical Robotics	Blue Prism
21	U23XXCX21	Advance Programming Using C	CISCO
22	U23XXCX22	Advance Programming Using C ++	CISCO
23	U23XXCX23	C Programming	CISCO
24	U23XXCX24	C++ Programming	CISCO
25	U23XXCX25	CCNP Enterprise: Advanced Routing	CISCO
26	U23XXCX26	CCNP Enterprise: Core Networking	CISCO
27	U23XXCX27	Cisco Certified Network Associate - Level 2	CISCO
28	U23XXCX28	Cisco Certified Network Associate- Level 1	CISCO
29	U23XXCX29	Cisco Certified Network Associate- Level 3	CISCO
30	U23XXCX30	Fundamentals of Internet of Things	CISCO
31	U23XXCX31	Internet of Things / Solar and Smart Energy System with IoT	CISCO
32	U23XXCX32	Java Script Programming	CISCO
33	U23XXCX33	NGD Linux Essentials	CISCO
34	U23XXCX34	NGD Linux I	CISCO
35	U23XXCX35	NGD Linux II	CISCO
36	U23XXCX36	Advance Java Programming	Ethnotech
37	U23XXCX37	Android Programming / Android Medical App Development	Ethnotech
38	U23XXCX38	Angular JS	Ethnotech

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39	U23XXCX39	Catia	Ethnotech
40	U23XXCX40	Communication Skills for Business	Ethnotech
41	U23XXCX41	Coral Draw	Ethnotech
42	U23XXCX42	Data Science Using R	Ethnotech
43	U23XXCX43	Digital Marketing	Ethnotech
44	U23XXCX44	Embedded System Using C	Ethnotech
45	U23XXCX45	Embedded System with IOT / Arduino	Ethnotech
46	U23XXCX46	English For IT	Ethnotech
47	U23XXCX47	Plaxis	Ethnotech
48	U23XXCX48	Sketch Up	Ethnotech
49	U23XXCX49	Financial Planning, Banking and Investment Management	Ethnotech
50	U23XXCX50	Foundation Of Stock Market Investing	Ethnotech
51	U23XXCX51	Machine Learning / Machine Learning for Medical Diagnosis	Ethnotech
52	U23XXCX52	IOT Using Python	Ethnotech
53	U23XXCX53	Creo (Modelling & Simulation)	Ethnotech
54	U23XXCX54	Soft Skills, Verbal, Aptitude	Ethnotech
55	U23XXCX55	Software Testing	Ethnotech
56	U23XXCX56	MX-Road	Ethnotech
57	U23XXCX57	CLO 3D	Ethnotech
58	U23XXCX58	Solid works	Ethnotech
59	U23XXCX59	Staad Pro	Ethnotech
60	U23XXCX60	Total Station	Ethnotech
61	U23XXCX61	Hydraulic Automation	Festo
62	U23XXCX62	Industrial Automation	Festo
63	U23XXCX63	Pneumatics Automation	Festo
64	U23XXCX64	Agile Methodologies	IBM
65	U23XXCX65	Block Chain	IBM
66	U23XXCX66	Devops	IBM
67	U23XXCX67	Artificial Intelligence	ITS
68	U23XXCX68	Cloud Computing	ITS
69	U23XXCX69	Computational Thinking	ITS
70	U23XXCX70	Cyber Security	ITS
71	U23XXCX71	Data Analytics	ITS
72	U23XXCX72	Databases	ITS
73	U23XXCX73	Java Programming	ITS
74	U23XXCX74	Networking	ITS
75	U23XXCX75	Python Programming	ITS
76	U23XXCX76	Web Application Development (HTML, CSS, JS)	ITS
77	U23XXCX77	Network Security	ITS & Palo alto
78	U23XXCX78	MATLAB	MathWorks
79	U23XXCX79	Azure Fundamentals	Microsoft
80	U23XXCX80	Azure AI (AI-900)	Microsoft
81	U23XXCX81	Azure Data (DP -900)	Microsoft
82	U23XXCX82	Microsoft 365 Fundamentals (SS-900)	Microsoft



83	U23XXCX83	Microsoft Security, Compliance and Identity (SC-900)	Microsoft
84	U23XXCX84	Microsoft Power Platform (PI-900)	Microsoft
85	U23XXCX85	Microsoft Dynamics Fundamentals 365 – CRM	Microsoft
86	U23XXCX86	Microsoft Excel	Microsoft
87	U23XXCX87	Microsoft Excel Expert	Microsoft
88	U23XXCX88	Securities Market Foundation	NISM
89	U23XXCX89	Derivatives Equinity	NISM
90	U23XXCX90	Research Analyst	NISM
91	U23XXCX91	Portfolio Management Services	NISM
92	U23XXCX92	Cyber Security	Palo alto
93	U23XXCX93	Cloud Security	Palo alto
94	U23XXCX94	PMI – Ready	PMI
95	U23XXCX95	Tally – GST & TDS	Tally
96	U23XXCX96	Advance Tally	Tally
97	U23XXCX97	Associate Artist	Unity
98	U23XXCX98	Certified Unity Programming	Unity
99	U23XXCX99	VR Development	Unity

Annexure – IV
ABILITY ENHANCEMENT COURSES – (B) SKILL ENHANCEMENT COURSES

Sl. No.	Course Code	Course Title
1	U23BMS301	Skill Enhancement Course 1*
		1) Testing and Troubleshooting of Medical Equipment
		2) Masters in Microsoft Excel
		3) Power Point Presentation Design and Animation
2	U23BMS402	Skill Enhancement Course 2*
		1) Testing of Electronic and Medical Devices
		2) PCB Board Designing
		3) Presentation Skills using ICT

* Choose any one Skill Enhancement Course in the list for SEC 1 and SEC 2

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Annexure – V

HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY

COURSE DETAILS											
Sl. No.	Semester	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
					L	T	P		CAM	ESM	Total
Theory											
1	IV	U23SXB401	Smart Sensors	PC	3	0	2	4	50	50	100
2	V	U23SXT502	Nano Biosensors*	PC	3	0	0	3	25	75	100
3	VI	U23SXB603	Embedded Sensing Technologies	PC	3	0	2	4	50	50	100
4	VII	U23SXT704	IoT and Sensor Networks*	PC	3	0	0	3	25	75	100
5	VIII	U23SXT805	Wearable Devices and its Applications*	PC	3	0	0	3	25	75	100
6	VIII	U23SXW806	Project / Model Making	PA	0	0	4	2	50	50	100
	Total							19	225	375	600
Equivalent NPTEL courses ^{##}											
1	IV to VII Semester	U23XXXN01	Sensors Technology Equivalent NPTEL Courses					3	12 Week Course		

^{##} The student shall be given an option to earn 3 credits through one equivalent 12 week NPTEL course instead of any one course listed for honours / minor degree programme that should be completed before the commencement of eighth semester. The equivalent courses are subject to change based on its availability as per NPTEL course list.

List of NPTEL Courses

1. Sensors and Actuators
2. Biophotonics
3. Embedded Systems Design
4. Introduction to Industry 4.0 and Industrial Internet of Things
5. Microsensors, Implantable Devices and Rodent Surgeries for Biomedical Applications



SEMESTER – I										
Department	Mathematics			Programme: B.Tech.						
Semester	I			Course Category: BS			End Semester Exam Type: TE			
Course Code	U23MATC01			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Engineering Mathematics – I			3	1	0	4	25	75	100
(Common to ALL Branches Except CSBS)										
Prerequisite	Basic Mathematics									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Understand the concept of Eigen values and Eigen vectors, Diagonalization of a Matrix							K3	
	CO2	Solve higher order differential equations							K3	
	CO3	Understand the different types of partial differential equations							K3	
	CO4	Know about the Applications of double and triple integrals							K3	
	CO5	Gain the knowledge about Vector Calculus and its Applications							K3	
UNIT – I	Matrices						Periods:12			
Rank of a Matrix – Systems of Linear Equations – Characteristic equation – Cayley Hamilton Theorem – Eigen values and Eigen vectors of a real Matrix – Diagonalization of Matrices.									CO1	
UNIT – II	Differential Equations (Higher Order)						Periods:12			
Linear Differential equations of higher order with constant coefficients – Euler's linear equation of higher order with variable coefficients – Method of Variation of parameters.									CO2	
UNIT – III	Functions of Several Variables						Periods:12			
Partial derivatives – Total derivatives – Maxima and Minima of two variables – Lagrange's Method of multipliers.									CO3	
UNIT – IV	Multiple Integrals						Periods:12			
Multiple Integrals – Change of order of integration (Cartesian form). Applications: Area as a double integral (Cartesian form) – Volume as a triple integral (Cartesian form).									CO4	
UNIT – V	Vector Calculus						Periods:12			
Gradient – Divergence and Curl – Directional derivatives – Irrotational and Solenoidal vector fields – Properties (Statement only) – Gauss Divergence Theorem and Stoke's Theorem (without proofs).									CO5	
Lecture Periods: 45			Tutorial Periods: 15			Practical Periods: -		Total Periods: 60		
Text Books										
1. M.K. Venkataraman, "Engineering Mathematics", The National Publishing Company, 2 nd Edition, 2016.										
2. N. P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9 th Edition, 2018.										
3. S.Narayanan and T.K. Manickavasagam Pillay, "Differential Equations and Its Applications", Viswanathan. S, Printers & Publishers Pvt Ltd, 2009.										
Reference Books										
1. G. Balaji, "Matrices and Calculus (Engineering Mathematics – I)" Balaji Publications, 9 th Edition June 2023										
2. A. Singaravelu, "Engineering Mathematics – I", Meenakshi publications, 1998.										
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", Wiley, 10 th Edition, 2019.										
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6 th Edition, 2018.										
5. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3 rd Edition, 2019.										
Web References										
1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra-slides- systems of equation-handout.pdf										



2.	http://www.math.cum.edu/~wn0g/2ch6a.pdf
3.	https://nptel.ac.in/courses/122/104/122104017/
4.	https://nptel.ac.in/courses/111/106/111106051/
5.	https://nptel.ac.in/courses/111/108/111108081/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	-	2	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	-	-	-	-	1	3	-	-
3	3	2	1	1	-	1	-	-	-	-	1	3	-	-
4	3	2	1	1	-	1	-	-	-	-	1	3	-	-
5	2	2	1	-	-	-	-	-	-	-	1	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Physics and Chemistry				Programme: B.Tech.							
Semester	I / II				Course Category: BS			End Semester Exam Type: TE				
Course Code	U23BSTC01				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Physical Science for Engineers				3	0	0	3	25	75	100	
(Common to all Branches)												
Prerequisite	Physics of 12 th standard or equivalent / Chemistry of 12 th standard or equivalent.											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the basic of properties of magnetic, dielectric and superconductors.									K2	
	CO2	Identify the wave nature of the particles, physical significance of wave functions									K3	
	CO3	Understand the basic principles of laser and fiber optics communication									K2	
	CO4	Understand and familiar with the water treatment.									K2	
	CO5	Understand the electrode potential for its feasibility in electrochemical reaction and uses of various batteries.									K2	
	CO6	Understand the specific operating condition under which corrosion occurs and suggest a method to control corrosion.									K2	
SECTION A – PHYSICS												
UNIT-I	Magnetic, Dielectric and Superconducting Materials						Periods: 8					
Introduction to magnetic materials, Ferromagnetism- Domain Theory-Types of energy-Hysteresis-Hard and Soft magnetic materials-ferrites-Dielectric materials-Types of polarization – Langevin-Debye equation-Frequency effects on polarization-Dielectric breakdown- Ferroelectric materials-Superconducting materials and their properties.										CO1		
UNIT-II	Quantum Mechanics						Periods: 7					
Matter Waves - de Broglie Wavelength - Uncertainty Principle –Physical Significance of wave functions - Schrodinger wave Equation - Time Dependent - Time Independent - Application to Particle in a One Dimensional Box - Tunnel Diode.										CO2		
UNIT-III	Laser And Fiber Optics						Periods: 7					
Lasers - Principles of Laser - Spontaneous and Stimulated Emissions - Einstein's Coefficients - Population Inversion and Laser Action –components of laser - Types of Lasers - NdYAG, CO ₂ laser, GaAs Laser Fiber Optics - Principle and Propagation of light in optical fiber - Numerical aperture and acceptance angle - Types of optical fibers (material, refractive index, mode)										CO3		
SECTION B – CHEMISTRY												
UNIT-IV	Water And Its Treatment						Periods: 8					
Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD. Desalination of brackish water: Reverse osmosis-disadvantages of using hard water in boiler - Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment–Ion exchange demineralization and zeolite process.										CO4		
UNIT-V	Electrochemical Cells and Storage Devices						Periods: 8					
Galvanic cells, single electrode potential, standard electrode potential, electrochemical series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen, calomel and Ag/AgCl. Batteries and fuel cells: Types of batteries- alkaline battery-lead storage battery- nickel-cadmium battery- fuel cell H ₂ -O ₂ fuel cell-applications.										CO5		
UNIT-VI	Corrosion						Periods: 7					
Corrosion –Introduction - factors – types – chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method. Uses of inhibitors, metallic coating – anodic coating, cathodic coating. Metal cladding, Electroplating of Copper and electroless plating of nickel.										CO6		

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45
Text Books			
1. V Rajendran, "Engineering Physics", TMH, New Delhi , 2 nd Edition ,2011. 2. S.S Dara – "A text book of Engineering Chemistry" -. S.Chand Publications, 15 th Edition, 2021 3. C.Jain, Monica Jain"Engineering Chemistry. Dhanpat Rai Pub. Co., New Delhi, 17 th Edition (2015).			
Reference Books			
1. R.Murugesan, "Modern Physics", S. Chand &Co, New Delhi,2006. 2. William D Callister Jr., "Material Science and Engineering", John Wiley and sons, 6 th Edition, 2009. 3. Jain & Jain "Engineering chemistry", DhanpatRai Publishing Company. 23 rd Edition, 2022 4. Mars Fontana "Corrosion Engineering", July 2017 5. JinaRedlin, "Handbook of Electrochemistry", March 2005			
Web References			
1. https://www.sciencedaily.com/terms/materials_science.htm . 2. https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers/materials_science.html . 3. https://study.com/academy/lesson/semiconductors-superconductors-definition-properties.html 4. https://mechanicalc.com/reference/engineering-materials 5. http://ndl.ethernet.edu.et/bitstream/123456789/89589/1/%5BPerez_N.%5D_Electrochemistry_and_corrosion%28BookZZ.org%29.pdf			

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	2	-	-
2	3	2	3	2	-	-	-	-	-	-	-	2	-	-
3	3	2	3	2	-	-	-	-	-	-	-	2	2	-
4	3	1	-	-	-	-	-	-	-	-	-	2	-	-
5	3	1	-	-	-	-	-	-	-	-	-	2	-	-
6	3	1	-	-	-	-	-	-	-	-	-	2	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering				Programme:B.Tech.							
Semester	I				Course Category:BS		*End Semester Exam Type:TE					
Course Code	U23BMT101				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Human Anatomy and Physiology				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Describe basic structural and functional elements of human body.										K2
	CO2	Explain the function of heart and its conduction and knowledge on nervous systems.										K3
	CO3	Illustrate the Physiological function of Eye, Ear and Excretory systems										K3
	CO4	Distinguish the types of skeletal systems and functions of respiration										K3
	CO5	Elucidate the classification, Metabolism of Macromolecules and its Measurement										K3
UNIT-I	Basic Elements of Human Body							Periods:9				
Structure and function of Cell and cellular components, Membrane Potential, Action Potential, Generation and Conduction, Blood Cell: Composition, Fluid and electrolytic balance, Blood Groups - ABO and Rh System, Estimation of RBC and WBC.											CO1	
UNIT-II	Cardiovascular and Nervous System							Periods:9				
Cardiovascular system - Heart and vascular system, ECG, Blood Pressure, Homeostasis, Cardiac Cycle, Basics of Cardiac Output and Heart Sounds, PCG.											CO2	
Nervous System - Structure and functions of Neurons, Synapse, Reflex action and Receptors, Velocity of Conduction of Nerve Impulses, Nerve conduction Test, Nervous control of Heart.												
UNIT-III	Urinary and Visual -Auditory System							Periods:9				
Gastro Urinal system, Structure and function of kidneys and Nephron, Mechanism of Urine formation, Urine Reflex. Optics of Eye: Retina, Photochemistry of Vision, Accommodation, Neurophysiology of Vision, Structure and functions of Internal Ear, Mechanism of Hearing, Auditory pathway, Hearing Tests.											CO3	
UNIT-IV	Musculo Skeletal and Respiratory System							Periods:9				
Musculo Skeletal System: Muscle Tissue, Structure of Skeletal Muscle, Types of Muscle, Types of Joints, Major Muscles of Limbs and their actions.											CO4	
Respiratory system: Physiological aspects of respiration, Exchange of gases, Regulation of Respiration, Pulmonary function test, Artificial respiration.												
UNIT-V	Macromolecules and Measurement							Periods:9				
Carbohydrates: Classification, Metabolism of carbohydrate and its dysfunction. Lipids: Classification, Metabolism of lipids and dysfunction, Protein: Classification of Amino acids, architecture of protein molecules.											CO5	
Measurement: Principles of Photometry, Spectrophotometry, Flurometry, Flame Photometry, Densitometry, Calorimetry,												
LecturePeriods:45			Tutorial Periods:-			Practical Periods:-			TotalPeriods:45			
Text Books												
1. Guyton, “Text book of Medical Physiology”, WB Jaunder company Philadelphia, 10 th Edition, 2010												
2. Elaine.N. Marieb, “Essential of human Anatomy and Physiology”, Pearson Education New Delhi, 8 th Edition, 2010												
3. C.L.Ghai, “A textbook of Practical physiology”, Jaypee Medical Publishers, 5 th Edition, 2013												
Reference Books												

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology", Pearson Publishers, 5th Edition, 2014
2. Gillian Pocock, Christopher D. Richards, "The Human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 8th Edition, 2013
3. William F. Ganong, "Review of Medical Physiology", McGraw Hill, New Delhi, 22nd Edition, 2010
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, 2015
5. Guyton & Hall, "Medical Physiology", Elsevier Saunders, 13th Edition, 2015

Web References

1. <https://byjus.com/biology/human-body-anatomy/>
2. <https://www.khanacademy.org/>
3. <https://www.youtube.com/channel/UCJayvjGvKEblkA3KYK1BQQw>
4. <https://www.britannica.com/browse/Anatomy-Physiology>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	-	-	-	2	-	-	-	2	3	-	-	3
2	3	2	-	-	-	2	-	-	-	2	3	2	-	3
3	3	2	-	-	-	2	-	-	-	2	3	2	2	3
4	3	2	-	-	-	2	-	-	-	2	3	2	-	3
5	3	2	-	-	2	2	-	-	-	2	3	2	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabu



Department	Biomedical Engineering				Programme :B.Tech.							
Semester	I				Course Category:ES		*End Semester Exam Type:TE					
Course Code	U23BMT102				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Basic Electrical Circuits				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Gain knowledge in fundamentals of electrical circuits										K2
	CO2	Analyze the electrical parameters of the circuits using basic theorems										K3
	CO3	Compare frequency response of resonant circuits										K3
	CO4	Determine the steady state and transient response of RL, RC and RLC circuits										K4
	CO5	Analyze the working principle and application of electrical machines										K3
UNIT-I	Introduction to Electrical Circuits							Periods:12				
Basic Components of electric Circuits, Ohms Law, Kirchhoff’s Law, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Star-Delta conversion Concepts of AC circuits: RMS value, Average Value, Form Factor, Peak Factor, study of RL, RC, RLC series and parallel circuit, phasor representation in Polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor.												CO1
UNIT-II	Network Theorems							Periods:12				
Mesh analysis, Nodal analysis, Superposition Theorem, Thevenin’s Theorem, Norton’s Theorem, Reciprocity Theorem, Compensation Theorem, Maximum Power Transfer Theorem, Millman’s Theorem.												CO2
UNIT-III	Resonance And Coupled Circuits							Periods:12				
Resonance: Series and Parallel resonance, Variation of Impedance, Current and Voltage with frequency in series and parallel resonant circuits, Bandwidth, Q factor and Selectivity. Coupled Circuits: Self-inductance, Mutual inductance, Dot rule, Coefficient of coupling - Series and Parallel connection of coupled inductors - Single tuned coupled circuit.												CO3
UNIT-IV	Transient Response Analysis							Periods:12				
Steady State and Transient Response, Source free, Step, Impulse, Sinusoidal and exponential response for RL, RC and RLC circuits.												CO4
UNIT-V	Electrical Machines and Safety							Periods:12				
Working principle of DC generator, motor-EMF and Torque equation – Types: Shunt, Series and Compound, Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single- phase induction motor- Applications. Operating principles of Synchronous motor, stepper motor-Applications. Safety measures in electrical system- Electrical tools and accessories–wiring standards.												CO5
LecturePeriods:45			TutorialPeriods:15			Practical Periods: -			TotalPeriods:60			
Text Books												
1. Charles K. Alexander, Matthew N. O. Sadiku” Fundamentals of Electric Circuits”, McGraw Hill May, 7th Edition ,2022. 2..ChakrabatiA,“CircuitTheoryAnalysisandSynthesis”, Dhanpath Rai and Sons,New Delhi, 7 th edition, 2018 3.WilliamH.Hayt,Jr.JackE.KemmerlyandStevenM.Durbin,“EngineeringCircuitAnalysis”, McGraw Hill Science Engineering, 8 th Edition, 11th Reprint 2016.												
Reference Books												
1. William Haystack, E Kemmerly and Steven M Durbin, “Engineering Circuits Analysis”, Tata McGraw-Hill, 8 th Edition 2013, 2. John Bird, “Electrical Circuit theory and technology”, Routledge, 5 th Edition2013. 3. KothariDPandI.JNagrath,“BasicElectricalandElectronicsEngineering”, McGrawHillEducation,7 th Edition2014. 4. Joseph Edminister and Mahmood Nahvi. “Electric Circuits”. Schaum”s Outline Series. . Tata McGraw Hill												

5. Publishing Company, New Delhi, 5th Edition Reprint 2016.
6. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, McGraw Hill, 9th Edition Reprint 2015.

Web References

1. <https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic>
2. <https://www.thelearningpoint.net/home/electrical-science-and-engineering/circuit-theory>
3. <https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444>
4. https://swayam.gov.in/nd1_noc19_ee36/preview
5. <https://nptel.ac.in/courses/117/106/117106108/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	2	1	1	1	1	2	3	3	2	3
3	2	3	2	2	2	1	1	1	1	2	2	3	2	2
4	3	3	2	3	2	1	1	1	1	2	3	3	2	3
5	3	3	3	2	3	2	2	2	2	3	3	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Civil and Mechanical				Programme: B.Tech.						
Semester	I / II				Course Category: ES		*End Semester Exam Type: TE				
Course Code	U23ESTC01				Periods/Week		Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM
Course Name	Basics of Civil and Mechanical Engineering				3	0	0	3	25	75	100
(Common to ECE, EEE, ICE, MECH, CIVIL, MCTR, BME Branches)											
Prerequisite	Basic Science										
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)
	CO1	Understand the types of buildings and materials.									K2
	CO2	Summarize on the various components of buildings and surveying concepts									K2
	CO3	Identify the various infrastructure facilities									K2
	CO4	To familiarize the working principles of IC engines and automobile systems									K2
	CO5	To understand about the power generation systems and its components									K1
	CO6	To acquire knowledge about the various machining process.									K2
SECTION A - CIVIL ENGINEERING											
UNIT - I	Buildings And Buildings Materials									Periods: 08	
Buildings – Definition – Classification according to NBC-plinth area, Floor area, carpet area, floor space index - Development of Smart cities - Green building, Benefits from green building. Building Materials - stone, brick, cement, cement mortar, concrete, steel, Timber - their properties and uses										CO1	
UNIT - II	Buildings Components and Surveying									Periods: 08	
Various Buildings Components and their functions. Foundation: function and types - Brick masonry, Stone Masonry and its types – Floors, Roofs and its types. Surveying: Objects – Classification – Principles – Measurements of Distances and areas – Leveling										CO2	
UNIT - III	Basic Infrastructure									Periods: 07	
Roads and Bridges – types, components advantage and disadvantages. Railways - Permanent way and its elements. Sources of Water - Quality of Water- Domestic sewage Treatment – Rain Water harvesting – Dams - site selection for dam construction, types of dams.										CO3	
SECTION B – MECHANICAL ENGINEERING											
UNIT- IV	Internal And External Combustion Systems									Periods: 08	
IC engines – Classification – Working principles – Diesel and Petrol Engines: Two stroke and four stroke engines – merits and demerits.Steam generators (Boilers) – Classification – Constructional features (of only low-pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.										CO4	
UNIT- V	Power Generation Systems, Refrigeration and Air Conditioning System									Periods: 07	
Power plants: Thermal – Nuclear, Hydraulic, Solar, Wind, Geothermal, Wave, Tidal and Ocean Thermal Energy Conversion systems - Functions, Applications - Schemes and layouts (Description only) Refrigeration and Air Conditioning System: 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.										CO5	
UNIT- VI	Manufacturing Process									Periods: 07	
Lathe - types, Specifications, Operations of a centre lathe. Casting - Pattern making, Allowances, Green sand and dry sand moulding, casting defects. Welding - Arc and Gas welding process, brazing and soldering (process description only).										CO6	
Lecture Periods: 45				Tutorial Periods: -				Practical Periods: -		Total Periods: 45	



Text Books

1. Dr. S. Jayakumar, "Basic Civil Engineering", Aagash Nekaa Publications, 2011
2. G Shanmugam, MS Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education, 1st Edition, 2018.
3. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.

Reference Books

1. M.P. Poonia, S.C. Sharma and T.R. Banga, Basic Mechanical Engineering, Khanna Publishing House 2018.
2. S.S.Bhavikatti, Basic Civil engineering, New Age International Ltd. 2018.
3. V. Rameshbabu, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
4. Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, Pearson Publication, 7th Edition, 2014.
5. Gopi Satheesh, Basic Civil engineering, Pearson Publications, 3rd Edition, 2015.

Web References

1. <https://nptel.ac.in/courses/112107291/>
2. <https://nptel.ac.in/courses/112/103/112103262/>
3. <https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/lecture-notes/>
4. <https://nptel.ac.in/courses/105102088/>
5. <https://nptel.ac.in/courses/105104101/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	-	-	-
2	3	1	1	-	1	-	-	-	-	-	1	-	-	-
3	3	1	1	-	1	-	-	-	-	-	1	-	-	-
4	3	1	-	-	-	-	-	-	-	-	1	-	-	-
5	3	1	-	-	-	-	-	-	-	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	English			Programme: B.Tech.						
Semester	I			Course Category : HS			End Semester Exam Type: TE			
Course Code	U23ENBC01			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Communicative English - I			2	-	2	3	50	50	100
(Common to ALL Branches except CSBS)										
Prerequisite	Basics of English Language									
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Understand the communication flow in organization and its objectives								K2
	CO2	Write the technical contents with grammatically precise sentences								K2
	CO3	Articulate with correct pronunciation and overcome vernacular impact in speaking								K3
	CO4	Express opinions confidently in formal and informal communicative contexts								K2
	CO5	Attend interview with assertiveness								K3
UNIT- I	Workstead Communication						Periods:10			
Communication, Definition, Process, Channels, Barriers, Strategies for Effective Communication, Verbal and Nonverbal Communication - Listening, Types, Barriers, Enhancing Listening Skills - Bibliography: Book, Journal and Internet References										CO1
UNIT- II	Common Errors In Writing And Comprehension Strategies						Periods:10			
Subject Verb Agreement, Misplaced Modifiers, Squinting Modifiers, Dangling Modifier, Fused Sentence, Comma Splice, Sentence Fragment - Reading Comprehension: Technical passage, Strategies: Skimming, Scanning, Intensive and Extensive Reading, Prediction, and Contextual Meaning										CO2
UNIT- III	Phonetics						Periods:10			
Pronunciation Guidelines to consonants and vowels, Sounds Mispronounced, Silent and Non-silent Letters, Intonation, Spelling Rules and Words often misspelled, Mother Tongue Influence (MTI), Various Techniques for Neutralization of Mother Tongue										CO3
UNIT- IV	Communication Practice-I						Periods:15			
List of Exercises Listening: Self Introduction videos Speaking: Self-Introduction, Extempore, and Role Play Reading: Non-Technical Comprehension Passage Writing: Common Errors in Writing										CO4
UNIT-V	Interpersonal Communication-I						Periods:15			
List of Exercises Listening: Speech Sounds, Interview Videos Speaking: Debate, Structured Group Discussion, and Conversation Reading: Commonly Confused Words Writing: Transcription										CO5
Lecture Periods:30			Tutorial Periods:-			Practical Periods:30		Total Periods:60		
Text Books										
1. Richa Mishra , Ratna Rao, “A textbook of English Language Communication Skills”, Macmillan Publishers India Private Ltd., Revised Edition 2021. 2. Rizvi M. Ashraf, “Effective Technical Communication”, New Delhi: Tata-McGraw-Hill Publishing Company Limited, 4th Edition, 2010. 3. Balasubramanian T, “English Phonetics for Indian students workbook”, 2nd Edition, Trinity Press, 2016.										

Reference Books

1. N.P.Sudharshana, C. Savitha, "English for Engineers", Cambridge University Press, 2018.
2. Raman, Meenakshi, and Sharma, Sangeetha, "Technical Communication - Principles and Practice", 3rd Edition, Oxford University Press, 2017.
3. Comfort, Jeremy, et al., "Speaking Effectively: Developing Speaking Skills for Business English", Cambridge University Press, Cambridge, Reprint 2011.
4. Wren & Martin, "High School English Grammar and Composition", S Chandh & Co. Ltd, 2015.
5. Boove, Courtland L, "Business Communication Today", Pearson Education, New Delhi, 2002.

Web References

1. <https://lemongrad.com/subject-verb-agreement-rules/>
2. <https://opentextbc.ca/advancedenglish/chapter/misplaced-and-dangling-modifiers/>
3. <https://www.hitbullseye.com/Reading-Comprehension-Tricks.php>
4. <https://www.softwaretestinghelp.com/how-to-crack-the-gd/>
5. <https://worldscholarshipvault.com/neutralize-mother-tongue-interference/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	1	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20(to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical					
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks
30(to be weighted for 10 marks)			30 marks		40
Listening (L)*	10		Listening (L)*	10	
Speaking(S)	5		Speaking(S)	5	
Reading(R)*	10		Reading(R)*	10	
Writing(W)*	5		Writing(W)*	5	

- LRW components of Practical can be evaluated through Language Lab Software



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	I			Course Category: BS			*End Semester Exam Type: LE				
Course Code	U23BMP101			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Physiology Laboratory			0	0	2	1	50	50	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Evaluate and Analysis the practice of Physiology								K4	
	CO2	Identify the General Tests of carbohydrates, Proteins and lipids								K4	
	CO3	Apply the principles and preparation of serum and plasma from blood								K3	
	CO4	Identify the Quantitative Estimation present in the slide								K3	
	CO5	Measurement of pH level in the body fluids								K3	
List of Experiments:											
1. Blood Group Test 2. Estimation of RBC count 3. Estimation of WBC count 4. General tests for Carbohydrates 5. General tests for Proteins 6. General tests for Lipids 7. Preparation of Serum from blood. 8. Preparation of Plasma from blood. 9. Quantitative estimation of Blood Glucose 10. Quantitative estimation of Creatinine 11. Quantitative estimation of Cholesterol 12. Quantitative estimation of Urea 13. Study of Measurement of pH and conductivity of body fluids											
Lecture Periods: -0			Tutorial Periods: -0			PracticalPeriods:30			TotalPeriods:30		
Reference Books											
1. Mohammad A, "Practical Examination Manual of Pathology", CBS, January 2011. 2. Kanika Sharma Ane's student edition, "Manual of Microbiology tools and techniques", March 2010. 3. Sabitri Sanyal Aparna Bhattacharaya, "Clinical Pathology: A Practical Manual", Elsevier India, 3 rd Edition, 2014 4. McPherson Henry's "Clinical Diagnosis and Management by Laboratory Methods", Elsevier, 24 ^e , South Asia Edition January 2021 5. Rajbala Yadav, Nidhi Verma, Meeta Singh, "Essentials of Practical Pathology for Undergraduates", Elsevier India 1st Updated Edition Paperback – October 2019.											
Web References											
1. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures 2. https://ocw.mit.edu/courses/biology/8-012-introduction-to-biology-fall-2004/videolectures 3. nptel.ac.in/courses/102105034/											

* TE – Theory Exam, LE – Lab Exam

Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	1	2	1	3	3	2	2	3
2	3	2	2	2	2	1	1	1	1	3	3	2	2	3
3	3	2	2	2	2	2	1	1	1	3	3	3	3	3
4	3	3	2	3	2	1	1	1	1	2	3	3	2	3
5	3	2	2	2	3	2	1	1	1	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	I			Course Category:ES			*End Exam Type:LE				
Course Code	U23BMP102			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Basic Electrical Circuits Laboratory			0	0	2	1	50	50	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Construct electrical circuits to analyze the basic laws								K4	
	CO2	Observe and analyze the theorems in electrical circuits								K4	
	CO3	Analyze the electrical characteristics of RL, RC and RLC circuits								K4	
	CO4	Classify the operation of types of lamps								K3	
	CO5	Understand the wiring concepts and trouble shooting of electrical equipment								K3	
List of Experiments:											
1. Verification of ohms law and Kirchhoff law 2. Verification of mesh and nodal analysis 3. Verification of superposition theorem 4. Verification of Thevenin's and Norton's Theorem 5. Verification of maximum power transfer theorem and reciprocity theorem 6. Demonstration of CRO (Measurement of Amplitude, Time and Frequency) 7. Measurement of electrical quantities–voltage, current, power & power factor in RL, RC and RLC circuits. 8. Study of types of wiring (fluorescent lamp wiring, staircase wiring, etc.) 9. Study of types of lamps 10. Measurement of resistance to earth of an electrical equipment 11. Study of troubleshooting of electrical equipment (fan, iron box, mixer-grinder, etc.)											
Lecture Periods: -			Tutorial Periods: -			PracticalPeriods:30		TotalPeriods:30			
Reference Books											
1. Brian Kelly, “Introduction to Electrical Circuits”, Lab manual, OUP Canada, 8 th Edition, August 2008 2. Karen Craigs, Lauren Fuentes, “Introduction to Electric Circuits: Lab Manual”, OUP Canada., 10 th Edition August 2019. 3. K.A. Navas , “ Electronics Lab Manual Volume-1”, , PHI Learning,5 th Edition, November 2015. 4. David A. Bell “Fundamentals of Electric Circuits: Lab Manual, OUP Canada,” 7 th Edition, September 2009. 5. Robert Boylestad , Louis Nashelsky, Franz Monssen ,“ Lab Manual for Electronic Devices and Circuit Theory”, Pearson 11 th Edition ,August 2012.											
Web References											
1. https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444											

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	1	-	1	-	2	2	1	2	3
2	3	3	2	2	2	1	-	1	-	2	2	2	2	3
3	3	3	2	2	2	1	-	1	-	2	2	2	2	3
4	2	2	2	1	2	1	-	1	-	2	2	1	2	2
5	2	2	2	1	3	2	-	1	1	2	2	1	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Mechanical Engineering			Programme: B.Tech.						
Semester	I / II			Course Category : ES			*End Semester Exam Type: LE			
Course Code	U23ESPC02			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Design Thinking and IDEA Lab			0	0	2	1	50	50	100
(Common to ALL Branches)										
Prerequisite	Basic Knowledge of Science									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Demonstrate a comprehensive understanding of the tools and inventory associated with the IDEA Lab.							K2	
	CO2	Develop proficiency in ideation techniques to generate creative and innovative solutions for various design and problems challenges							K3	
	CO3	Acquire practical knowledge of mechanical and electronic fabrication processes, including hands-on experience with machinery, tools, and techniques used in the manufacturing and assembly of physical components.							K3	
	CO4	Cultivate the skills necessary for developing innovative and desirable products, including the ability to integrate user needs, market trends, and technological advancements into the design process.							K4	
	CO5	Apply iterative design methodologies to refine and improve solutions based on feedback, user testing, and evaluation of functional, aesthetic, and usability aspects							K4	
Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer Needs, Insight-leaving from the lives of others/standing on the shoes of others, Observation										
Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, Wooden model, Clay model, 3D printing; Experimenting/testing.										
Sustainable product design, Ergonomics, Semantics, Entrepreneurship/business ideas, Product Data Specification, establishing target specifications, Setting the final specifications. Design projects for teams.										
List of Lab Activities and Experiments										
1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.										
2. Machining of 3D geometry on soft material such as softwood or modelling wax.										
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.										
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.										
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.										
6. Familiarity and use of welding equipment.										
7. Familiarity and use of normal and wood lathe.										
8. Embedded programming using Arduino and/or Raspberry Pi.										



9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.
10. Discussion and implementation of a mini project.
11. Documentation of the mini project (Report and video).

Lecture Periods: -**Tutorial Periods: -****Practical Periods: 30****Total Periods: 30****Text Books**

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd
2. Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.

Reference Books

1. Ulrich and Eppinger, Product Design and Development, McGraw Hill, 3rd Edition, 2004
2. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018.
3. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan, Weldon Owen; 2017.
4. . Paul Horowitz and Winfield Hill "The Art of Electronics" Cambridge University Press. 3rd edition.
5. Paul Sherz and Simon Monk "Practical Electronics for Inventors". .. McGraw Hill. 4th edition
6. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education.
7. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill.
8. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer
9. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and Distributors, 5th Edition, 2002.

Web References

1. https://onlinecourses.nptel.ac.in/noc23_mg72

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	2	2	-	2	-	3	2	-	-	-
2	3	3	3	2	2	2	-	2	-	3	2	-	-	-
3	3	3	3	2	3	2	-	2	-	3	2	-	-	-
4	3	3	3	2	3	2	-	2	-	3	2	-	-	-
5	3	3	3	2	3	2	-	2	-	3	2	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High**Evaluation Methods**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Viva				
Marks	15	5	5	15	10	50	100

A. V. J.

Department	Biomedical Engineering	Programme: B.Tech.						
Semester	I	Course Category: AEC			*End Semester Exam Type: LE			
Course Code	U23BMC1XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – I	0	0	4	-	100	-	100
Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50		Total Periods:50		

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering				Programme: B.Tech.						
Semester	I				Course Category: MC		End Semester Exam Type: -				
Course Code	U23BMM101				Periods/Week		Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM
Course Name	Induction Programme				2 weeks		Non-Credit	-	-	-	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Develop holistic attitude and harmony in the individual, family, and Society								K2	
	CO2	Acquire grammar skills and capable to write and speak English confidently								K2	
	CO3	Understand the basic concepts in Mathematics and Programming								K2	
	CO4	Know about the art and culture, language and literature of this vastsecularnation								K2	
	CO5	Identify the inherent talent and develop it professionally								K3	
UNIT-I	Universal Human Values						Periods:12				
Welcome and Introductions - Getting to know each other, Aspirations and Concerns - Individual Academic and Career, Expectations of Family, Peers, Society, Nation, Fixing one's Goals, Self-Management - Self-confidence, Peer Pressure, Time Management, Anger, Stress Personality Development, Self-improvement, Health - Health issues, Healthy diet, Healthy lifestyle, Hostel life, Relationships - Home sickness, Gratitude towards Parents, Teachers and others Ragging and interaction, Competition and Cooperation, Peer Pressure, Society - Participation in Society, Natural Environment - Participation in Nature, Sum Up - Role of Education, Need for a Holistic Perspective, Self-evaluation and Closure - Sharing and feedback.											CO1
UNIT-II	Proficiency in English						Periods:12				
Communication skills – Prognostic test on Grammar - Synonyms, Antonyms, Tenses, Sentence Completion, Idioms and Phrases, One-word Substitution, Homophones, Homonyms, Use of Prepositions, Subject-verb Agreement - Writing –Paragraph writing, Letter writing, Essay writing, Story Development.											CO2
UNIT-III	Bridge Course in Mathematics and C Programming						Periods:12				
Mathematics: Fundamentals of differential and integral calculus: Theory and Practice, Limit of function - Fundamental results on limits - Continuity of a function - Concept of differentiation - Concept of derivative - Slope of a curve -Differentiation Techniques - Derivatives of elementary functions from first principle –Derivatives of inverse functions – Logarithmic differentiation – Method of substitution – Differentiation of parametric functions – Differentiation of implicit functions –Higher order derivatives. Integrals of functions containing linear functions -Method of integration (Decomposition method, method of substitution, integration by parts) – Definite integrals. Simple definite integrals – Properties of Definite integrals –Reduction formulae - Area and volume –Length of curve –surface area of a solid.											CO3
C Programming: Features of C and its basic Structure - Keywords - constants - variables - operators - Data types - Formatted input and output statements - Control and Looping statement - Arrays - Functions - Strings - writing simple C programs.											
UNIT-IV	Literary Activities						Periods:12				
Team building activities - Quiz - Oral Exercises - Group discussion, Debate, Extempore, Role play, சிறப்பு சொற்பொழிவு – தமிழ்மரபு மற்றும் தமிழர் தொழில் நுட்பம்.											CO4
UNIT-V	Creative Arts						Periods:12				
Introduction to painting ad renowned artworks -Documentary and Short films -Music -Vocal, Instrumental - Dance - Classical, Cinematic -Mimicry -Mime.											CO5
Lecture Periods:60			Tutorial Periods:-			Practical Periods:-			Lecture Periods:60		
Reference Books											
1. R.R Gaur, R. Asthana, G.P. Bagaria,” A Foundation Course in Human Values and Professional Ethics”, Excel Books, New Delhi, 2 nd Revised Edition, 2019.											

2. Kumar Mohan R, "English Grammar for all (Functional and Applied Grammar)", Unicare Academy, 2022.
3. Seely, John," Oxford A-Z of Grammar and Punctuation, Oxford Publication, 2013.
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
5. Dr. A. Singaravelu, "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019.
6. E. Balagurusamy, "PROGRAMMING IN ANSI C", Mc Graw Hill, 8th Edition, 2019.
7. Dr.K.K.Pillay,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL
8. R.Balakrishnan, "Journey of Civilization", Roja muthiah research publishers, 1st Edition 2019
9. தமிழகவரலாறு - மக்களும் பண்பாடும், பிள்ளை, கே. கே. , சென்னை : உலகத்தமிழாராய்ச்சிநிறுவனம் , 2002.
10. கணிணித்தமிழ் - முனைவர்இல.சுந்தரம், விகடன்பிரசுரம்.
11. சீழடி – வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம், தமிழக தொல்லியல் துறை

Web References

1. <http://www.newsociety.com/Books/S/Slow-isBeautiful>
2. <https://www.aplustopper.com/formal-letter/>
3. <https://www.javatpoint.com/c-programming-language-tutorial>
4. <http://www.math.cum.edu/~wn0g/2ch6a.pdf>
5. <https://education.nsw.gov.au/teaching-and-learning/curriculum/creative-arts>

A. on

SEMESTER – II											
Department	Mathematics			Programme : B.Tech.							
Semester	II			Course Category: BS			*End Semester Exam Type: TE				
Course Code	U23MATC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Mathematics – II			3	1	0	4	25	75	100	
(Common to ALL Branches Except CSBS, FT)											
Prerequisite	Basic Mathematics										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Convert a periodic function into series form.								K2	
	CO2	Compute Fourier transforms of various functions.								K3	
	CO3	Solve Differential Equations using Laplace transforms.								K3	
	CO4	Apply inverse Laplace transform of simple functions.								K3	
	CO5	Solve difference equations using Z – transforms.								K3	
UNIT – I	Fourier Series						Periods:12				
Dirichlet's conditions – General Fourier series – Odd and Even functions – Half-Range sine series and cosine series – Change of intervals – Parseval's Identity.										CO1	
UNIT – II	Fourier Transforms						Periods:12				
Fourier Transforms and its inverse – Properties of Fourier Transform (without proof) – Fourier sine and cosine Transforms and their properties (excluding proof).										CO2	
UNIT – III	Laplace Transforms						Periods:12				
Laplace transforms of elementary functions and Periodic functions – Basic properties (excluding proof) – Laplace transforms of derivatives and integrals – Initial and final value theorems.										CO3	
UNIT – IV	Inverse Laplace Transforms						Periods:12				
Definition of inverse Laplace Transforms – Convolution theorem (excluding proof) – Solutions of Linear Ordinary Differential Equations of second order with constant coefficients.										CO4	
UNIT – V	Z – Transforms						Periods:12				
Z-transforms – Elementary Properties – Inverse Z-transforms (using partial fraction and Residues) – Solution of difference equations using Z - transform.										CO5	
Lecture Periods: 45		Tutorial Periods: 15		Practical Periods: -			Total Periods: 60				
Text Books											
1. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 3 rd Edition, 2011.											
2. C. P. Gupta, Shree Ram Singh. M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2 nd Edition, 2016.											
3. H.K. Dass, "Advanced Engineering Mathematics", S. Chand, New Delhi, 22 nd Edition 2019.											
Reference Books											
1. N.P. Bali and Dr. Manish Goyal, "A Textbook of Engineering Mathematics", University Science Press, India, 8 th Edition, 2016.											
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearson India Education services Pvt. Ltd, India 1 st Edition, 2017.											
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10 th Edition, 2019.											



4. G. Balaji, "Engineering Mathematics - Transforms and Partial Differential Equations", G. Balaji Publishers, 18th Edition, 2022.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2017.

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1. <https://nptel.ac.in/courses/111105121/>
2. <https://nptel.ac.in/courses/111105035/>
3. <https://nptel.ac.in/courses/11110711>
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. <https://nptel.ac.in/courses/111/103/111103021/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	-	1	-	-	-	-	1	1	-	-
2	3	2	1	1	-	1	-	-	-	-	1	3	-	-
3	3	2	1	1	-	1	-	-	-	-	1	3	-	-
4	3	2	1	1	-	1	-	-	-	-	1	3	-	-
5	3	2	1	1	-	1	-	-	-	-	1	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Computer Science and Engineering			Programme: B.Tech.						
Semester	I / II			Course Category: ES			*End Semester Exam Type: TE			
Course Code	U23CSTC01			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Programming in C			3	0	0	3	25	75	100
(Common to All Branches)										
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Comprehend the basics of Computers.							K2	
	CO2	Illustrate the concepts of control structures and looping.							K2	
	CO3	Implement programs using arrays and functions.							K3	
	CO4	Demonstrate programs using Structure and Pointers.							K3	
	CO5	Build the programs using Union and File management Operations.							K3	
UNIT-I	Introduction						Periods:09			
Generation and Classification of Computers - Block Diagram of a Computer –Categories of Software – Network Structure - Number System – Binary – Decimal – Conversion – Algorithm – Pseudo code – Flow Chart.										CO1
UNIT-II	C Programming Basics						Periods:09			
Introduction to ‘C’ Programming – Basic structure of a ‘C’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations – Decision Making and Branching – Looping statements.										CO2
UNIT-III	Arrays and Functions						Periods:09			
Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion										CO3
UNIT-IV	Structure and Pointers						Periods:09			
Structure Introduction – Structure definition – Structure declaration – Structure within a structure –Self Referential Structure. Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays -Pointer to Function –Pointer and Structure- Simple programs.										CO4
UNIT-V	Unions and Files						Periods:09			
Union Introduction - Programs Using Structures and Unions – Introduction to File - File Operations - File Input and Output Functions - Random Access to Files - File System Functions - Command Line Arguments- Storage Classes - Pre-Processor Directives- Dynamic Memory Functions.										CO5
LecturePeriods:45			Tutorial Periods:			Practical Periods:-			TotalPeriods:45	
Text Books										
1. Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill, 8thEdition,2019. 2. YashvantKanetkar, “Let us C”, BPB Publications, 16th Edition, 2017 3. Herbert Schildt,” C: The Complete Reference”, McGraw Hill, FourthEdition,2014										
ReferenceBooks										
1. Vikas B. Agarwal Jyoti P. Mirani, “Computer Fundamentals , Nirali Prakashan Aug-2019, 2. Ashok N Kamthane, “Computer Programming”, Pearson education, 2 nd Impression,2012. 3. VikasVerma, “A Workbook on C “, Cengage Learning, 2 nd Edition,2012. 4. P.Visu, R.Srinivasan and S.Koteeswaran, “Fundamentals of Computing and Programming”, Sri Krishna Publications, 4 th Edition, 2012. 5. PradipDev, ManasGhoush, “Programming in C”, Oxford University Press,2 nd Edition, 2011.										



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1. <https://www.programiz.com/c-programming>
2. <https://www.geeksforgeeks.org/c-language-set-1-introduction/>
3. <https://www.tutorialspoint.com/cprogramming>
4. <https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c>
5. <https://nptel.ac.in/courses/106/104/106104128/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	3	-	3
2	2	1	-	-	3	-	-	-	-	-	-	3	-	3
3	3	2	1	1	3	-	-	-	-	-	-	3	-	3
4	3	2	1	1	3	-	-	-	-	-	-	3	-	3
5	3	2	1	1	3	-	-	-	-	-	-	3	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme:B.Tech.						
Semester	II				Course Category:PC			*End Semester Exam Type:TE			
Course Code	U23BMT01				Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM			
Course Name	Electron Devices and Circuits				3	0	0	3	25	75	100
(Common to BME and ICE Branches)											
Prerequisite	Physics										
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)
	CO1	Explain the operation of basic semiconductor diodes and its applications									K2
	CO2	Classify the transistors configuration and analyze its characteristics									K3
	CO3	Distinguish the special semiconductor devices and its applications									K3
	CO4	Analyze the transistor using small signal model and understand the operation of different categories of amplifiers									K4
	CO5	Investigate the operation of different types of feedback amplifiers and oscillators									K3
UNIT-I	Diodes and their Applications							Periods:9			
Formation of P-N junction diode- forward and reverse biased P-N junction, V-I characteristics, diffusion and transient capacitance, Zener diode and its reverse characteristics, Zener breakdown, Avalanche breakdown, Rectifiers-half wave rectifier, full wave rectifier with and without filters, Clippers, Clampers, Voltage Regulator – Zener diode as Voltage regulator.										CO1	
UNIT-II	Bipolar Junction Transistor and Field Effect Transistor							Periods:9			
Bipolar Junction Transistor: Principle of operation –Current components, CE, CB, and CC Configurations, Input and output characteristics – Cut-off, active and saturation region, Transistor as a switch, Transistor as an amplifier.										CO2	
Field Effect Transistor: Classification - JFET and its characteristics – JFET parameters, MOSFET – principle of operation- Depletion and enhancement modes.											
UNIT-III	Special Semiconductor Devices							Periods:9			
Unijunction Transistor (UJT), Tunnel diode, Varactor diode, Schottky diode, Gunn diode, Light Emitting Diode (LED), Laser, PIN diode, Photo diode, Liquid Crystal Display (LCD), Silicon Control Rectifier (SCR), DIAC, TRIAC, Applications of SCR, DIAC, TRIAC.										CO3	
UNIT-IV	Amplifiers							Periods:9			
BJT small signal low frequency model using h parameter – Analysis of CE, CB and CC amplifiers, RC coupled amplifiers, Cascade amplifier, Power amplifiers –Class A, Class B, Class AB, Push Pull, Class C amplifiers.										CO4	
UNIT-V	Feedback Amplifiers and Oscillators							Periods:9			
Feedback amplifiers-Properties of negative feedback-voltage and current, Series and Shunt feedback, Positive feedback, Barkhausen Condition for oscillations, Classification of Oscillators, RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.										CO5	
Lecture Periods:45			Tutorial Periods:-			Practical Periods:-			TotalPeriods:45		
Text Books											
1. S.Salivahanan, N. Suresh Kumar, A. Vallavaraj, “Electronic Devices and Circuits”, Tata Mcgraw-Hill, 2nd Edition, 2017											
2. Jacob Millman,Chritos CHalkias,“Electronic Devices and Circuits”,McGrawHill, 4 th edition, 2015											
3. R S Sedha “A Textbook of Applied Electronics”S.Chand Publications, 2008											
Reference Books											
1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson, 9th Edition, 2013.											
2. ThomasL.Floyd,“Electronicdevices”PrenticeHall”, 10 th Edition,2018											



3. Kumar and Jain, "Electronic devices and Circuits" PHI learning, 2016
4. Bakshi, U. A., & Godse, A. P., "Electronic Devices and Circuits", Technical Publications, 2008
5. Anil Kumar Maini, Varsha Agrawal, "Electronic devices and circuits", Wiley, 2019

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1. <https://nptel.ac.in/courses/117/103/117103063/>
2. <https://nptel.ac.in/courses/108108122/>
3. <https://www.electronics-tutorials.ws/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	1	3
2	3	3	2	2	2	1	1	1	1	2	3	3	1	3
3	3	2	2	1	2	1	1	1	1	2	3	2	2	3
4	3	3	3	2	3	1	1	2	2	3	3	3	2	3
5	3	3	3	2	3	1	1	2	2	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	II			Course Category: PC			*End Semester Exam Type: TE				
Course Code	U23BMT203			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Biosensors and Transducers			3	0	0	3	25	75	100	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand various measurements and instruments								K2	
	CO2	Apply fundamental transduction and photo sensing principles using various sensors								K3	
	CO3	Distinguish transducers and electric sensors its application								K3	
	CO4	Analyze different types of electrodes in biological measurements								K3	
	CO5	Interpret various biochemical sensors used in physiological measurement								K3	
UNIT-I	Introduction To Measurements						Periods:09				
Measurement System–Instrumentation–Classification and Characteristics of Transducers– Static and Dynamic–Errors in Measurements– Calibration–Primary and secondary standards. Measurements using AC & DC Bridges										CO1	
UNIT-II	Displacement, Pressure and Temperature Sensors						Periods:09				
Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gauge, biomedical applications; strain gauge as displacement & pressure transducers: Capacitive transducer, Inductive transducer, LVDT, Passive types: RTD materials range, relative resistances. temperature characteristics, thermistor characteristics, biomedical applications of Temperature sensors. Active type: Thermocouple–Characteristics.										CO2	
UNIT-III	Transducers And Photoelectric Sensors						Periods:09				
Introduction to Transducers, Piezoelectric active transducer and biomedical applications as pressure& Ultrasound transducer comparison of photoelectric transducers, Spectro photometric applications of photoelectric transducers. Ionizing & Non-Ionizing radiation and its effects. Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photoconductive cells, photo diodes, phototransistor.										CO3	
UNIT- IV	Electrodes						Periods:09				
Recording Electrodes– Half cell potential and action potential, Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Surface Electrodes– Needle electrodes– Microelectrodes-Electrical conductivity of electrode. Measurement of Skin Resistance										CO4	
UNIT-V	Biochemical Transducers						Periods:09				
Biosensors– Chemoreceptor, hot and cold receptors, Baro receptors, sensors for smell, sound, vision, osmolality and taste. Transducers for the measurement of ions and dissolved gases. Ion exchange membrane electrodes– Measurement of pH– Glass pH electrodes. Measurement of pO2, Measurement of pCO2.ISFET for glucose.										CO5	
Lecture Periods: -		Tutorial Periods: -		Practical Periods: -			TotalPeriods:45				
Text Books											
1.A.K. Sawhney, “A Course in Electrical and Electronic measurements and Instruments”, Dhanpat Rai and Sons,2012. 2.Prof.PingWang and Dr. Qingjun Liu, “Biomedical Sensors and Measurement “,Springer Publications”, 1 st Edition,2011. 3.Tatsuo Tagawa, Toshio Tamura and Ake Oberg, “Biomedical Sensors and Instruments”, CRC Press Taylor and Francis Group, 2 nd Edition, 2011.											
Reference Books											
1.R. Anandanatarajan, “Biomedical Instrumentation nad measurements”, PHI Learning, 2 nd Edition,December20 2.Ernest O Doebelin and Dhanesh N Manik, “Measurement Systems, Applications and Design”, MCGraw-Hill, 5 th edition 2007. 3.MichaelJ.McGrath, Clíodhna Ní Scanail,“Sensor Technologies: Healthcare, Wellness and Environmental Applications, Apress,8 th Edition 2013.											

4. Richard S. C. Cobbold, "Transducers for Biomedical Measurements: Principles and Applications", John Wiley and Sons, 7th Edition, 2004.
5. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation", PHI, 2nd Edition, 2013.

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1. <http://www.gvpcew.ac.in/unit%202.pdf>
2. <http://www.123seminaronly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf>
3. <https://nptel.ac.in/courses/108/108/108108147/>
4. <https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf>
5. <https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	3	1	1	1	1	2	3	3	2	3
3	3	3	2	2	3	1	1	1	1	2	3	3	3	3
4	3	3	2	2	2	2	1	1	1	2	3	3	2	3
5	3	3	2	2	2	2	1	1	1	3	3	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	II			Course Category: HS			End Semester Exam Type: -				
Course Code	U23HSTC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Universal Human Values –II			2	0	0	2	25	75	100	
Prerequisite	UHV-I: Universal Human Values-Introduction										
Course Outcomes	The course will enable the student to								BT Mapping (Highest Level)		
	CO1	Aware of themselves, and their family, society and nature.								K2	
	CO2	Be responsible in life, and in handling problems while keeping human relationships and human nature in mind.								K2	
	CO3	Apply creativity in their education and develop holistic model.								K2	
	CO4	Apply what they have learnt to their real life.								K2	
	CO5	Be proficient to provide sustainable solutions to the problems in society and nature.								K2	
UNIT-I	Introduction to Value Education						Periods:09				
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) - Understanding Value Education - Self-exploration as the Process for Value Education -Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario- Method to Fulfil the Basic Human Aspirations										CO1	
UNIT-II	Harmony in the Human Being						Periods:09				
Understanding Human being as the Co-existence of the Self and the Body-Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self-Understanding Harmony in the Self-Harmony of the Self with the Body-Programme to ensure self-regulation and Health										CO2	
UNIT-III	Harmony in the Family and Society						Periods:09				
Harmony in the Family – the Basic Unit of Human Interaction- ‘trust’ – the Foundational Value in Relationship- ‘Respect’ – as the Right Evaluation-Other Feelings, Justice in Human-to-Human Relationship-Understanding Harmony in the Society-Vision for the Universal Human Order.										CO3	
UNIT-IV	Harmony in the Nature/Existence						Periods:09				
Understanding Harmony in the Nature-Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature-Realizing Existence as Co-existence at All Levels-The Holistic Perception of Harmony in Existence										CO4	
UNIT-V	Implications of the Holistic Understanding – a Look at Professional Ethics						Periods:09				
Natural Acceptance of Human Values-Definitiveness of (Ethical) Human Conduct-: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics-Holistic Technologies, Production Systems and Management Models-Typical Case Studies-Strategies for Transition towards Value-based Life and Profession										CO5	
LecturePeriods:45		Tutorial Periods: -		Practical Periods: -			TotalPeriods:45				
Text Books											
A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019.											
Reference Books											
1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999											
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.											
3. The Story of Stuff (Book).											
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi											
5. Small is Beautiful - E. F Schumacher											
6. Slow is Beautiful - Cecile Andrews											
7. Economy of Permanence - J C Kumarappa											

8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	English			Programme: B.Tech.							
Semester	II			Course Category : HS			End Semester Exam Type:TE				
Course Code	U23ENBC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Communicative English - II			2	-	2	3	50	50	100	
(Common to ALL Branches except CSBS)											
Prerequisite	Basics of English Language										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Draft effective written communication in professional environment								K2	
	CO2	Apply the mechanics of creative writing with precision and clarity								K3	
	CO3	Acquire language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation								K2	
	CO4	Develop language fluency and gain self-confidence								K3	
	CO5	Express thoughts and ideas with clarity and focus								K2	
UNIT-I	Business Correspondence						Periods:10				
Business Writing: Circular, Agenda, Memoranda, Notice, Instruction, Minutes, Email Writing ,Report Writing- Official and Demi Official Letters : Applying for Educational / Car / Home Loans / Joining Report, Leave Letter, Industrial Visit, In plant Training, Letter to the Editor, Calling for a quotation, Placing Order, Letter of Complaints, Letter seeking Clarification, Resume', Job Application Letter, Bio-data, CV									CO1		
UNIT-II	Functional Writing Skills						Periods:10				
Four Modes of Writing, Sentence Structure , Art of condensation: Summary Writing and Note Making, Use of phrase and clause in sentence, Principles of paragraph writing, Techniques of Essay Writing, Jumbled Sentence, Paraphrasing									CO2		
UNIT-III	Etiquettes						Periods:10				
Etiquette: Meaning, Kinds: Corporate Etiquette, Meeting Etiquette, Telephone Etiquette, Email Etiquette, Social Media Etiquette, Dining Etiquette, Communication Etiquette									CO3		
UNIT-IV	Communication Practice-II						Periods:15				
List of Exercises									CO4		
Listening: Letter writing tips											
Speaking: Just a Minute, Impromptu Speech, Contemporary Issues											
Reading: Variety of examples for Modes of Writing											
Writing: Different types of letters											
UNIT-V	Interpersonal Communication-II						Periods:15				
List of Exercises									CO5		
Listening: Videos on different types of Etiquettes											
Speaking: Team Presentation, Negotiation Skills											
Reading: Phrases and Clauses											
Writing: Free writing on any given topic, Paraphrasing Practice											
LecturePeriods:30			Tutorial Periods: -			Practical Periods:30			Total Periods:60		
Text Books											
1. PC Das, “Letter Writing including Official and Business Letters”, New Central Book Agency, 2020.											
2. Kumar, Sanjay, Pushpalatha,” Communication Skills”. Oxford University Press, 2018.											
3. Raman, Meenakshi&Sangeetha Sharma,” Communication Skills”, New Delhi: OUP,2018.											
Reference Books											
1. Sahukar, Nimeran , Bhalla, Prem,, “The book of Etiquettes and Manners”.PustakMahal Publisher, New Delhi; 1st Edition 2009.											

2. Gerson Sharon J, Steven M. Gerson, "Technical Writing Process and Product", Pearson Education Pvt. Ltd. 3rd Edition, 2009.
3. Grussendorf, Marion, "English for Presentations". Oxford University Press, Oxford, 2007.
4. Seely John, "The Oxford Guide to Writing and Speaking", Oxford University Press, 2006.
5. R.C. Sharma, Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill & Co. Ltd., New Delhi, 2001.

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1. <https://www.indeed.com/career-advice/finding-a-job/how-to-write-an-application-letter>
2. <https://owlcation.com/humanities/Four-Types-of-Writing>
3. <https://targetstudy.com/languages/english/paragraph-writing.html>
4. <https://www.businessnewsdaily.com/8262-email-etiquette-tips.html>
5. <https://www.youtube.com/watch?v=UOceysteljo>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20(to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical					
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks
30(to be weighted for 10 marks)			30 marks		40
Listening (L)*	10		Listening (L)*	10	
Speaking(S)	5		Speaking(S)	5	
Reading(R)*	10		Reading(R)*	10	
Writing(W)*	5		Writing(W)*	5	

- LRW components of Practical can be evaluated through Language Lab Software



Department	Mechanical Engineering			Programme : B.Tech.							
Semester	I / II			Course Category: ES			*End Semester Exam Type: LE				
Course Code	U23ESPC03			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Graphics Using AutoCAD			0	0	2	1	50	50	100	
(Common to all Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Familiarize with the fundamentals and standards of engineering graphics.								K3	
	CO2	Perform drawing of basic geometrical constructions and multiple views of objects.								K2	
	CO3	Visualize the isometric and perspective sections of simple solids.								K3	
	CO4	Connect side view associate on front view.								K4	
	CO5	Correlate sectional views and lateral surface developments of various solids.								K4	
List of Experiments											
1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures. 2. Drawing a Title Block with necessary text and projection symbol. 3. Drawing 2D sketch by applying modify tools like fillet, mirror, array, etc., 4. Drawing front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning. 5. Drawing front view, top view and side view of objects from the given pictorial views (eg. Simple stool, V-block, Mixie Base). 6. Drawing a plan of residential building (Two bed rooms, kitchen, hall, etc.) 7. Drawing sectional views of prism, pyramid, cylinder, cone, etc, 8. Drawing lateral surface development of prism, pyramid, cylinder, cone, etc, 9. Drawing isometric projection of simple objects. 10. Creating 3D model of simple object and obtaining 2D multi-view drawings. 11. Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.											
Lecture Periods: -		Tutorial Periods: -		Practical Periods: 30				Total Periods: 30			
Reference Books											
1. James D. Bethune, Engineering Graphics with AutoCAD A Spectrum book 1st Edition, Macromedia Press, Pearson, 2020. 2. NS Parthasarathy and Vela Murali, Engineering Drawing, Oxford university press, 2015. 3. M.B Shah, Engineering Graphics, ITL Education Solutions Limited, Pearson Education Publication, 2011. 4. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017. 5. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd., 7th Edition, New Delhi, 2016. 6. C M Agrawal, Basant Agrawal, Engineering Graphics, McGraw Hill, 2012. 7. Dhananjay A. Jolhe, Engineering Drawing: With An Introduction To CAD McGraw Hill, 2016. 8. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.											
Web References											
1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php											



2. <http://www.nptelvideos.in/2012/12/computer-aided-design.html>
3. <https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/>
4. <https://autocadtutorials.com>
5. <https://dwgmodels.com>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	3	-	-	2	3	3	3
2	3	1	-	-	3	-	-	3	-	-	3	3	3	3
3	3	1	-	-	3	-	-	3	-	-	3	3	3	3
4	3	1	-	-	3	-	-	3	-	-	2	3	3	3
5	3	1	-	-	3	-	-	3	-	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Computer Science and Engineering			Programme:B.Tech.							
Semester	I / II			Course Category:ES			*End Semester ExamType:LE				
Course Code	U23CSPC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming In C Laboratory			0	0	2	1	50	50	100	
(Common to all Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Implement logical formulations to solve simple problems leading to specific applications.								K3	
	CO2	Execute C programs for simple applications making use of basic constructs, arrays and strings.								K3	
	CO3	Experiment C programs involving functions, recursion, pointers, and structures.								K3	
	CO4	Demonstrate applications using sequential and random access file processing.								K3	
	CO5	Build solutions for online coding challenges.								K3	
List of Exercises							Periods:09				
1. Create a C program to find the Area of the triangle. 2. Develop a C program to read a three digit number and produce output like 1 hundreds 7 tens 2 units For an input of 172. 3. Write a C program to check whether a given character is vowel or not using Switch – Case statement. 4. Print the numbers from 1 to 10 along with their squares using C program. 5. Demonstrate do—While loop in C to find the sum of ‘n’ numbers. 6. Find the factorial of a given number using Functions in C. 7. Write a C program to check whether a given string is palindrome or not? 8. Write a C program to check whether a value is prime or not? 9. Develop a C program to swap two numbers using call by value and call by reference. 10. Construct a C program to find the smallest and largest element in an array. 11. Implement matrix multiplication using C program. 12. Create a C program to perform various string handling functions like strlen, strcpy, strcat, strcmp. 13. Develop a C program to remove all characters in a string except alphabets. 14. Create a C program to find the sum of an integer array using pointers. 15. Write a C program to find the Maximum element in an integer array using pointers. 16. Construct a C program to display Employee details using Structures 17. Write a C program to display the contents of a file on the monitor screen. 18. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands. 19. Write a C program to create two files with a set of values. Merge the two file contents to form a single file 20. Create a C program to pass the parameter using command line arguments.											
Lecture Periods:			Tutorial Periods:			PracticalPeriods:30			TotalPeriods:30		
Reference Books											
1. Zed A Shaw, “Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)”, Addison Wesley,2016. 2. Anita Goel and Ajay Mittal,” Computer Fundamentals and programming in C”, Pearson Education, First edition, 2011. 3. Maureen Sprinkle Hubbard,” Problem Solving and Programming Concepts,” Pearson,9th Edition, 2011. 4. Yashwanth Kanethkar, “Let us C”, BPB Publications,13th Edition,2008. 5. B.W.Kernighan and D.M. Ritchie, “The C Programming Language”, Pearson Education, 2nd Edition, 2006.											



Web References

1. <https://alison.com/course/introduction-to-c-programming>
2. <https://www.geeksforgeeks.org/c-programming-language/>
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. <https://www.tenouk.com/clabworksheet/clabworksheet.html>
5. <https://fresh2refresh.com/c-programming/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	3	-	3
2	2	1	-	-	3	-	-	-	-	-	-	3	-	3
3	3	2	1	1	3	-	-	-	-	-	-	3	-	3
4	3	2	1	1	3	-	-	-	-	-	-	3	-	3
5	3	2	1	1	3	-	-	-	-	-	-	3	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme:B.Tech.						
Semester	II			Course Category:PC		*End Semester Exam Type:LE				
Course Code	U23BMPC01			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Electron Devices and Circuits Laboratory			0	0	2	1	50	50	100
(Common to ICE and BME Branches)										
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Demonstrate the characteristic of PN Junction diode and Zener diode							K3	
	CO2	Construct and analyze the applications of diodes							K4	
	CO3	Analyze the characteristics of different types of transistors and special diodes.							K4	
	CO4	Design the LC oscillators and analyze the frequency response of CE amplifier.							K4	
	CO5	Simulate the power amplifiers and feedback amplifiers.							K3	
List of Experiments:										
1. Characteristics of PN Junction Diode and Zener Diode. 2. Analysis of Half wave and Full wave Rectifiers. 3. Analysis of wave shaping circuits (Clippers and Clampers). 4. Characteristics of LED and Photo diode. 5. Characteristics of BJT in CB configuration 6. Characteristics of BJT in CE configuration 7. Characteristics of JFET 8. Negative resistance characteristics of UJT 9. Characteristics of Thyristors 10. Study the frequency response of CE Amplifier. 11. Design and Testing of LC Oscillators. 12. Simulation of Power Amplifiers and Feedback Amplifiers.										
Lecture Periods: -			Tutorial Periods: -			Practical Periods: 30		Total Periods:30		
Reference Books										
1. Srinivasa Murthy, "Electronic Devices and Circuits Laboratory Manual", 4 th Edition, October 2015 2. David A.Bell," Lab Manual For Electronic Devices & Circuits", Fourth edition, PHI learning private limited, January 2004 3. Robert Boylestad , Louis Nashelsky, Franz Monssen , " Lab Manual for Electronic Devices and Circuit Theory", Pearson, 11 th Edition, August 2012. 4. Maheswari. L.K and Anand.M.M.S, "Laboratory Manual for Introductory Electronic Experiments", New Age, 2010. 5. Muhammad H. Rashid "Introduction to PSpice using OrCAD for circuits and electronics,Pearson, 3 rd Edition , 2004.										
Web References										
1. www.allaboutcircuits.com 2. www.circuitstoday.com 3. www.tutorialspoint.com										

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping



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B.Tech. Biomedical Engineering

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	2	1	1	1	1	2	3	3	2	3
3	3	3	2	2	3	1	1	1	1	2	3	3	2	3
4	3	3	3	2	3	1	1	2	1	2	3	3	2	3
5	3	2	2	2	3	1	1	2	1	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	II			Course Category: PC			*End Semester Exam Type: LE				
Course Code	U23BMP203			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Biosensors and Transducers Laboratory			0	0	2	1	50	50	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)	
	CO1	Study the characteristics of instruments and measurements									K3
	CO2	Performance measurements of AC and DC bridges									K3
	CO3	Perform the displacement, temperature and pressure measurement using appropriate sensors / transducers									K4
	CO4	Study the characteristics of an LVDT, load cell and pH Electrodes									K4
	CO5	Perform torque measurement with strain gauge and bio transducers and bioelectrodes									K4
List of Experiments:											

* TE – Theory Exam, LE – Lab Exam



COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	1	2	1	2	3	2	2	3
2	3	2	2	2	3	1	1	2	1	2	2	3	2	3
3	3	3	3	3	3	2	1	2	2	2	3	3	3	3
4	3	2	2	2	3	2	1	2	2	2	3	3	2	3
5	3	3	3	3	3	2	1	2	2	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	II	Course Category: AEC				*End Semester Exam Type: LE		
Course Code	U23BMC2XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course - II	0	0	4	-	100	-	100
Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods:-		Practical Periods: 50		Total Periods:50		

* TE – Theory Exam, LE – Lab Exam

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	II				Course Category: MC			End Semester Exam Type:-				
Course Code	U23BMM202				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Sports Yoga and NSS				0	0	2	Non-Credit	100	-	100	
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility and relaxation.										K2
	CO2	Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.										K2
	CO3	Develop understanding of psychological problems associated with age and lifestyle.										K2
	CO4	Recognize the importance of national service in community development.										K2
	CO5	Convert existing skills into socially relevant life skills.										K2
UNIT-I	Introduction To Physical Education							Periods: 06				
Definition, Aims and Objectives of Physical Education - Changing trends in Physical Education Physical Fitness, Wellness and Lifestyle: Importance of Physical Fitness and Wellness - Components of Physical fitness - Components of Health related fitness - Components of wellness - Preventing Health Threats through Lifestyle Change - Concept of Positive Lifestyle.												CO1
UNIT-II	Yoga And Lifestyle							Periods: 06				
Importance of Yoga - Elements of Yoga - Introduction - Asanas, Pranayama, Meditation and Yogic Kriyas - Yoga for concentration and related Asanas (Sukhasana, Tadasana, Padmasana and Shashankasana) - Relaxation Techniques for improving concentration - Yog-nidra. Asanas as preventive measures – Hypertension – Obesity - Back Pain-Diabetes - Asthema.												CO2
UNIT-III	Training And Planning In Sports							Periods: 06				
Training - Warming up and limbering down-Skill, Technique and Style - Objectives of Planning – Tournament - Knock-Out, League/Round Robin and Combination. Psychology and Sports - Important of Psychology in Physical Education and Sports - Differentiate Between Growth and Development - Adolescent problems and their Management - Emotion: Concept, Type and Controlling of emotions - Concepts and Types of Aggressions in Sports - Psychological benefits of exercise - Anxiety and Fear and its effects on Sports Performance - Motivation, its type and techniques - Understanding Stress and Coping strategies												CO3
UNIT-IV	Introduction To National Service Scheme							Periods: 06				
Orientation of NSS volunteers: History, motto, symbol, awards, structure and activities of NSS - Days of National and International Importance - Sensitizing about the thrust areas and awareness activities - Importance of tree plantation and voluntary blood donation - The role of SHGs and NGOs in community development – CSR - Life skills and youth development-extension activities in HEIs - various clubs and schemes like RRC, ELC, YRC, UBA, SBA, etc.,												CO4
UNIT-V	Community Issues And The Use Of Technology							Periods: 06				
Common Problems of rural India - Technology development and its suitability – Sustainability - Value addition to agricultural products - Service learning and youth volunteering – Shramdaan - Campus cleaning - Field visit to nearby communities - village survey - Initiatives to clean and green environment - preservation of water bodies in adopted villages.												CO5
Lecture Periods:-			Tutorial Periods:-			Practical Periods:30			Total Periods: 30			
1. Brar Ajmer Singh, Gill Jagtar Singh, Bains Jagdish, “Modern Textbook of Physical Education Health and Sports- I”, Kalyani i. Publishers , 6 th Edition, 2014												
2. B.K.S. Iyengar, “Light on Yoga: The Definitive Guide to Yoga Practice”,Thorsons Publishers, Thorsons Classics edition, 2015												
3. Joseph, Siby K, Mahodaya, “Bharat Essays on Conflict Resolution”, Institute of Gandhian Studies Publishers, 2007												
4. Barman Prateeti , Goswami, “Document on Peace Education”, Triveni Akansha Publishing House, New Delhi, 2009												
5. Prof R.B.S. Verma, “Field Work Practicum in Social Work-Emerging Concerns”,Rapid Publisher, Lucknow, 2020												



6. Sibereisen, K , Richard M, "Lerner Approaches to Positive Youth Development", Sage Publications, New Delhi, 2007
7. Hoshier Singh, "Administration of Rural Development in India", Sterling Publisher, the University of Michigan, 2009

Web References

1. <http://www.thebetterindia.com/140/national-service-scheme-nss>
2. <http://en.wikipedia.org/wiki/national-service-scheme> 19=<http://nss.nic.in/adminstruct>
3. <http://nss.nic.in>
4. <http://socialworknss.org/about.html>
5. Young Journal on Youth published by SAGE: <http://you.sagepub.com>

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



Department	Mathematics			Programme: B.Tech.						
Semester	III			Course Category Code:BS		*End Semester Exam Type:TE				
Course Code	U23MATC03			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Probability and Statistics			3	1	-	4	25	75	100
(Common to All Branches Except CSBS)										
Prerequisite	Basic Probability									
Course Outcome	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Apply the concept of probability.								K3
	CO2	Solve the problem on Random variables.								K3
	CO3	Evaluate the correlation and Regression.								K3
	CO4	Find Correlation between variables.								K3
	CO5	Analyze the problems in small samples.								K3
UNIT – I	Theory of Probability						Periods:12			
Random Experiments - Sample Space - Exhaustive events- Axioms of probability – Conditional probability – Total probability – Bayes theorem.									CO1	
UNIT – II	Random Variables						Periods:12			
Moments–Moment generating functions and their properties. Binomial distribution – Poisson distribution – Exponential distribution – Normal distribution (Excluding Derivation of Mean, Variance and MGF)									CO2	
UNIT – III	Design of Experiments						Periods:12			
Analysis of variance: One way and two-way classifications. Correlation – Rank correlation and Regression.									CO3	
UNIT – IV	Large Samples						Periods:12			
Large Samples: Single Propositions – Difference of Proportions – Single Mean – Difference of Mean – Difference of Standard Deviations									CO4	
UNIT – V	Small Samples						Periods:12			
Test for Mean – Test for Ratio of Variances – Chi-Square test for Goodness of Fit and Independence of Attributes.									CO5	
Lecture Periods:45			Tutorial Periods:15			Practical Periods:-		Total Periods:60		
Text Books										
B.S. Grewal, “Higher Engineering Mathematics”, Khanna publishers, 3 rd Edition,2017.										
T. Veerarajan, “Probability, Statistics and Random Processes”, Tata McGraw-Hill, 3 rd Edition, 2008.										
A. Singaravelu, “Probability and Statistics”, Meenakshi Agency, 2019.										
Reference Books										
1. Ravish R. Singh, Mukul Bhatt “Engineering Mathematics”, McGraw-Hill, 1 st Edition, 2017.										
2. William Mendenhall, Robert J. Beaver and Barbara M. Beaver: “Introduction to Probability & Statistics”, Cengage Learning, 15 th Edition, 2019.										
3. Richard. A. Johnson, Irwin Miller and John E. Freund,” Probability and Statistics for Engineers”, Pearson Education, Asia, 9 th Edition, 2018.										
4. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, “An Introduction to Probability and Statistics”, Wiley, 3 rd Edition 2008.										
Web References										
1. www.stat110.net										
2. http://www.nptel.ac.in/courses/111105035 (R.V)										
3. http:// www.probabilitycourse.com.										



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4. www.edx.org/Probability5. <http://www2.aueb.gr/users/demos/pro-stat.pdf>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	1	1	1	1
2	3	2	1	1	-	-	-	-	-	-	1	1	1	1
3	2	2	-	-	-	1	-	-	-	-	1	1	1	1
4	3	2	1	1	-	1	-	-	-	-	1	1	1	1
5	3	2	1	1	-	1	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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Department	Artificial Intelligence and Data Science			Programme: B.Tech							
Semester	III			Course Category : ES			End Semester Exam Type: TE				
Course Code	U23ADTC01			Periods / Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Python			3	0	0	3	25	75	100	
(Common to All Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Interpret the basic concepts of Python programs.								K2	
	CO2	Articulate the concepts of Sets, Dictionaries and Object-Oriented concepts.								K2	
	CO3	Experiment with Numpy package.								K3	
	CO4	Apply and analyze Data Manipulation with Pandas.								K3	
	CO5	Illustrate programming concept for Visualization with Matplotlib.								K3	
UNIT-I	Introduction to Python						Periods: 09				
Structure of Python Program – Underlying mechanism of Module Execution – Branching and Looping – Problem Solving Using Branches and Loops – Functions – Lambda Functions – Lists and Mutability – Problem Solving Using Lists and Functions.										CO1	
UNIT-II	Sequence Datatypes and Object-Oriented Programming						Periods: 09				
Sequences – Mapping and Sets – Dictionaries. Classes: Classes and Instances – Inheritance – Exception Handling – Introduction to Regular Expressions using “re” module.										CO2	
UNIT-III	Using Numpy						Periods: 09				
Basics of NumPy – Computation on NumPy – Aggregations – Computation on Arrays – Comparisons – Masks and Boolean Arrays – Fancy Indexing – Sorting Arrays – Structured Data: NumPy’s Structured Array.										CO3	
UNIT-IV	Data Manipulation with Pandas						Periods: 09				
Introduction to Pandas Objects – Data indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Combining Data Sets. Aggregation and Grouping – Pivot Tables –Vectorized String Operations – Working with Time Series – High Performance Pandas – eval() and query().										CO4	
UNIT-V	Visualization With Matplotlib						Periods: 09				
Basic functions of Matplotlib – Simple Line Plot – Scatter Plot – Density and Contour Plots – Histograms – Binnings and Density – Customizing Plot Legends – Colour Bars – Three-Dimensional Plotting in Matplotlib.										CO5	
Lecture Periods: 45			Tutorial Periods:			Practical Periods:		Total Periods: 45			
Text Books											
1. Jake VanderPlas, “Python Data Science Handbook - Essential Tools for Working with Data”, O’Reily Media Inc, 2016. 2. Zhang.Y, “An Introduction to Python and Computer Programming”, Springer Publications, 2016. 3. Wesley J Chun, “Core Python Programming”, Pearson Education, 2 nd Edition, 2006.											
Reference Books											
1. John Paul Mueller, Luca Massaron, “Python for Data Science for Dummies”, 2 nd Edition, John Wiley& Sons, 2019. 2. Jesus Rogel-Salazar, “Data Science and Analytics with Python”, CRC Press Taylor and Francis Group, 2017. 3. Brian Draper, “Python Programming A Complete Guide for Beginners to Master and Become an Expert in Python Programming Language”, CreateSpace Independent Publishing Platform, 2016. 4. Mark Lutz, Laura Lewin, Frank Willison, “Programming Python”, O’Reilly Media, 3 rd Edition, 2006. 5. Gowrishankar S, Veena A, “Introduction to Python Programming”, CRC Press, 2018.											
Web References											
1. https://nptel.ac.in/courses/106/106/106106212/ 2. https://www.geeksforgeeks.org/data-analysis-visualization-python/ 3. https://www.coursera.org/learn/python-data-analysis											

4. <https://www.python.org/>
5. <https://www.programiz.com/python-programming>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	3	-	3
2	2	2	1	3	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	2	3	2	3
4	3	3	2	3	-	-	-	-	-	-	3	3	3	3
5	3	3	2	3	-	-	-	-	-	-	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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Department	Biomedical Engineering			Programme: B.Tech.							
Semester	III			Course Category Code: PC		*End Semester Exam Type: TE					
Course Code	U23BMT304			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Biosignals and Systems			2	1	-	3	25	75	100	
Prerequisite	-										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Distinguish the continuous and discrete-time signals and systems								K2	
	CO2	Capable of characterizing LTI-CT systems in the Transform domain								K3	
	CO3	Analyse the concepts of Z-transform and discrete Fourier transform								K4	
	CO4	Capable of characterizing LTI-DT systems in the Transform domain								K4	
	CO5	Apply DFT for the analysis of digital signals and systems								K4	
UNIT – I	Basics of Discrete and Continuous Time Signals and Systems						Periods:12				
Generation, Representation of discrete time signals and continuous time signals - Standard discrete time signals, Standard continuous time signals - Classification of signals: Continuous time (CT) Discrete time (DT) signals, Basic bio signals, Mathematical operations on CTS and DTS - Scaling, folding, time shifting, addition and multiplication. Classification of systems: static and dynamic systems - time invariant and time variant - linear and nonlinear systems - causal and non-causal systems, stable and unstable systems.										CO1	
UNIT – II	Linear Time Invariant Continuous Time Systems						Periods:12				
Impulse response - Convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series / parallel.										CO2	
UNIT – III	Transforms of Discrete Time Signals						Periods:12				
Z transform-properties-Region of convergence - Representation of poles and zeros in z transform, Inverse z transform - Power series expansion, Partial Fraction method, Discrete time Fourier transform - Properties, Relation between Z transform and DTFT										CO3	
UNIT – IV	Linear Time Invariant-Discrete Time Systems						Periods:12				
Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.										CO4	
UNIT – V	Discrete Fourier Transforms						Periods:12				
Discrete Fourier transforms (DFT) - Properties of DFT - Periodicity, Symmetry, Circular convolution. Linear filtering using DFT. Filtering long data sequences - Overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.										CO5	
Lecture Periods:45		Tutorial Periods:15		Practical Periods:			Total Periods:60				
Text Books											
1. P. Ramesh Babu, “Signals and Systems”, Fifth Edition, Scitech Publishers, 2014.											
2. Allan V. Oppenheim, Allan S.Willsky and S.HamidNawab, “Signals and Systems”, Second Edition, PHI Learning, New Delhi, 2010.											
3. B. P. Lathi, “Principles of Linear Systems and Signals”, Third Edition, Oxford University Press, 2012.											
Reference Books											
1. A. Anand Kumar, “Signals and systems”, Third edition PHI learning Pvt. Ltd., 2015.											
2. M.J. Roberts, “Signals and Systems: Analysis using transform methods and MATLAB”, Second edition, Tata McGraw Hill, 2012.											
3. Suresh R, Devashayam, “Signals and Systems in Biomedical Engineering”, Second edition, Springer US, 2013.											
4. Dr Chitode ”Signals and system”, Technical Publications 2014.											



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5. A.Nagoor Kani, "Digital Signal Processing", 2nd edition, McGraw Hill Education, 2016.

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1. <http://www.nptelvideos.in/2012/12/signals-and-system.html>
2. <http://freevidelectures.com/Course/3177/Signals-and-Systems>
3. <https://nptel.ac.in/courses/117/101/117101055/>
4. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home2.20.html
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home4.30.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	1	-	-	-	-	2	2	-
2	3	3	3	2	-	-	1	-	-	-	-	2	2	-
3	3	3	3	2	-	-	1	-	-	-	-	2	2	-
4	3	3	3	2	-	-	1	-	-	-	-	2	2	-
5	3	3	3	2	-	-	1	-	-	-	-	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Instrumentation and Control Engineering			Programme: B.Tech.						
Semester	III			Course Category: PC			End Semester Exam Type: TE			
Course Code	U23ICTC01			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Linear Integrated Circuits			3	0	0	3	25	75	100
(Common to ICE & BME Branches)										
Prerequisite	Knowledge of electronic circuits									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Acquire knowledge on basic operation of op-amp							K2	
	CO2	Understand the different applications of Operational Amplifier and their design							K3	
	CO3	Gain knowledge on the comparators and waveform generators							K3	
	CO4	Demonstrate the basic concepts and design of active filters and data converters							K4	
	CO5	Gain knowledge on operation, applications of timers and describe the basic concepts of PLL and Voltage regulators.							K3	
UNIT – I	Op-Amp and its Characteristics						Periods:09			
Basics of operational amplifier (op amp) and its ideal characteristics, Internal Building Block, Inverting and non-inverting amplifier, Voltage follower, Differential Amplifier, DC characteristics and AC characteristics.										CO1
UNIT – II	Op-Amp Applications						Periods:09			
Basic Op Amp Applications- Summing Amplifier, Subtractor, Differentiator and Integrator, Half wave rectifier and Full wave rectifier, Peak detector, Clipper and Clamper, Sample and hold circuit, log amplifier, Instrumentation amplifier, V-I and I-V converter.										CO2
UNIT – III	Comparators and Waveform Generators						Periods:09			
Comparator and its applications - Schmitt trigger, Astable multivibrator, Monostable multivibrator, Triangular wave generator, Sawtooth wave generator, RC Phase shift oscillator, Wien bridge oscillator.										CO3
UNIT – IV	Active Filters and Data Converters						Periods:09			
Active Filters: First order low pass and high pass filter, Band Pass Filter, Band Stop Filter. Digital to Analog converters (DAC): Weighted Resistor DAC, R-2R ladder DAC, Inverted R-2R DAC. Analog to Digital converters (ADC): Flash type ADC, Successive approximation ADC, Dual slope ADC.										CO4
UNIT – V	Timer, PLL and Voltage Regulators						Periods:09			
555 timer IC pin diagram and functional diagram, 555 timer in monostable mode and its application as pulse width modulation, 555 timer in astable mode and its application as frequency shift keying (FSK), Phase Lock Loop IC 565. Voltage Regulators: Series op-amp regulator, LM78XX, 79XX fixed voltage regulator, 723 General Purpose Regulator, Switched Mode Power Supply.										CO5
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -		Total Periods: 45				
Text Books										
1. D Roy Choudhury and Shail Jain, “Linear integrated circuits”, New Age Science Limited, Fourth edition, 2018 2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, Fourth Edition, Prentice Hall / Pearson Education, 2015 3. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2010.										
Reference Books										
1. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Fourth Edition,Tata Mc Graw-Hill, 2016. 2. S.Salivahanan& V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”. Second Edition. TMH. 4th Reprint. 2016.										


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3. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2008.
4. B.S.Sonde, "System design using Integrated Circuits", Second Edition, New Age Pub, 2010
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2009.

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1. <http://www.ti.com/applications/industrial/medical/technical-documents.html>
2. <https://e-box.co.in/linear-integrated-circuits.shtml>
3. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

* TE – Theory Exam, LE – Lab Exam

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	2	-	-	-	-	-	-	-	2	3	1	-
2	3	2	2	-	-	-	-	-	-	-	1	3	1	-
3	3	3	3	-	-	-	-	-	-	-	1	3	1	1
4	3	2	2	-	-	-	-	-	-	-	2	3	1	-
5	3	3	3	1	2	-	-	-	-	-	2	3	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Dr. A.Vijayalakshmi

Department	Instrumentation and Control Engineering				Programme: B.Tech.							
Semester	III				Course Category: PC			End Semester Exam Type: TE				
Course Code	U23ICTC02				Periods/Week			Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM	
Course Name	Digital Logic Circuits				2	1	0	3	25	75	100	
(Common to ICE & BME Branches)												
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Interpret the concepts of number systems and binary codes.									K2	
	CO2	Analyze the operations of Boolean algebra and logic gates.									K3	
	CO3	Design and implement combinational logic circuits									K3	
	CO4	Design and implement sequential logic circuits									K3	
	CO5	Understand the memory devices, programmable logic devices and Logic families									K3	
UNIT – I	Number Systems and Binary Codes						Periods:12					
Number Systems-Binary, Octal, Decimal, Hexadecimal. Number system conversions, Binary Arithmetic, Representation of signed binary numbers, 1s and 2s Complements. Binary Codes - Classification, Binary coded decimal (BCD), Weighted, non-weighted, Reflective, sequential, Alphanumeric codes. Error detection codes. Error correction codes.										CO1		
UNIT – II	Boolean Algebra and Logic Gates						Periods:12					
Boolean Algebra: Basic Theorems and Properties, Standard Forms of Boolean Expression-Sum of Product (SOP), Product of Sum(POS), Canonical and Standard forms, Simplification of Boolean expressions - Algebraic simplification, Karnaugh-Map simplification, Quine McClusky simplification. Logic gates: Basic logic gates; Universal gates; Implementation of Boolean function using gates										CO2		
UNIT – III	Combinational Logic Circuits						Periods:12					
Binary adders- Half adder, Full adder, Parallel Adder, Look ahead carry adder, Binary Subtractors - Half subtractor, Full subtractor, 1bit and 2bit Magnitude comparators, Code converters, Decoders and encoders, Multiplexers and Demultiplexers, Parity bit generator and checker.										CO3		
UNIT – IV	Sequential Logic Circuits						Periods:12					
Types of sequential circuits, Comparison between combinational and sequential circuits, Latches-RS latch; Flip flops (FF) – RS,D, JK, and T, JK Master/Slave FF, triggering of flip flops, Excitation tables, Flip flop conversions. Design of Counters- Asynchronous (Ripple) Counters, synchronous counters, Shift registers, Classification of shift registers, Universal Shift Register, Ring Counter, Johnson counter.										CO4		
UNIT – V	Memory, Programmable Logic Circuits and Logic Families						Periods:12					
Memory Classification- Random Access Memory (RAM), Static RAM, Dynamic RAM, Read Only Memory (ROM); PROM, EPROM, EEPROM. Programmable Logic Devices: Programmable ROM (PROM), Programmable Array Logic (PAL), Programmable Logic Array (PLA), Implementation of combinational circuits using PROM, PAL, PLA. Logic families: Characteristics - propagation delay, power dissipation, fan-in, fan-out, noise margin, TTL, ECL, CMOS.										CO5		
Lecture Periods: 60			Tutorial Periods: -			Practical Periods: -			Total Periods: 60			
Text Books												
1. M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008. 2. Anand Kumar, Fundamentals of Digital Circuits Prentice Hall of India, Pvt Ltd, New Delhi, Second Edition, 2014. 3. R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.												


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Reference Books

1. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 6th Edition, TMH, 2003.
2. Charles H. Roth, Larry L. Kinney, Raghunandan G.H. Fundamentals of Logic Design, Cengage Learning India Pvt. Ltd.; 1st edition, 1 September 2019
3. William H. Gothmann, Digital Electronics Prentice Hall, 2001
4. John M. Yarbrough, Digital logic: Applications and Design Thomas Vikas Publishing House, 2002.
5. Ananda Natarajan R, Digital Design, Second edition, Eastern Economy Editions, PHI Learning Pvt. Ltd., 2015.

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1. <https://nptel.ac.in/courses/117106086/>
2. <https://learn.ni.com/teach/resources/1104/digital-electronics>
3. <http://nptel.ac.in/courses/117106/117106086/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	-	-	-	3	1	1
2	3	2	2	-	-	-	-	-	-	-	-	3	1	1
3	3	2	2	-	-	-	-	-	-	-	-	3	1	1
4	3	-	1	-	-	-	-	-	-	-	-	3	1	1
5	3	2	1	-	-	-	-	-	-	-	-	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Biomedical Engineering			Programme: B.Tech							
Semester	III			Course Category: PC			End Semester Exam Type: TE & LE				
Course Code	U23BMB301			Periods / Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Pathology and Microbiology			2	0	2	3	50	50	100	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the structural and functional aspects of living organisms								K2	
	CO2	Understand the importance of Fluid related disorders								K2	
	CO3	Describe the structure of Bacteria and virus								K3	
	CO4	Knowledge about the function of microscope								K3	
	CO5	Define methods involved in easing the pathological diseases								K3	
UNIT-I	Cell Degeneration, Repair and Neoplasia						Periods: 10				
Cell injury and Necrosis, Apoptosis – Intracellular accumulations – Pathological calcification, cellular adaptations of growth and differentiation – Inflammation and Repair including fracture healing, Neoplasia – Classification, Benign and Malignant tumours – carcinogenesis, spread of tumours – Autopsy and biopsy.										CO1	
UNIT-II	Fluid and Hemodynamic Derrangements And Microscopes						Periods: 10				
Edema, normal hemostasis, thrombosis – disseminated intravascular coagulation – embolism, infarction, shock. Hematological disorders – Bleeding disorders, Leukaemias, Lymphomas. Microscopes: Light microscope – bright field, dark field, phase contrast, fluorescence – Electron microscope (TEM & SEM). – Preparation of samples for electron microscope – Staining methods – simple, gram staining and AFB staining.										CO2	
UNIT-III	Microbial Cultures and Immunology						Periods: 10				
Morphological features and structural organization of bacteria – growth curve, identification of bacteria – culture media and its types – culture techniques and observation of culture. Immunology: Natural and artificial immunity – opsonization, phagocytosis, inflammation – Immune deficiency syndrome – antibodies and its types – antigen and antibody reactions – immunological techniques: immune diffusion, immuno electrophoresis – RIA and ELISA – monoclonal antibodies.										CO3	
UNIT-IV	Pathology Lab Experiments						Periods: 15				
1. Sterilization techniques. 2. Preparation of culture media for micro-organisms. 3. ABO blood grouping and Cross matching of blood. 4. Hemoglobin estimation. 5. Bleeding time and clotting time. 6. Manual paraffin tissue processing and section cutting (Demonstration)										CO4	
UNIT-V	Microbiology Lab Experiments						Periods: 15				
1. Study and handling of light microscope. 2. Total RBC count. 3. Peripheral smear study (i) Morphology (ii) WBC differential count. 4. Urine physical and chemical examination. 5. Identification of Bacterial morphology by phase contrast Microscopy/Live and dead bacterial cells by Fluorescence Microscopy (Demonstration) 6. Identification of bacteria using 16s-rRNA sequencing (Demonstration)										CO5	
Lecture Periods: 30			Tutorial Periods:			Practical Periods: 30			Total Periods: 60		
Text Books											
1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, “Pathologic Basis of Diseases”, 10th edition, WB Saunders Co. 2020. 2. Prescott, Harley and Klein, “Microbiology”, 10th edition, McGraw Hill, 2021 3. Harsh Mohan: Text book of Pathology. Jaypee publishers. 9th edition. 2023											


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1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 5th edition, 2010.
2. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 12/E ,2022.
3. Dubey RC and Maheswari DK. "A Textbook of Microbiology" Chand & Company Ltd, 5th edition ,2022
4. Vinay Kumar, Abul K. Abbas" Robbins Essential Pathology" Elsevier, 2020
5. Apurba S Sastry, Sandhya Bhat "Review of Microbiology & Immunology" Jaypee Brothers Medical Publishers Pvt. Limited, 2 Jun 2020

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1. <https://tinyurl.com/ydcze6yx>
2. <http://www.rkmyat.in/up1/34/1629.pdf>
3. <http://moscmm.org/pdf/Ananthanarayan%20microbio.pdf>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	3	1	3	-	1	-	-	-	1	2	-	-
2	3	3	3	1	-	-	1	-	-	-	1	2	-	-
3	3	3	3	1	-	-	1	-	2	-	1	2	-	-
4	2	2	2	2	-	-	-	1	2	-	-	1	2	2
5	1	-	-	-	3	1	-	1	1	3	2	-	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical					
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks
30(to be weighted for 10 marks)			30 marks		40
Conduction of Practical	15 marks		Procedure / Algorithms	5 marks	
Report	10 marks		Experiment / Program Execution	10 marks	
Viva-Voce	5 marks		Result / Output	10 marks	
Total	30 marks		Viva-Voce	5 marks	



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Department	English		Programme: B.Tech.							
Semester	III		Course Category Code: HS				*End Semester Exam Type: LE			
Course Code	U23ENP301		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	General Proficiency- I		0	0	2	1	50	50	100	
(Common to ALL Branches except CSBS)										
Prerequisite	Basics of English Language									
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Interpret meaning and apply reading strategies in technical and non-technical context							K3	
	CO2	Develop interpersonal communication skills professionally							K4	
	CO3	Demonstrate various forms of formal writing							K3	
	CO4	Decode graphical data coherently							K2	
	CO5	Apply the techniques of verbal aptitude in competitive exams							K3	
UNIT- I	Comprehension Analysis					Periods:6				
Listening: Dialogue based on social contexts (IELTS based) - Speaking: Break the iceberg (IELTS based) Submitting Video Recording - Reading: Reading technical passage (IELTS based) - Writing: Writing Task: 2 (IELTS Academic) - Vocabulary: Synonyms (IELTS)									CO1	
UNIT- II	Personality Development					Periods:6				
Listening: Monologue about the everyday social issues (IELTS based) - Interview Videos - Speaking: Speak about the topic in the Flash Card (IELTS based) - Reading: British & American Vocabulary - Writing: SWOT Analysis - Vocabulary: Idioms and Phrases (IELTS)									CO2	
UNIT- III	Inferential Learning					Periods:6				
Listening: Conversation between 4 people regarding education (IELTS based), Anecdotes - Speaking: Structure Discussion (IELTS based) - Reading: Distinguish between facts & opinions (IELTS based), - Writing: Writing Conversation to different context - Vocabulary: Phrasal Verbs (IELTS)									CO3	
UNIT- IV	Interpretation And Functional Writing					Periods:6				
Listening: Monologue on an academic subject (IELTS based), Group Discussion videos - Speaking: Group Discussion Practice - Reading: Read and review (Books, Magazines) - Writing: Writing Task 1: (IELTS Academic: Graph/ chart/tables description) - Vocabulary: Collocations (IELTS)									CO4	
UNIT-V	Verbal Aptitude - I					Periods:6				
Language Enhancement: Articles, Preposition, Conjunction Verbal Ability Enhancement: Ordering of sentences, Blood Relation, Completing Statements- Cloze test, Spotting Errors - Sentence Improvement, Word Analogy, Word Groups (GATE)									CO5	
Lecture Periods: -			Tutorial Periods: -		Practical Periods:30		Total Periods:30			
Reference Books										
1.Lewis, Norman, “Word Power Made Easy”.Goyal Publishers and Distributors Pvt.Ltd., Latest Edition, 2020. 2.Patterson, Kerry, Joseph Grenny,Ron McMillan, Al Switzler, “Crucial Conversation Tools for talking when Stakes are High”, Kindle Publication,2nd Edition, 2011. 3.Comfort, Jeremy,et.al. “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge: Reprint 2011. 4.Agarwal, R. S. “A Modern Approach to Verbal & Non-Verbal Reasoning”. S. Chand, 2010. 5.Wren, Percival Christopher, and Wren Martin. “High School English Grammar and Composition”. S Chand, 2005.										
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1. https://www.ielts-exam.net/grammar/ 2. https://ieltsfocus.com/2017/08/02/collocations-ielts/ 3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers 4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/ 5. https://www.examsbook.com/word-analogy-test-questions-with-answers										


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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	1	-	3	-	2	1	1	1
2	1	-	-	-	-	-	1	-	3	-	2	1	1	1
3	1	-	-	-	-	-	1	-	3	-	2	1	1	1
4	1	-	-	-	-	-	1	-	3	-	2	1	1	1
5	1	-	-	-	-	-	1	-	3	-	2	1	1	1

Correlation Level: 1-Low, 2-Medium, 3-High**Evaluation Methods**

Practical					
Continuous Assessment Internal Evaluation			End Semester External Evaluation		Total Marks
50 marks			50 marks		100
Conduction of Practical (Assignment 1&2 -10 Marks Performance in practical classes - 5 Marks)	15		Listening (L)	20	
Record	5		Speaking(S)	10	
Viva	5		Reading(R)	10	
Model Practical Examination (Model Exam is conducted for 50 Marks that will be converted to 15 Marks)	15		Writing(W)	10	
Attendance	10				



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Department	Mathematics			Programme: B.Tech.							
Semester	III			Course Category Code: CC			*End Semester Exam Type: LE				
Course Code	U23MAPC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Mathematics Laboratory			0	0	2	1	50	50	100	
(Common to all Branches Except CSBS)											
Prerequisite	Matrices, Fourier Transforms, Laplace Transforms										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Perform and evaluate Matrix Operations								K3	
	CO2	Solve Differential and Integral Equations								K3	
	CO3	Construct Fourier series and Fourier Transforms of the given function								K3	
	CO4	Find the Measures of Central tendency								K3	
	CO5	Analyze Correlation and Regression lines								K3	
List of Experiments:											
1. Find the Inverse, Rank, Eigen values and Eigen Vectors of the matrix. 2. Solve the first order differential equation. 3. Find the integration of $\int_a^b f(x)dx$. 4. Find the Fourier series of f(x). 5. Find the Fourier Transform of f(x). 6. Find the Laplace Transform of f(x). 7. Find the Mean, Median and Mode. 8. Construct the Pie and Bar Diagram. 9. Find the Correlation coefficient. 10. Find the Regression lines.											
Lecture Periods:- Nil			Tutorial Periods:- Nil			Practical Periods: 3 0		Total Periods :30			
Reference Books											
1. T. Veerarajan, "Engineering Mathematics, Tata McGraw Hill Education (India) Private Limited Chennai 2nd Edition Paperback – 1 January 2018. 2. M.K. Venkataraman, "Engineering Mathematics, The National Publishing Company, Madras, 2016. 3. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback – 1, 2019.											
Web References											
1. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf 2. https://www.nrigroupindia.com/niist/wp-content/uploads/sites/6/2022/02/lab-manual-it406matlab.pdf 3. https://www.studocu.com/row/document/comsats-university-islamabad/signals-and-systems/lab-lab-manual/38332410											

* TE – Theory Exam, LE – Lab Exam



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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	-	-	-	-	1	1	1	1
2	3	2	1	1	-	1	-	-	-	-	1	1	1	1
3	2	1	-	-	-	1	-	-	-	-	1	1	1	1
4	2	1	-	-	-	1	-	-	-	-	1	1	1	1
5	3	2	1	1	-	1	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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Department	Artificial Intelligence and Data Science		Programme: B.Tech							
Semester	III		Course Category : ES			End Semester Exam Type:LE				
Course Code	U23ADPC01		Periods / Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Python Laboratory		0	0	2	1	50	50	100	
	(Common to All Branches)									
Prerequisite	NIL									
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Describe common Python functionality and features used for data science.							K2	
	CO2	Query Data Frame structures for cleaning and processing.							K2	
	CO3	Configure your programming environment							K3	
	CO4	Experiment the concept using data visualization.							K3	
	CO5	Analyze real time datasets,							K3	
List of Exercises										
1. Build a python program to implement Fibonacci series. 2. Build a python program to get a range of numbers from user and to separate even numbers and odd numbers respectively. 3. Build a function in Python to check duplicate letters. It must accept a string, i.e., a sentence. The function should return True if the sentence has any word with duplicate letters, else return False. 4. Build a program to perform arithmetic operations using lambda function. 5. Build a Python program that takes a list of numbers as input and returns a new list containing only the even numbers from the input list. 6. Build a python program to create a class called Car with attributes Company, model, and year. Implement a method that returns the age of the car in years. 7. Build a python program to create a base class called Shape that has a method called area which returns the area of the shape (set it to 0 for now). Then, create two derived classes Rectangle and Circle that inherit from the Shape class to calculate the area of derived classes. 8. Build a python program to implement aggregation using Numpy. 9. Build a python program to perform Indexing and Sorting. 10. Build a python program to perform Handling of missing data. 11. Build a python program to perform usage of Pivot table using Titanic datasets 12. Build a python program to perform use of eval () and query () 13. Build a python program to perform Scatter Plot 14. Build a python program to perform 3D plotting 15. Implement an application to process a real time data.										
Lecture Periods:		Tutorial Periods:		Practical Periods: 30			Total Periods: 30			
Reference Books										
1. Chirag Shah, “A Hands-On Introduction to Data Science”, Cambridge University Press, 2020. 2. Siddhartha Chatterjee, Michal Krystianczuk, “Python Social Media Analytics”, Packt Publishing, 2017. 3. Jake VanderPlas, “Python Data Science Handbook - Essential Tools for Working with Data”, O’Reilly Media Inc, 2016. 4. Zhang.Y, “An Introduction to Python and Computer Programming”, Springer Publications, 2016. 5. Wesley J Chun, “Core Python Programming”, Pearson Education, 2nd Edition, 2006.										
Web References										
1. https://nptel.ac.in/courses/106/106/106106212/ 2. https://www.geeksforgeeks.org/data-analysis-visualization-python/ 3. https://www.coursera.org/learn/python-data-analysis										


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4. <https://www.python.org/>
5. <https://www.programiz.com/python-programming>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	2	2	1	3	-	-	-	-	-	-	2	2	2
2	2	3	2	2	3	-	-	-	-	-	-	2	3	2
3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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Department	Biomedical Engineering			Programme: B. Tech.						
Semester	III			Course Category: PC			*End Semester Exam Type: LE			
Course Code	U23ICPC01			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Linear and Digital Integrated Circuits Lab			0	0	2	1	50	50	100
(Common to ICE & BME Branches)										
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Design various applications of op-amp.							K4	
	CO2	Able to design signal conditioning circuits necessary for instrumentation.							K3	
	CO3	Design various sequential digital circuits like shift registers, counters.							K3	
	CO4	Design asynchronous sequential circuits.							K3	
	CO5	Implement Multiplexer and demultiplexer							K2	
PART –A 1. Design and Testing of Inverting amplifier, Noninverting amplifier and Voltage Follower. 2. Design and Testing of Summer and Subtractor circuits. 3. Design and Testing of Differentiator and Integrator. 4. Design and Testing of Instrumentation amplifier. 5. Design and Testing of First order active filters (LPF, HPF). 6. Implementation of 4-bit DAC using OP AMP, ADC using op-amp. 7. Design and Testing of Astable and monostable multivibrators using 555 Timer. PART –B 8. Study of Logic Gates. 9. Design and implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor circuits. 10. Implementation of Code converters. 11. Implementation of Encoders and Decoders. 12. Verification of multiplexer and demultiplexer. 13. Implementation of Flip flops. 14. Design and implementation of counters. 15. Design and implementation of 4-bit shift registers.										
Lecture Periods:		Tutorial Periods:-			Practical Periods: 30			Total Periods: 30		
Reference Books										
1. D Roy Choudhury and Shail Jain, “Linear integrated circuits”, New Age Science Limited, Fourth edition, 2018. 2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, Fourth Edition, Prentice Hall / Pearson Education, 2015. 3. M. Morris Mano and Michael D. Cilette, Digital DesignII, Prentice Hall, Fifth Edition,2012 4. Thomas L Floyd, “Digital Fundamentals”, Prentice Hall, 11 th Edition, 2014. 5. Anand Kumar, Fundamentals of Digital CircuitsII, Prentice Hall of India, Pvt Ltd, New Delhi, 4th Edition, 2016.										
Web References										
1. https://www.electronics-lab.com/ 2. http://vlabs.iitkgp.ernet.in/be/# 3. https://nptel.ac.in/courses/122/106/122106025/										


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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	-	-	-	-	-	1	3	1	1
2	3	1	-	1	2	-	-	-	-	-	1	3	1	1
3	3	1	-	-	2	-	-	-	-	-	1	3	1	1
4	3	2	3	3	2	-	-	-	-	-	1	3	1	1
5	3	2	3	3	2	-	-	-	-	-	1	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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Department	Biomedical Engineering	Programme: B.Tech.						
Semester	III	Course Category: AE			*End Semester Exam Type: LE			
Course Code	U23BMC3XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – III	0	0	4	-	100	-	100
Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50		Total Periods:50		

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



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Department	Biomedical Engineering			Programme: B.Tech.							
Semester	III			Course Category: AE			*End Semester Exam Type: LE				
Course Code	U23BMS301			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Skill Enhancement Course 1*			0	0	2	-	100		100	
Prerequisite											
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Apply safety protocols in medical equipment troubleshooting.								K3	
	CO2	Execute preventive maintenance for optimal blood pressure monitors.								K3	
	CO3	Learn about the Shortcut keys, Formulae etc.								K3	
	CO4	Explore about power p[oint Presentation								K3	
	CO5	Learn various methods to design in power point presentation								K3	
Course Content:											
Testing and Troubleshooting of Medical Equipment											
1. Rules of Engagements											
a. Look at the device/procedure/process.											
b. Listen to the user/device/procedure/process.											
c. Applications for the device/procedure/process											
2. Blood Pressure Monitor Equipment (Manual)											
a. Preventive Maintenance											
b. Disassembling a Mercury Manometer											
c. Mercury handling protocol											
3. Centrifuge Equipment											
a. Preventive Maintenance											
b. Checking Motor Functions											
c. RPM Measurements											
d. Bypassing Interlock											
4. Microscope											
a. Preventive Maintenance											
b. Checking Light Source											
c. Adjustments of Knobs											
d. Ensuring the amount of Lubricants											
5. Sphygmomanometer											
a. Preventive Maintenance											
b. Mercury leakage											
c. Pressure check.											
d. Aneroid instrument pressure check.											
6. Stethoscopes											
a. Earpiece sound check.											
b. Tube connector check in headpiece.											
c. Parts damaged or faulty.											
Lecture Periods:			Tutorial Periods:			Practical Periods:30		Total Periods: 30			
Reference Books											
1. Justin Cooper and Alex Dahinten, "Medical Equipment Troubleshooting Flowchart Handbook" Published by: Engineering world health, Vesion- 6, 2013											



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Web References

1. <https://www.youtube.com/watch?v=whp2pnCBs6s>
2. <https://www.youtube.com/watch?v=EJJVrCm3YT4>
3. <https://www.youtube.com/watch?v=T0QmUe0bwL8>
4. <https://www.youtube.com/watch?v=3kXnL0AQhYA>
5. <https://www.usms.biz/preventive-maintenance-for-medical-devices/>

Masters in Microsoft Excel**Module I: Excel Basics****(6 Hrs)**

About Excel, The Excel environment, The Title Bar – The Ribbon – Scroll Bars – The MS Office Button – The Quick Access Toolbar – The Formula Bar – The Workbook Window – The Status bar – The Workbook View Buttons – The Zoom Slider – the Mini toolbar – Keyboard Shortcuts.

Module II: Data handling**(6 Hrs)**

Sorting & Filtering: Techniques for sorting and filtering data, including controlling the order of precedence in a sort, advanced filters, and an introduction to PivotTables. Using sorting and filtering to check and 'clean' data. Controlling user input: Controlling the way users can enter data into a spreadsheet to reduce risk of error and increase efficiency. Covers Data Validation and using IS- functions to trap errors. Working with Text: Entering and formatting text, extracting or combining parts of text. 'Cleaning' data for typos and bugs. Lookup & Reference: Looking up information in a basic table, and more flexibly. VLOOKUP() and the more flexible INDEX()/MATCH() combination. Advanced lookups.

Module III: Formatting**(6 Hrs)**

Cell Formatting - Basic font formatting, alignment – Including horizontal and vertical alignment, wrapping, merging, orientation, Alt-Return; consistent, sensible row heights & column. Number Formatting - Types of number (E.g., currency, %, decimal, negative numbers) – and Excel formats best employed. Custom number formats and how to maximise impact and clarity. Conditional Formatting - Changing the format of cells depending on their value. Graphical conditional formats. Writing conditional format formulas.

Module IV: Presentation**(6 Hrs)**

Graphs and Charts - Creating simple charts and editing them to control and improve formatting. Choosing the right chart Principles and guidelines for communicating well with charts. Sparkline's and Maps (when and how to use). Page & Print Setup - Displaying spreadsheets as pages. Page layout view, page breaks, print area, Printing from multiple Worksheets (and that default will be to print only from active Worksheet). Headers and footers. Adjusting page setup. Printing very large sheets of data and finally printing!

Module V: Advanced Excel Capabilities**(6 Hrs)**

Conditional formatting, importing data and text to columns, Functions – Mathematical, String, IF, AND, OR, Searching: match, search, vlookup, Dates, Misc, Pivot tables, Recording and editing Macros.

Lecture Periods:	Tutorial Periods:	Practical Periods:30	Total Periods: 30

Text Books

1. Michael Alexander, "Excel 2007 Dashboards and Reports for Dummies", John Wiley & Sons, 2011
2. Ellen Monk, Spring Davidson, Joseph Brady, "Problem Solving Cases in Microsoft Access and Excel", Cengage Learning, 2009
3. Colleen Conmy, Bill Hazlett, Bill Jelen, Adrienne Soucy, "Excel for Teachers", Tickling Keys, 2010

Reference Books

1. Noreen Brown, Barbara Lave, Julie Romey, "Beginning Excel 2019", Open Oregon Educational Resources, 2017
2. Greg Harvey, "Excel 2019 All-in-One For Dummies", John Wiley & Sons, 2018
3. John Walkenbach, "Excel 2007 Bible", John Wiley & Sons, 2011
4. Matthew MacDonald, "Excel 2010: The Missing Manual", O'Reilly Media, Inc., 2010
5. Rob Bovey, Stephen Bullen, Dennis Wallentin, John Green, "Professional Excel Development: The Definitive Guide to Developing Applications Using Microsoft Excel, VBA, and .NET", Addison-Wesley Professional, 2009



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Web References

1. <https://www.google.com/search?q=ms+excel+working&oq=MS+Excel+working&aqs=chrome.0.0i457j0l3j0i22i30l4.9421j0j4&sourceid=chrome&ie=UTF-8>
2. <https://www.investintech.com/resources/blog/archives/5430-excel-data-tips.html>
3. <https://edu.gcfglobal.org/en/excel2010/working-with-basic-functions/1/>
4. <https://www.online-tech-tips.com/ms-office-tips/microsoft-excel-basics-tutorial-learning-how-to-use-excel/>
5. <https://spreadsheets.com/how-to-use-excel/>

Power Point Presentation Design and Animation**Module I: Getting acquainted with PowerPoint****(6 Hrs)**

Understanding and working with the PowerPoint interface including: the Outline and Slides pane, the Ribbon, Quick Access toolbar, notes pane and the Status Bar.

Module II: Objects and Formatting**(6 Hrs)**

Working with objects in PowerPoint. Copying and moving objects. Formatting including the format painter. Fonts and effects. Inserting new slides. Slide layout. Selecting multiple objects. Grouping objects. The different objects that you can include on a slide. Six slides that demonstrate the six content types: Table, Chart, Graphic, Picture, Clip art, Media clip (movie).

Module III: Slide Design**(6 Hrs)**

Templates and Slide Masters, How to use themes, masters and templates to make slide design quick and consistent. Layouts and footers. Principles of slide design - Principles to guide good, clean design and formatting of slides. Making your slides clearer. Creating professional-looking slides with real impact.

Module IV: Making an Impact**(6 Hrs)**

When and why to use images. How to insert and edit images. Cropping, resizing and manipulating images. Screenshots and videos. Removing picture backgrounds. Applying artistic effects.

Module V: Animation**(6 Hrs)**

Adding and controlling transition effects between slides. Detailed animation and transition options. Animating individual elements of text boxes, charts and diagrams. Presenter tools and features. Custom slide shows. Annotating your slide during a talk. Navigating a presentation. Self-running presentations.

Lecture Periods:	Tutorial Periods:	Practical Periods:30	Total Periods: 30

Text Books

1. Joan Lambert, "Microsoft PowerPoint step by step 2016", Microsoft Press, 2016
2. Curtis Frye, Joan Preppernau, and Joyce Cox, "Microsoft® Office PowerPoint® 2007 Step by Step", Microsoft Press, 2015
3. John Walkenbach, Michael R. Groh, Herb Tyson, Faithe Wempen, "Office 2010 Library: Excel 2010 Bible, Access 2010 Bible, PowerPoint 2010 Bible, Word 2010 Bible", John Wiley & Sons, 2010

Reference Books

1. Joan Lambert, "Microsoft PowerPoint step by step 2019", Microsoft Press, 2019
2. David W. Beskeen, "Illustrated Course Guide: Microsoft PowerPoint 2013 Advanced" Cengage Learning, 2014
3. Joan Preppernau and Joyce Cox, "PowerPoint 2010", Microsoft Press, 2010
4. "Microsoft PowerPoint 2013", John Wiley and Sons, 2013
5. Ann Shaffer and Katherine T. Pinard, "New Perspectives Microsoft Office 365 & PowerPoint 2016: Intermediate", Course Technology, 2016

Web References

1. <https://smallbusiness.chron.com/bibliography-powerpoint-40572.html>
2. <https://bookboon.com/en/powerpoint-ebooks>
3. <https://penandthepad.com/cite-book-powerpoint-8344519.html>
4. <https://www.bookdepository.com/category/1931/PowerPoint>



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Evaluation Method

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	Report	Presentation / Demo / Skill Test	
Marks	10	40	50	100



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Department	Biomedical Engineering	Programme: B.Tech.						
Semester	III	Course Category: MC				*End Semester Exam Type:-		
Course Code	U23BMM303	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Climate Change	0	2	0	-	100	-	100
UNIT- I	Atmosphere and its Components					Periods:6		
Importance of Atmosphere-Physical Chemical Characteristics of Atmosphere- Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability-Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.								
UNIT- II	Global Climate					Periods:6		
Account of past climate Environmental indicators and instrumental records Human Footprints on global warming- Predicting future climates- Temperature regime - Extreme climate events								
UNIT- III	Impacts of Climate Change					Periods:6		
Causes of Climate change: Change of Temperature in the environment-Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem - Water Resources Human Health Industry, Settlement and Society Methods and Scenarios - Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change - Risk of Irreversible Changes.								
UNIT- IV	Observed Changes and its Causes					Periods:6		
Climate change and Carbon credits- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks-The Montreal Protocol UNFCCC - IPCC Evidences of Changes in Climate and Environment on a Global Scale and in India.								
UNIT-V	Climate Change and Mitigation Measures					Periods:6		
Clean Development Mechanism -Carbon Trading- examples of future Clean Technology - Biodiesel Natural Compost Eco Friendly Plastic Alternate Energy Hydrogen Bio-fuels-Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices-Carbon sequestration - Carbon capture and storage (CCS) - International and Regional cooperation- Remedial measures.								
Lecture Periods: 30		Tutorial Periods: -		Practical Periods:			Total Periods:30	
Text Books 1. Joan Fitzgerald "Greenovation: Urban Leadership on Climate Change, Oxford University Press 2020. 2. J. David Neelin" Climate change and climate modelling" Cambridge University press (2011). 3. Robin Moilveen "Fundamentals of weather and climate" Oxford University Press (2nd Edition) (2010), 4. Andrew Dessler and Edward A. Parson "The Science and Politics of Global Climate Change" 2009 5. Dash Sushil Kumar, "Climate Change An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.								
Reference Books 1. Bill McKibben (2012), The Global Warming Reader: A Century of Writing About Climate Change,Penguin. 2. Jason Smerdon(2009) Climate Change: The Science of Global Warming and Our Energy Future, Columbia University 3. Adaptation (2006) and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge. 4. J.M. Wallace and P.V. Hobbs (2006) Atmospheric Science, Elsevier / Academic Press. 5. Jan C. van Dam, (2003) Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press								
Web References 1. https://nptel.ac.in/courses/105102089/ 2. https://www.warmheartworldwide 3. https://nptel.ac.in/content/storage								



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Evaluation methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



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Department	Mathematics		Programme : B.Tech.						
Semester	IV		Course Category Code: BS				End Semester Exam Type: TE		
Course Code	U23MATC04		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Numerical Methods and Optimization		3	1	-	4	25	75	100
(Common to EEE, ECE, ICE, BME, MECH, CIVIL & MECHATRONICS)									
Prerequisite	Basic Mathematics								
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Solve Algebraic and Transcendental equations						K2	
	CO2	Solve Simultaneous Equations by various Numerical Techniques.						K3	
	CO3	Apply the Numerical Techniques of interpolation in various Intervals.						K3	
	CO4	Solve Linear programming problems by using Optimization Techniques.						K3	
	CO5	Find the solution of Transportation and Assignment Problems.						K3	
UNIT – I	Solution of algebraic and transcendental equations					Periods:12			
Solution of Algebraic and Transcendental equations – Bisection method - Method of False position – Newton Raphson method (single only) – Eigen value and Eigen vector by Power method.									CO1
UNIT – II	Linear system of equations					Periods:12			
Solutions of Linear system of equations and Matrix Inversion – Gauss Elimination and Gauss - Jordan methods. Iterative methods – Gauss Jacobi – Gauss Seidel.									CO2
UNIT – III	Interpolation and solution of ordinary differential equations					Periods:12			
Interpolation by Newton's Forward and Backward Difference formula for equal intervals – Lagrange's method for unequal intervals. Integration by Trapezoidal and Simpson's rules (Single integration only). Fourth order Runge-Kutta method for solving first order Differential Equations.									CO3
UNIT – IV	Linear programming problems					Periods:12			
Linear Programming Problems – Graphical Method – Simplex Method: Big M method – Two phase method.									CO4
UNIT – V	Transportation and assignment problems					Periods:12			
Transportation Problems – Initial basic feasible solution using North-West Corner rule, Least Cost Method, Vogel's Approximation Method – Optimality in Transportation Problem by Modified Distribution (MODI) Method. Assignment Problems – Solutions of Assignment Problems by Hungarian Method – Unbalanced Assignment Problems.									CO5
Lecture Periods:45			Tutorial Periods:15		Practical Periods: -			Total Periods:60	
Text Books									
1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, “Numerical Methods”, S. Chand Limited, 2008.									
2. R. Panneerselvam “Operations Research” Prentice Hall of India, 2 nd Edition,2004.									
3. P.K. Gupta, D.S. Hira, “Operations Research”, S. Chand, 5 th Edition, 2018.									
Reference Books									
1. Atul Goyal, Madhuchanda Rakshit Suchet Kumar, “Numerical Methods”, New India publishing Agency, 1 st Edition, 2019.									



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2. Rajesh Kumar Gupta, "Numerical Methods - Fundamental and Applications", Cambridge University Press, 1st Edition, 2019.
3. S.Kalavathy, "Operation Research", Vikas Publishing house, 4th Edition, 2012.
4. Kevin J. Hastings, "Introduction to the Mathematics of Operations Research with Mathematica", Taylor and Francis, 2nd Edition, 2019.
5. T. Veerarajan, "Operations Research", McGraw Hill, 1st Edition, 2018.

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1. <https://nptel.ac.in/courses/111106101/>
2. <https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00>
3. <https://freecomputerbooks.com/Numerical-Methods-with-Applications.html>
4. <https://www.pphmj.com/journals/IJNMA.htm>
5. <https://nptel.ac.in/courses/106/108/106108056/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	1	1	2	2	2	1
2	3	3	2	2	2	-	-	-	1	1	2	2	2	1
3	3	3	2	2	2	-	-	-	1	1	2	2	2	1
4	3	3	3	2	3	-	-	-	1	2	2	2	3	2
5	3	3	3	2	3	-	-	-	1	2	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Computer Science Engineering		Programme : B.Tech							
Semester	IV		Course Category: ES			End Semester Exam Type: TE				
Course Code	U23CSTC03		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Data Structures		3	0	0	3	25	75	100	
(Common to All Branches except CSBS and FT)										
Prerequisite	Any Programming Knowledge									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Compute time and space complexity for given problems							K2	
	CO2	Demonstrate stack, queue and its operation.							K2	
	CO3	Illustrate the various operations of linked list.							K3	
	CO4	Use the concepts of tree for various applications.							K3	
	CO5	Outline the various Tables, Graphs and Sets techniques.							K3	
UNIT - I	Basic Terminologies of Data Structures					Periods:09				
Introduction: Basic Terminologies – Asymptotic Notations: Complexity analysis. Array and its operations - Searching: Linear Search and Binary Search Techniques. Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort. Performance and Comparison among the sorting methods.									CO1	
UNIT - II	Stack and Queue Operations					Periods:09				
Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.									CO2	
UNIT - III	Linked List Operations					Periods:09				
Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.									CO3	
UNIT - IV	Trees					Periods:09				
Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree- Red Black Tree.									CO4	
UNIT - V	Graphs, Tables and Sets					Periods:09				
Graph: Basic Terminologies and Representations – Graph traversal algorithms. Tables: Different types of tables – Hash Table and its operations - Applications. Sets: Representation of Sets- Operations and its applications.									CO5	
Lecture Periods:45			Tutorial Periods:		Practical Periods:-		Total Periods:45			
Text Books										
1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.										
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.										
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4 th Edition, 2009.										
Reference Books										
1. D. Samanta, "Classic Data Structures", Prentice-Hall of India, Second Edition, 2012.										
2. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c" . Prentice-Hall of India, Second Edition, 2007.										
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second. Edition,2006.										
4. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition, Addison-Wesley										



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- Publishing Company, 1995.
 5. Mark Allen Weiss, "Algorithms, Data Structures and Problem Solving with C++", Addison- Wesley Publishing Company, Illustrated Edition, 1995.

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1. <https://www.geeksforgeeks.org/data-structures/>
2. <https://www.javatpoint.com/data-structure-tutorial/>
3. <https://www.studytonight.com/data-structures/>
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. <https://www.w3schools.in/data-structures-tutorial/intro/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	1	1	2	2	2	1
2	3	2	2	1	3	-	-	-	1	1	2	2	2	2
3	3	2	2	2	3	-	-	-	1	1	2	2	2	2
4	3	2	2	2	3	-	-	-	1	2	2	2	3	2
5	3	3	2	2	3	-	--		1	2	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabu



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Department	Biomedical Engineering			Programme: B.Tech.							
Semester	IV			Course Category: PC			End Semester Exam Type: TE				
Course Code	U23BMT405			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Biomechanics			3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the fundamental principles of biomechanics								K2	
	CO2	Analyse the deformability, strength of bone, modes of loading and failure								K3	
	CO3	Analyse the elasticity and deformation properties of soft tissues								K3	
	CO4	Explain the types and mechanics of skeletal joints								K2	
	CO5	Know the locomotion principles of human body								K2	
UNIT-I	Introduction to biomechanics					Periods: 9					
Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Biofluid mechanics, flow properties of blood.										CO1	
UNIT-II	Hard tissue biomechanics					Periods: 9					
Hard Tissues: Bone structure and composition mechanical properties of bone, cortical and cancellous bones,viscoelastic properties, Maxwell and Voight models — anisotropy. Electrical properties of bone, type of fractures, biomechanics of fracture healing.										CO2	
UNIT-III	Soft tissue biomechanics					Periods: 9					
Soft Tissues: Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle; Modelling: Cartilage, Tendon, Ligament, and Muscle.										CO3	
UNIT-IV	Joints biomechanics					Periods: 9					
Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle.										CO4	
UNIT-V	Movement biomechanics					Periods: 9					
Gait analysis, body and limbs- mass and motion characteristics actions, forces transmitted by joints. Joints forces results in the normal and disable human body, normal and fast gait on the level. Patterns: Push/Throw Continuum Biomechanics of push - like motions, Biomechanics of throw - like motions										CO5	
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -			Total Periods: 45				
Text Books											
1. Gerhard A. Holzapfel, Ray W. Ogden, “Mechanics of Biological Tissue”, Springer, 2010.											
2. Sean P. Flanagan and Flanagan, “Biomechanics: A case-based Approach”, Jones and Bartlett Publishers,2018.											
3. Carol A. Oatis, “The Mechanics and Pathomechanics of Human Movement”, Lippincott Williams and Wilkins, 2010.											
Reference Books											
1. Ozkaya, N, Leger, D, Goldsheyder, D, Nordin, M, “Fundamentals of Biomechanics: Equilibrium, Motion,and											



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- Deformation", 4th edition. Springer International Publishing, 2017.
- Donald R. Peterson and Joseph D. Branzino, "Biomechanics: principles and applications", third edition. CRC Press, 2011.
 - Ray W. Ogden, "Biomechanics of Soft Tissue in Cardiovascular Systems", Springer Vienna, 2014.
 - Subrata Pal, "Text book of Biomechanics", Viva education Private limited, New Delhi. 2009
 - Susan J. Hall, "Basics Bio Mechanics" 5th Edition, McGraw-Hill Publishing Co, Newyork, 2007.

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- <https://tinyurl.com/y9bm4f9q>
- <https://tinyurl.com/y8osnq6d>
- <https://tinyurl.com/y78y4cvy>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	2	2	-	-	1	1	2	3	2	1
2	3	3	3	2	3	2	-	-	1	2	2	3	3	2
3	3	3	3	2	3	2	-	-	1	2	2	3	3	2
4	3	2	2	2	2	2	-	-	1	1	2	3	2	1
5	3	2	2	1	2	2	-	-	1	1	2	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Biomedical Engineering				Program: B.Tech.							
Semester	IV				Course Category: PC		End Semester Exam Type: TE					
Course Code	U23BMT406				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Biomedical Instrumentation				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Gain knowledge in electrodes and its functions.										K2
	CO2	Understand the different types of electrodes and its placement for various recordings.										K3
	CO3	Analyse bio amplifier and signal conditioning circuits.										K4
	CO4	Explain various techniques for non-electrical physiological measurements.										K3
	CO5	Investigate various assist and respiratory devices.										K3
UNIT – I	BIOPOTENTIAL ELECTRODES							Periods:9				
Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes											CO1	
UNIT – II	BIOPOTENTIAL MEASUREMENTS							Periods:9				
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven „s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG											CO2	
UNIT – III	SIGNAL CONDITIONING CIRCUITS							Periods:9				
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering											CO3	
UNIT – IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS							Periods:9				
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.											CO4	
UNIT – V	ASSIST DEVICES AND RESPIRATORY DEVICES							Periods:9				
Pacemakers - Defibrillators – Audiometry – Hearing aid, Ventilators, Spirometer, Lung Volume and capacities, Pneumo tachometers: different types											CO5	
Lecture Periods: 45			Tutorial Periods:			Practical Periods: -			Total Periods: 45			
Text Books												
1. R. S. Khandpur, “Biomedical Instrumentation Technology and Applications”, McGraw-Hill Professional, 2014.												
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd edition. PHI, 2008.												
3. Raja Rao, C and Guha S.K, “Principles of Medical Electronics and Biomedical Instrumentation”, Orient Longman Publishers, 2001												
Reference Books												
1. R. Anandanatarajan, “Biomedical Instrumentation”, 2nd edition, PHI Learning, 2016.												
2. Andrew G. Webb, “Principles of Biomedical Instrumentation”, Cambridge University Press, 2018.												
3. John G. Webster, “Medical Instrumentation: Application and Design”, 4th edition. John Wiley and Sons, New York, 2010.												



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4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, 2002.

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1. <https://apm.iitm.ac.in/biomedical/sai/>
2. <https://www.youtube.com/watch?v=iK-6q4nnmtA>
3. <https://www.youtube.com/watch?v=8m8yNSaCMpg>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	2	2		1	1	2	3	2	1
2	3	2	2	1	2	2	2		1	1	2	3	2	1
3	3	3	3	2	3		2		1	1	2	3	3	2
4	3	3	3	2	3	2	2		1	2	2	3	3	2
5	3	3	3	2	3	2	2		1	2	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Biomedical Engineering		Programme: B.Tech.							
Semester	IV		Course Category Code: PC		*End Semester Exam Type: TE					
Course Code	U23BMB401		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Biosignal Processing		2	-	2	3	50	50	100	
Prerequisite										
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Design and implement IIR digital filters							K4	
	CO2	Design and implement FIR digital filters							K4	
	CO3	Identify the process of analyzing ECG & EEG Signals							K3	
	CO4	Implement the FIR and IIR filters in various applications							K3	
	CO5	Simulates and analyses Bio signals							K3	
UNIT-I	Infinite impulse response filters				Periods:10					
Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.								CO1		
UNIT-II	Finite impulse response filters				Periods:10					
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.								CO2		
UNIT-III	Biological signal processing				Periods:10					
Preprocessing of ECG signal, QRS detection Methods-Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms, Automated ECG analysis, Correlation. Detection of EEG Rhythms, Template matching for EEG spike and wave detection, Sleep EEG classification and epilepsy. Medical Applications of Adaptive Noise Cancellation, Speech signal analysis.								CO3		
UNIT- IV	Impulse response filters				Periods:15					
List of Experiments 1.Generation of Discrete and Continuous time signals 2.Linear and Circular Convolution 3.Frequency analysis using DFT 4. IIR Filter Design 5. FIR Filter Design 6. Spectrum analysis and noise removal of biomedical signals								CO4		
UNIT-V	ECG Signal Processing				Periods:15					
List of Experiments 1. ECG Data Compression techniques 2. Detection of QRS Component from ECG signal 3. Analysis of PCG Signal 4. Analysis of EEG Signal 5. Speech signal analysis 6. Down sampling and up-sampling of ECG signals								CO5		



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Lecture Periods:30	Tutorial Periods:-	Practical Periods:30	Total Periods:60
Text Books			
1. Rangayyan, R.M."Biomedical signal analysis (Vol. 33)", John Wiley & Sons,2015. 2. Reddy, D.C."Biomedical signal processing: principles and techniques". McGraw-Hill,2005 3. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012			
Reference Books			
1. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice",Oxford University Press, 2012. 2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2010. 3. StephaneMallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011. 4. Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group,LLC, Second edition. 2012 5. Li Tan , Jean Jiang "Digital Signal Processing fundamentals and Applications", Second edition,Academic Press, 2013			
Web References			
1. https://www.youtube.com/watch?v=S_U-s27nPLE 2. https://www.youtube.com/watch?v=bFeYjFtSsrg 3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles 4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069 5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf			

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	3	2	3	-	-	-	1	1	2	2	3	1
2	3	2	3	2	3	-	-	-	1	1	2	2	3	1
3	3	3	2	2	2	2	-	-	1	1	2	2	3	2
4	3	2	3	2	3	-	-	-	1	1	2	2	3	2
5	3	3	2	2	2	2	-	-	1	1	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	



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Practical			
Continuous Assessment Internal Evaluation		End Semester Internal Evaluation	
30(to be weighted for 10 marks)		30 marks	
Conduction of Practical	15 marks	Procedure / Algorithms	5 marks
Report	10 marks	Experiment / Program Execution	10 marks
Viva-Voce	5 marks	Result / Output	10 marks
Total	30 marks	Viva-Voce	5 marks
		40	



Dr. A.Vijayalakshmi

Department	English			Programme: B.Tech.							
Semester	IV			Course Category: HS			*End Exam Type : LE				
Course Code	U23ENPC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	General Proficiency- II			0	0	2	1	50	50	100	
Prerequisite	Basics of English Language										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Infer ideas to attend international standardized test by broadening receptive and productive skills								K2	
	CO2	Interpret the types of writing in different state of affairs								K3	
	CO3	Acquire meticulous exposure in speaking and get rid of performance anxiety								K2	
	CO4	Articulate the ideas and opinions effectively and coherently								K2	
	CO5	Progress the skills to compete in various competitive exams like GATE, GRE, UPSC, etc.								K4	
UNIT- I	Career Skills						Periods:6				
Listening: Listening at specific contexts - Speaking: Demonstrative speaking practice using visual aids (charts, graphs, maps) - Reading: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) - Writing: Integrated Writing Task (TOEFL) - Vocabulary: Synonyms and Antonyms (IELTS)										CO1	
UNIT- II	Corporate Skills						Periods:6				
Listening: Listening English news and reproducing in own words - Speaking: Team Presentation - Reading: Short texts and Longer Passages (cloze reading) - Writing: Analytical Writing: Analyzing an issue and Argument task (GRE based) - Vocabulary: Prefix and Suffix										CO2	
UNIT- III	Functional Skills						Periods:6				
Listening: Listening TED Talks - Speaking: Brainstorming & Individual Presentation - Reading: Text Completion (GRE Based) - Writing: Picture Inference - Vocabulary: Word Formation										CO3	
UNIT- IV	Transferrable Skills						Periods:6				
Listening: Listening Documentaries and making notes - Speaking: Mock Interview - Reading: Read texts on emerging trends - Writing: Agreeing & Disagreeing Essay (IELTS) - Vocabulary: Euphemism, Redundancy, Clichés and Intensifier.										CO4	
UNIT-V	Verbal Aptitude - li						Periods:6				
Transformational Grammar: Tenses, Change of Voice, Concord Verbal Ability Enhancement: Letter Series, Coding &Decoding, Sentence Equivalence (GRE)Analytical Reasoning and Logical Reasoning (GATE), Syllogism, One-word Substitution, Jumbled Sentences										CO5	
Lecture Periods: -			Tutorial Periods: -			Practical Periods:30		Total Periods:30			
Reference Books											
1. Cullen, Pauline, Amanda French, and Vanessa Jakeman. "The official Cambridge guide to IELTS for academic & general training".Cambridge, 2014. 2. Prasad, Hari Mohan, Sinha, Uma Rani, "Objective English for Competitive Examinations", Tata Mc Graw Hill: Noida,2010. 3. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008. 4. Grussendorf, Marion, "English for Presentations", Oxford University Press, Oxford, 2007. 5. Murphy, Raymond English Grammar in Use with answers: Reference and Practice for Intermediate students, Cambridge: CUP,2004.											
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1. <https://www.englishclub.com/grammar/nouns-compound.htm>
2. <https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/I3p1>
3. <https://www.grammarwiz.com/phrases-and-clauses-quiz.html>
4. <https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/>
5. <http://www.englishvocabularyexercises.com/general-vocabulary/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	2	2	-	-	1	2	-	3	2	2	-
2	2	3	-	2	1	-	-	-	3	-	2	2	2	-
3	1	2	-	1	-	-	2	3	3	2	2	-	-	-
4	2	2	-	2	-	-	2	2	3	2	2	-	-	-
5	3	3	-	3	2	-	-	1	2	2	3	3	3	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Dr. A. Vijayalakshmi

Department	Computer Science Engineering			Programme: B.Tech.							
Semester	IV			Course Category: ES			*End Semester Exam Type: LE				
Course Code	U23CSPC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Data Structures Laboratory			0	0	2	1	50	50	100	
(Common to all Branches Except CSBS and FT)											
Prerequisite	Basic Programming Knowledge										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Analyse the algorithm's / program's efficiency in terms of time and space complexity.								K3	
	CO2	Solve the given problem by identifying the appropriate Data Structure.								K3	
	CO3	Solve the problems of searching and sorting techniques.								K3	
	CO4	Solve problems in linear Data Structures.								K4	
	CO5	Solve problems in non-linear Data Structures.								K4	
List of Exercises:											
1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.											
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.											
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT											
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. a) Delete an elementfrom list b) Search for a key element in list c) count number of nodes in list.											
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.											
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.											
7. Write a C program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree.											
8. Write a C program that use recursive functions to traverse the given binary tree in a) Preorder b) Inorder c) Postorder.											
9. Write a C program to perform the AVL tree operations.											
10. Write a C program to implement Graph Traversal Techniques.											
11. Write a C program to implement the Set operations.											
Union b) Intersection c) Difference.											
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods: 30		Total Periods: 30			
Reference Books											
1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd Edition, 2019.											
2. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st Edition, 2019.											
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st Edition, 2017.											
4. Reema Thareja, "Data structures using C", Oxford University, 2nd Edition, 2014.											



Dr. A. Vijayalakshmi

Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st Edition, 2013.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. <https://www.w3schools.in/data-structures-tutorial/intro/>
3. <https://nptel.ac.in/courses/106103069/>
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. <https://nptel.ac.in/courses/106103069>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	-	2	3	-	-	-	1	-	2	2	3	-
2	3	3	2	2	3	-	-	-	1	-	2	3	3	-
3	3	3	2	2	3	-	-	-	1	-	2	3	2	-
4	3	3	2	2	3	-	-	-	1	-	2	3	2	-
5	3	3	2	2	3	-	-	-	1	-	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practicalclasses			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Dr. A. Vijayalakshmi



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B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Programme : B.Tech.					
Semester	IV			Course Category: PC		*End Semester Exam Type: LE			
Course Code	U23BMP404			Periods/Week		Credit	Maximum Marks		
				L	T	P	C	CAM	ESE
Course Name	Biomedical Instrumentation Laboratory			0	0	2	1	50	50
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Determine the heart axis in different leads and analyse the heart rate							K4
	CO2	Examine the blood pressure using sphygmomanometer							K4
	CO3	Investigate cardiac efficiency test, tuning fork tests for hearing							K4
	CO4	Explain the stimulation of eye, near point and near response							K3
	CO5	Demonstrate Artificial respiration and Cardio Pulmonary Resuscitation							K4
LIST OF EXPERIMENTS									
1. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle									
2. Recording of blood pressure using sphygmomanometer and stethoscope									
3. Measurement of Blood pressure using photo-plethysmography									
4. Measurements of various time intervals between each segment of ECG, Measurement of R-R interval and calculation of Heart Rate									
5. Cardiac Efficiency Test									
6. Measurement of Visually Evoked Potential									
7. Galvanic Skin Resistance (GSR) Measurement									
8. Peripheral pulse signal in different physical posture									
9. EMG Signal for different stress on the muscle									
10. Recording and interpretation of Heart sounds									
11. Demonstration of Artificial respiration and Cardiopulmonary Resuscitation									
12. Determination of Nerve conduction velocity									
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods: 30		Total Periods: 30	
Textbooks									
1. A.K.Sawhney ,”A Course in Electrical and Electronic measurements and Instruments” Dhanpat Rai and Sons, 2000.									
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd edition. PHI, 2018.									
3. Raja Rao, C and Guha S.K, “Principles of Medical Electronics and Biomedical Instrumentation”, Orient Longman Publishers, 2001									
Reference Books									
1. R. Anandanatarajan, Biomedical Instrumentation. PHI Learning, 2009.									
2. Andrew G. Webb, Principles of Biomedical Instrumentation. Cambridge University Press, 2018.									
3. John G. Webster, “Medical Instrumentation: Application and Design”, 4th edition. John Wiley and Sons, New York, 2010.									



4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, 2002.

Web References

1. <https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory>
2. <https://apm.iitm.ac.in/biomedical/sai/>
3. <https://www.electrical4u.com/introduction-to-biomedical-instrumentation/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	2	-	2	3	3	-
2	3	3	2	2	2	2	-	-	2	-	2	3	2	-
3	3	3	2	3	2	-	-	-	2	-	2	3	3	-
4	3	2	2	2	2	-	-	-	2	-	2	3	2	-
5	3	2	3	2	2	3	2	2	3	2	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	IV	Course Category: AEC				*End Semester Exam Type: LE		
Course Code	U23BMC4XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – IV	0	0	4	-	100	-	100
Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50			Total Periods:50	

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	IV			Course Category: AEC			*End Semester Exam Type:				
Course Code	U23BMS402			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Skill Enhancement Course 2*			0	0	2	-			100	
Prerequisite											
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Knowledge about electrical equipment that realize specified testing functions								K2	
	CO2	Analyze the different types of testing in medical equipment								K3	
	CO3	Understand the concept of PCB								K2	
	CO4	Gain adequate knowledge of PCB designing								K3	
	CO5	Acquire presentation skills using ICT								K2	
Course Content:											
Testing of Electronic and Medical Devices											
MODULE 1: Testing of Electrical Equipment (6 Hrs)											
AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires - Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring- Megger-Testing equipment and instruments.											
MODULE 2: Testing of Electronic Components (6 Hrs)											
Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse											
MODULE 3: Testing of Surgical Equipment (Coursera) (6 Hrs)											
Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.											
MODULE 4: Testing of ICU Equipment (Coursera) (6 Hrs)											
X-ray machines, Testing of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.											
MODULE 5: Life Cycle Management of Medical Equipment (6 Hrs)											
Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle, Case study.											
Lecture Periods:			Tutorial Periods:			Practical Periods: 30			Total Periods:		
Reference Books											
1. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York, 4th edition, 2008.											
2. Keith Willson, Keith Ison, Slavik Tabakov, “Medical equipment management”, CRC Press, UK, 2014.											
3. Jenny Dooley,John Lehnert Virginia Evans, “Career Paths: Medical Equipment Repair”, Express Publishing, UK,2018											
4. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation systems”, Cengage Learning Technology & Engineering, 2010.											
5. David Herres, “Troubleshooting and Repairing Commercial Electrical Equipment”, McGraw Hill Professional edition, 2013.											



Web References

1. <https://www.element.com/connected-technologies/electronics-test-methods>
2. <https://www.electronics-notes.com/articles/test-method>
3. <https://www.element.com/more-sectors/medical-device>
4. <https://www.metlabs.com/industries/medical-device-testing/>
5. <https://www.intertek.com/medical/>

PCB Board Designing:**MODULE 1: Introduction to PCB Designing Concepts****(6 Hrs)**

Introduction & Brief History - What is PCB, Difference between PWB and PCB, Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer), PCB Materials? Introduction to Electronic design Automation (EDA) - Brief History of EDA, Latest Trends in Market, How it helps and why it requires, Different EDA tools, Introduction to SPICE and PSpice Environment, Introduction and Working of PROTEUS.

MODULE 2: Component Introduction and their Categories**(6 Hrs)**

Types of Components - Active Components, Passive Components, Component Package Types - Through Hole Packages: Axial lead o Radial Lead, Single Inline Package (SIP), Dual Inline Package (DIP), Transistor Outline (TO), Pin Grid Array(PGA), Through Hole Packages: Metal Electrode Face(MELF), Leadless Chip Carrier(LCC), Small Outline Integrated Circuit(SOIC), Quad Flat Pack(QFP) and Thin QFP (TQFP), Ball Grid Array(BGA), Plastic Leaded Chip Carrier(PLCC)

MODULE 3: Introduction to Development Tools**(6 Hrs)**

Introduction to PCB Design using OrCAD tool, Introduction to PCB Design using PROTEUS tool

MODULE 4: Detailed Description and Practical of PCB Designing**(6 Hrs)**

PCB Designing Flow Chart - Schematic Entry, Net listing, PCB Layout Designing, Prototype Designing - Design Rule Check (DRC), Design for Manufacturing (DFM), PCB Making - Printing, Etching, Drilling, Assembly of components. Description of PCB Layers - Electrical Layers, Mechanical Layers, Documentation Layers, PCB Materials, Rules for Track, Study of IPC Standards

MODULE 5: Designing and Fabrication Process**(6 Hrs)**

Starting the PCB designing, Understanding the schematic Entry, Creating Library & Components, Drawing a Schematic, Flat Design / hierarchical Design, Setting up Environment for PCB, Design a Board Auto routing - Introduction to Auto routing, Setting up Rules, Defining Constraints, Auto router Setup, PCB Designing Practice, Post Designing & PCB Fabrication Process.

Lecture Periods:**Tutorial Periods:****Practical Periods: 30****Total Periods:****Reference Books**

1. Christopher T Robertson, Printed Circuit Board Designer's Reference; Basics, Prentice Hall Modern Semiconductor Design, 2003
2. Bosshart, Printed Circuit Boards: Design and Technology, Tata McGraw-Hill Education, 1983
3. R. S. Khandpur, Printed Circuit Boards, McGraw-Hills, 2005.
4. Charles A. Harper, High Performance Printed Circuit Boards, McGraw Hill Professional, 2000
5. Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002

Web References

1. https://www.electronics-notes.com/articles/analogue_circuits/pcb-design/how-to-design-pcb-board-basics.php
2. <https://www.circuitbasics.com/make-custom-pcb/>
3. <https://learn.sparkfun.com/tutorials/pcb-basics/all>
4. <https://www.pcbpower.com/>
5. <https://www.build-electronic-circuits.com/pcb-design/>



Presentation Skills using ICT:

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

CT skills

- Understand ICT work flow in cloud computing.
- Manage multitasking.
- Deal with main issues using technology in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Teaching tools

- Different ways to create audio visual activities.
- Handle audio visual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained on this course is not considered for CGPA calculation.

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

Department	Biomedical Engineering	Programme: B.Tech.						
Semester	IV	Course Category: MC				*End Semester Exam Type:-		
Course Code	U23BMM404	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Right To Information and Good Governance	2	0	-	-	100	-	100
UNIT- I	Introduction				Periods:6			
Conceptual background - Right to know - Open Government - Transparency in governance and accountability - Right to information under the Indian Constitution - Article 19 (1)(a) and Article 21 of the Constitution - Role of NGOs and movement for right to information - Right to Information Act, 2005 - Scope and objectives.								
UNIT- II	Obligation of Public Authorities				Periods:6			
Obligations of public authorities: Section 4 Designation of Public Information Officers: Section 5 Disposal of request: Section 7 Exemption from disclosure of information: Section 8 Grounds for rejection to access in certain cases: Section 9 Severability: Section 10 Third party information: Section 11								
UNIT- III	Central and State Information Commission				Periods:6			
Constitution of Central and State Information Commissions Terms of office and conditions of service Removal of Chief Information Commissioner or Information Commissioner. Powers and functions of Information Commissions.								
UNIT- IV	Judiciary and Right to Information Act				Periods:6			
Protection of right to access the information - Role of the Supreme Court and High Courts Recent attempts of dilution of the right to information Law								
UNIT-V	Right to Information Act, 2005 and its relevance to other laws				Periods:6			
Public Records Act, 1993 Whistle Blowers Protection Act, 2014 Official Secrets Act, 1923								
Lecture Periods:-		Tutorial Periods: -		Practical Periods:50			Total Periods:50	

* TE – Theory Exam, LE – Lab Exam

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

PROFESSIONAL ELECTIVE - I

Department	Biomedical Engineering				Programme: B.Tech							
Semester	IV				Course Category: PE		End Semester Exam Type:- TE					
Course Code	U23BME401				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Medical Physics				3	0	0	3	25	75	100	
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Comprehend the significance and role of non-ionizing radiation in Medical Applications										K2
	CO2	Understand radioactive decay and production of radio nuclides.										K2
	CO3	Understand the concepts of different interaction of radiation with matter										K2
	CO4	Discuss the measurement of ionizing radiation										K3
	CO5	Enumerate the effect of ionizing radiation in human body										K3
UNIT-I	Nonionizing Radiation and its Medical Application							Periods: 09				
Light- Physics of light, Intensity of light color vision and limits of vision sound - Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) Interaction of Ultrasound with Materials- Reflection and Refraction – Absorption and Scattering Nonionizing Electromagnetic Radiation, Tissue as a leaky dielectric — Relaxation process- overview of non-ionizing radiation effects- low frequency effect- high frequencyeffect.											CO1	
UNIT-II	Principles of Radioactive Nuclides							Periods: 09				
Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positrondecay, 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 Radionuclide- fission and electron Capture reaction, radionuclide Generator-Milking process – Linearaccelerator.											CO2	
UNIT-III	Interaction of Radiation with Matter							Periods: 09				
Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of Gamma radiation with matter- Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.											CO3	
UNIT-IV	Principles of Radiation Detection and Dosimeters							Periods: 09				
Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge.											CO4	
UNIT-V	Radiation Effects							Periods: 09				
Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous system syndrome - Gastro intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation -Stochastic and Deterministic effects Late Deterministic effect in different organs and tissues.											CO5	
Lecture Periods: -45			Tutorial Periods: -			Practical Periods:			Total Periods: 45			
Text Books												
1. Gopal B. Saha “Physics and Radiobiology of Nuclear Medicine”, Fourth Edition, Springer, 2013. 2. ThayalanKuppusamy, “Basic Radiological Physics” Second Edition, Jaypee Brothers Medical Publishers, 2017. 3. Kwan Hoong Ng, “Problem and solutions in Medical Physics: Diagnostic imaging Physics”, Third volume, CRC press, 2011.												



Reference Books

1. Muhammad Maqbool, "An Introduction to Medical Physics", Springer, 2018.
2. SlavikTabakov, "Encyclopedia of Medical Physics", volume 1, CRC press, 2012.
3. Andrew Webb, Nadrine Barrie Smith, "Introduction to Medical Imaging: Physics, Engineering and Clinical Applications, Cambridge University press, 2010.
4. Faiz M Khan, "Khan's Lecture: Handbook of the Physics of Radiation Therapy", 2011.
5. Faiz M Khan, John P Gibbons, "Khan's the physics of Radiation Therapy" Fifth Edition, 2014.

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1. <https://g.co/kgs/CBBKUU>
https://en.m.wikipedia.org/wiki/Medical_physics
2. <https://www.medphys.org/>
3. <https://physicsworld.com/c/medical-physics/>
4. <https://www.classcentral.com/course/medical-applications-particle-accelerator-12557>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	2	-	-	-	-	2	3	2	-
2	3	2	-	-	2	2	-	-	-	-	2	3	2	-
3	3	3	-	2	2	1	-	-	-	-	2	3	3	-
4	3	2	2	3	3	2	2	-	1	-	2	3	3	2
5	3	2	-	2	1	3	3	-	-	-	2	3	2	1

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	IV			Course Category: PE			End Semester Exam Type: TE				
Course Code	U23BME402			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Environmental Biotechnology			3	1	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Gain knowledge in the basic concepts of environmental biotechnology								K2	
	CO2	Familiarize with the biodegrading and bioremediation modules and its functions								K2	
	CO3	Describe the principles of microbiological treatment technologies to clean up contaminated environments.								K3	
	CO4	Explain the replacement of conventional treatment methodologies by using biocatalyst and bioreactors								K2	
	CO5	Understand the various bioproducts production and composting technology								K3	
UNIT – I	Introduction						Periods:9				
Biotechnology in the reduction of carbon dioxide emission- Microbial flora of soil - Microbial treatment of heavy Metal – bioleaching, bioaccumulation, biosorption and bioprecipitation Understand the various bioproducts production and composting technology of heavy metals - Soil, water and air - sources and effects - Removal of Pollutants.										CO1	
UNIT – II	Biodegradation and Bioremediation						Periods:9				
Aerobic degradation of aliphatic and aromatics compounds - Anaerobic degradation of aromatic compounds - Biodegradation of herbicides and pesticides - Remediation Technologies - Bioventing, bio sparging and bio slurping, phytoremediation – Bio desulphurization of coal and oil - microbial treatment of oil pollution.										CO2	
UNIT – III	Microbial Treatment of Waste and Waste Water						Periods:9				
Biological treatment of anaerobic and aerobic- methanogenesis, methanogenic, acetogenic- Use of genetically engineered organisms - Biotechnological Processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.										CO3	
UNIT – IV	Biocatalysts and Bioreactors						Periods:9				
Enzymes isolation, whole cell systems - Biocatalytic Application - Advantages & Disadvantages- Design of activatedsludge process and anaerobic digestion system - Trickling Filter - Rotating biological contactors - Fluidized bed reactor - Up-flow anaerobic sludge blanket reactor (UASB) - High-rate anaerobic waste water treatment.										CO4	
UNIT – V	Bioproducts and Renewable Sources						Periods:9				
Biofertilizers – Biopesticides - Biofuel production – Bioethanol – Biohydrogen – Biodiesel - Bioplastics and biopolymers - Composting technologies, composting systems, compost quality.										CO5	
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -			Total Periods: 45				
Text Books											
1. Bhattacharya B. C. and Banerjee R, “Environmental Biotechnology”, Oxford University Press, 2017.											
2. Jordening H. J. and Winter J., “Environmental Biotechnology: Concepts and Application”, Wiley ,2015.											
3. Bruce Rittmann and Perry McCarty,” Environmental Biotechnology”, McGraw-Hill, 2011.											
Reference Books											
1. W.D. Grant & P.E. Long, Blakie, Environmental Microbiology, Springer, 2019.											
2. H. Polasa, Microbial Gene Technology, South Asian Publishers, 2011.											
3. D. L. Wise, Biotreatment Systems. CRC Press, 2010.											
Web References											
1. https://en.wikipedia.org/wiki/Environmental_biotechnology											
2. http://dbtindia.gov.in/schemes-programmes/research-development/energy-environment-and-bio-resource-based-applications-0											
3. https://www.hindawi.com/journals/scientifica/si/269412/											



* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	2	-	-	1	-	2	3	2	-
2	3	3	-	2	2	3	-	-	1	-	2	3	3	-
3	3	3	2	3	2	2	-	-	1	-	2	3	3	2
4	3	3	3	3	3	2	-	-	1	-	2	3	3	2
5	3	2	3	2	2	3	1	-	2	1	3	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High**Evaluation Methods**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	IV				Course Category: PE		End Semester Exam Type: TE					
Course Code	U23BME403				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Biometric Recognition Systems				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the knowledge of engineering principles underlying biometric systems									K2	
	CO2	Apply algorithms to model finger print									K3	
	CO3	Classify different face recognition and hand geometry pattern									K3	
	CO4	Analyze the design and performance of biometrics									K3	
	CO5	Explain various computations of authentication methods									K2	
UNIT – I	Introduction to Biometrics							Periods:9				
Introduction and background – biometric technologies – passive biometrics – active biometrics - Biometric systems — Enrollment — templates — algorithm — verification — Biometric applications — biometric characteristics- Authentication technologies –Need for strong authentication - Protecting privacy and biometrics and policy – Biometric applications — biometric characteristics.											CO1	
UNIT – II	Fingerprint Technology							Periods:9				
History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching											CO2	
UNIT – III	Face Recognition and Hand Geometry							Periods:9				
Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithms – Biometric fusion.											CO3	
UNIT – IV	Multimodal Biometrics and Performance Evaluation							Periods:9				
Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy – training and adaptability – examples of multimodal biometric systems – Performance Evaluation-Statistical Measures of Biometrics – FAR – FRR – FTE EER – Memory requirement and allocation.											CO4	
UNIT – V	Biometric Authentication							Periods:9				
Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines. Biometric authentication by fingerprint – biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication. Voice and Gait authentication.											CO5	
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Textbooks												
1. Joseph N. Pato, Lynette I. Millette, “Biometric Recognition: Challenges and Opportunities”, 2010.												
2. Zhenan Sun, Jianhuang Lai, Xilin Chen, Tieniu Tan, “ Biometric Recognition” Sixth Chinese conference, 2011.												
3. Anil Kumar Jain, Arun A Ross, KarthikNandakumar, “Introduction to Biometrics”, Springer, 2011.												
Reference Books												
1. Ravi Das, “Biometric Technology: Authentication, Biocryptography and cloud based architecture”, CRC Press, 2014.												
2. Sebastien Marcel, Mark S Nixon, Stan Z. Li, “Handbook of Biometric Anti- spoofing”, Springer, 2014.												
3. Mohammad S Obaidat, IssaTraoreIssacWoungang, “Biometric- Based Physical and cybersecurity systems”, Springer, 2018.												



4. Amine Nait-ali, "Hidden Biometrics when biometric security meets Biomedical Engineering", Springer, 2019.

5. Ted Dunstone, "Biometric system and Data Analysis", Springer, 2010.

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1. <https://www.mooc-list.com/tags/biometric>

2. <https://www.coursera.org/lecture/usable-security/biometric-authentication-RXVog>

3. <https://www.udemy.com/course/biometrics/>

4. <https://nptel.ac.in/courses/106/104/106104119/>

5. http://www.scholarpedia.org/article/Biometric_authentication

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	1	-	2	3	2	-
2	3	3	2	2	3	-	-	-	1	-	2	3	3	2
3	2	3	2	2	3	-	-	-	1	-	2	3	3	2
4	2	3	3	3	3	-	-	-	1	-	2	3	3	2
5	2	3	2	3	3	2	1	-	2	1	3	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

A. 

Department	Biomedical Engineering		Programme: B.Tech.						
Semester	IV		Course Category: PE			End Semester Exam Type: TE			
Course Code	U23BME404		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Hospital Equipment Safety and Management		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Assess practice-based learning and improvement in quality and health policies for patients						K2	
	CO2	Increase the trend for developing educational interventions in patient safety						K2	
	CO3	Know the necessity of improving standard and quality of the hospital						K2	
	CO4	Gain the roles and responsibilities of hospital staffs in various functions of hospital						K3	
	CO5	Able to reach the hospital management standard for the patient safety						K4	
UNIT – I	Clinical Engineering					Periods:9			
Clinical engineering program, Educational responsibilities, Role to be performed by them in hospital, Staff structure in hospital – HIS. Need for evolving health policy, Health organization in state, Health financing system, Health education, Health insurance, Health legislation.									CO1
UNIT – II	Hospital and Industrial Organization					Periods:9			
Difference between hospital and industrial organization, Levels of training, Steps of training, Developing training program, Evaluation of training, Wages and salary, Employee appraisal method.									CO2
UNIT – III	Standardization					Periods:9			
Necessity for standardization, Indian Standards, FDA, AERB, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.									CO3
UNIT – IV	Strategic Management in Hospitals					Periods:9			
Nature and value of strategic management in hospitals - Awareness on the application of IT in Various functions of Hospital. Application of statistical tools in the areas of Health services. Introduction to support services — Disaster management, Ambulance services, Laundry services, Civil Assets.									CO4
UNIT – V	Safety Measures					Periods:9			
Elements of Safety - Safety Publications and Standards Organizations - Orientation to Laboratory Safety - Types of risks in the hospitals - factors of environment - Safety showers and Eye Washes — Radiation hazards — radiation detection — safety measures — standards. Ergonomics - Flammables and Explosives — Formaldehydes - PEL Standards and Calculations - Material Safety - Organization of Safety in the hospitals.									CO5
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -		Total Periods: 45			
Textbooks									
1. Joydeep Das Gupta, “Hospital Administration and Management: A Comprehensive Guide”, Jaypee Brothers Medical Publishers, 2015.									
2. Saxena.M, “Hospital Management”, CBS Publishing, First edition, 2016.									
3. Girdhar J Gyani and Alexander Thomas, “Handbook of Healthcare quality and patient safety” Second edition, Jaypee brothers medical publisher, 2019.									
Reference Books									
1. Sonu Dr. Goel, “Textbook of Hospital Administration”, Elsevier, 2014.									
2. William Charney, “Handbook of Modern Hospital Safety”, CRC press, Second edition, 2010.									
3. Ramani. K. V, “Hospital Management”, Pearson, 2011.									
4. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care ManagementII”, Sixth Edition, Cengage Learning, 2011.									
5. Cindy Taylor, “The Hospital Safety Professional’s Handbook”, Fifth Edition, 2015.									



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1. https://en.wikipedia.org/wiki/Medical_equipment_management
2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. <https://www.who.int/news-room/fact-sheets/detail/patient-safety>
4. <https://www.coursera.org/browse/health/healthcare-management>
5. <https://www.who.int/management/newitems/en/index1.html>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	2	-	3	2	1	2	2	3	2	-	-
2	2	2	-	-	-	3	2	1	2	1	3	2	-	-
3	2	3	2	2	1	3	2	1	2	2	3	3	1	-
4	2	2	2	2	2	2	1	3	3	3	3	2	-	2
5	2	2	3	2	1	3	2	2	3	3	3	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	IV				Course Category: PE		End Semester Exam Type: TE					
Course Code	U23BMECO1				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Communication Systems				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Understand the various Analog modulation techniques										K2
	CO2	Gain knowledge in Digital modulation techniques										K2
	CO3	Knowledge about fiber optic and satellite communication systems										K2
	CO4	Analyse spread spectrum and multiple access techniques										K3
	CO5	Realize the importance of radio communication										K2
UNIT – I	Analog Modulation							Periods:9				
Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM –Power relation – Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.												CO1
UNIT – II	Digital Modulation							Periods:9				
Principles of pulse modulation – sampling theorem, PAM, PWM, PPM, Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction todigital modulation systems – PCM, DPCM, Delta Modulation, ADM, ASK, FSK and PSK.												CO2
UNIT – III	Fiber Optic and Satellite Communication							Periods:9				
Need for fiber optics- principle of light transmission through a fiber- fiber classification-fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system - Power budget analysis for an optical link- Recent medical application of fiber optics.												CO3
Block diagram of a satellite communication system, Satellite Orbits, satellite parameters, satellite link model, GPS services.												
UNIT – IV	Spread Spectrum and Multiple Access Techniques							Periods:9				
Pseudo-noise sequence, DS spread spectrum, FH spread spectrum, multiple access techniques –TDMA andFDMA, source coding of speech for wireless communication.												CO4
UNIT – V	Radio Communication							Periods:9				
Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off- Introduction to 4G & 5G technologies												CO5
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Text Books												
1. Wayne Tomasi, “Advanced Electronic Communication Systems”, Sixth Edition, Pearson Education, 2010.												
2. Kennedy Davis, “Electronic Communication Systems”, Fifth Edition,Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2011.												
3. William C.Y. Lee, “Mobile Cellular Telecommunication Systems”, McGraw Hill International Edition, Third edition, 2008.												
Reference Books												
1. Simon Haykin, “Communication Systems”, Fourth Edition, John Wiley and Sons, 2009.												
2. Rappaport T.S, "Wireless Communications: Principles and Practice", Second Edition, PearsonEducation, 2010												
3. H.Taub, D L Schilling and G Saha, “Principles of Communication”, Third Edition, Pearson Education,2010												
4. B. P.Lathi, “Modern Analog and Digital Communication Systems”, Third Edition, Oxford University Press,2009												
5. Martin S.Roden, “Analog and Digital Communication System”, Fifth Edition, Prentice Hall of India, 2012.												



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1. <https://nptel.ac.in/courses/108104091/>
2. <https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/>
3. <https://nptel.ac.in/courses/117/105/117105143/>
4. <https://nptel.ac.in/courses/108104091/>
5. <https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	1	-	2	3	-	-
2	3	2	-	-	2	-	-	-	1	-	2	3	2	-
3	3	2	2	2	3	1	-	-	1	-	2	3	2	2
4	3	3	2	3	3	-	-	-	1	-	2	3	3	2
5	3	2	-	-	2	2	-	1	2	1	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Management Studies			Programme : B.Tech.						
Semester	V			Course Category Code: HS		*End Semester Exam Type: TE				
Course Code	U23HSTC02			Periods/Week			Credit Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Research Methodology			2	0	0	2	25	75	100
(Common to All Branches)										
Prerequisite	Nil									
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Interpret the different types of research and explain how research methods can be used to address engineering problems.								K2
	CO2	Discuss the research problems, conduct comprehensive literature reviews, and utilize tools and services for effective information retrieval.								K2
	CO3	Apply appropriate methods to design experiments, analyze data, and interpret results using both numerical and graphical techniques.								K3
	CO4	Analyze and apply ethical guidelines to structure and write research papers and dissertations, ensuring academic integrity and avoiding plagiarism.								K4
	CO5	Examine the fundamentals of intellectual property rights to protect and enforce them, with emphasis on their role in fostering innovation and entrepreneurship in engineering.								K3
UNIT-I	Introduction to Research						Periods: 6			
Meaning and Importance of Research, Types of Research: Overview of Basic, Applied, and Developmental Research, Overview of the Research Process, Defining a Research Problem: Key Considerations, Setting Research Objectives and Research Questions, Introduction to Research Design: Basic Concepts, Approaches to Research: Quantitative vs. Qualitative.										CO1
UNIT-II	Problem Formulation and Literature Review						Periods: 6			
Identifying and Formulating Research Problems, conducting a Literature Review: Essential Steps, Referencing and Citation Methods: Basic Techniques. Sources of Information: Overview of Libraries and Online Databases.										CO2
UNIT-III	Research Methods and Data Analysis						Periods: 6			
Introduction to Experimental Research, Developing Hypotheses: Basic Approach. Data Collection Methods:Sampling and Surveys, Basics of Data Analysis: Numerical and Graphical Analysis, Introduction to Inferential Statistics.										CO3
UNIT-IV	Writing and Presenting Research						Periods: 6			
Preparing a Research Report: Key Sections (Abstract, Introduction, Methodology, Results, Discussion, Conclusion). Referencing and Citation: Brief Overview.										CO4
UNIT-V	Ethics and Legal aspects in research						Periods: 6			
Ethical Considerations in Research: Introduction to Scientific Misconduct. Basics of Intellectual Property Rights - Introduction to Patents, Copyrights, and Trademarks – Case studies on ethical dilemmas in research.										CO5
Lecture Periods: 30			Tutorial Periods:			Practical Periods:		Total Periods: 30		
Text Books										
1. Kumar, R. "Research Methodology: A Step-by-Step Guide for Beginners", SAGE Publications, 5 th Edition 2019.										
2. Ram Ahuja," Research methods ". Rawat Publications. 2 nd Edition ,2022										
3. Creswell, J. W., and Creswell, J. D. "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", SAGE Publications, 5 th Edition, 2018.										
Reference Books										
1. Thiel, D. V. "Research methods for engineer", Cambridge University Press". 2014										
2. Ganesan,.R. "Research methodology for engineers", MJP Publishers. 2024.										
3. Agarwal.C. & Sharma.V. "Research methodology in sociology" ,Common wealth Publishers,2012										
4. Thody, A."Writing and presenting research SAGE Study Skills Series", SAGE Publications,2006										
5. Kothari CR. Research methodology – methods and techniques. 5 th Edition, New Delhi: New Age International Publishers; 2023.										



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2. https://owl.purdue.edu/owl/research_and_citation/conducting_research/writing_a_literature_review.html
3. <https://files.eric.ed.gov/fulltext/ED536788.pdf>
4. <https://researcheracademy.elsevier.com/>
5. <https://www.wipo.int/>
6. <https://www.scholastic.com/7-steps-to-successful-research-report.html>
7. <https://www.futurelearn.com/info/courses/business-research-methods-investigation>
8. <https://articles.manupatra.com/article-details/Patent-Types-Laws-related-to-them-in-India>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	-	2	-	-	-	-	-	-	2	3	-	-
2	3	3	-	3	2	-	-	-	-	-	2	3	2	-
3	3	3	2	3	3	-	-	-	-	-	2	2	3	2
4	-	-	-	-	-	-	3	-	2	-	-	-	-	-
5	-	-	-	-	-	2	-	-	-	3	3	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Information Technology			Programme: B.Tech.							
Semester	V			Course Category Code: ES		*End Semester Exam Type: TE					
Course Code	U23ITTC02			Periods / Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Java			3	0	0	3	25	75	100	
(Common to All Branches)											
Prerequisite	Basic knowledge of Object-Oriented Programming Principles										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Articulate the concept of Java fundamentals, OOPs and Strings								K2	
	CO2	Demonstrate the principles of inheritance, packages and interfaces with real time applications								K2	
	CO3	Create real time applications using exception handling and thread programming.								K3	
	CO4	Build distributed applications using Collections and IO streams								K3	
	CO5	Design and build simple GUI programs using AWT, Swings and build database applications								K3	
Unit- I	Introduction								Periods: 09		
Introduction: Java: History – Features – JVM - JRE – JDK – Java Compilation and Execution – Data Types - Variables, Types, Expressions, Assignment Statements, Input/Output Statements: Scanner/System class, Type Casting (Primitives to Primitives), Conditional and Iterative Control Structures - Arrays										CO1	
OOPs with Java: Introduction to OOPs Concepts - Class – Objects – Methods - Access Modifiers – Creating Class and Objects, Object Life-Cycle - Garbage Collection-Constructors - this – static – Array of Objects – Nested Classes.											
String: String Class– Built-in Methods – String Builder - String Buffer											
Unit- II	Inheritance, Interfaces and Packages								Periods: 09		
Inheritance: Types of Inheritance – is-a Relationship, has-a Relationship – super keyword – final keyword – Polymorphism - Method overloading and Method overriding – Abstract Class										CO2	
Interfaces: Define – Extend – Implement – Access - Interfaces vs Abstract classes, Type Conversions (Primitives to Objects vice-versa): Autoboxing and Auto unboxing											
Packages: Define – Create – Access – Import											
Unit- III	Exception Handling and Multithreading								Periods: 09		
Exception Handling: Exception Hierarchy – Checked and Unchecked Exceptions – try, catch, throws, throw and finally – User Defined Exceptions.										CO3	
Multithreading: Thread – Life cycle – Defining and Running – Implementation Types – Thread Priorities – Thread Synchronization - Inter-Thread Communication											
Unit- IV	Collections and I/O Streams								Periods: 09		
Collections: List: Array List and Linked List. Set: Hash Set and Tree Set. Map: HashMap – Stack – Queue. Lambda Expressions.										CO4	
I/O Streams: Streams – Byte Streams and Character Streams – File Input Stream and File Output Stream – File Reader and File Writer. Object Serialization : Object Input Stream and Object Output Stream											
Unit- V	GUI and JDBC								Periods: 09		
AWT: Components – Controls – Event Handling										CO5	
SWING: Swing Components – Layout Management.											
JDBC: JDBC Architecture – JDBC Driver Types – Implementation of JDBC.											
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45		

A. Vijayalakshmi

Text Books

1. Allen B. Downey and Chris Mayeld, "Think Java - How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2020
2. Herbert Schildt, "Java: The Complete Reference", TMH Publishing Company Ltd, 11th Edition, 2018.
3. H.M.Dietel and P.J.Dietel, "Java How to Program", 11th Edition, Pearson Education/PHI, 2017
4. Cay S. Horstmann, Gary Cornell, "Core Java Volume - I Fundamentals", 9th Edition, Prentice Hall, 2013.

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1. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018.
2. Poaul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
3. P.J. Dietel and H.M Dietel, "Java for Programmers", Pearson Education, 9th Edition, 2011.
4. Steven Holzner, "Java 2 Black book", Dreamtech Press, 2011.

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1. <https://www.javatpoint.com/java-tutorial>
2. <https://docs.oracle.com/en/java/>
3. <https://www.studytonight.com/java/>
4. <https://onlinecourses.nptel.ac.in/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Correlation Level: 1 - Low, 2 - Medium, 3 – High

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	2	-	2	3	-	-
2	3	2	2	-	2	-	-	-	2	-	2	3	2	-
3	3	2	3	2	3	-	-	-	2	-	2	3	3	2
4	3	2	2	3	3	-	-	-	2	-	2	3	3	2
5	3	2	3	2	3	2	-	-	3	3	2	3	3	3

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Program: B.Tech.							
Semester	V			Course Category: PC			End Semester Exam Type: TE				
Course Code	U23BMT507			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Microcontroller and its Medical Applications			3	0	0	3	25	75	100	
Prerequisite	Digital Logic Circuits										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the fundamental concepts of 8051 microprocessors								K2	
	CO2	Apply knowledge in programming and interfacing of devices with Microcontroller								K3	
	CO3	Interpret PIC Microcontroller based system design								K3	
	CO4	Elucidate about peripheral devices and interfacing for data communication								K4	
	CO5	Illustrate the applications of microcontroller in biomedical systems								K3	
UNIT – I	8051 Microcontroller						Periods:9				
Architecture of 8051 – Pin diagram – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Addressing modes – Instruction set – Assembly language programming.								CO1			
UNIT – II	Interfacing microcontroller						Periods:9				
Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD and Keyboard Interfacing – ADC, DAC and Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation.								CO2			
UNIT – III	PIC Microcontroller						Periods:9				
General Introduction – PIC 18F4X2 architecture – Von Neumann Architecture and Harvard Architecture – Memory Organization – Addressing Modes – Instruction Set.								CO3			
UNIT – IV	Peripherals and Interfacing						Periods:9				
GPIO programming – Timers Programming – Serial Communication – PWM programming– ADC, DAC and Sensor Interfacing - Stepper Motor								CO4			
UNIT – V	Medical Applications						Periods:9				
Physiological monitoring: Microcontroller based ECG Machine - Pulse oximeter circuit using microcontroller – Design of EOG based home automation – Design of Multipara monitoring system: Temperature - Blood Pressure and Respiration rate.								CO5			
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45					
Text Books											
1. A.K.Ray, K. M. Bhurchandi, “Advanced Microprocessor and Peripherals”, Tata McGraw Hill, 3 rd Edition, 2013											
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2 nd Edition, Pearson education, 2013											
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, ,” PIC Microcontroller and Embedded Systems using Assembly and C for PIC18”, Pearson Education 2016											
Reference Books											
1. Krishna Kant, “Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096”, PHI, 2013											
2. DoughlasV.Hall, Microprocessors and Interfacing, Programming and Hardware”, TMH,2012											
3. Peatman J., “Embedded system Design using PIC18Fxxx”, Prentice Hall, 2013.											
4. Raj Kamal,” Microcontrollers: Architecture, Programming, Interfacing and System Design” Pearson,2011											
5. Martin P. Bates,” Programming 8-bit PIC Microcontrollers in C” Newnes,2008											
Web References											
1. https://www.youtube.com/watch?v=S1QCZW92fU4											
2. https://swayam.gov.in/nd1_noc20_ee42/microprocessors-and-microcontrollers/											



3. <https://www.classcentral.com/course/swayam>
4. <https://freevidelectures.com/course/3018/microprocessors>
5. <https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	2	3	-	-
2	3	3	3	2	3	-	-	2	2	2	2	3	3	3
3	3	3	3	2	3	-	-	-	2	2	2	3	3	3
4	3	3	2	3	3	-	-	-	2	2	2	3	3	3
5	3	3	2	2	3	2	-	-	2	2	2	3	3	3

Correlation level: 1 - Low 2 - Medium 3 - High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Programme: B.Tech							
Semester	V		Course Category: PC		*End Semester Exam Type: TE & LE					
Course Code	U23BMB502		Periods / Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Biocontrol Systems		2	0	2	3	50	50	100	
Prerequisite	Biosignals and Systems									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Explain the concepts of different modelling systems.							K3	
	CO2	Analyse the time response of different order systems, steady state error and frequency response using various plots							K4	
	CO3	Determine the stability and root locus concepts and Investigate the biomedical applications							K4	
	CO4	Demonstrate Transient analysis of signals							K4	
	CO5	Simulate the model of Biological Control System							K4	
UNIT-I	Modelling of Systems					Periods: 10				
Classification of control systems - Open loop and closed loop control systems - advantages and disadvantages, Transfer function, Modelling of electrical systems, Modelling of translational and rotational mechanical systems, Analogous systems, Block diagram reduction technique, Signal flow graph, conversion of block diagram to signal flow graph.								CO1		
UNIT-II	Time and Frequency Response Analysis					Periods: 10				
Standard test signals - step, ramp, parabolic and impulse type and order of a system, Time response of first order systems, Time response of second order systems, Transfer function-Time constant form and pole zero form, time domain specifications, Steady state error.								CO2		
Frequency Response Analysis: Frequency response - Frequency domain specifications, Polar plot, Bode plot.										
UNIT-III	Stability Analysis and Biological Control Systems					Periods: 10				
Stability criterion- necessary conditions for stability, Determining the stability by Routh and Hurwitz criterion, Root locus concepts, Rules for the construction of root locus. Effect of adding poles and zeros to a system.								CO3		
Biological control Systems - Cardiovascular Control System, Skeletal Muscle Servomechanism, Oculo - motor system, sugar level Control Mechanism, Lung mechanics model with proportional control										
UNIT-IV	Simulation of Transient and Stability Analysis					Periods: 15				
1. Generation of Periodic, Exponential, Sinusoidal, Step, Impulse, Ramp signals 2. Transient Analysis of Impulse Response 3. Transient Analysis of Step Response 4. Determine the Time response of Second Order system 5. Frequency Domain Analysis of Signals 6. Stability analysis (Bode, Root Locus) of Linear Time Invariant system.								CO4		
UNIT-V	Simulation of Biological Control Systems Modelling					Periods: 15				
1. State space model for classical transfer function 2. Pole Zero Configuration in S-plane for the given transfer function 3. ECG Signal Generation 4. Simple Lung Mechanics using Transfer Function 5. Blood Glucose Regulation using Simulink 6. Neuromuscular Regulation using Simulink								CO5		
Lecture Periods: 30		Tutorial Periods:-		Practical Periods:30			Total Periods: 60			
Textbooks										
1. Nagrath J and Gopal M, "Control system engineering", 5 th Edition, New Age International Publishers, 2011. 2. Rajeev Gupta, "Control systems engineering", 1 st Edition. Wiley India Pvt Ltd, 2011. 3. Michael C K Khoo. Physiological control systems-Analysis, simulation and estimation", Second Edition, India, 2018.										



Reference Books

1. Norman S Nice, "Control system engineering", 7th Edition, Wiley India Pvt Ltd, 2015.
2. K R Varmah, "Control systems", 1st Edition. Tata McGraw Hill, 2010.
3. Salivahanan, "Control systems Engineering", Pearson Education India, 2015
4. K. Padmanabhan, "Control systems", Wiley India Pvt Ltd, 2020
5. A. Anand Kumar, "Control systems", 2nd Edition. PHI Learning Pvt Ltd, 2015.

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1. <https://nptel.ac.in/courses/107106081/>
2. <https://www.youtube.com/watch?v=QY9NTVh-Awo&list=PLDK4cGT3XCf3GovuGIqmp-mgfm8pXIPH6>
3. <https://www.youtube.com/watch?v=RJleGwXorUk>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	2	3	-	-
2	3	3	2	2	3	-	-	-	-	-	2	3	3	-
3	3	3	2	3	2	-	-	-	2	2	2	3	3	2
4	3	2	-	2	3	-	-	-	-	-	2	3	3	-
5	3	3	3	3	3	-	-	-	2	2	2	3	3	3

Correlation Level: 1 - Low, 2 -Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	
Practical						
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks	
30(to be weighted for 10 marks)			30 marks		40	
Conduction of Practical		15 marks	Procedure / Algorithms	5 marks		
Report		10 marks	Experiment / Program Execution	10 marks		
Viva-Voce		5 marks	Result / Output	10 marks		
Total		30 marks	Viva-Voce	5 marks		

A. [Signature]

Department	Information Technology			Programme: B.Tech						
Semester	V			Course Category Code: ES		*End Semester Exam Type: LE				
Course Code	U23ITPC02			Periods / Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Programming in Java Laboratory			0	0	2	1	50	50	100
(Common to All Branches)										
Prerequisite	Basic concepts of Object-Oriented Programming Principles									
Course Outcome	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Apply and practice logical formulations to solve simple problems leading to specific applications.								K3
	CO2	Demonstrate the use of inheritance, interface and package in relevant applications								K3
	CO3	Implement robust application programs in Java using exception handling and multithreading								K3
	CO4	Build java distributed applications using Collections and IO streams.								K3
	CO5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java.								K3
LIST OF EXERCISES										
1. Develop simple programs using java 2. Develop a java program that implements class and object. 3. Write a java program to find the frequency of a given character in a string 4. Write a java program to demonstrate inheritance and interfaces. 5. Develop a java program that implements the Packages. 6. Create java applications using Exception Handling for error handling. 7. Develop a simple real life application program to illustrate the use of Multi-Threads. 8. Implement simple applications using Collections. 9. Develop application using the concept of I/O Streams 10. Write a Java Program to demonstrate AWT and Swing Components 11. Develop a simple application and use JDBC to connect to a back-end database.										
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods: 30		Total Periods: 30		
Reference Books										
1. Allen B. Downey and Chris Mayeld, "Think Java - How to Think Like a Computer Scientist", Green Tea Press, 2nd Edition, 2020 2. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018 3. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Vol 2, Advanced Features, Pearson Education, 7th Edition, 2010										
Web References										
1. http://www.ibm.com/developerworks/java/ 2. http://docs.oracle.com/javase/tutorial/rmi/. 3. IBM's tutorials on Swings, AWT controls and JDBC. 4. https://www.edureka.co/blog. 5. https://www.geeksforgeeks.org.										

* TE – Theory Exam, LE – Lab Exam

A. Vijayalakshmi

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	-	2	-	2	3	2	-
2	3	2	3	-	3	-	-	-	2	-	2	3	3	-
3	3	2	3	2	3	-	-	-	2	2	2	3	3	2
4	3	2	2	2	3	-	-	-	2	2	2	3	3	2
5	3	2	3	-	3	-	-	-	3	3	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Evaluation Method							
Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme : B.Tech.					
Semester	V			Course Category: PC		End Semester Exam Type: LE			
Course Code	U23BMP505			Periods/Week		Credit	Maximum Marks		
				L	T	P	C	CAM	ESE
Course Name	Microcontroller and its Medical Applications Laboratory			0	0	2	1	50	50
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Develop Proficiency in Microcontroller Assembly Language Programming							K3
	CO2	Execute Assembly Language Programming for arithmetic operations							K4
	CO3	Analyze controller interfacing with external devices.							K4
	CO4	Implement Interfacing devices using Keil / Proteus Software							K4
	CO5	Interface memory and I/O device with controller.							K4
LIST OF EXPERIMENTS									
Part A: Experiments using 8051 Microcontroller									
1. Study of 8051 Microcontroller trainer kit.									
2. Assembly Language Program for addition of 8-bit numbers stored in an array.									
3. Assembly Language Program for Multiplication by successive addition of two 8-bit numbers.									
4. Assembly Language Program for finding largest no. from a given array of 8-bit numbers.									
5. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order.									
6. Stepper motor control by 8051 Microcontroller.									
7. Interfacing of 8-bit ADC 0809 with 8051 Microcontroller.									
8. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller and Waveform generation.									
Part B: Experiments with PIC microcontroller using Keil / Proteus Software									
9. Implementation of GPIO									
10. Implementation of ADC									
11. Interfacing of Stepper motor									
12. Interfacing of 7 Segment display									
13. Design of heart rate monitoring circuit using PIC microcontroller									
Reference Books									
1. A.K .Ray, K. M. Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3 rd Edition, 2013									
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2 nd Edition, Pearson education, 2013									
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey , " PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education 2016									
4. Krishna Kant, "Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096", PHI, 2013									
5. Doughlas V.Hall, Microprocessors and Interfacing, Programming and Hardware", TMH,2012									
Web References									
1. https://www.youtube.com/watch?v=S1QCZW92fU4									
2. https://swayam.gov.in/nd1_noc20_ee42/microprocessors-and-microcontrollers/									
3. https://www.classcentral.com/course/swayam									
4. https://freevideolectures.com/course/3018/microprocessors									
5. https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics									



* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	3	-	-	-	-	-	2	3	2	2
2	3	2	-	-	3	-	-	-	-	-	2	3	2	2
3	3	3	2	2	3	-	-	-	2	2	2	3	3	3
4	3	2	3	2	3	-	-	-	2	2	2	3	3	3
5	3	3	3	2	3	-	-	-	2	2	2	3	3	3

Correlation level: 1 - Low 2 - Medium 3 - High**Evaluation Method**

Evaluation Method							
Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	V		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP506		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Hospital Training		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Apply principles of medical instrumentation to patient care.					K3	
	CO2	Analyze healthcare challenges using biomedical engineering techniques.					K3	
	CO3	Gain hands-on experience of radiological techniques in diagnosing orthopedic and neurological disorders.					K4	
	CO4	Evaluate effectiveness of biomedical engineering solutions in critical care units.					K5	
	CO5	Recognize the importance of inter-professional collaboration in healthcare.					K5	
Department Visit								
1. Cardiology 2. Ophthalmology 3. ENT 4. Orthopaedic and Physiotherapy 5. ICU/CCU 6. Operation Theatre 7. Neurology 8. Nephrology 9. Radiology 10. Nuclear Medicine 11. Pulmonology 12. Urology 13. Obstetrics and Gynaecology 14. Emergency Medicine 15. Biomedical Engineering Department 16. Histo Pathology 17. Biochemistry 18. Pediatric and Neonatal 19. Dental 20. Oncology 21. Medical records/Telemetry								
Text Books								
1. Girdhar J Gyani and Alexander Thomas, “Handbook of Healthcare quality and patient safety”, Jaypee brothers medical publisher, 2 nd Edition, 2019. 2. Shakti Kumar Gupta,Sunil Kant, R Chandrashekhar and Sidharth Satpathy,“Modern Trends in Planning & Designing of Hospitals: Principles and Practice”, Jaypee, 2007. 3. Dr Malhotra’s series, “Step by Step Hospital designing & planning”, Jaypee, 2007.								



Reference Books

1. Sonu Dr. Goel, "Textbook of Hospital Administration", Elsevier, 2014.
2. William Charney, "Handbook of Modern Hospital Safety", CRC press, 2nd Edition, 2010.
3. Cindy Taylor, "The Hospital Safety Professional's Handbook", HCPPro, BLR, 5th Edition. 2015.

Web References

1. https://en.wikipedia.org/wiki/Medical_equipment_management
2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. <https://www.who.int/news-room/fact-sheets/detail/patient-safety>
4. <https://www.coursera.org/browse/health/healthcare-management>
5. <https://www.who.int/management/newitems/en/index1.html>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	3	2	2	3	3	-	2	2	2	3	2	3
2	3	3	2	3	2	2	2	-	2	2	2	3	3	3
3	2	2	-	3	3	2	-	-	2	-	2	3	3	3
4	3	3	3	3	2	3	3	2	2	2	2	3	3	3
5	2	-	-	-	-	3	3	3	3	2	3	2	2	2

Correlation level: 1 - Low 2 - Medium 3 - High

Evaluation Method

Evaluation Scheme							
Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering				Programme: B. Tech.							
Semester	V				Course Category Code: PA		*End Semester Exam Type: -					
Course Code	U23BMW501				Periods / Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Micro Project				0	0	2	1	100	-	100	
Prerequisite	Biomedical Instrumentation, Electronics											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Identify the problem statement for the micro project work through the literature survey									K2	
	CO2	Choose the proper components as per the requirements of the design/ system.									K2	
	CO3	Apply the acquainted skills to develop final model/system									K3	
There shall be a Micro Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the micro project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Micro-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team. The Micro Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Micro Project work with weightage as indicated evaluation Methods.												
Lecture Periods: -			Tutorial Periods: -			Practical Periods: 30			Total Periods: 30			

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	2	-	2	2	2	3	2	2
2	2	2	3	2	3	2	-	2	2	2	2	3	3	3
3	3	3	3	3	3	2	2	3	2	3	3	3	3	3

Correlation Level: 1 – Low, 2 – Medium, 3 - High


Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Evaluation Method

Assessment	Review 1			Review 2				Total Marks
	Novelty	Presentation	Viva	Presentation	Demonstration	Viva	Report	
Marks	10	20	10	20	20	10	10	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	V	Course Category: AEC			*End Semester Exam Type:			
Course Code	U23BMC5XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – V	0	0	4	-	100	-	100
Prerequisite								
of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation. (i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks. (ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass. (iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50		Total Periods:50		

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering			Programme: B.Tech.						
Semester	V			Course Category Code: MC		*End Semester Exam Type: -				
Course Code	U23BMM505			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Essence of Indian Traditional Knowledge			2	0	0	-	100	- 100	
Common to ALL Branches										
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Familiarize with the philosophy of Indian culture							K2	
	CO2	Distinguish the Indian languages and literature							K2	
	CO3	Describe the philosophy of ancient, medieval and modern India							K2	
	CO4	Illustrate the information about the fine arts in India							K2	
	CO5	Describe the contribution of scientists of different eras							K2	
UNIT- I	Introduction To Culture							Periods:06		
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India								CO1		
UNIT- II	Indian Languages, Culture and Literature							Periods:06		
Indian Languages and Literature - I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature								CO2		
UNIT- III	Religion and Philosophy							Periods:06		
Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)								CO3		
UNIT- IV	Fine Arts in India (Art, Technology and Engineering)							Periods:06		
Indian Painting, Indian handicrafts, Music, divisions of Indian classical music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India								CO4		
UNIT-V	Education System in India							Periods:06		
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India								CO5		
Lecture Periods:30			Tutorial Periods: -		Practical Periods: -			Total Periods:30		
Reference Books										
1. KapilKapoor, "Text and Interpretation:The India Tradition", ISBN:81246033375,2005										
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN13:978-8187276333,2007										
3. NCERT, "Position paper on Arts,Music,Dance and Theatre", ISBN 81-7450494-X,200										
4. S.Narain, "Examinations in ancient India", Arya Book Depot,1993										
5. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978 - 8120810990, 2014										
Web References										
1. https://nptel.ac.in/courses/109/104/109104102/										
2. https://nptel.ac.in/courses/101/104/101104065/										
3. https://nptel.ac.in/courses/109/108/109108158/										
4. https://nptel.ac.in/courses/109/106/109106059/										
5. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ae01/										

COs/POs/PSOs Mapping


Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	-	-	-	-	3	2	2	2	1	2	2	-	-
2	2	-	-	-	-	2	2	2	3	1	2	2	-	-
3	3	-	-	-	-	3	3	-	2	-	2	2	-	-
4	2	-	-	-	-	2	2	2	3	-	2	2	-	-
5	3	1	-	-	-	2	-	-	2	1	2	2	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



PROFESSIONAL ELECTIVE – V

Department	Biomedical Engineering		Programme: B.Tech							
Semester	V		Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME505		Periods / Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Laser and Fiber Optics in Medicine		3	0	0	3	50	50	100	
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Understand the basic principles of optical fibers							K2	
	CO2	Analyse the characteristics and configurations of different laser types.							K4	
	CO3	Elucidate the use of laser systems in medicine							K4	
	CO4	Evaluate optical fiber techniques for measurements and applications.							K5	
	CO5	Analyse the applications of laser in medicine							K4	
UNIT-I	Optical Fibers and their Properties					Periods: 09				
Introduction to optical fiber - fiber characteristics - principles of light propagation through a fiber - Different types of fibers and their properties - Losses in the optical fiber - Dispersion - advantages and disadvantages of optical fibers									CO1	
UNIT-II	Laser Fundamentals					Periods: 09				
Laser Fundamentals: Introduction to lasers - Laser characteristics – Laser configuration – Three level and four level lasers – Q-switching – Mode locking – Types of lasers: Gas lasers, Solid lasers, Liquid lasers and Semiconductorlasers.									CO2	
UNIT-III	Laser Systems					Periods: 09				
Lasers used in medical practice: Ruby laser, CO2 laser, Nd-Y AG laser and related solid-state laser. Laser - issue Interaction: Terminology, spectral band designations, energy & power, irradiant & radiant exposure.									CO3	
UNIT-IV	Applications of Optical Fibers					Periods: 09				
Interferometer method of measurement of length – Moire fringes – Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope – Polarization maintaining fibers - Applications.									CO4	
UNIT-V	Laser Applications in Medicine					Periods: 09				
Application in general surgery-Dermatology, Ophthalmology, Cardiovascular &chest surgery, Dentistry, Neuro surgery, Otolaryngology & head and neck surgery, Laser Oncology, Gynecologic laser, Endoscopy, Laparoscopy.									CO5	
Lecture Periods: 45		Tutorial Periods:-		Practical Periods:-			Total Periods: 45			
Textbooks										
1. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic press Inc, 2012. 2. Helena Jelinkova, “Lasers for medical Applications”, Woodhead Publishing, 2013. 3. David A Boas. “Handbook of Biomedical Optics”. CRC Press. 2011.										



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1. Tuan Vo-Dinh, "Biomedical Photonics Handbook", 3 volume set, 2018.
2. Tosi Daniele, "Fiber optics Sensor for Biomedical Applications", 2010.
3. KeyvanNouri, "Laser in Dermatology and Medicine", Springer, 2011.
4. Nagabhushana, "Laser and Optical Instrumentation", I.K International House Pvt Ltd. 2010.

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1. https://en.wikipedia.org/wiki/Fiber_laser
2. https://en.wikipedia.org/wiki/Optical_fiber
3. https://ethw.org/Fiber_Optics
4. <https://www.classcentral.com/course/swayam-fiber-optics-7913>
5. <https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	2	3	2	2
2	3	3	2	2	3	-	-	-	2	2	2	3	3	3
3	3	2	2	2	2	3	3	-	2	2	2	3	3	3
4	3	3	3	2	3	-	-	-	2	2	2	3	3	3
5	3	3	2	2	2	3	2	1	2	2	2	3	3	3

Correlation Level: 1 - Low, 2 -Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. Vijayalakshmi

Department	Biomedical Engineering			Program: B.Tech.							
Semester	V			Course Category: PE		*End Semester Exam Type: TE					
Course Code	U23BME506			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Computers In Medicine			3	0	0	3	25	75	100	
Prerequisite	Biomedical Instrumentation										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the fundamental principles of computer systems and their applications in healthcare								K2	
	CO2	Analyze the Biosignals and medical imaging data								K4	
	CO3	Gain the knowledge about patient monitoring using computers								K3	
	CO4	Evaluate the benefits and limitations of various medical computing technologies.								K3	
	CO5	Explore diverse applications of computational tools in healthcare solutions.								K4	
UNIT – I	Introduction to Computers in Medicine						Periods:9				
Introduction -Overview of computer systems-Medical computing history and evolution-Healthcare information systems-Medical informatics principles-Ethical considerations.									CO1		
UNIT – II	Medical Imaging and Data Analysis						Periods:9				
Multichannel computerized ECG, EMG and EEG-Medical imaging modalities -MRI, CT, PET-Image processing and analysis-Medical image informatics-Picture Archiving and Communication Systems (PACS)- Image-based diagnosis and decision support.									CO2		
UNIT – III	Computers in Patient Monitoring						Periods:9				
Physiological monitoring, automated ICU, computerized arrhythmia monitoring, information flow in a clinical lab, computer interfacing to HIS.									CO3		
UNIT – IV	Computers In Medical Systems Modeling						Periods:9				
Radiotherapy-types- drug design, drug delivery system, physiological system modeling and simulation.									CO4		
UNIT – V	Application of Computers in Medicine						Periods:9				
AI-driven diagnostics and predictive analytics-Applications of ML in personalized medicine, Applications in securing medical records and improving transparency									CO5		
Lecture Periods: 45			Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books											
1. R.D.Lee, “ Computers in Medicine: Progress in Medical Informatics ”, Tata McGraw-Hill, New Delhi, 2010											
2. J. G. L. Garcia Computers in Medicine" Tata McGraw-Hill, January 2006											
3. Dhiya Al-Jumeily Abir Hussain Conor Mallucci Carol Oliver, “Applied computing in medicine and health”, 1 st Edition, 2015.											
Reference Books											
1. David J. Brailer, David B. Kibbe “Computers In Medicine”, Springer-Verlag,1991											
2. Edward H. Shortliffe, James J. Cimino , “ Biomedical Informatics: Computer Applications in Health Care and Biomedicine ”, Springer, 2014											
3. Naval Kishore, “Computer in medicine”, S.Chand (G/L) & Company Ltd, 2003.											
Web References											
1. https://www.techwalla.com/articles/10-ways-computers-are-used-in-medicine											
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2233671/											
3. https://www.online-sciences.com/computer/computers-in-medicine-uses-advantages-and-disadvantages/											



COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	2	2	-	-	2	2	2	3	2	2
2	3	3	3	3	3	2	-	-	2	2	2	3	3	3
3	3	2	2	2	2	3	2	-	2	2	2	3	3	3
4	3	3	2	2	3	3	3	2	2	2	3	3	3	3
5	3	3	2	2	3	2	2	2	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Programme: B.Tech.							
Semester	V		Course Category Code: PE			*End Semester Exam Type: TE				
Course Code	U23BME507		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Transportation in living Systems		3	0	0	3	25	75	100	
Prerequisite	Human Anatomy and Physiology									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Develop and solve models of living system as a microvascular network							K2	
	CO2	Analyse how the living system characteristics depend on the underlying network structure							K4	
	CO3	Evaluate fluid transport systems through natural membranes.							K5	
	CO4	Apply concepts of lymph transportation in human systems.							K3	
	CO5	Provides clear idea about human system along with artificial organ							K2	
UNIT – I	Introduction					Periods:09				
Organization of the human body, cells, tissues, different organs, natural membrane system. Transport of momentum, heat and mass by molecular motion- Newton"s law of viscosity, Fourier"s law of heat conduction and Fick"s law of diffusion. Transport properties – Viscosity, Thermal conductivity and Mass diffusivity.									CO1	
UNIT – II	Heat Transport					Periods:09				
Body temperature regulation based on thermostate principle and its operation, transportation in tissues, muscle, skin and other organs in different environmental temperature.									CO2	
UNIT – III	Transportation of Fluids					Periods:09				
Blood transport through internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, diffusion, osmosis, electroosmosis, ultrafiltration, reverse osmosis through natural membrane systems, reverse osmosis through artificial synthetic membranes.									CO3	
UNIT – IV	Transportation of Lymph					Periods:09				
Transportation of lymph through internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, problems on lymph transfer in human body.									CO4	
UNIT – V	Mass Transfer					Periods:09				
Constituents of blood, urine, mass transfer in kidney, skeletal, nervous, gastro intestine system, cardio pulmonary system,comparison with artificial organs.									CO5	
Lecture Periods:45		Tutorial Periods:		Practical Periods: -			Total Periods:45			
Textbooks										
1. David O.Cooney, “An introduction to fluid, heat & mass transport process-Principles”, Marcel Dekker Inc., Vol.1, 2 nd Edition, 2007										
2. Richard P. Menninger, “Best and Taylor's Physiological Basis of Medical Practice”, LippinCott Williams and Wilkins, 2008										
3. RB Bird, WE Stewart and EN Lightfoot,” Transport Phenomena”, Second Edition, John Wiley and Sons, 2007.										
Reference Books										
1. Kim Barrett, Susan Barman, Jason Yuan, Heddwen Brooks, “Ganong's Review of Medical Physiology”, McGraw-Hill Education, 2019.										
2. SujitK.Chaudhuri, “Concise Medical Physilogy” New Central Book agency, 6 th Edition, 2011.										
3. Patrick Tabeling, “Introduction to Microfluidics”, Oxford University Press, 2005.										
4. Edwin N Lightfoot, “Transport phenomena and living systems; Biomedical aspects of momentum and mass transport”, Wiley; 1 st Edition,1974.										
5. Truskey and Yuan and Katz, “Transport Phenomena in Biological Systems “, Pearson Prentice Hall 2009.										



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1. <https://www.toppr.com/ask/question/transportation-in-the-living-organisms-is-necessary-because-of-the-following-reasons/>
2. https://link.springer.com/content/pdf/10.1007/978-1-349-14068-8_6.pdf
3. <https://secondarytwojyssscience.weebly.com/transport-system-in-living-things.html>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	1	1	2	3	2	2
2	3	3	2	2	2	2	-	-	1	1	2	3	2	2
3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
4	3	2	2	2	2	2	2	-	2	2	2	3	3	3
5	3	3	3	2	3	3	3	2	2	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Program: B.Tech.						
Semester	V		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME508		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Medical Informatics		3	0	0	3	25	75	100
Prerequisite	-								
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Discuss about health informatics and the function of Hospital Information Systems						K2	
	CO2	Analyze medical standards						K4	
	CO3	Explain about storage of medical data						K2	
	CO4	Understand the basic concepts of bioinformatics						K2	
	CO5	Discuss about the application of medical informatics						K3	
UNIT – I	Medical Informatics					Periods:9			
Introduction, Medical Informatics, Bioinformatics, Health Informatics, Structure of Medical Informatics, Functional capabilities of Hospital Information System, On-line services and off-line services, History taking by computer, Dialogue with the computer							CO1		
UNIT – II	Medical Standards					Periods:9			
Evolution of Medical Standards, IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics Patient Records, Healthcare Standard Organizations, JCAHO (Join Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation), Evidence Based Medicine, Bioethics.							CO2		
UNIT – III	Medical Data Storage and Automation					Periods:9			
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, Data mining.							CO3		
UNIT – IV	Health Informatics					Periods:9			
Bioinformatics Databases, Bio, information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training							CO4		
UNIT – V	Recent Trends in Medical Informatics					Periods:9			
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment, Surgical simulation, Radiation therapy and planning , Telemedicine , virtual Hospitals , Smart Medical Homes , Personalized ehealth services , Biometrics , GRID and Cloud Computing in Medicine							CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. R.D.Lele, —Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd, New Delhi,2005									
2. H. K. Huang , “PACS and Imaging Informatics: Basic Principles and Applications”, 2010									
3.Oleg S. Pinykh, “Digital Image Quality in Medicine”, Springer. 2014									
Reference Books									
1. Mohan Bansal, —Medical informatics, Tata McGraw Hill Publishing Computers Ltd, New Delhi,2003									
2. N.Mathivanan, —PC-Based Instrumentation, Prentice Hall of India Pvt Ltd , New Delhi , 2007									
3. Orpita Bosu and Simminder KaurThukral, —Bioinformatics Databases, Tools and Algorithms, Oxford University press, , New Delhi,2007									
4. Yi , Ping Phoebe Chen, —Bioinformatics Technologies, Springer International Edition, New Delhi,2007									
5. Wager, K. A., Lee, F. W., & Glaser, J. P, “Health care information systems: A practical approach for health care management”,4 th Edition, 2017									
Web References									
1. https://www.springer.com/series/1114/books?srsIid=AfmBOopn8yFsNpXa7zA9V11RiO62iZvVTroR29Sn-VsktB5wjCYnYtK									



2. <https://researchguides.uic.edu/c.php?g=252330&p=1683330>
3. <https://elearn.nptel.ac.in/shop/nptel/data-integration-interoperability-in-healthcare/?v=c86ee0d9d7ed>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	3	2	1	2	2	2	3	2	2
2	3	3	2	2	3	3	2	-	2	2	2	3	3	3
3	3	2	2	1	3	2	-	-	2	2	2	3	2	3
4	3	2	2	2	2	2	-	-	1	2	3	3	2	2
5	3	3	2	2	2	2	2	1	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	V				Course Category: PE		*End Semester Exam Type: TE					
Course Code	U23BME509				Periods/Week			Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM	
Course Name	VLSI Systems				3	0	0	3	25	75	100	
Prerequisite	Digital Electronics											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the analysis of CMOS digital electronics circuits									K2	
	CO2	Knowledge about moderately sized CMOS circuits that realize specified digital functions									K2	
	CO3	Apply CMOS technology in sequential circuit design									K3	
	CO4	Apply the concepts of CMOS in designing Memory structures									K3	
	CO5	Implement different design approach of programmable logic devices									K4	
UNIT – I	Introduction TO VLSI Design Styles and CMOS Logic							Periods:9				
Introduction to VLSI Design, Different types of VLSI design styles Full custom, VLSI Design flow. operation of MOS transistors, CMOS logic: PMOS, NMOS and CMOS, Electrical characteristics, stick diagram										CO1		
UNIT – II	Combinational MOS Logic Design							Periods:9				
Static MOS design; Complementary MOS, Rationed logic, Pass Transistor logic, complex logic circuits, Dynamic MOS Design, Dynamic Logic Families and Performances.										CO2		
UNIT – III	CMOS Sequential Circuit Design							Periods:9				
CMOS Sequential circuits: Static latches and Registers, Dynamic latches and Registers, Sense Amplifier Based Register Pipelining, Schmitt Trigger, Monostable Sequential Circuits, A stable Sequential Circuits.										CO3		
UNIT – IV	Design of Arithmetic Building Blocks							Periods:9				
Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Static and Dynamic Adder circuits - The Array Multiplier - Multiplier structures-Baugh-Wooly – Booth Multiplier - Barrel shifter.										CO4		
UNIT – V	Design Approach of Programmable Logic Devices							Periods:9				
Design approach of Programmable logic devices - PLA, PAL and FPGA. FPGA Building Block Architectures, FPGA Interconnect Routing Procedures, ASIC – Types of ASICs, Programmable ASICs.										CO5		
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Text Books												
1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective",, Pearson, 2 nd Edition,2016.												
2. Wayne wolf, “Modern VLSI Design: System on Chip Design”, Prentice Hall of India, 2012.												
3. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, A system Perspective, Addison Wesley, McGraw-Hil, 4 th Edition, 2010.												
Reference Books												
1. Neil H. E. Weste, Kamran Eshraghian, "CMOS Digital Integrated Circuits Analysis and Design", 4 th Edition,2011,												
2. E.Eshranghian, D.A.Pucknelland S.Eshraghian, “Essentials of VLSI circuits and systems”, PHI, 2009.												
3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI DESIGN”, Prentice Hall of India, 3 rd Edition, 2007.												
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2019												
5. Deba Prasad Das, “VLSI Design”, Oxford University Press, 2012.												
Web References												
1. www.cmosvlsi.com												
2. www.vlsi-world.com												

TE – Theory Exam, LE – Lab Exam

A. bn

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	1	1	2	3	2	2
2	3	3	3	2	3	-	-	-	1	2	2	3	3	2
3	3	3	3	2	3	-	-	1	1	2	2	3	3	3
4	3	3	3	2	3	-	-	1	1	2	2	3	3	3
5	3	3	3	2	3	-	-	1	1	2	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT608		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Diagnostic and Therapeutic Equipment		3	0	0	3	25	75	100
Prerequisite	Biomedical Instrumentation								
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Understand Ultrasonic Techniques							K2
	CO2	Describe the patient monitoring and Biotelemetry							K3
	CO3	Understand the classification of Diathermy							K3
	CO4	Interpret special diagnostic techniques							K4
	CO5	Acquire knowledge in patient's safety							K3
UNIT – I	Ultrasonic Techniques					Periods:9			
Diagnosis-Basic principles of Echo technique - display techniques A, B and M mode - Application of ultrasound technique- Echocardiogram, abdomen - obstetrics and gynecology, contrast-enhanced ultrasound,3D and 4D ultrasound imaging.								CO1	
UNIT – II	Patient Monitoring System					Periods:9			
ICU/CCU Equipment - Infusion pumps - bed side monitors - wearable health monitoring - Central consoling controls - Radio Telemetry (single, multi) - Portable and Landline Telemetry unit, - Applications in ECG and EEG Transmission.								CO2	
UNIT – III	Diathermy					Periods:9			
IR and UV lamp and its application - Thermography - Recording and clinical application - short wave diathermy -ultrasonic diathermy - Microwave diathermy - Electro surgery machine - Current waveforms, Tissue Responses -Electro surgical current level, Radiofrequency Ablation.								CO3	
UNIT – IV	Special Diagnostic and Therapeutic Techniques					Periods:9			
Endoscopy, Laparoscopy, Optical Coherence Tomography (OCT), CT-700,EECP(Enhanced External Counter pulsation) -Need for heart lung machine - functioning of bubble - disc type and membrane type oxygenators - finger pump - roller pump - electronic monitoring of functional parameter – Haemo Dialyzer unit – Lithotripsy- Principles of Cryogenic technique and application								CO4	
UNIT – V	Patient Safety					Periods:9			
Physiological effects of electricity - important susceptibility parameters -Macro shock – Micro shock hazards – Patient's electrical environment - Isolated Power system – Conductive surfaces - Electrical safety codes and standards- Basic Approaches to protection against shock - Protection equipment design - Electrical safety analyzer - Testing the Electric system								CO5	
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. Leslie Cromwell," Biomedical Instrumentation and Measurement", 2 nd Edition, Prentice Hall, 2015.									
2. John G. Webster, "Medical Instrumentation Application and Design", 5th Edition, John Wiley and sons,2020.									
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology",3rd Edition, John Wiley and sons, New York, 2003									
Reference Books									
1. Khandpur,R.S,"Handbook of Biomedical Instrumentation ",2nd Edition. Tata Mc Graw Hill, 2003									
2. Rick Krohn, David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, 2013									
3. Principles of Applied Biomedical Instrumentation L. A Geddas and L.E.Baker – 2004.									



4. John G. Webster, "Medical Instrumentation: Application and Design", 4th Edition. John Wiley and Sons, New York, 2010.
5. Samuel A. Fricker, Christoph Thümmel, Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015

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1. <https://www.nap.edu/read/21794/chapter/7>
2. <https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems>
3. [https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206 Diagnostic and Therapeutic Equipment Training.pdf](https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206%20Diagnostic%20and%20Therapeutic%20EquipmentTraining.pdf)

* TE - Theory Exam, LE - Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	1	1	1	2	1	3	3	1
2	3	2	2	2	3	2	1	1	2	2	1	2	3	2
3	3	2	3	2	3	2	1	2	2	2	2	3	3	2
4	3	2	3	3	3	2	2	2	2	2	2	3	3	2
5	3	3	2	2	3	3	2	3	1	2	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT609		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Embedded Systems for Healthcare		3	0	0	3	25	75	100
Prerequisite	Microcontroller								
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Gain in-depth knowledge about embedded processor, its hardware and Instruction set						K2	
	CO2	Analyze memory management and debugging tools for embedded processors.						K4	
	CO3	Familiarize with various Embedded networking protocols						K3	
	CO4	Design embedded systems using EDLC models and hardware-software co-design						K4	
	CO5	Design a Real time embedded system for biomedical applications						K5	
UNIT – I	Introduction to Embedded System and ARM Architecture					Periods:9			
Introduction to Embedded Systems – Embedded system design process. Embedded processors – ARM processor – Architecture, ARM and Thumb Instruction sets								CO1	
UNIT – II	Embedded Computing Platform Design					Periods:9			
Structural units in Embedded processor Structural unit of embedded system - DMA – Memory management methods - Timer and Counting devices, Watchdog Timer - Real Time Clock - In circuit emulator - Target Hardware Debugging.								CO2	
UNIT – III	Embedded Networking					Periods:9			
Embedded Networking: Introduction, I/O Device Ports and Buses– Serial Bus communication protocols –RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers								CO3	
UNIT – IV	Embedded Firmware Development Environment					Periods:9			
Embedded Product Development Life Cycle- objectives - different phases of EDLC - Modelling of EDLC - issues in Hardware-software Co-design - Data Flow Graph - state machine model - Sequential Program Model - concurrent Model - object oriented Model.								CO4	
UNIT – V	Real Time Health Care applications					Periods:9			
Biomedical application- Pulmonary, Patient monitoring system, Body temperature measurement, Mobile phone based bio signal recording								CO5	
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -		Total Periods: 45			
Text Books									
1. RajKamal, “Embedded Systems Architecture, Programming and Design”, Tata McGrawHill ,Second Edition, 2014									
2. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.									
3. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, Mc Graw Hill 1997									
Reference Books									
1. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.									
2. Tim Wilhurst, “An Introduction to the Design of Small Scale Embedded Systems,Palgrave, 2004									
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2005.									
4. Jonathan Valvano, "Embedded Systems: Real-Time Interfacing to Arm Cortex-M3",CreateSpace Independent Publishing Platform,2011									
5. David Simon,"Embedded Systems: A Contemporary Design Tool",Wiley,2009									



Web References

1. <https://www.youtube.com/watch?v=uFhDGagZzjs>
2. <https://nptel.ac.in/courses/108102045>
3. <https://www.amoriabond.com/en/insights/blog/real-time-applications-of-embedded-systems/>
4. <https://www.youtube.com/watch?v=S-daLDfkoyY>
5. <https://www.youtube.com/watch?v=7LqPJGnBPMM>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	-	1	-	1	-	3	2	1
2	3	2	2	2	3	3	-	-	-	-	-	3	3	-
3	3	3	2	3	1	2	-	1	1	1	1	3	3	2
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering			Program: B.Tech.							
Semester	VI			Course Category: PC			*End Semester Exam Type: TE				
Course Code	U23BMT610			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Medical Internet of Things			3	0	0	3	25	75	100	
Prerequisite	Biomedical Instrumentation										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the architecture of IoT and its associated protocols								K2	
	CO2	Apply cloud service models in networked IoT systems								K3	
	CO3	Analyze the impact of IoT in healthcare and focusing on patient monitoring								K3	
	CO4	Evaluate IoT integration in surgical equipment monitoring.								K4	
	CO5	Describe wearable technologies and applications of M-IOT								K4	
UNIT-I	Introduction to IoT						Periods: 09				
Brief History of IoT – Architectural Layers of IoT – Bluetooth – Zigbee - Wi-Fi - IP-Based Protocols – UPnP – CoAP – MQTT – XMPP – SCADA - Authentication protocols - IEEE 802.15.4.60.								CO1			
UNIT-II	Cloud Integration						Periods: 09				
Network layer – Cloud - Network Technologies - Types of Networks – BAN - Cloudterminologies - Types of Cloud - Service Models - Fog and edge customization - BigData								CO2			
UNIT-III	IoT in Healthcare						Periods: 09				
Introduction to Raspberry Pi – Implementation of IoT with Raspberry Pi – Wearable Technologies and IOT - Electronic tattoos - Smart lenses for diabetics - Bio-monitoring drugs - Baby Monitoring system- Aging in place - Wireless patient Monitoring								CO3			
UNIT-IV	IoT in Surgery						Periods: 09				
Perception Layer – RFIDs – cameras – Sensors - Introduction to ASICs - pulse oximeters, instrumentation amplifiers - Surgical equipment and dependencies - Surgery and its types - role of IOT in surgery.								CO4			
UNIT-V	Applications of IoT						Periods: 09				
Ventilators - Wearable Technologies - Smart watches - Remote patient monitoring systems- Smart Care technology Systems								CO5			
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45					
Text Books											
1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra “Medical Big Data and Internet of Medical Things”, CRC Press, 1st Edition, 2018											
2. P. B. Pankajavalli, G. S. Karthick“Incorporating the Internet of Things in Healthcare Applications and Wearable Devices,Advances in Medical Technologies and Clinical Practice(AMTCP)”, IGI Global, 1st Edition, 2019											
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015											
Reference Books											
1. Valentia E.Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar “Internet of Things in Biomedical Engineering”, Academic Press, 2019											
2. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014											
3. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad “A Handbook of Internet of Things in Biomedical and Cyber Physical System” Springer International Publishing,2019											
4. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues “Internet of Medical Things for Smart Healthcare” Springer Singapore,2019											
Web References											
1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/											

2. <https://www.digimat.in/nptel/courses/video/108105091/L01.html>
3. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7113786>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT611		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Artificial Intelligence and Machine Learning in Healthcare		3	0	0	3	25	75	100
Prerequisite	-								
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Define the various characteristics of intelligent agents						K2	
	CO2	Describe the different search strategies in AI						K3	
	CO3	Apply the particular agent strategy to solve a given problem						K3	
	CO4	Classify the different machine learning techniques						K3	
	CO5	Acquire knowledge on applications of AIML in biomedical applications						K4	
UNIT – I	Introduction					Periods:9			
Introduction–Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach, Artificial Intelligence in Medicine.								CO1	
UNIT – II	Problem Solving Methods					Periods:9			
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation.								CO2	
UNIT – III	Knowledge Representation					Periods:9			
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining,Data Preprocessing-Data cleaning, handling missing values, normalization, data augmentation								CO3	
UNIT – IV	Machine Learning for Healthcare					Periods:9			
Supervised learning algorithms for healthcare prediction - Unsupervised learning techniques in healthcare - Evaluation and validation of machine learning models in healthcare								CO4	
UNIT – V	Healthcare Applications					Periods:9			
Predictive modelling for disease diagnosis and prognosis - Healthcare resource allocation and optimization - Fraud detection and anomaly detection in healthcare data. - Case studies in cancer treatment, neurodegenerative diseases								CO5	
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. Lei Xing, Maryellen L. Giger, James K. Min “Artificial Intelligence in Medicine Technical Basis and Clinical Applications” Elsevier Science 2020.									
2. Bratko, “PrologProgramming for Artificial Intelligence”, Fourth Edition, Addison-Wesley Educational Publishers,2011.									
3. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall,2009,									
Reference Books									
1. Gerhard Weiss, “Multi Agent Systems”, 2nd Edition, 2013, MIT Press.									
2. David L. Poole and Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, 4th Edition Cambridge University Press, 2010									
3. Richard Szeliski, “Computer Vision: Algorithms and Applications”, 1st Edition, 2010, Springer									
4. Simon J.D. Prince, “Computer vision: models, learning and inference”, 1 st Edition, Cambridge University Press,2012									
Web References									
1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/									
2. https://sigmoidal.io/artificial-intelligence-and-machine-learning-for-healthcare/									
3. https://link.springer.com/book/10.1007/978-981-16-0811-7									

* TE – Theory Exam, LE – Lab Exam

A. 

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	1	1	1	-	-	-	-	-	2	1	1	1
2	3	3	2	3	1	-	-	-	-	-	2	1	1	1
3	2	3	2	3	-	1	-	-	-	-	2	1	1	1
4	2	3	2	2	-	1	-	-	-	-	2	1	1	1
5	2	2	1	1	-	1	-	-	-	-	2	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	VI		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP607		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Diagnostic and Therapeutic Equipment Laboratory		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Experiment the analysis of ECG, EEG and EMG signals.					K3	
	CO2	Simulate ECG signals and Pacemaker.					K4	
	CO3	Conduct investigation using Defibrillator simulator.					K3	
	CO4	Describe shortwave and ultrasonic diathermy.					K3	
	CO5	Demonstrate the protection equipment's for electrical safety measures.					K3	
LIST OF EXPERIMENTS								
1. Recording and analysis of ECG signals 2. Recording and analysis of EEG signals 3. Recording - Fatigue test of EMG signals 4. Simulation of ECG – detection of QRS complex and heart rate 5. Operation and analysis of a Pacemaker and Defibrillator simulator 6. Analyze the functioning and safety aspects of surgical diathermy, shortwave and ultrasonic diathermy 7. Transmission and Reception of biological signal using a telemetry system 8. Study of Endoscopy and Laparoscopy equipment's 9. Electrical safety measurements 10. Auditory system checkup using Audiometer 11. Measurement of Oxygen Saturation and Heart Rate using Pulse-oximeter 12. Study of heart lung machine model.								
Reference Books								
1. Richard Aston, “Principles of Biomedical Instrumentation and Measurement”, Merrill Publishing Company, 2007. 2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 3rd Edition, New Delhi, 2003. 3. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, Mc Graw Hill, 2003. 4. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008. 5. Antony Y.K.Chan, “Biomedical Device Technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.								
Web References								
1. https://www.nap.edu/read/21794/chapter/7 2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems . 3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206								

* TE – Theory Exam, LE – Lab Exam



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	VI		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP608		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Embedded Systems for Healthcare Laboratory		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Write programs in ARM for a specific Application					K2	
	CO2	Interface memory, A/D and D/A convertors with ARM system					K3	
	CO3	Write program for interfacing keyboard, display, motor and sensor.					K3	
	CO4	Generate PWM signals for motor control applications					K3	
	CO5	Formulate a mini project using embedded system					K4	
LIST OF EXPERIMENTS								
1. Study of ARM evaluation system								
2. Flashing of LEDS								
3. Interfacing Buzzer								
4. Interfacing ADC								
5. Interfacing DAC								
6. Interfacing Seven segment display								
7. Interfacing real time clock								
8. Interlinking Keyboard and LCD								
9. Interfacing of stepper motor								
10. Interfacing DC motor								
11. Interfacing of PWM based LED lighting board								
12. Interfacing Temperature sensor								
Text Books								
1. 1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGrawHill ,2nd Edition, 2008								
2. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 3rd Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.								
3. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997								
4. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", 3rd Edition Cengage Learning, 2012.								
5. Jonathan Valvano, "Embedded Systems: Real-Time Interfacing to Arm Cortex-M3",CreateSpace Independent Publishing Platform,2011								
6. David Simon,"Embedded Systems: A Contemporary Design Tool",Wiley,2009								
Web References								
1. https://www.youtube.com/watch?v=uFhDGagZzjs								
2. https://nptel.ac.in/courses/108102045								
3. https://www.amoriabond.com/en/insights/blog/real-time-applications-of-embedded-systems/								
4. https://www.youtube.com/watch?v=S-daLDfkoyY								
5. https://www.youtube.com/watch?v=7LqPJGnBPMM								
6. https://www.youtube.com/watch?v=uFhDGagZzjs								

* TE – Theory Exam, LE – Lab Exam

A. 

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering	Programme : B.Tech.					
Semester	VI	Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP609	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE
Course Name	Medical Internet of Things Laboratory	0	0	2	1	50	50

Prerequisite							
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)
	CO1	Gain knowledge in Programming for embedded applications.					K3
	CO2	Realize human fall detection, ECG system, and surgical system.					K4
	CO3	Familiarize with ThingSpeak cloud.					K3
	CO4	Integrate Raspberry pi and ThingSpeak.					K3
	CO5	Analyze smart systems					K4

LIST OF EXPERIMENTS

Conduct the Experiments using Arduino / Raspberry pi

1. Study of Raspberry pi, UART Communication
2. To interface LED/Buzzer and write a program to 'turn ON' LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) and write a program to 'turn ON' LED when push button is pressed or at sensor detection.
4. Study of REST and HTTP protocols, PUSH, PUT and GET commands, Linux CLI, Raspberry OS
5. Human Fall detection system using an Accelerometer sensor
6. Study of ECG system, which gets Heart beat sensor reading from different modes
7. Surgical automation system, which runs 2 motor using a Servo Motor based inputs given on console in pc and operates the motor operation.
8. Baby Monitoring system, to prevent sudden infant death syndrome
9. Clinical Management system consisting of RFIDs tags and cards which constantly uploads inpatient and outpatient details to ThingSpeak. Server
10. Smart Ventilator system to control through various modes of ventilator connected to ThingSpeak. server, and remotely operated.
11. Waste Management system consisting of moisture and Gas sensor connected to server and remotely indicating the recycle process of medical waste
12. Smart watch system, to indicate and alert users of their routine works and also monitor the pulse and temperature readings.

Reference Books

1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra "Medical Big Data and Internet of Medical Things", CRC Press, 1st Edition, 2018
2. P. B. Pankajavalli, G. S. Karthick "Incorporating the Internet of Things in Healthcare Applications and Wearable Devices, Advances in Medical Technologies and Clinical Practice (AMTCP)", IGI Global, 1st Edition, 2019
3. Valentia E. Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar "Internet of Things in Biomedical Engineering", Academic Press, 2019
4. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad "A Handbook of Internet of Things in Biomedical and Cyber Physical System" Springer International Publishing, 2019
5. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues "Internet of Medical Things for Smart Healthcare"



Springer Singapore, 2019

Web References

1. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/>
2. <https://www.digimat.in/nptel/courses/video/108105091/L01.html>
3. <https://www.jmir.org/2020/11/e20135/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	3	3	3	2	-	2	2	-	3	3	1	1
2	3	3	3	3	3	2	-	2	2	-	3	3	1	1
3	3	3	3	3	3	2	-	2	2	-	3	3	1	1
4	3	3	3	3	3	2	-	2	2	-	3	3	1	1
5	3	3	3	3	3	2	-	2	2	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 -High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

A. 

Department	Biomedical Engineering	Programme: B. Tech.						
Semester	VI	Course Category Code: PA			*End Semester Exam Type: -			
Course Code	U23BMW602	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	MINI PROJECT	0	0	2	1	100	-	100

Prerequisite	Biomedical Instrumentation, Electronics, C Programming							
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)
	CO1	Identify the problem statement for the mini project work through the literature survey						K2
	CO2	Choose the proper components as per the requirements of the design/ system.						K2
	CO3	Apply the acquainted skills to develop final model/system						K3

There shall be a Mini Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the mini project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Mini-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Mini Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Mini Project work with weightage as indicated evaluation Methods.

Lecture Periods: -	Tutorial Periods: -	Practical Periods: 30	Total Periods: 30

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	3	3	-	1	1	1	1
2	3	3	3	2	2	2	2	3	3	3	1	2	2	2
3	3	2	2	1	-	2	-	3	3	3	1	2	2	2

Correlation Level: 1 – Low, 2 – Medium, 3 – High

A. 

Evaluation Method

Assessment	Review 1			Review 2				Total Marks
	Novelty	Presentation	Viva	Presentation	Demonstration	Viva	Report	
Marks	10	20	10	20	20	10	10	100



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering	Programme: B. Tech.						
Semester	VI	Course Category: AEC			End Semester Exam Type: -			
Course Code	U23BMC6XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	CERTIFICATION COURSE - VI	0	0	4	-	100	-	100
Prerequisite	-							

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

- (i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.
- (ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.
- (iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering			Programme: B. Tech.							
Semester	VI			Course Category: MC		End Semester Exam Type :					
Course Code	U23BMM606			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Gender Equality			2	0	0	-	100	-	100	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Describe the general identity, social construction of gender roles.								K2	
	CO2	Illustrate the causes and issues of gender discrimination in Indian society.								K2	
	CO3	Describe the workplace discrimination, media influences on gender and culture.								K2	
	CO4	Familiarize with international and Indian frameworks on gender equality.								K2	
	CO5	Illustrate the current challenges in gender equality, including the glass ceiling and the role of technology.								K2	
UNIT – I	Introduction to Gender Equality						Periods:06				
Gender equality – exploring gender identity and expression, Understanding the social construction of general roles and norms, historical perspectives on gender roles, Analyzing key milestones in the fight for gender equality.										CO1	
UNIT – II	Gender Inequality and Its Manifestations						Periods:06				
Gender discrimination in Indian society – causes of gender inequality – Illiteracy, patriarchal set up, lack of awareness, social beliefs, practice and custom – Issues of gender discrimination – Child marriage, child domestic work, poor education and health, violence and exploitation in workplace.										CO2	
UNIT – III	Gender and Culture						Periods:06				
Workplace discrimination, Media influences on gender and culture, Gender and power dynamics in society. Strategies for promoting gender equality and cultural understanding.										CO3	
UNIT – IV	Promoting Gender Equality						Periods:06				
Gender Equality and Human Rights – International frameworks and Conventions on Gender Equality – Equality under the Indian Constitution – Policies and initiatives for gender mainstreaming – Strategies for promoting Gender Equality in various contexts.										CO4	
UNIT – V	Contemporary Challenges and Future Directions						Periods:06				
Current challenges and emerging issues in gender equality – Glass ceiling – role of technology in continuing or challenging gender inequality – Exploring possibilities for transformative change and envisioning a gender-equal future.										CO5	
Lecture Periods: 30		Tutorial Periods: -		Practical Periods: -			Total Periods: 30				
Text Books											
1. "Gender and Society" by Raewyn Connell – This book provides a comprehensive overview of gender roles, power dynamics, and the social construction of gender.											
2. "The Second Sex" by Simone de Beauvoir – A historical and philosophical examination of women's oppression and gender inequality.											
3. "Women and Gender in the Indian Society" by Neera Desai and Usha Thakkar – Focuses on the context of gender roles, inequality, and feminist movements in India.											
Reference Books											



1. Woman in early Indian societies, New Delhi: Manohar Publications. Sita A. Raman (2009).
2. A social and Cultural history, Volume1. Connecticut: Oxford: Praeger. Sita Raman (2009).
3. A social and Cultural history, Volume2. Connecticut: Oxford: Praeger.
4. Iftikhar R. (2016). Indian Feminism: Class, Gender and Identity in Medieval Ages. Chennai: Notion Press. Iftikhar, R. (2012).

Web References

1. <https://www.unwomen.org>
2. <https://ncw.nic.in>
3. <https://en.unesco.org/themes/gender-equality>
4. <https://www.weforum.org/reports>
5. <https://wcd.nic.in>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	3	-	1	1	-	1
2	1	-	-	-	-	-	-	-	3	-	1	1	-	1
3	1	-	-	-	-	-	-	-	3	-	1	1	-	1
4	1	-	-	-	-	-	-	-	3	-	1	1	-	1
5	1	-	-	-	-	-	-	-	3	-	1	1	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

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PROFESSIONAL ELECTIVE-VI

Department	Biomedical Engineering		Program: B.Tech.							
Semester	VI		Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME610		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Troubleshooting and Quality Control in Medical Equipment		3	0	0	3	25	75	100	
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Apply troubleshooting techniques to identify equipment failures.							K3	
	CO2	Describe the testing procedures of active and passive components.							K3	
	CO3	Analyze the fault diagnosis in analog circuits and digital ICs.							K4	
	CO4	Identify the problems in common biomedical equipment in hospitals when it is not working and provide a suitable solution.							K4	
	CO5	Describe the various quality measures & standards adapted for medical systems							K3	
UNIT – I	Fundamental Troubleshooting Testing Procedures					Periods:9				
Equipment failure and its cause-Functional block diagram of a troubleshooting system-Troubleshooting process & fault-finding aids-Troubleshooting techniques and their correction action-Testing of active and passive components: resistor, capacitor, inductor, BJT, JFET, & MOSFET								CO1		
UNIT – II	Fault Diagnosis in Analog & Digital Integrated Circuits					Periods:9				
Characteristics of ideal op-amps, typical op-amp based medical circuits-Fault diagnosis in op-amp circuits-Digital troubleshooting methods-Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator-Circuit board Troubleshooting.								CO2		
UNIT – III	Biomedical Equipment Troubleshooting					Periods:9				
Troubleshooting- ECG Machine, EEG Machine- defibrillator, electrosurgical unit Troubleshooting- anesthesia machine, autoclaves & sterilizers- endoscope, incubators, nebulizer- oxygen concentrators, sphygmomanometers, suction machine- X-ray machine.								CO3		
UNIT – IV	Medical Device Design Quality					Periods:9				
Definition of quality, essence of quality-Quality operating system and the device life cycle-Evolution of quality Business excellence: a value proposition-Health care quality.								CO4		
UNIT – V	Design For Six Sigma and Medical Device Regulation					Periods:9				
Global Perspective on medical device regulations, medical device classification (USA, Europe & GHTF-Medical device safety, medical device quality management systems requirements-Medical device regulation throughout the product development life cycle-Purpose of ISO 9001:2001&ISO 13485.								CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Textbooks										
1. Khandpur R S, “Troubleshooting Electronic Equipment- Includes Repair & Maintenance”, 2nd Edition, Tata McGrawHill, 2009.										
2. Basem S EL-Haik& Khalid S Mekki, “Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness”, 1st Edition, John Wiley & Sons 2008.										
3. Gopalakrishna, P. Purchasing and Materials Management, Tata MC.Graw Hill, New Delhi, 2017.										
Reference Books										
1. Nicholas Cram & Selby Holder, “Basic Electronic Troubleshooting for Biomedical Technicians”, 2nd Edition, 2010, TSTC Publishing.										
2. Dan Tomal& Neal Widmer, “Electronic Troubleshooting”, 3rd Edition, McGraw Hill ,2004,.										
3. Richard Fries, “Reliable Design of Medical Devices”, 2nd Edition, CRC Press., 2006										



4. Joseph J Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment", 2nd Edition, Charles C Thomas Publisher Ltd. , 2005
5. Gopalakrishna, P., Materials Management, Prentice Hall, New Delhi, 2015.

Web References

1. https://www.who.int/medical_devices/publications/en/MD_Regulations.pdf
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924127/>
3. <https://www.ncbi.nlm.nih.gov/pubmed/7613571>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	-	-	-	-	1	2	2	3
2	3	2	1	1	2	1	-	-	-	-	1	2	2	3
3	3	3	2	1	2	1	-	-	-	-	1	2	2	3
4	3	3	2	1	2	1	-	-	-	-	1	2	1	1
5	3	3	2	1	2	1	-	-	-	-	1	2	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Instrumentation and Control Engineering			Programme: B.Tech.						
Semester	VI			Course Category Code: PE			*End Semester Exam Type: TE			
Course Code	U23ICEC02			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Soft Computing Techniques			3	0	0	3	25	75	100
(Common to ICE, ECE and BME Branches)										
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Familiarize in the neural network architecture.							K2	
	CO2	Impart knowledge on various training algorithm of neural network and its application							K3	
	CO3	Illustrate the fuzzy sets and the properties of fuzzy logic							K2	
	CO4	Comprehend fuzzy logic controllers and its applications.							K2	
	CO5	Understand the concepts of optimization algorithms.							K2	
UNIT – I	Introduction to Neural Network						Periods:9			
Introduction to neural networks – Biological neural networks, Artificial Neural network: Single and Multi-layer feed forward network- Activation function, types (step and sigmoid function), threshold function- Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.										CO 1
UNIT – II	Neural Networks Control						Periods:9			
Back propagation neural net: standard architecture, algorithm -Hopfield net: architecture and algorithm- Kohonnen's Self Organizing map- Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control - Applications of neuro controller.										CO2
UNIT – III	Introduction to Fuzzy Logic						Periods:9			
Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations linguistic variables – Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.										CO3
UNIT – IV	Fuzzy Logic Control System						Periods:9			
Introduction to Fuzzy logic controller: Architecture – Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification - Applications of Fuzzy logic controller.										CO4
UNIT – V	Optimization						Periods:9			
Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithm Search – Downhill Simplex Search.										CO5
Lecture Periods:45			Tutorial Periods:45			Practical Periods:-		Total Periods:45		
Text Books										
1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions,2010										
2. Laurene Fausett, "Fundamentals of Neural Networks" Pearson Education, 2008										
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic ". Prentice Hall, USA .2015										
Reference Books										
1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019										
2. Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall										
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education 2007										
4. W.T.Miller, R.S.Sutton and P.J.Webrose, Neural Networks for Control, MIT Press, 2001.										
5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw Hill Education, 1st Edition, 2017.										



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1. <https://lecturenotes.in/subject/922>.
2. <https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf>.
3. <https://nptel.ac.in/courses/106/105/106105173/>.

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	-	-	3	2	1
2	3	3	-	3	3	2	-	-	-	-	-	2	2	1
3	3	3	2	3	3	2	-	-	-	-	-	2	2	1
4	3	2	3	3	3	2	-	-	-	-	-	2	2	1
5	3	3	3	2	2	2	-	-	-	-	-	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	VI				Course Category: PE		*End Semester Exam Type: TE					
Course Code	U23BME611				Periods/Week			Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM	
Course Name	Physiological System Modeling				3	0	0	3	25	75	100	
Prerequisite	Human Anatomy and Physiology											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Explain the application of Physiological models and vital organs										K2
	CO2	Formulate the methods and techniques for analysis and synthesis of dynamic models										K3
	CO3	Describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software										K2
	CO4	Describe nonlinear models of physiological systems										K2
	CO5	Compute the Simulation of physiological systems										K3
UNIT – I	Introduction to Physiological Modeling								Periods:9			
Approaches to modelling: The technique of mathematical modelling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modelling.										CO1		
UNIT – II	Modeling of Dynamic Physiological System								Periods:9			
Dynamic systems and their control, modelling and block diagrams, The Circulatory System -Blood flow, circulation, arterial pulse. The Endocrine System - Pituitary gland, insulin and glucose. The pupil control systems (Human Eye), the dynamic response characteristics of the pupil control system, The Inner Ear - Frequency tuning, models of the cochlea, resonance in hair cells.										CO2		
UNIT – III	Nonlinear Models of Physiological Systems								Periods:9			
Nonparametric Modelling-Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modelling- Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.										CO3		
UNIT – IV	Compartmental Physiological Model								Periods:9			
Modelling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modelling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.										CO4		
UNIT – V	Simulation of Physiological Systems								Periods:9			
Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: -Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.										CO5		
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Textbooks												
1. Michel C Khoo, “Physiological Control Systems -Analysis, simulation and estimation”, Prentice Hall of India, 2021.												
2. Marmarelis, “Nonlinear Dynamic Modelling of Physiological Systems”, Wiley-IEEE Press, 2004.												
Reference Books												
1. Benjamin C Kuo, “Automatic control systems”, Tenth Edition, McGraw-Hill Education, 2017.												
2. David.T Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003.												
3. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,“ Advanced Computational Methods in Life System Modelling and Simulation”, Springer,2017												
4. Mathematical Modeling in Systems Biology, by Brian Ingalls (ISBN: p780262315623)												
Web References												
1. https://nsec.lab.uconn.edu/home/courses-2/bme-3100-physiological-modeling/												
2. https://lcp.mit.edu/pdf/HeldtLNM10Ch2.pdf												



3. <https://www.sciencedirect.com/topics/engineering/physiological-models>

TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	1	1	1	-
2	3	1	1	-	-	-	-	-	-	1	1	1	1	-
3	3	-	1	-	-	-	-	-	-	-	1	1	1	-
4	3	3	3	2	1	-	-	-	-	-	1	1	1	-
5	3	2	3	2	3	-	-	-	-	-	1	1	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllab



Department	Biomedical Engineering		Program: B.Tech.							
Semester	VI		Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME612		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Hospital Engineering and Information Systems		3	0	0	3	25	75	100	
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Provide good academic ambience by adopting best information system							K2	
	CO2	Achieve the best possible support from patient and administration							K3	
	CO3	Deliver efficient delivery of high-quality health services							K2	
	CO4	Develop decision support systems, health information standards and information systems acquisitions							K3	
	CO5	Identify problems and alternate solutions related to records management in the healthcare environment							K3	
UNIT – I	Health System					Periods:9				
Concept of Hospital Management - Roles and Responsibilities of Administrator - Hospital Design - Health organization of the country, state, and cities, Health Financing System, Health policies and regulations								CO1		
UNIT – II	Hospital Organisation					Periods:9				
Organization of Out-Patient Services - Problems encountered in functioning of O.P Department – Organization of In- Patient Services - Casualty & Emergency Services - Organization and management of Operation theatres, Medical Records Department								CO2		
UNIT – III	Hospital Services					Periods:9				
Engineering department - maintenance management- clinical engineering- electrical system- air conditioning system- water supply and sanitary system- centralized medical gas system-communication system, Biomedical Waste Management								CO3		
UNIT – IV	Infection Control and Waste Management					Periods:9				
Importance of infection control-hand hygiene-clinical laboratory standards to infection control-health care workers safety-solid waste management and transportation, Sterilization Techniques								CO4		
UNIT – V	Integrated Medical Information System					Periods:9				
Integration of inter and intra hospital information system. Role of expert systems-web based Multimedia information system- introduction of a computerized HIS Automation of medical record-cost and Benefits of HIS Modems and Networking in Hospitals, Electronic Health Records (EHRs).								CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books										
1. Dr. L.L. Rao, “Hospital Management”, Annamalai University Press, 2nd Edition, 2013 2 3.										
2. R. D. Lele, “Computers in Medicine”, Tata McGraw Hill, 3rd Edition, 2005										
3. Mohan Bansal, “Medical informatics”, Tata McGraw Hill. 2nd Edition, 2005.										
Reference Books										
1. Gupta, Kant, Chandrashekhar, Satpathy,” Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM”, JaySpee Medical publishers, 1st Edition,2007.										
2. Sharma, “Essentials for Hospital Support Services and Physical Infrastructure”, Jaypee Medical Publishers, 1 st Edition, 2003										
3. Ramani.K.V.,”Hospital Management”, Pearson, 2011.										
4. Sakharkar, “Principles of Hospital Administration and Planning”, Jaypee Medical, 1st Edition, 2004.										
5. Harold E. Smalley, “Hospital Management Engineering – A guide to the improvement of hospital management system “, PHI, 1st Edition, 1982.										

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1. https://en.wikipedia.org/wiki/Hospital_information_system
2. <https://www.ncbi.nlm.nih.gov/books/NBK22862>
3. https://en.wikipedia.org/wiki/Healthcare_engineering

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	-	1	3	-	-	-	-	1	3	1	1
2	3	2	1	-	1	3	-	-	-	-	1	3	1	1
3	3	2	1	-	1	3	-	-	-	-	1	3	1	1
4	2	2	1	-	1	3	-	-	-	-	1	3	1	1
5	3	2	1	-	1	3	-	-	-	-	1	3	1	1

Correlation Level: 1 - Low, 2 -Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Program: B.Tech.						
Semester	VI			Course Category: PE		*End Semester Exam Type: TE				
Course Code	U23BME613			Periods/Week		Credit	Maximum Marks			
				L	T		P	C	CAM	ESE
Course Name	Biotelemetry and Telemedicine			3	0	0	3	25	75	100
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Understand telemetry basics and its classification								K2
	CO2	Gain knowledge about telemetry and telemedicine applications								K2
	CO3	Describe the applications of Biotelemetry								K3
	CO4	Acquire clear idea about the fundamentals of telemedicine								K2
	CO5	Explain the Applications of telemedicine in various fields								K3
UNIT – I	Introduction to Telemetry						Periods:9			
Basic system - Classification - Nonelectrical telemetry systems - Mechanical and Pneumatic type, Voltage and Current telemetry systems - Local transmitters and Converters - Frequency telemetry system - Power Line carrier communication (PLCC).										CO1
UNIT – II	Biotelemetry Systems and Components						Periods:9			
Sensors and Transducers: Types and functions. Signal Acquisition: Methods for collecting physiological signals.Data Transmission: Wireless technologies and protocols.										CO2
UNIT – III	Application of Biotelemetry						Periods:9			
Wireless Telemetry - Single Channel and Multi-channel Telemetry systems - Multi Patient Telemetry – Implantable Telemetry Systems - Ambulatory patient monitoring. .										CO3
UNIT – IV	Fundamentals of Telemedicine						Periods:9			
History and advancements in telemedicine - Benefits of telemedicine – Functional Block of a telemedicine system - Use of computers in distance mode of healthcare delivery - Familiarizing with technology of telemedicine – scanner, electro stethoscope - data reception equipment - Scope for telemedicine - Limitations of telemedicine.										CO4
UNIT – V	Applications of Telemedicine						Periods:9			
Tele radiology: Basic parts of Teleradiology system -Telemedicine in Neuroscience - Telecardiology – Telepathology — Telepediatrics – Telepharmacy – Telepsychiatry and mental health – Veterinary.										CO5
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books										
1. Konstantina S.Nikita, "Handbook of Biomedical Telemetry", 1st Edition, 2014										
2. Charles J.Amlaner and David W. Macdonald, "A Handbook on biotelemetry and Radio Tracking", 1st Edition,2013										
3. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine", 5th Edition, 2006, Royal Society of Medicine Press Ltd.										
Reference Books										
1. Bemmell, J.H. van, Musen, M.A. (Eds.), "Handbook of Medical Informatics", 2nd Edition, 2002, Springer.										
2. Olga (EDT), Ferre Roca, M. Sosa (EDT, "Handbook of Telemedicine", 3rd Edition, 1998, IOS press										
3. Ferrer-Roca, O., Sosa-ludicissa, , "Handbook of Telemedicine", 12th Edition, 2002, IOS Press										
4. Norris, A.C, "Essentials of Telemedicine and Telecare", 8th Edition, 2002, Wiley.										
5. Bashshur , R. L. , Sanders, J. H and Shannon, G, "Telemedicine: Theory and Practice", 6th Edition, 1999, Springer.										
Web References										
1. https://en.wikipedia.org/wiki/Biotelemetry										
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf										



3.. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	2	1	2	1	1	2	-	-
2	3	2	1	-	1	2	2	1	2	1	1	2	-	-
3	3	2	2	-	2	2	2	1	2	2	1	3	1	-
4	3	1	-	-	1	1	1	1	2	1	1	3	-	-
5	3	1	1	-	1	2	1	1	2	1	1	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Open Elective – I / Open Elective – II

Department	Biomedical Engineering		Programme: B.Tech.						
Semester	V / VI		Course Category Code: OE		*End Semester Exam Type: TE				
Course Code	U23BMOC01		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	MEDICAL ELECTRONICS		3	-	-	3	25	75	100
Prerequisite	-								
Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, MCTR, AI&DS,CSBS/CSEBS									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Know the human body electro- physiological parameters and recording of bio-potentials						K2	
	CO2	Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.						K3	
	CO3	Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators						K3	
	CO4	Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods						K4	
	CO5	Know about recent trends in medical instrumentation						K4	
UNIT – I	Electro-Physiology and Bio-Potential Recording					Periods:9			
Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics.							CO1		
UNIT – II	Bio-Chemical and Non-Electrical Parameter Measurement					Periods:9			
pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.							CO2		
UNIT – III	Assist Devices					Periods:9			
Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.							CO3		
UNIT – IV	Physical Medicine and Biotelemetry					Periods:9			
Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.							CO4		
UNIT – V	Recent Trends in Medical Instrumentation					Periods:9			
Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.							CO5		
Lecture Periods:45		Tutorial Periods:-		Practical Periods: -		Total Periods:45			
Textbooks									
1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007									
2. M. Arumugam, “Biomedical Instrumentation”,Anuradha Agencies Publishers, 2002.									
3. Andrew Webb, “Introduction to Biomedical Imaging”, 2nd Edition, Cambridge University Press, United Kingdom, 2018									
Reference Books									
1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA Mc Graw-Hill, New Delhi, 2003.									
2. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2004.									
3. Onkar N. Pandey, Rakesh Kumar, “Bio-Medical Electronics and Instrumentation”, 3rd Edition, Katson Books, 2002.									
4. Michael R. Neuman, “Biomedical Sensors and Instruments”, 3rd Edition, CRC Press, Boca Raton, 2023.									

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5. **Barbara Christe**, *"Introduction to Biomedical Instrumentation: The Technology of Patient Care"*, 2nd Edition, Cambridge University Press, 2022.

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1. <https://www.sciencedirect.com/topics/engineering/medical-electronics>
2. https://en.wikipedia.org/wiki/Electronics_for_Medicine
3. <https://www.scribd.com/document/378058078/Medical-Electronics-Lecture-Notes-Study-Material-and-Important-Questions-Answers>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	2	1	2	1	1	3	2	3
2	3	2	1	-	1	2	2	1	2	1	1	3	3	2
3	3	2	2	-	2	2	2	1	2	2	1	3	3	3
4	3	1	-	-	1	1	1	1	2	1	1	3	3	3
5	3	1	1	-	1	2	1	1	2	1	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering			Programme: B.Tech.							
Semester	V / VI			Course Category: OE			Course Category: TE				
Course Code	U23BMOC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	BIOMETRIC SYSTEMS			3	0	0	3	25	75	100	
Prerequisite	-										
Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, MCTR, AI&DS, CSBS/CSEBS											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Explain the fundamentals of biometric systems								K2	
	CO2	Describe the various fingerprint technologies								K3	
	CO3	Distinguish different face recognition and hand geometry pattern								K3	
	CO4	Analyze the multimodal biometrics and performance evaluation of biometrics								K4	
	CO5	Recognize various Biometric authentication methods								K3	
UNIT – I	Introduction to Biometrics						Periods:9				
Introduction– biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification –Need for strong authentication - Protecting privacy and biometrics policy – Biometric applications – biometric characteristics.								CO1			
UNIT – II	Fingerprint Technology						Periods:9				
History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching- Hand geometry.								CO2			
UNIT – III	Face Recognition						Periods:9				
Introduction to face recognition - face recognition from correspondence maps - scanning - feature extraction - Adaptive Classifiers - Visual Based feature extraction and Pattern Classification -types of algorithm - Retina scan -Iris scan - Biometric fusion.								CO3			
UNIT – IV	Multimodal Biometrics and Performance Evaluation						Periods:9				
Introduction to multimodal biometric system: Physiological biometrics –Behavioral biometrics - Voice scan - Integration strategies - Architecture -level of fusion - combination strategy – training and adaptability - examples of multimodal biometric systems - Performance evaluation - Statistical Measures of Biometrics- FAR - FRR - FTE - EER -Memory requirement and allocation.								CO4			
UNIT – V	Biometric Authentication						Periods:9				
Introduction - Biometric Authentication Methods - Authentication technologies- Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines- Biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.								CO5			
Lecture Periods:45		Tutorial Periods:-		Practical Periods: -			Total Periods:45				
Textbooks											
1. Anil K. Jain, Arun Ross, and KarthikNandakumar “Introduction to Biometrics”, Springer,2011											
2. Richard O. Duda, David G.Stork,Peter E. Hart “Pattern Classification”, Wiley 2007											
3. S.Y.Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach”, Prentice Hardcover September 2004											
Reference Books											
1. Anil K. Jain, Patrick Flynn, and Arun A. Ross,” Handbook of Biometrics” Springer, 2008											



2. John Chirillo, Scott Blaul, "Implementing Biometric Security": John Wiley, 2003.
3. John R. Vacca, "Biometric Technologies and Verification System", Elsevier Inc, 2007
4. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems "Technology Design and Performance Evaluation" Springer, 2005
5. Nikolaos V. Boulgouris, Konstantinos N. Plataniotis, Evangelia Micheli-Tzanakou, "Biometrics" Theory, Methods, and Applications, Wiley 2009

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1. <http://www.findbiometrics.com/Pages/glossary.html>
2. <http://www.biometrics.gov/Documents/privacy.pdf>
3. http://zing.ncsl.nist.gov/biouda/docs/Usability_and_Biometrics_final2.pdf
4. User Interface, System Design
5. http://www.cesg.gov.uk/site/ast/biometrics/media/BEM_10.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	1	2	2	-
2	3	2	2	1	1	2	-	-	-	-	1	3	3	-
3	3	2	2	1	2	2	-	-	-	-	1	3	3	-
4	3	1	1	1	1	1	-	-	-	-	1	3	3	-
5	3	1	2	1	2	2	-	-	-	-	1	3	3	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering				Programme: B.Tech							
Semester	VII				Course Category: PC			End Semester Exam Type: TE				
Course Code	U23BMT712				Periods/Week			Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM	
Course name	BIOMATERIALS AND ARTIFICIAL ORGANS				3	0	0	3	25	75	100	
Prerequisite	Human Anatomy and Physiology											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Understand the basic knowledge about the biomaterials.										K2
	CO2	Distinguish the types of Biomaterials										K2
	CO3	Analyze the tissue implant materials used in the medical applications.										K4
	CO4	Gain adequate knowledge of artificial organs										K3
	CO5	Explain the artificial organs implanted in the human body.										K3
UNIT-I	Overview of Biomaterials							Periods:9				
Introduction to biomaterials – uses of biomaterials – biomaterials in organ and body systems – materials used in the body – performance of biomaterials. Metallic biomaterials – Introduction – stainless steel – Cobalt – chromium alloy - Titanium alloy – Titanium nickel alloy - dental metals – Corrosion of metallic implant, manufacturing of implant.											CO1	
UNIT-II	Types of Biomaterials							Periods:9				
Biomaterials types – Ceramic - non absorbable/relatively bioinert, bio ceramics, biodegradable, bio reactive ceramic – deterioration of ceramics, Polymeric –basic structure, polymers used as biomaterials, sterilization, Composite – Structure - bounds on properties an isotropy of composites - particulate composites - fibrous composites, porous materials and biocompatibility, biodegradable polymer materials.											CO2	
UNIT-III	Tissue Materials and Tissue Replacement							Periods:9				
Structure and properties of collagen and collagen rich tissue, Resorbable collagen based medical implant, Types of transplants by stem cell, sutures, surgical tapes, Tissue adhesive/glue, effect of materials selection – effect of surface properties. Preservation techniques –non-freezing storage – freeze thaw technology – freeze drying.											CO3	
UNIT-IV	Artificial Organs							Periods:9				
Introduction – Outlook of organ replacement – Design, consideration and evaluation process – overview – immunological consideration – blood transfusion – individual organs – kidney, liver, heart, lungs, bone marrow, cornea.											CO4	
UNIT-V	Artificial Organ Implants							Periods:9				
Neural and neuromuscular implants – heart valves implant – heart and lungs assist devices – artificial heart, cardiac pacemakers – artificial kidney – dialysis membrane and artificial blood - gastrointestinal system – dentistry – maxillofacial and craniofacial replacement – soft tissue replacement and augmentation.											CO5	
Lecture Periods:45			Tutorial Periods:			Practical Periods:			Total Periods: 45			
Textbooks												
1. Lysaght M, Webster T J., “Biomaterials for artificial organs”, Woodhead Publishing Limited, 1st edition, 2011												
2. Hench L, Jones J., “Biomaterials, artificial organs and tissue engineering”, Woodhead Publishing Limited, 1st edition, 200S5.												
3. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain., “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2015												



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1. Joseph D. Bronzino, Donald R. Peterson., "Biomedical engineering fundamentals", CRC Press, 4th edition, 2014.
2. R S Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2003
3. David Williams, "Essential biomaterials science", Cambridge University Press, 1st edition, 2014
4. Yannas, I. V, "Tissue and Organ Regeneration in Adults", New York, NY: Springer, 2001.
5. Donatella Duraccio , Federico Mussano, Maria Giulia Faga., "Biomaterials for dental implants: current and future trends", Journal of Materials Science, 2015.

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2. <https://youtu.be/XqFSIG6WKO0>
3. <https://youtu.be/DsAvyykwB8>
4. <https://nptel.ac.in/courses/106/105/106105077/>
5. <https://nptel.ac.in/courses/102/101/102101068/>

*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	3	2	1	-
2	3	2	2	-	-	-	-	-	-	2	3	3	2	-
3	3	1	1	-	-	-	-	-	-	1	3	3	1	-
4	3	1	2	-	-	-	-	-	-	1	3	3	3	2
5	3	1	1	-	-	-	2	-	-	2	2	3	1	2

Correlation Level: 1-Low, 2-Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving /Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VII		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT713		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	REHABILITATION ENGINEERING		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Understand the quality and safety standards in design of devices for user needs						K2	
	CO2	Describe the applications of different orthosis and prosthesis for various disabilities						K3	
	CO3	Compare the different therapeutic exercises and design an orthopedic wheelchair						K2	
	CO4	Interpret the techniques and aids for impairments related to sensory and motor functions.						K4	
	CO5	Explore the use of Robots and Virtual Reality tool in rehabilitative curative care.						K4	
UNIT – I	Fundamentals of Rehabilitation					Periods:9			
Introduction to Rehabilitation Engineering - Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Impairment disability handicap, Primary & secondary Disabilities-Rehabilitation team, Classification of members-The human component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles.							CO1		
UNIT – II	Prosthetic and Orthotics Devices					Periods:9			
Prosthetics: Hand and Arm replacement, body-powered prosthetics, externally powered limb prosthetics, Myoelectric hand and arm prosthetics - FES System: Restoration of hand function; restoration of standing and walking. Orthotics: General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO.							CO2		
UNIT – III	Therapeutic Devices and Wheelchairs					Periods:9			
Therapeutic exercise: Co-ordination exercises, Frenkel's exercises, Gait -Pathological Gaits, Gait Training, Relaxation exercises, Methods for training Relaxation, Strengthening exercises - Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.							CO3		
Wheelchair: History and Categories of Wheelchairs, Seating Assessment, Wheelchair Structure and Component Design, Ergonomics of wheel chair propulsion, Power Wheelchair Electrical System- Wheel chair transportation.									
UNIT – IV	Management of Communication Impairments					Periods:9			
Speech Impairment: Introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Speech Augmentative Devices and Text-to-Speech (TTS) Systems.							CO4		
Visual impairment: Categories of visual impairment - Cortical & retinal implants - Auditory Information Display, Blind mobility aids, reading writing & graphics access, Braille Reader, Tactile devices for visually challenged.									
Auditory impairment: Hearing functional assessment, Types of deafness - Surgical and non-surgical hearing aids, Cochlear implants									
UNIT – V	Recent trends in Rehabilitation					Periods:9			
Rehabilitation Robots- Automated gait training devices, Automated training devices for the upper extremities, Therapeutic and Learning Support Virtual Reality Applications- virtual environments in the treatment of motor skills impairments- VR based tele-rehabilitation.							CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -			Total Periods: 45		
Text Books									
1. Dr. S. Sunder, “Textbook of Rehabilitation”, 4 th Edition, Jaypee Medical Publications, New Delhi. 2019.									
2. Joseph D.Bronzino,“The Biomedical Engineering Handbook”, 3 rd Edition, CRC Press, 2006.									
3. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.									



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Reference Books

1. Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visually impaired and blind people", Springer Publications, First edition, 2008.
2. Sashi S Kommu; Rehabilitation Robotics, 1 edition, CRC Press, 2007.
3. Suzanne Robitaille, "The illustrated guide to Assistive technology and devices—Tools and gadgets for living independently", Demos Health New York, First edition, 2010.
4. Patrice L. (Tamar) Weiss, Emily A. Keshner, Mindy F. Levin, "Virtual Reality for Physical and Motor Rehabilitation", 2014.
5. Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007

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2. <https://www.embs.org/about-biomedical-engineering/our-areas-of-research/rehabilitation-engineering/>
3. <https://bme.unc.edu/rehabilitation-engineering/>
4. <https://youtu.be/-y2jDL-diz0>
5. <https://youtu.be/s3rEAlwLEXM?t=2>

*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	1	2	1	-	2	1	1	1	-	-	-	-	1
2	3	3	3	2	2	2	2	2	1	1	1	3	3	3
3	3	3	3	2	2	2	2	2	1	1	-	1	2	1
4	3	3	3	3	2	2	2	2	2	2	1	1	3	2
5	2	2	2	2	3	2	2	2	2	2	-	1	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Programme: B.Tech						
Semester	VII		Course Category Code: PC			*End Semester Exam Type: TE			
Course Code	U23BMT714		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	MEDICAL IMAGE PROCESSING		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Gain knowledge in fundamentals of digital image processing.						K2	
	CO2	Examine image enhancement techniques in medical images.						K3	
	CO3	Execute restoration and segmentation techniques in medical images						K3	
	CO4	Apply the compression Techniques in medical images						K3	
	CO5	Describe the representations of features and recognize the images						K2	
UNIT-I	Fundamental of Digital Image Processing					Periods:09			
Introduction, Steps in Digital Image Processing -Components –Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization -Relationships between pixels - colour models. Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering.									CO1
UNIT-II	Frequency domain Enhancement					Periods:09			
Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth andGaussian filters, Wavelets -Sub band coding, Wavelets based image processing.									CO2
UNITIII	Medical Image Restoration And Segmentation					Periods:09			
Image Restoration: Noise Model – Notch Filters– Inverse Filtering – Wiener filtering. Image Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Region Growing, Region Splitting, Morphological processing- erosion and dilation – Watershed algorithm.									CO3
UNIT -IV	Medical Image Compression					Periods:09			
Image Compression models–Error Free Compression–Variable Length Coding–Bit-Plane Coding–Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding –Discrete wavelet transform for image compression-Compression Standards-JPEG, Image Registration (Multimodal Image Registration)									CO4
UNIT- V	Medical Image Representation and Recognition					Periods:09			
Boundary representation- Chain Code-Polygonal approximation, signature, boundary segments-Boundary description – Shape number - Regional Descriptors – Topological feature, Texture –Patterns and Pattern classes. Image Recognition: Digital Imaging and Communication (DICOM) in Medicine, Various modalities of Medical Imaging-CT, MRI, PET, Thermography, Angiography.									CO5
LecturePeriods:45			Tutorial Periods:		Practical Periods: -		TotalPeriods:45		
Text Books									
1 G.R. Sinha, Bhagwati Charen Patel, “Medical Image Processing: Concepts and Applications”, PHI Learningprivatelimited.2014									
2 Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw HillPvt.Ltd.,2011									
3 Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing”,2 nd Edition, CRC Press,2005.									
Reference Books									
1 Anil JainK.“Fundamentals of Digital Image Processing”,PHI Learning Pvt.Ltd.,2011.									
2 E.R.Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press,2012.									
3 MalayK.Pakhira, “Digital Image Processing and Pattern Recognition”, 1 st Edition, PHI Learning Pvt.Ltd.,2011.									
4 Geoff Dougherty, “Medical Image Processing: Techniques and Applications”, Springer Science & BusinessMedia,2011									
5 IsaacN.Bankman,“Hand book of Medical Image Processing and Analysis”,Science Direct,2 nd Edition,2009.									



Dr. A.Vijayalakshmi

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2	https://youtu.be/0SIPA8TvCbU
3	https://youtu.be/8fBZFjiHw3I
4	https://youtu.be/PqBS3tFZYI8
5	https://m.youtube.com/watch?v=i8a2LdyenoY

*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	-	3	2	-
2	3	3	2	-	3	-	-	-	-	1	-	3	3	2
3	2	3	3	3	3	-	-	-	-	2	-	2	3	3
4	3	3	2	2	3	-	-	-	-	1	-	3	3	2
5	2	3	2	2	3	-	-	1	1	3	1	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering				Programme: B.Tech.							
Semester	VII				Course Category Code: PC *End Semester Exam Type: LE							
Course Code	U23BMP710				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	3D PRINTING IN BIOMEDICAL APPLICATIONS LABORATORY				0	0	2	1	50	50	100	
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand 3D printing principles, techniques, and biomedical applications.									K2	
	CO2	Operate and calibrate FDM/SLA printers for biomedical model production.									K3	
	CO3	Analyze print parameters' effects on mechanical properties and accuracy.									K4	
	CO4	Design patient-specific biomedical models using 3D scanning and modeling.									K5	
	CO5	Evaluate surface quality and enhance prints with post-processing techniques.									K6	
List of Experiments:												
1. Study of FDM 3D Printer Operation and Calibration 2. 3D Scanning of Biomedical Model of ear and finger Using a Handheld Scanner 3. Scanning and Reconstruction of an artificial Dental Model Using an Intraoral Scanner 4. Conversion of DICOM Images to 3D Printable STL Files 5. Design and Printing of a Patient-Specific Skull Model 6. Study of Layer Thickness and Print Orientation on Mechanical Properties 7. Fabrication of a Dental Crown Using SLA Printing 8. 3D Printing of a Custom Prosthetic Finger Using Flexible Filament 9. Development of a 3D-Printed Microfluidic Device for Biofluid Analysis 10. Evaluation of Surface Roughness in SLA vs. FDM Printing 11. Design and Printing of a Patient-Specific Surgical Guide for nose Placement 12. Fabrication of a 3D-Printed Rehabilitative Orthopedic Cast with Ventilation												
Lecture Periods: -0			Tutorial Periods: -0			Practical Periods:30			TotalPeriods:30			
Textbook												
1. Prosenjit Saha, “3D Bioprinting from Lab to Industry” , Wiley , 2023. 2. Mohamad Zaki Hassan and Ilyas Aufa, “Handbook of 3D Printing in Biomedical Applications”, CRC Press , 2022. 3. Neeta Raj Sharma, Karupppasamy Subburaj, Kamalpreet Sandhu, and Vivek Sharma , “Applications of 3D Printing in Biomedical Engineering”, Springer , 2021.												
Reference Books												
1. Mohanan, P. V., editor. Compendium of 3D Bioprinting Technology. CRC Press, 2025. 2. BioCraft: Unleashing the Future of Bioprinting. Independently published, 2024. 3. Narayan, Roger J., editor. Advances in 3D Bioprinting. CRC Press, 2024. 4. Crook, Jeremy M., editor. 3D Bioprinting: Principles and Protocols. Humana Press, 2020. 5. Guvendiren, Murat, editor. 3D Bioprinting in Medicine: Technologies, Bioinks, and Applications. Springer												
Web References												
1. https://link.springer.com/book/10.1007/978-1-0716-0520-2 2. https://en.wikipedia.org/wiki/3D_bioprinting 3. https://www.iipseries.org/assets/docupload/rsl2024F767C1609A33C6E.pdf 4. https://youtu.be/yLaXBQgMdR8												



*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	1	-	-	-	-	3	2	2
2	2	2	2	2	3	-	-	-	2	2	2	3	3	3
3	2	3	2	2	3	-	-	-	2	2	1	3	3	3
4	3	3	3	3	3	1	1	-	3	3	3	3	3	2
5	3	2	2	2	3	-	1	2	3	3	2	3	3	3

Correlation Level: 1-Low, 2- Medium, 3 –High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	BIOMEDICAL ENGINEERING			Programme: B.Tech.							
Semester	VII			Course Category: PC			*End Semester Exam Type: LE				
Course Code	U23BMP711			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	MEDICAL IMAGE PROCESSING LABORATORY			0	0	2	1	50	50	100	
Prerequisite	MATLAB Basics, Image Processing, Mathematics, Signal Processing, Computer Vision.										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Describe digital image fundamentals								K3	
	CO2	Examine image enhancement techniques in medical images								K4	
	CO3	Execute restoration and segmentation techniques in medical images								K4	
	CO4	Apply various transforms to the images								K3	
	CO5	Describe the representations of features and recognize the images								K3	
List of Exercises:											
1. Image sampling and quantization. 2. Analysis of spatial and intensity resolution of images. 3. Intensity transformation of images 4. DFT analysis of images 5. Transforms (Walsh, Hadamard, DCT, Haar). 6. Histogram Processing. 7. Image Enhancement-Spatial filtering. 8. Image Enhancement- Filtering in frequency domain 9. Image segmentation – Edge detection, line detection and point detection 10. Basic Morphological operations 11. Basic Thresholding functions 12. Analysis of images with different color models 13. Watershed Algorithm for Image Segmentation.											
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods:30		TotalPeriods:30			
Text Books											
1. G.R. Sinha, Bhagwati Charen Patel, "Medical Image Processing: Concepts and Applications", PHI Learning private limited,2014. 2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", 3rdEdition, Tata McGraw Hill Pvt.Ltd., 2011.Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", CengageIndia1st Edition, 2017. 3. Kayvan Najarian and Robert Splinter,"Biomedical Signal and Image Processing", 2nd Edition, CRC Press,2005.											
Reference Books											
1. AnilJainK."Fundamentals of Digital Image Processing",PHI Learning Pvt Ltd,2011. 2. E.R. Davies,"Computer& Machine Vision", 4th Edition, Academic Press,2012. 3. MalayK.Pakhira,"Digital Image Processing and Pattern Recognition", 1st Edition,PHI Learning Pvt Ltd,2011. 4. Geoff Dougherty, "Medical Image Processing: Techniques and Applications", Springer Science & BusinessMedia,2011. 5. Isaac N. Bankman, "Handbook of Medical Image Processing and Analysis", Science Direct, 2nd Edition,2009.											
Web References											
1. https://youtu.be/0UPoSdBFd48 2. https://youtu.be/6mXXN1-vHQQ 3. https://youtu.be/8fBZFjiHw3I 4. https://youtu.be/PqBS3tFZYI8 5. https://m.youtube.com/watch?v=i8a2LdyenoY											

Dr. A. Vijayalakshmi

*TE–Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	3	-	-	-	-	-	-	3	2	-
2	2	3	2	-	3	-	-	-	-	2	-	3	3	2
3	2	3	3	3	3	-	-	-	-	2	-	3	3	3
4	3	2	2	2	3	-	-	-	-	2	-	3	3	2
5	3	2	2	2	3	-	-	2	2	3	1	3	3	2

Correlation Level: 1-Low, 2-Medium, 3-High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Viva				
Marks	15	5	5	15	10	50	100



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	BIOMEDICAL ENGINEERING	Programme: B.Tech.						
Semester	VII	Course Category: PA				*End Semester Exam Type: LE		
Course Code	U23BMW703	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	PROJECT PHASE - I	0	0	4	2	50	50	100
Prerequisite								

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester.

In the phase I of the project work, the progress of the work carried out in the 7th semester will be monitored and assessed. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment. The project work and the report will be evaluated by the internal assessment committee by conducting three reviews for a total of 50 marks. The end semester examination which carries a total of 50 marks will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner

CAM and ESM break-up for Project Phase-I

Sl. No	Description			Weightage
1	Continuous Assessment Marks			
a	Review1	Review Committee	10	15
		Supervisor	5	
b	Review2	Review Committee	10	15
		Supervisor	5	
c	Review3	Review Committee	15	20
		Supervisor	5	
	Total CAM			50
2	End Semester Marks			
	Evaluation of Phase I Report and Viva-voce	Report	15	50
		Presentation and Viva	20	
		Demonstration	15	
	Total ESM			50
	Total Marks			100



Dr. A. Vijayalakshmi

Department	BIOMEDICAL ENGINEERING	Programme: B.Tech.						
Semester	VII	Course Category: PA			*End Semester Exam Type: LE			
Course Code	U23BMW704	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	INTERNSHIP/ INPLANT TRAINING	0	0	2	1	100	-	100
Prerequisite								

Students may undergo Inplant training or internship during summer / winter vacation at Industry/ Research organization for a period of two weeks to four weeks. Students are also permitted to undergo internships during their seventh semester after the theory classes are over. Each student has to submit a detailed report on In-Plant Training which He / She have undergone. The department committee will assess the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of Inplant training or internship.

Assessment method for Industrial Training/Internship

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Report	Presentation	
Marks	50	50	100



PROFESSIONAL ELECTIVE –IV
(Offered in Semester VII)

Department	Biomedical Engineering			Program: B.Tech.							
Semester	VII			Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME714			Periods/Week			Credit	Maximum Marks			
Course Name	VIRTUAL BIOINSTRUMENTATION			L	T	P	C	CAM	ESE	TM	
				3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the basic concepts of Virtual instrumentation								K2	
	CO2	Realize the programming language used in VI								K3	
	CO3	Analyze the concept of data acquisition using VI								K3	
	CO4	Interpret the interfacing concept used in LabVIEW								K3	
	CO5	Apply the concept of VI for medical applications								K4	
UNIT – I	Introduction						Periods:9				
History of Virtual Instrumentation, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, LabVIEW basics – graphical programming, LabVIEW environment											
UNIT – II	Programming Techniques						Periods:9				
VIS and sub-VIS, loops and charts, arrays, clusters, graphs, case and sequence structures, formula modes, local and global variable, string and file input. Publishing measurement data in the web.											
UNIT – III	Data Acquisition						Periods:9				
Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input / Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements											
UNIT – IV	Instrument Interfaces						Periods:9				
Current loop, GPIB, System basics, interface basics: USB, PCMCIA, networking basics for office and industrial application VISA and IVI, image acquisition and processing, Motion Control, waveform generator.											
UNIT – V	Biomedical Applications						Periods:9				
Biofeedback systems and its components, Virtual applications for ECG, EEG, EMG signals, Air Flow and Lung Volume, Non-invasive Blood Pressure Measurement, Virtual Reality and 3D graphical modelling, Virtual Prototyping.											
Lecture Periods: 45			Tutorial Periods:			Practical Periods: -		Total Periods: 45			
Text Books											
1. Jon B. Olansen, Eric Rosow, “Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW” Prentice Hall PTR, 2001											
2. Gary Johnson, “LABVIEW Graphical Programming”, 4 th Edition, McGraw Hill, 2006.											
3. Ronald W. Larsen, “LabVIEW for Engineers”, Pearson , 1 st Edition, 2010											
Reference Books											
1. Robert H. Bishop,” Learning with LabVIEW” , Pearson, First edition, 2014											
2. Jerome, “Virtual Instrumentation Using LabView”, PHI, 2010.											
3. Sanjay Gupta and Joseph John, ” Virtual Instrumentation using LabVIEW”, Tata Mc Graw – Hill Publishing Company Limited New Delhi, 1 st Edition, 2005.											
4. John Essick,” Hands-on Introduction to LabVIEW for Scientists and Engineers “,Oxford University Press, 4 th Edition,2018											
5. Kevin James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control”, Newnes, 2000.											
Web References											
1. https://youtu.be/_2IZVC902kg											
2. https://youtu.be/78dZ8ljJ52M											
3. https://youtu.be/fly6XT3CdPQ											
4. https://youtu.be/U0bQBOEiBQY											
5. https://youtu.be/Q8rFSpaa84Q											



*TE–Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	3	-	-	-	-	1	-	3	2	-
2	3	2	-	-	3	-	-	-	-	2	-	3	2	1
3	3	3	2	2	3	-	-	-	-	2	-	3	3	3
4	3	3	2	2	3	-	-	-	-	2	1	3	3	3
5	3	3	3	3	3	1	1	2	2	3	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. V.

Department	Biomedical Engineering				Program: B.Tech.							
Semester	VII				Course Category: PE *End Semester Exam Type: TE							
Course Code	U23BME715				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	NANOTECHNOLOGY IN MEDICINE				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Understand the basic concept of nanomaterial synthesis										K2
	CO2	Analyze the mechanisms involved in biological nanoparticle formation.										K3
	CO3	Evaluate blood-biomaterial interactions, including heparin effects										K3
	CO4	Explain the characterization techniques used in nanomaterials										K3
	CO5	Assess vascular and lymphatic targeting strategies for nanoparticle drug delivery.										K4
UNIT – I	Physical and Chemical Process							Periods:9				
Chemical processes: Chemical precipitation and co-precipitation, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Microwave assisted synthesis, Core-Shell nanostructure, Physical Methods: Inert gas condensation, Arc discharge, RF- plasma, Plasma arc technique, Laser ablation, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD) method.										CO1		
UNIT – II	Biological Methods of Synthesis							Periods:9				
Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magneto tactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the nanostructured materials; synthesis process and application, Role of plants in nanoparticle synthesis.										CO2		
UNIT – III	Biological Interactions with Materials							Periods:9				
Introduction, Biocompatibility, Toxicity, Cytotoxicity, Hypersensitivity, Carcinogenicity, Interaction of Materials with Soft Tissues, Inflammation, Granulation Tissue Formation, Foreign Body Reaction, Fibrosis, Modification of Blood-Biomaterial Interactions, Interaction with Blood by Heparin, Interactions with Proteins, Cell Adhesion, Interactions with Hard Tissues, The Vroman Effect, Adhesion of Osteoblasts, Osseointegration, Fibrous Capsule Formation,										CO3		
UNIT – IV	Characterization Techniques							Periods:9				
Nanostructured materials Characterization Techniques X-ray diffraction (XRD), SEM, EDAX, TEM, Elemental mapping, FTIR, UV-Visible spectrophotometer, Nanomechanical Characterization using Nanoindentation, Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermo gravimetric Analysis (TGA), TEM, X-ray Photoelectron Spectroscopy (XPS), ICP-AES chemical analysis.										CO4		
UNIT – V	Biological Transport for Targeted Drug Delivery							Periods:9				
Drug transport mechanisms – Passive and active targeting – Nanocarriers (liposomes, dendrimers, polymeric nanoparticles) – Nanobots for precision medicine – Stimuli-responsive drug delivery – Controlled release systems – Tumor-targeted therapy – Blood-brain barrier penetration – Real-time tracking and monitoring of drug delivery.										CO5		
Lecture Periods: 45				Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books												
1 Harry F. Tibbals, “Medical Nanotechnology and Nanomedicine”, 1st Edition, CRC Press, 2011.												
2 Hossein Hossein Khani, “Nanomaterials in Advanced Medicine”, Wiley, 2019.												
3 Kirthi, A. Vishnu, Karthik, L., Janarthanan, Pushpamalar, “Nanotechnology in Medicine”, Springer, 2021.												
Reference Books												
1. BIOMEDICAL NANOSTRUCTURES. Edited by Kenneth E. Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair, WILEY-INTERSCIENCE A JOHN WILEY & SONS, INC., PUBLICATION, 2008												
2. Z.L Wang ,” Characterization of Nanophase materials”, 1 st Edition, Wiley-VCH, 2000.												
3. G. Schmidt, “Nanoparticles: From theory to applications”, 2 nd Edition, Wiley Weinheim, 2004.												
4. Zoraida Aguilar, “Nanomaterials for Medical Applications”, 1 st Edition,Elsevier, 2012.												
5. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemama 2009.												

Web References

1. <https://en.wikipedia.org/wiki/Nanomedicine>
2. <https://www.medicalnewstoday.com/articles/244972>
3. <https://www.azonano.com/article.aspx?ArticleID=4840>
4. <https://youtu.be/ZS1QPndpD2w>
5. https://youtu.be/iiT_KJJ1Uhs

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	1	-	-	1	-	3	2	-
2	3	3	2	2	2	-	-	-	-	2	-	3	3	-
3	3	3	2	3	2	3	2	2	-	2	-	3	3	2
4	3	3	2	2	3	-	-	-	-	2	-	3	2	2
5	3	3	3	2	3	2	2	2	1	3	2	3	3	2

Correlation Level: 1-Low, 2-Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Programme: B.Tech							
Semester	VII			Course Category Code: PE		*End Semester Exam Type: TE					
Course Code	U23BME716			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	DYNAMICS OF BIOFLUID			3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand to apply the fluid mechanics principles in bio fluid studies								K2	
	CO2	Gain adequate knowledge about the Vascular Mechanics								K2	
	CO3	Comprehend the physical, chemical and rheological properties of blood								K2	
	CO4	Analyze cardiovascular dynamics, fluid flow, pressure, compliance, elastance, and modeling.								K4	
	CO5	Comprehend dynamics of cerebrospinal fluid, alveolar mechanics, and synovial fluid.								K3	
UNIT–I	Fundamentals of Biofluid Mechanics						Periods:09				
Intrinsic Fluid Properties: Density, Viscosity, Compressibility, Surface Tension, Hydrostatics -Macroscopic Balances of Mass and Momentum - Microscopic Balance of Mass and Momentum – The Bernoulli Equation - Dimensional Analysis - Fluid Mechanics in a Straight Tube - Flow Stability and Related Characteristics - Effect of Flow Pulsatility - Boundary Layer Separation.										CO1	
UNIT–II	Vascular Mechanics						Periods:09				
Anatomical Organization of the Vasculature, Mechanical Properties of Blood Vessels, Functional Properties of Blood, Control Aspects of the Vascular System, Hemodynamic of Large Arteries, Heart Valves, Ventricular Outflow and the Aorta, Pressure-Flow Relations and Vascular Impedance, Wave Propagation Phenomena- Wave Reflection Phenomena.										CO2	
UNIT–III	Rheology of Blood						Periods:09				
Physical Properties of Blood - Viscous Behavior of Blood - Pressure–Flow Relationship for Non-Newtonian Fluids- Viscometry and Theory for Capillary - Capillary Viscometer - Coaxial Cylinder Viscometer - Cone and Plate Viscometer - Hemolysis and Platelet Activation with Fluid – Structural Components of the Blood Vessel - Material Behavior of Blood Vessels.										CO3	
UNIT –IV	Computation Fluid Dynamics						Periods:09				
Cardiovascular system – Ventricular pressure -volume diagram, Blood flow in arteries-blood vessel bifurcation-Uniform shear hypothesis -Two-element – Electric analogy model for two, three and four element model-Wave Propagation-Review concepts of compliance and Elastance- in arterial circulation-pressure changes in different distance from heart.										CO4	
UNIT– V	Bio-fluid Dynamic of Human Brain, Respiratory and Orthopedic						Periods:09				
Cerebro Spinal Fluid – Cerebral blood flow – Blood brain barrier – Brain diseases. Alveoli mechanics – Interaction of Blood and Lung P-V curve of Lung – Breathing mechanism – Airway resistance – Physics of Lung diseases, Pleural Fever. Synovial joint – Synovial fluid – Diseases affecting synovium.										CO5	
Lecture Periods:45			Tutorial Periods:			Practical Periods: -		Total Periods:45			
Text Books											
1. Goyal, M.R., Bhowmik, A., & Chauhan, A. (Eds.). (2025). Biofluid Dynamics of Human Body Systems: Expanded and Revised Edition (1st ed.). Apple Academic Press.											
2. Goyal, Megh R., et al. "Introduction and Properties of Biofluids in the Human Body Systems." Biofluid Dynamics of Human Body Systems. Apple Academic Press 1-52.											
3. Nithiarasu, P. "Biofluid Dynamics." Chapter 2 (2022): 20-21.											
4. Lauga, Eric. The fluid dynamics of cell motility. Vol. 62. Cambridge University Press, 2020.											
5. David A. Rubenstein, Weiyin, Mary D. Frame, “Biofluid Mechanics- An Introduction to fluid Mechanics, Macrocirculation and Microcirculation”, 2015, 1st Edition, Academic Press, Massachusetts, New York.											
Reference Books											



1. Taylor, R. L., and P. Nithiarasu. The finite element method for fluid dynamics. Elsevier, 2024.
2. Chin, Wilson C., and Jamie A. Chin, eds. Biofluids Modeling: Methods, Perspectives, and Solutions.
3. Grotberg, James B. Biofluid mechanics: analysis and applications. Cambridge University Press, 2021.

*TE –Theory Exam, LE–Lab Exam

Web References

1. https://en.wikipedia.org/wiki/Biofluid_dynamics
2. <http://www.dicat.unige.it/rrepetto/linked-files/biofluid-dynamics.pdf>
3. <https://www.maths.gla.ac.uk/~xl/Arasu-biofluid.pdf>
4. <https://www.youtube.com/watch?v=6ABq269ALFk>
5. <https://youtu.be/L4eZ0IOafvc>
6. <https://youtu.be/emmf2JYAD-0>
7. <https://youtu.be/NILy-u61yyk>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	2	2	-	1	-	-	1	-	3	2	-
2	3	2	2	2	2	2	-	-	-	1	-	3	3	-
3	3	3	-	2	3	1	-	2	-	1	-	3	3	2
4	3	3	3	3	3	1	-	-	-	2	-	3	3	2
5	3	2	2	2	2	2	2	1	-	2	-	3	3	2

Correlation Level: 1-Low, 2-Medium, 3– High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

A. Vijayalakshmi

Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Programme: B.Tech.						
Semester	VII			Course Category Code: PE		*End Semester Exam Type: TE				
Course Code	U23BME717			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	MEDICAL SAFETY AND STANDARDS			3	0	0	3	25	75	100
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Gain knowledge about hospital safety devices necessary for health care system							K2	
	CO2	Understand the techniques to shield patient from electrical hazards							K3	
	CO3	Gain knowledge in radiation safety and control measures							K2	
	CO4	Apply the various methods to monitor and assess quality in healthcare							K3	
	CO5	Apply the guidelines for medical standards in hospitals							K3	
UNIT-I	Hospital Safety					Periods:09				
Security and Safety of Hospital -Property, Staff & Patients, Safety precautions, Safe medical devices - device requirements - devices for varying age – initial inspection –maintenance-Safe handling and operation Reporting- Bed rails- Flawed mechanics- removable parts and packaging. Personal protective Equipment.									CO1	
UNIT-II	Electrical Safety					Periods:09				
Physiological effects of electricity - Electrical faults in medical devices - Leakage Current-Electrical isolation - Grounding system -Emergency power system - Uninterrupted power supply. IEC Standards for Electrical Safety.									CO2	
UNIT-III	Radiological Safety					Periods:09				
Fundamentals of radiation detection-Classification of radiation - Biological effects of Ionizing and Non-Ionizing radiation - Hazards associated with UV radiation - UV monitor and control measures, LASER - radiation hazards - control measures, Guidelines for CT installations, MRI safety guidelines.									CO3	
UNIT-IV	Quality Assessment in Healthcare					Periods:09				
Quality management-risk management- types of responsibilities – CSR, Individual and institutional Responsibility-MDRA and medical device standards - ICRP regulations for radiation safety- Methods Adopted to monitor the standards, Evaluation of hospital services – Quality Assurance in Hospitals Sop's -TQM in Health care organization- Quality assurance methods.									CO4	
UNIT-V	Hospital Accreditation and Standards					Periods:09				
Accreditation- JCI Accreditation & its Policies, Patient centered standards, ISO standards and CDSCO Standards for medical safety. Healthcare Organization management standards, Life Safety Standards- Protecting Occupants, Protecting the Hospital from Fire, Smoke, and Heat, Providing and Maintaining Fire Alarm Systems, Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste.									CO5	
Lecture Periods:45		Tutorial Periods:		Practical Periods: -			Total Periods:45			
Textbooks										
1. Barbara J. Youngberg, " Patient Safety Handbook "Jones& Bartlett Learning, 2 nd Edition, 2013										
2. Peter Lachman, Moira Stewart, and Siobhan McQuillan," Safety and Improvement in Primary Care: The Essential Guide", Radcliffe Publishing, 1 st Edition,2012.										
3. Hani H. Abujudeh, "Quality and Safety in Radiology", Oxford University Press, 1 st Edition, 2010.										
4. Ronda Hughe, "Patient Safety and Quality: An Evidence-Based Handbook for Nurses" , Agency for Healthcare Research and Quality, 1 st Edition, 2008.										



Reference Books

1. Peter Lachman, Moira Stewart, and Siobhan McQuillan, "Safety and Improvement in Primary Care: The Essential Guide", Radcliffe Publishing, 1st Edition, 2012.
2. Lucian L. Leape, "Making Healthcare Safe: The Story of the Patient Safety Movement", Springer, 1st Edition, 2021
3. Pascale Carayon, "Handbook of Human Factors and Ergonomics in Health Care and Patient Safety", CRC Press, 2nd Edition, 2011.
4. Robert Wachter and Kiran Gupta, "Understanding Patient Safety", McGraw-Hill Education, 3rd Edition, 2017

Web References

1. www.wma.net/what-we-do/education
2. www.medvarsity.com/courses/certificationcourse
3. www.medscape.com/courses/business
4. www.onlinecourses.swayam2.ac.in
5. www.healthcentral.com/healthcare

*TE–Theory Exam, LE– Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	3	2	2	1	2	1	3	2	3
2	3	3	2	2	3	3	2	2	1	2	1	3	2	3
3	3	2	2	2	3	3	3	3	-	2	1	3	3	2
4	3	3	3	2	2	2	2	2	1	3	2	3	2	2
5	3	3	3	2	2	3	3	3	2	3	2	3	2	2

Correlation Level: 1-Low, 2-Medium, 3-High Evaluation**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

A. Vijayalakshmi

Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VII		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME718		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	CRYPTOGRAPHY AND NETWORK SECURITY		3	0	0	3	25	75	100
Prerequisite	Network Essential								
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Explain the fundamentals of cryptography, including security attacks, encryption techniques, and steganography, to understand data protection principles.						K3	
	CO2	Compare and analyze symmetric and asymmetric cryptographic algorithms						K4	
	CO3	Demonstrate knowledge of authentication techniques and their applications in secure communication						K3	
	CO4	Describe IP security principles and key management strategies for secure networks						K2	
	CO5	Implement various network security protocols to mitigate security threats.						K4	
UNIT – I	Introduction				Periods:9				
Introduction To Cryptography - Security Attacks - Services And Mechanism - Conventional Encryption -Classical Encryption Techniques - Substitution Ciphers And Transposition Ciphers – Cryptanalysis – Steganography.							CO1		
UNIT – II	Symmetric and Asymmetric Cryptography				Periods:9				
Symmetric key Ciphers: Block ciphers principles - Data Encryption Standard (DES) - strength of DES - triple DES – Advanced Encryption Standard (AES)							CO2		
Asymmetric key Ciphers: Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - Elliptic curve cryptography									
UNIT – III	Message Authentication and Integrity				Periods:9				
Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions							CO3		
Integrity: Message Digest Algorithm (MD5) - Secure Hash Algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - Digital Signature Standards (DSS)									
UNIT – IV	Ip Security and Authentication Algorithms				Periods:9				
IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management. Authentication Applications: Kerberos and X.509.							CO4		
UNIT – V	Web and System Security				Periods:9				
Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - electronic mail security-pretty good privacy (PGP).							CO5		
System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems									
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. William Stallings: “Cryptography and Network Security”- Principles and Practice, 5th Edition, Pearson/PHI, 2011.									
2. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw-Hill,2017									
3. Wenbo Mao, —"Modern Cryptography-Theory and Practise", First Edition Pearson Education 2004									
Reference Books									
1. William Stallings, “Network Security Essentials (Applications and Standards)”, 4th Edition, Pearson Education. ,2012									
2. Atul Kahate, “Cryptography and Network Security”, 4th edition, Tata Mc Grawhill, 2019									
3. V.S. Bagad and I.A Dhotre, “Cryptography & Network Security”, 1 st edition, 2020.									
4. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, “Security in Computing”, Fifth Edition, Prentice Hall, New Delhi, 2015.									
5. Buchmann: “Introduction to Cryptography”, 2nd Edition, Springer, 2004									



Web References

1. <https://www.geeksforgeeks.org/cryptography-introduction/>
2. http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf
3. <https://nptel.ac.in/courses/106105031>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	1	3	1	2	1	3	2	1
2	3	3	2	2	2	-	-	3	-	2	-	3	2	-
3	3	3	2	2	2	2	1	3	2	2	2	3	2	1
4	3	3	2	2	3	2	1	3	-	2	2	3	2	1
5	3	3	2	2	3	2	2	3	1	3	2	3	3	2

Correlation Level: 1-Low, 2-Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

OPEN ELECTIVE –III
(Offered in Semester VII)

Department	BIOMEDICAL ENGINEERING				Programme: B.Tech.							
Semester	VII				Course Category: OE		End Semester Exam Type: TE					
Course Code	U23BMOC03				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	MEDICAL ROBOTICS				3	0	0	3	25	75	100	
Common to EEE, ECE, CSE, IT, ICE, CCE, CIVIL, AI&DS, CSBS / CSEBS												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the basics of robotic systems.									K2	
	CO2	Explore workspace and related motion of the Robots									K3	
	CO3	Analyse and extract information from the image using Robots									K3	
	CO4	Design of task planning and simulating the task.									K4	
	CO5	Construct Robots for Medical applications									K4	
UNIT-I	INTRODUCTION							Periods: 9				
Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot -Five-axis robot - Six-axis robot.											CO1	
UNIT-II	KINEMATICS							Periods: 9				
Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations-Robotic Manipulator – Continuous path motion – Interpolated motion – Straight-line motion.											CO2	
UNIT-III	ROBOT VISION							Periods: 9				
Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.											CO3	
UNIT-IV	PLANNING							Periods: 9				
Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.											CO4	
UNIT-V	MEDICAL APPLICATIONS							Periods: 9				
Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.											CO5	
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Text Books												
1. Robert Schilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall, January 2019.												
2. Paula Gomes,“Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications”,Woodhead Publishing,2012.												
3. Klafter, Chmielewski and Negin, “Robotic Engineering - An Integrated approach”,, PHI, first edition, 2009.												
Reference Books												
1. J.J.Craig, “Introduction to Robotics”, Pearson Education, 2019.												
2. Fu, Lee and Gonzalez., “Robotics, control vision and intelligence”, McGraw Hill International, 2nd edition, 2007												
3. John J. Craig, “Introduction to Robotics”, Addison Wesley Publishing, 3rd edition, 2010.												
4. Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, Prentice Hall, 2001.												
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, “Robotics”, McGraw Hill, 2008.												
Web References												
1.https://nptel.ac.in/courses/112/105/112105249/												
2.https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_robotic_surgery												



3. https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
 4. https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
 5. <https://www.worldscientific.com/worldscinet/jmrr>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	1	2	1	-
2	3	2	-	1	1	1	-	-	-	-	1	2	1	-
3	3	2	-	1	1	1	-	-	-	-	1	2	1	-
4	3	1	1	1	1	1	-	-	-	-	1	2	1	-
5	2	1	1	-	1	1	-	-	-	-	1	3	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	BIOMEDICAL ENGINEERING		Programme: B.Tech.							
Semester	VII		Course Category:OE			End Semester Exam Type: TE				
Course Code	U23BMOC04		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	TELEHEALTH TECHNOLOGY		3	0	0	3	25	75	100	
Prerequisite										
Common to EEE, ECE, CSE, IT, ICE, CCE, CIVIL, AI&DS, CSBS / CSEBS										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Understand the history and evolution of telemedicine.							K2	
	CO2	Understand the principles of multimedia communication, including text, audio, video, and data.							K2	
	CO3	Learn about medical information storage and management in telemedicine, including patient information, medical history, test reports, and medical images.							K3	
	CO4	Analyze the security and confidentiality concerns regarding medical records in telemedicine and understand the relevant cyber laws.							K2	
	CO5	Focusing on the applications of telemedicine in specialized areas like telecardiology, tele oncology, and neurosciences.							K3	
UNIT–I	Telemedicine and Health					Periods:9				
History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.								CO1		
UNIT –II	Telemedical Technology					Periods:9				
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, P0STN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.								CO2		
UNIT –III	Mobile Telemedicine					Periods:9				
Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system								CO3		
UNIT –IV	Telemedical Standards					Periods:9				
Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine								CO4		
UNIT–V	Telemedical Applications					Periods:9				
Telemedicine – health education and self-care. · Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.								CO5		
Lecture Periods:45			Tutorial Periods: -		Practical Periods: -		Total Periods:45			
TextBooks										
1. Haux, R., Heidrich, J.P., & Schleyer, T. "Introduction to Telemedicine", Springer, 2017										
2. Krishna, S., & Liss, A. "Telemedicine: A Practical Guide for Professionals", Springer, 2005										
3. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002										
Reference Books										
1. Goetz, S.K. "Telemedicine: The Electronic Practice of Medicine", Springer, 2011										
2. Krupinski, C. & Rhoads, J.M. "Telemedicine: Technology and Applications", CRC Press, 2019										
3. Ramakrishnan, S. & Chaturvedi, A. "Telemedicine: A Guide to Assessing Telecommunications for Healthcare", Wiley, 2006										
4. Gajendra, J.A. & Williams, A.J. "Telemedicine Technologies: Principles and Applications", Wiley, 2008										
5. McGonigle, D. & Mastrian, K.G. "Health Informatics: An Interprofessional Approach", Elsevier, 2020										
Web References										
1. https://www.who.int/health-topics/telemedicine										

2. <https://www.telemedicine.org>
3. <https://www.youtube.com/watch?v=TaOu0NB2dsc>

*TE–Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	1	1	1	-	-	-	-	1	3	1	1
2	3	2	-	1	1	1	-	-	-	-	1	2	1	1
3	3	2	2	2	1	1	-	-	-	-	1	3	1	1
4	3	3	2	2	2	1	-	-	-	-	1	3	1	2
5	2	3	3	3	2	1	-	-	-	-	2	3	1	2

Correlation Level: 1- Low,2- Medium,3 –High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

SEMESTER – I												
Department	Mathematics				Programme: B.Tech.							
Semester	I				Course Category: BS			End Semester Exam Type: TE				
Course Code	U23MATC01				Periods/Week			Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Mathematics – I				3	1	0	4	25	75	100	
(Common to ALL Branches Except CSBS)												
Prerequisite	Basic Mathematics											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the concept of Eigen values and Eigen vectors, Diagonalization of a Matrix									K3	
	CO2	Solve higher order differential equations									K3	
	CO3	Understand the different types of partial differential equations									K3	
	CO4	Know about the Applications of double and triple integrals									K3	
	CO5	Gain the knowledge about Vector Calculus and its Applications									K3	
UNIT – I	Matrices							Periods:12				
Rank of a Matrix – Systems of Linear Equations – Characteristic equation – Cayley Hamilton Theorem – Eigen values and Eigen vectors of a real Matrix – Diagonalization of Matrices.										CO1		
UNIT – II	Differential Equations (Higher Order)							Periods:12				
Linear Differential equations of higher order with constant coefficients – Euler's linear equation of higher order with variable coefficients – Method of Variation of parameters.										CO2		
UNIT – III	Functions of Several Variables							Periods:12				
Partial derivatives – Total derivatives – Maxima and Minima of two variables – Lagrange's Method of multipliers.										CO3		
UNIT – IV	Multiple Integrals							Periods:12				
Multiple Integrals – Change of order of integration (Cartesian form). Applications: Area as a double integral (Cartesian form) – Volume as a triple integral (Cartesian form).										CO4		
UNIT – V	Vector Calculus							Periods:12				
Gradient – Divergence and Curl – Directional derivatives – Irrotational and Solenoidal vector fields – Properties (Statement only) – Gauss Divergence Theorem and Stoke's Theorem (without proofs).										CO5		
Lecture Periods: 45			Tutorial Periods: 15			Practical Periods: -			Total Periods: 60			
Text Books												
1. M.K. Venkataraman, "Engineering Mathematics", The National Publishing Company, 2 nd Edition, 2016.												
2. N. P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9 th Edition, 2018.												
3. S.Narayanan and T.K. Manickavasagam Pillay, "Differential Equations and Its Applications", Viswanathan. S, Printers & Publishers Pvt Ltd, 2009.												
Reference Books												
1. G. Balaji, "Matrices and Calculus (Engineering Mathematics – I)" Balaji Publications, 9 th Edition June 2023												
2. A. Singaravelu, "Engineering Mathematics – I", Meenakshi publications, 1998.												
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", Wiley, 10 th Edition, 2019.												
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6 th Edition, 2018.												
5. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3 rd Edition, 2019.												
Web References												
1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra-slides- systems of equation-handout.pdf												



2.	http://www.math.cum.edu/~wn0g/2ch6a.pdf
3.	https://nptel.ac.in/courses/122/104/122104017/
4.	https://nptel.ac.in/courses/111/106/111106051/
5.	https://nptel.ac.in/courses/111/108/111108081/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	-	2	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	-	-	-	-	1	3	-	-
3	3	2	1	1	-	1	-	-	-	-	1	3	-	-
4	3	2	1	1	-	1	-	-	-	-	1	3	-	-
5	2	2	1	-	-	-	-	-	-	-	1	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Physics and Chemistry				Programme: B.Tech.							
Semester	I / II				Course Category: BS			End Semester Exam Type: TE				
Course Code	U23BSTC01				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Physical Science for Engineers				3	0	0	3	25	75	100	
(Common to all Branches)												
Prerequisite	Physics of 12 th standard or equivalent / Chemistry of 12 th standard or equivalent.											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the basic of properties of magnetic, dielectric and superconductors.									K2	
	CO2	Identify the wave nature of the particles, physical significance of wave functions									K3	
	CO3	Understand the basic principles of laser and fiber optics communication									K2	
	CO4	Understand and familiar with the water treatment.									K2	
	CO5	Understand the electrode potential for its feasibility in electrochemical reaction and uses of various batteries.									K2	
	CO6	Understand the specific operating condition under which corrosion occurs and suggest a method to control corrosion.									K2	
SECTION A – PHYSICS												
UNIT-I	Magnetic, Dielectric and Superconducting Materials						Periods: 8					
Introduction to magnetic materials, Ferromagnetism- Domain Theory-Types of energy-Hysteresis-Hard and Soft magnetic materials-ferrites-Dielectric materials-Types of polarization – Langevin-Debye equation-Frequency effects on polarization-Dielectric breakdown- Ferroelectric materials-Superconducting materials and their properties.										CO1		
UNIT-II	Quantum Mechanics						Periods: 7					
Matter Waves - de Broglie Wavelength - Uncertainty Principle –Physical Significance of wave functions - Schrodinger wave Equation - Time Dependent - Time Independent - Application to Particle in a One Dimensional Box - Tunnel Diode.										CO2		
UNIT-III	Laser And Fiber Optics						Periods: 7					
Lasers - Principles of Laser - Spontaneous and Stimulated Emissions - Einstein's Coefficients - Population Inversion and Laser Action –components of laser - Types of Lasers - NdYAG, CO ₂ laser, GaAs Laser Fiber Optics - Principle and Propagation of light in optical fiber - Numerical aperture and acceptance angle - Types of optical fibers (material, refractive index, mode)										CO3		
SECTION B – CHEMISTRY												
UNIT-IV	Water And Its Treatment						Periods: 8					
Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD. Desalination of brackish water: Reverse osmosis-disadvantages of using hard water in boiler - Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment–Ion exchange demineralization and zeolite process.										CO4		
UNIT-V	Electrochemical Cells and Storage Devices						Periods: 8					
Galvanic cells, single electrode potential, standard electrode potential, electrochemical series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen, calomel and Ag/AgCl. Batteries and fuel cells: Types of batteries- alkaline battery-lead storage battery- nickel-cadmium battery- fuel cell H ₂ -O ₂ fuel cell-applications.										CO5		
UNIT-VI	Corrosion						Periods: 7					
Corrosion –Introduction - factors – types – chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method. Uses of inhibitors, metallic coating – anodic coating, cathodic coating. Metal cladding, Electroplating of Copper and electroless plating of nickel.										CO6		



Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45
Text Books			
1. V Rajendran, "Engineering Physics", TMH, New Delhi, 2 nd Edition, 2011. 2. S.S Dara – "A text book of Engineering Chemistry" -. S.Chand Publications, 15 th Edition, 2021 3. C.Jain, Monica Jain "Engineering Chemistry. Dhanpat Rai Pub. Co., New Delhi, 17 th Edition (2015).			
Reference Books			
1. R.Murugesan, "Modern Physics", S. Chand &Co, New Delhi, 2006. 2. William D Callister Jr., "Material Science and Engineering", John Wiley and sons, 6 th Edition, 2009. 3. Jain & Jain "Engineering chemistry", Dhanpat Rai Publishing Company. 23 rd Edition, 2022 4. Mars Fontana "Corrosion Engineering", July 2017 5. JinaRedlin, "Handbook of Electrochemistry", March 2005			
Web References			
1. https://www.sciencedaily.com/terms/materials_science.htm . 2. https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers/materials_science.html . 3. https://study.com/academy/lesson/semiconductors-superconductors-definition-properties.html 4. https://mechanicalc.com/reference/engineering-materials 5. http://ndl.ethernet.edu.et/bitstream/123456789/89589/1/%5BPerez_N.%5D_Electrochemistry_and_corrosion%28BookZZ.org%29.pdf			

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	2	-	-
2	3	2	3	2	-	-	-	-	-	-	-	2	-	-
3	3	2	3	2	-	-	-	-	-	-	-	2	2	-
4	3	1	-	-	-	-	-	-	-	-	-	2	-	-
5	3	1	-	-	-	-	-	-	-	-	-	2	-	-
6	3	1	-	-	-	-	-	-	-	-	-	2	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering				Programme:B.Tech.							
Semester	I				Course Category:BS		*End Semester Exam Type:TE					
Course Code	U23BMT101				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Human Anatomy and Physiology				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Describe basic structural and functional elements of human body.									K2	
	CO2	Explain the function of heart and its conduction and knowledge on nervous systems.									K3	
	CO3	Illustrate the Physiological function of Eye, Ear and Excretory systems									K3	
	CO4	Distinguish the types of skeletal systems and functions of respiration									K3	
	CO5	Elucidate the classification, Metabolism of Macromolecules and its Measurement									K3	
UNIT-I	Basic Elements of Human Body						Periods:9					
Structure and function of Cell and cellular components, Membrane Potential, Action Potential, Generation and Conduction, Blood Cell: Composition, Fluid and electrolytic balance, Blood Groups - ABO and Rh System, Estimation of RBC and WBC.											CO1	
UNIT-II	Cardiovascular and Nervous System						Periods:9					
Cardiovascular system - Heart and vascular system, ECG, Blood Pressure, Homeostasis, Cardiac Cycle, Basics of Cardiac Output and Heart Sounds, PCG.											CO2	
Nervous System - Structure and functions of Neurons, Synapse, Reflex action and Receptors, Velocity of Conduction of Nerve Impulses, Nerve conduction Test, Nervous control of Heart.												
UNIT-III	Urinary and Visual -Auditory System						Periods:9					
Gastro Urinal system, Structure and function of kidneys and Nephron, Mechanism of Urine formation, Urine Reflex. Optics of Eye: Retina, Photochemistry of Vision, Accommodation, Neurophysiology of Vision, Structure and functions of Internal Ear, Mechanism of Hearing, Auditory pathway, Hearing Tests.											CO3	
UNIT-IV	Musculo Skeletal and Respiratory System						Periods:9					
Musculo Skeletal System: Muscle Tissue, Structure of Skeletal Muscle, Types of Muscle, Types of Joints, Major Muscles of Limbs and their actions.											CO4	
Respiratory system: Physiological aspects of respiration, Exchange of gases, Regulation of Respiration, Pulmonary function test, Artificial respiration.												
UNIT-V	Macromolecules and Measurement						Periods:9					
Carbohydrates: Classification, Metabolism of carbohydrate and its dysfunction. Lipids: Classification, Metabolism of lipids and dysfunction, Protein: Classification of Amino acids, architecture of protein molecules.											CO5	
Measurement: Principles of Photometry, Spectrophotometry, Flurometry, Flame Photometry, Densitometry, Calorimetry,												
LecturePeriods:45			Tutorial Periods:-			Practical Periods:-			TotalPeriods:45			
Text Books												
1. Guyton, “Text book of Medical Physiology”, WB Jaunder company Philadelphia, 10 th Edition, 2010												
2. Elaine.N. Marieb, “Essential of human Anatomy and Physiology”, Pearson Education New Delhi, 8 th Edition, 2010												
3. C.L.Ghai, “A textbook of Practical physiology”, Jaypee Medical Publishers, 5 th Edition, 2013												
Reference Books												



1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology", Pearson Publishers, 5th Edition, 2014
2. Gillian Pocock, Christopher D. Richards, "The Human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 8th Edition, 2013
3. William F. Ganong, "Review of Medical Physiology", McGraw Hill, New Delhi, 22nd Edition, 2010
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, 2015
5. Guyton & Hall, "Medical Physiology", Elsevier Saunders, 13th Edition, 2015

Web References

1. <https://byjus.com/biology/human-body-anatomy/>
2. <https://www.khanacademy.org/>
3. <https://www.youtube.com/channel/UCJayvjGvKEblkA3KYK1BQQw>
4. <https://www.britannica.com/browse/Anatomy-Physiology>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	-	-	-	2	-	-	-	2	3	-	-	3
2	3	2	-	-	-	2	-	-	-	2	3	2	-	3
3	3	2	-	-	-	2	-	-	-	2	3	2	2	3
4	3	2	-	-	-	2	-	-	-	2	3	2	-	3
5	3	2	-	-	2	2	-	-	-	2	3	2	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabu



Department	Biomedical Engineering				Programme :B.Tech.							
Semester	I				Course Category:ES		*End Semester Exam Type:TE					
Course Code	U23BMT102				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Basic Electrical Circuits				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Gain knowledge in fundamentals of electrical circuits									K2	
	CO2	Analyze the electrical parameters of the circuits using basic theorems									K3	
	CO3	Compare frequency response of resonant circuits									K3	
	CO4	Determine the steady state and transient response of RL, RC and RLC circuits									K4	
	CO5	Analyze the working principle and application of electrical machines									K3	
UNIT-I	Introduction to Electrical Circuits							Periods:12				
Basic Components of electric Circuits, Ohms Law, Kirchhoff's Law, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Star-Delta conversion												CO1
Concepts of AC circuits: RMS value, Average Value, Form Factor, Peak Factor, study of RL, RC, RLC series and parallel circuit, phasor representation in Polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor.												
UNIT-II	Network Theorems							Periods:12				
Mesh analysis, Nodal analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Compensation Theorem, Maximum Power Transfer Theorem, Millman's Theorem.											CO2	
UNIT-III	Resonance And Coupled Circuits							Periods:12				
Resonance: Series and Parallel resonance, Variation of Impedance, Current and Voltage with frequency in series and parallel resonant circuits, Bandwidth, Q factor and Selectivity.											CO3	
Coupled Circuits: Self-inductance, Mutual inductance, Dot rule, Coefficient of coupling - Series and Parallel connection of coupled inductors - Single tuned coupled circuit.												
UNIT-IV	Transient Response Analysis							Periods:12				
Steady State and Transient Response, Source free, Step, Impulse, Sinusoidal and exponential response for RL, RC and RLC circuits.											CO4	
UNIT-V	Electrical Machines and Safety							Periods:12				
Working principle of DC generator, motor-EMF and Torque equation – Types: Shunt, Series and Compound, Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single- phase induction motor- Applications. Operating principles of Synchronous motor, stepper motor-Applications. Safety measures in electrical system- Electrical tools and accessories–wiring standards.											CO5	
LecturePeriods:45			TutorialPeriods:15			Practical Periods: -			TotalPeriods:60			
Text Books												
1. Charles K. Alexander, Matthew N. O. Sadiku" Fundamentals of Electric Circuits", McGraw Hill May, 7th Edition ,2022. 2..ChakrabatiA,"CircuitTheoryAnalysisandSynthesis", Dhanpath Rai and Sons,New Delhi, 7 th edition, 2018 3.WilliamH.Hayt,Jr.JackE.KemmerlyandStevenM.Durbin,"EngineeringCircuitAnalysis", McGraw Hill Science Engineering, 8 th Edition, 11th Reprint 2016.												
Reference Books												
1. William Haystack, E Kemmerly and Steven M Durbin, "Engineering Circuits Analysis", Tata McGraw-Hill, 8 th Edition 2013, 2. John Bird, "Electrical Circuit theory and technology", Routledge, 5 th Edition2013. 3. KothariDPandI.JNagrath,"BasicElectricalandElectronicsEngineering", McGrawHillEducation,7 th Edition2014. 4. Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum"s Outline Series, , Tata McGraw Hill												



5. Publishing Company, New Delhi, 5th Edition Reprint 2016.
6. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, McGraw Hill, 9th Edition Reprint 2015.

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1. <https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic>
2. <https://www.thelearningpoint.net/home/electrical-science-and-engineering/circuit-theory>
3. <https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444>
4. https://swayam.gov.in/nd1_noc19_ee36/preview
5. <https://nptel.ac.in/courses/117/106/117106108/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	2	1	1	1	1	2	3	3	2	3
3	2	3	2	2	2	1	1	1	1	2	2	3	2	2
4	3	3	2	3	2	1	1	1	1	2	3	3	2	3
5	3	3	3	2	3	2	2	2	2	3	3	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Civil and Mechanical			Programme: B.Tech.							
Semester	I / II			Course Category: ES			*End Semester Exam Type: TE				
Course Code	U23ESTC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Basics of Civil and Mechanical Engineering			3	0	0	3	25	75	100	
(Common to ECE, EEE, ICE, MECH, CIVIL, MCTR, BME Branches)											
Prerequisite	Basic Science										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the types of buildings and materials.								K2	
	CO2	Summarize on the various components of buildings and surveying concepts								K2	
	CO3	Identify the various infrastructure facilities								K2	
	CO4	To familiarize the working principles of IC engines and automobile systems								K2	
	CO5	To understand about the power generation systems and its components								K1	
	CO6	To acquire knowledge about the various machining process.								K2	
SECTION A - CIVIL ENGINEERING											
UNIT - I	Buildings And Buildings Materials								Periods: 08		
Buildings – Definition – Classification according to NBC-plinth area, Floor area, carpet area, floor space index - Development of Smart cities - Green building, Benefits from green building. Building Materials - stone, brick, cement, cement mortar, concrete, steel, Timber - their properties and uses										CO1	
UNIT - II	Buildings Components and Surveying								Periods: 08		
Various Buildings Components and their functions. Foundation: function and types - Brick masonry, Stone Masonry and its types – Floors, Roofs and its types. Surveying: Objects – Classification – Principles – Measurements of Distances and areas – Leveling										CO2	
UNIT - III	Basic Infrastructure								Periods: 07		
Roads and Bridges – types, components advantage and disadvantages. Railways - Permanent way and its elements. Sources of Water - Quality of Water- Domestic sewage Treatment – Rain Water harvesting – Dams - site selection for dam construction, types of dams.										CO3	
SECTION B – MECHANICAL ENGINEERING											
UNIT- IV	Internal And External Combustion Systems								Periods: 08		
IC engines – Classification – Working principles – Diesel and Petrol Engines: Two stroke and four stroke engines – merits and demerits.Steam generators (Boilers) – Classification – Constructional features (of only low-pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.										CO4	
UNIT- V	Power Generation Systems, Refrigeration and Air Conditioning System								Periods: 07		
Power plants: Thermal – Nuclear, Hydraulic, Solar, Wind, Geothermal, Wave, Tidal and Ocean Thermal Energy Conversion systems - Functions, Applications - Schemes and layouts (Description only) Refrigeration and Air Conditioning System: 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.										CO5	
UNIT- VI	Manufacturing Process								Periods: 07		
Lathe - types, Specifications, Operations of a centre lathe. Casting - Pattern making, Allowances, Green sand and dry sand moulding, casting defects. Welding - Arc and Gas welding process, brazing and soldering (process description only).										CO6	
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45		

Text Books

1. Dr. S. Jayakumar, "Basic Civil Engineering", Aagash Nekaa Publications, 2011
2. G Shanmugam, MS Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education, 1st Edition, 2018.
3. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.

Reference Books

1. M.P. Poonia, S.C. Sharma and T.R. Banga, Basic Mechanical Engineering, Khanna Publishing House 2018.
2. S.S.Bhavikatti, Basic Civil engineering, New Age International Ltd. 2018.
3. V. Rameshbabu, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
4. Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, Pearson Publication, 7th Edition, 2014.
5. Gopi Satheesh, Basic Civil engineering, Pearson Publications, 3rd Edition, 2015.

Web References

1. <https://nptel.ac.in/courses/112107291/>
2. <https://nptel.ac.in/courses/112/103/112103262/>
3. <https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/lecture-notes/>
4. <https://nptel.ac.in/courses/105102088/>
5. <https://nptel.ac.in/courses/105104101/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	-	-	-
2	3	1	1	-	1	-	-	-	-	-	1	-	-	-
3	3	1	1	-	1	-	-	-	-	-	1	-	-	-
4	3	1	-	-	-	-	-	-	-	-	1	-	-	-
5	3	1	-	-	-	-	-	-	-	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	English			Programme: B.Tech.							
Semester	I			Course Category : HS			End Semester Exam Type: TE				
Course Code	U23ENBC01			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Communicative English - I			2	-	2	3	50	50	100	
(Common to ALL Branches except CSBS)											
Prerequisite	Basics of English Language										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the communication flow in organization and its objectives								K2	
	CO2	Write the technical contents with grammatically precise sentences								K2	
	CO3	Articulate with correct pronunciation and overcome vernacular impact in speaking								K3	
	CO4	Express opinions confidently in formal and informal communicative contexts								K2	
	CO5	Attend interview with assertiveness								K3	
UNIT- I	Workstead Communication					Periods:10					
Communication, Definition, Process, Channels, Barriers, Strategies for Effective Communication, Verbal and Nonverbal Communication - Listening, Types, Barriers, Enhancing Listening Skills - Bibliography: Book, Journal and Internet References										CO1	
UNIT- II	Common Errors In Writing And Comprehension Strategies					Periods:10					
Subject Verb Agreement, Misplaced Modifiers, Squinting Modifiers, Dangling Modifier, Fused Sentence, Comma Splice, Sentence Fragment - Reading Comprehension: Technical passage, Strategies: Skimming, Scanning, Intensive and Extensive Reading, Prediction, and Contextual Meaning										CO2	
UNIT- III	Phonetics					Periods:10					
Pronunciation Guidelines to consonants and vowels, Sounds Mispronounced, Silent and Non-silent Letters, Intonation, Spelling Rules and Words often misspelled, Mother Tongue Influence (MTI), Various Techniques for Neutralization of Mother Tongue										CO3	
UNIT- IV	Communication Practice-I					Periods:15					
List of Exercises Listening: Self Introduction videos Speaking: Self-Introduction, Extempore, and Role Play Reading: Non-Technical Comprehension Passage Writing: Common Errors in Writing										CO4	
UNIT-V	Interpersonal Communication-I					Periods:15					
List of Exercises Listening: Speech Sounds, Interview Videos Speaking: Debate, Structured Group Discussion, and Conversation Reading: Commonly Confused Words Writing: Transcription										CO5	
Lecture Periods:30			Tutorial Periods:-		Practical Periods:30			Total Periods:60			
Text Books											
1. Richa Mishra , Ratna Rao, “A textbook of English Language Communication Skills”, Macmillan Publishers India Private Ltd., Revised Edition 2021. 2. Rizvi M. Ashraf, “Effective Technical Communication”, New Delhi: Tata-McGraw-Hill Publishing Company Limited, 4th Edition, 2010. 3. Balasubramanian T, “English Phonetics for Indian students workbook”, 2nd Edition, Trinity Press, 2016.											

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1. N.P.Sudharshana, C. Savitha, "English for Engineers", Cambridge University Press, 2018.
2. Raman, Meenakshi, and Sharma, Sangeetha, "Technical Communication - Principles and Practice", 3rd Edition, Oxford University Press, 2017.
3. Comfort, Jeremy, et al., "Speaking Effectively: Developing Speaking Skills for Business English", Cambridge University Press, Cambridge, Reprint 2011.
4. Wren & Martin, "High School English Grammar and Composition", S Chandh & Co. Ltd, 2015.
5. Boove, Courtland L, "Business Communication Today", Pearson Education, New Delhi, 2002.

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1. <https://lemongrad.com/subject-verb-agreement-rules/>
2. <https://opentextbc.ca/advancedenglish/chapter/misplaced-and-dangling-modifiers/>
3. <https://www.hitbullseye.com/Reading-Comprehension-Tricks.php>
4. <https://www.softwaretestinghelp.com/how-to-crack-the-gd/>
5. <https://worldscholarshipvault.com/neutralize-mother-tongue-interference/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	1	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20(to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical					
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks
30(to be weighted for 10 marks)			30 marks		40
Listening (L)*	10		Listening (L)*	10	
Speaking(S)	5		Speaking(S)	5	
Reading(R)*	10		Reading(R)*	10	
Writing(W)*	5		Writing(W)*	5	

- LRW components of Practical can be evaluated through Language Lab Software



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	I			Course Category: BS			*End Semester Exam Type: LE				
Course Code	U23BMP101			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Physiology Laboratory			0	0	2	1	50	50	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Evaluate and Analysis the practice of Physiology								K4	
	CO2	Identify the General Tests of carbohydrates, Proteins and lipids								K4	
	CO3	Apply the principles and preparation of serum and plasma from blood								K3	
	CO4	Identify the Quantitative Estimation present in the slide								K3	
	CO5	Measurement of pH level in the body fluids								K3	
List of Experiments:											
1. Blood Group Test 2. Estimation of RBC count 3. Estimation of WBC count 4. General tests for Carbohydrates 5. General tests for Proteins 6. General tests for Lipids 7. Preparation of Serum from blood. 8. Preparation of Plasma from blood. 9. Quantitative estimation of Blood Glucose 10. Quantitative estimation of Creatinine 11. Quantitative estimation of Cholesterol 12. Quantitative estimation of Urea 13. Study of Measurement of pH and conductivity of body fluids											
Lecture Periods: -0			Tutorial Periods: -0			PracticalPeriods:30			TotalPeriods:30		
Reference Books											
1. Mohammad A, "Practical Examination Manual of Pathology", CBS, January 2011. 2. Kanika Sharma Ane's student edition, "Manual of Microbiology tools and techniques", March 2010. 3. Sabitri Sanyal Aparna Bhattacharaya, "Clinical Pathology: A Practical Manual", Elsevier India, 3 rd Edition, 2014 4. McPherson Henry's "Clinical Diagnosis and Management by Laboratory Methods", Elsevier, 24 ^e , South Asia Edition January 2021 5. Rajbala Yadav, Nidhi Verma, Meeta Singh, "Essentials of Practical Pathology for Undergraduates", Elsevier India 1st Updated Edition Paperback – October 2019.											
Web References											
1. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures 2. https://ocw.mit.edu/courses/biology/8-012-introduction-to-biology-fall-2004/videolectures 3. nptel.ac.in/courses/102105034/											

* TE – Theory Exam, LE – Lab Exam



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	1	2	1	3	3	2	2	3
2	3	2	2	2	2	1	1	1	1	3	3	2	2	3
3	3	2	2	2	2	2	1	1	1	3	3	3	3	3
4	3	3	2	3	2	1	1	1	1	2	3	3	2	3
5	3	2	2	2	3	2	1	1	1	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	I			Course Category:ES			*End Exam Type:LE				
Course Code	U23BMP102			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Basic Electrical Circuits Laboratory			0	0	2	1	50	50	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Construct electrical circuits to analyze the basic laws								K4	
	CO2	Observe and analyze the theorems in electrical circuits								K4	
	CO3	Analyze the electrical characteristics of RL, RC and RLC circuits								K4	
	CO4	Classify the operation of types of lamps								K3	
	CO5	Understand the wiring concepts and trouble shooting of electrical equipment								K3	
List of Experiments:											
Lecture Periods: -			Tutorial Periods: -			PracticalPeriods:30		TotalPeriods:30			
Reference Books											
Web References											

* TE – Theory Exam, LE – Lab Exam



COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	1	-	1	-	2	2	1	2	3
2	3	3	2	2	2	1	-	1	-	2	2	2	2	3
3	3	3	2	2	2	1	-	1	-	2	2	2	2	3
4	2	2	2	1	2	1	-	1	-	2	2	1	2	2
5	2	2	2	1	3	2	-	1	1	2	2	1	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Mechanical Engineering				Programme: B.Tech.						
Semester	I / II				Course Category : ES		*End Semester Exam Type: LE				
Course Code	U23ESPC02				Periods/Week		Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM
Course Name	Design Thinking and IDEA Lab				0	0	2	1	50	50	100
(Common to ALL Branches)											
Prerequisite	Basic Knowledge of Science										
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)
	CO1	Demonstrate a comprehensive understanding of the tools and inventory associated with the IDEA Lab.									K2
	CO2	Develop proficiency in ideation techniques to generate creative and innovative solutions for various design and problems challenges									K3
	CO3	Acquire practical knowledge of mechanical and electronic fabrication processes, including hands-on experience with machinery, tools, and techniques used in the manufacturing and assembly of physical components.									K3
	CO4	Cultivate the skills necessary for developing innovative and desirable products, including the ability to integrate user needs, market trends, and technological advancements into the design process.									K4
	CO5	Apply iterative design methodologies to refine and improve solutions based on feedback, user testing, and evaluation of functional, aesthetic, and usability aspects									K4
Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer Needs, Insight-leaving from the lives of others/standing on the shoes of others, Observation											
Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, Wooden model, Clay model, 3D printing; Experimenting/testing.											
Sustainable product design, Ergonomics, Semantics, Entrepreneurship/business ideas, Product Data Specification, establishing target specifications, Setting the final specifications. Design projects for teams.											
List of Lab Activities and Experiments											
1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.											
2. Machining of 3D geometry on soft material such as softwood or modelling wax.											
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.											
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.											
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.											
6. Familiarity and use of welding equipment.											
7. Familiarity and use of normal and wood lathe.											
8. Embedded programming using Arduino and/or Raspberry Pi.											



9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.
10. Discussion and implementation of a mini project.
11. Documentation of the mini project (Report and video).

Lecture Periods: -**Tutorial Periods: -****Practical Periods: 30****Total Periods: 30****Text Books**

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd
2. Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.

Reference Books

1. Ulrich and Eppinger, Product Design and Development, McGraw Hill, 3rd Edition, 2004
2. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018.
3. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan, Weldon Owen; 2017.
4. . Paul Horowitz and Winfield Hill "The Art of Electronics" Cambridge University Press. 3rd edition.
5. Paul Sherz and Simon Monk "Practical Electronics for Inventors". .. McGraw Hill. 4th edition
6. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education.
7. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill.
8. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer
9. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and Distributors, 5th Edition, 2002.

Web References

1. https://onlinecourses.nptel.ac.in/noc23_mg72

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	2	2	-	2	-	3	2	-	-	-
2	3	3	3	2	2	2	-	2	-	3	2	-	-	-
3	3	3	3	2	3	2	-	2	-	3	2	-	-	-
4	3	3	3	2	3	2	-	2	-	3	2	-	-	-
5	3	3	3	2	3	2	-	2	-	3	2	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High
Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	I	Course Category: AEC			*End Semester Exam Type: LE			
Course Code	U23BMC1XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – I	0	0	4	-	100	-	100
Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50		Total Periods:50		

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering				Programme: B.Tech.						
Semester	I				Course Category: MC		End Semester Exam Type: -				
Course Code	U23BMM101				Periods/Week		Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM
Course Name	Induction Programme				2 weeks		Non-Credit	-	-	-	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Develop holistic attitude and harmony in the individual, family, and Society								K2	
	CO2	Acquire grammar skills and capable to write and speak English confidently								K2	
	CO3	Understand the basic concepts in Mathematics and Programming								K2	
	CO4	Know about the art and culture, language and literature of this vastsecularnation								K2	
	CO5	Identify the inherent talent and develop it professionally								K3	
UNIT-I	Universal Human Values						Periods:12				
Welcome and Introductions - Getting to know each other, Aspirations and Concerns - Individual Academic and Career, Expectations of Family, Peers, Society, Nation, Fixing one's Goals, Self-Management - Self-confidence, Peer Pressure, Time Management, Anger, Stress Personality Development, Self-improvement, Health - Health issues, Healthy diet, Healthy lifestyle, Hostel life, Relationships - Home sickness, Gratitude towards Parents, Teachers and others Ragging and interaction, Competition and Cooperation, Peer Pressure, Society - Participation in Society, Natural Environment - Participation in Nature, Sum Up - Role of Education, Need for a Holistic Perspective, Self-evaluation and Closure - Sharing and feedback.											CO1
UNIT-II	Proficiency in English						Periods:12				
Communication skills – Prognostic test on Grammar - Synonyms, Antonyms, Tenses, Sentence Completion, Idioms and Phrases, One-word Substitution, Homophones, Homonyms, Use of Prepositions, Subject-verb Agreement - Writing –Paragraph writing, Letter writing, Essay writing, Story Development.											CO2
UNIT-III	Bridge Course in Mathematics and C Programming						Periods:12				
Mathematics: Fundamentals of differential and integral calculus: Theory and Practice, Limit of function - Fundamental results on limits - Continuity of a function - Concept of differentiation - Concept of derivative - Slope of a curve -Differentiation Techniques - Derivatives of elementary functions from first principle –Derivatives of inverse functions – Logarithmic differentiation – Method of substitution – Differentiation of parametric functions – Differentiation of implicit functions –Higher order derivatives. Integrals of functions containing linear functions -Method of integration (Decomposition method, method of substitution, integration by parts) – Definite integrals. Simple definite integrals – Properties of Definite integrals –Reduction formulae - Area and volume –Length of curve –surface area of a solid.											CO3
C Programming: Features of C and its basic Structure - Keywords - constants - variables - operators - Data types - Formatted input and output statements - Control and Looping statement - Arrays - Functions - Strings - writing simple C programs.											
UNIT-IV	Literary Activities						Periods:12				
Team building activities - Quiz - Oral Exercises - Group discussion, Debate, Extempore, Role play, சிறப்பு சொற்பொழிவு – தமிழ்மரபு மற்றும் தமிழர் தொழில் நுட்பம்.											CO4
UNIT-V	Creative Arts						Periods:12				
Introduction to painting ad renowned artworks -Documentary and Short films -Music -Vocal, Instrumental - Dance - Classical, Cinematic -Mimicry -Mime.											CO5
Lecture Periods:60			Tutorial Periods:-			Practical Periods:-			Lecture Periods:60		
Reference Books											
1. R.R Gaur, R. Asthana, G.P. Bagaria,” A Foundation Course in Human Values and Professional Ethics”, Excel Books, New Delhi, 2 nd Revised Edition, 2019.											



2. Kumar Mohan R, "English Grammar for all (Functional and Applied Grammar)", Unicare Academy, 2022.
3. Seely, John," Oxford A-Z of Grammar and Punctuation, Oxford Publication, 2013.
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
5. Dr. A. Singaravelu, "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019.
6. E. Balagurusamy, "PROGRAMMING IN ANSI C", Mc Graw Hill, 8th Edition, 2019.
7. Dr.K.K.Pillay,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL
8. R.Balakrishnan, "Journey of Civilization", Roja muthiah research publishers, 1st Edition 2019
9. தமிழகவரலாறு - மக்களும் பண்பாடும், பிள்ளை, கே. கே. , சென்னை : உலகத்தமிழாராய்ச்சிநிறுவனம் , 2002.
10. கணிணித்தமிழ் - முனைவர்இல.சுந்தரம், விகடன்பிரசுரம்.
11. சீழடி – வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம், தமிழக தொல்லியல் துறை

Web References

1. <http://www.newsociety.com/Books/S/Slow-isBeautiful>
2. <https://www.aplustopper.com/formal-letter/>
3. <https://www.javatpoint.com/c-programming-language-tutorial>
4. <http://www.math.cum.edu/~wn0g/2ch6a.pdf>
5. <https://education.nsw.gov.au/teaching-and-learning/curriculum/creative-arts>

A. on

SEMESTER – II											
Department	Mathematics			Programme : B.Tech.							
Semester	II			Course Category: BS			*End Semester Exam Type: TE				
Course Code	U23MATC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Mathematics – II			3	1	0	4	25	75	100	
(Common to ALL Branches Except CSBS, FT)											
Prerequisite	Basic Mathematics										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Convert a periodic function into series form.								K2	
	CO2	Compute Fourier transforms of various functions.								K3	
	CO3	Solve Differential Equations using Laplace transforms.								K3	
	CO4	Apply inverse Laplace transform of simple functions.								K3	
	CO5	Solve difference equations using Z – transforms.								K3	
UNIT – I	Fourier Series						Periods:12				
Dirichlet's conditions – General Fourier series – Odd and Even functions – Half-Range sine series and cosine series – Change of intervals – Parseval's Identity.									CO1		
UNIT – II	Fourier Transforms						Periods:12				
Fourier Transforms and its inverse – Properties of Fourier Transform (without proof) – Fourier sine and cosine Transforms and their properties (excluding proof).									CO2		
UNIT – III	Laplace Transforms						Periods:12				
Laplace transforms of elementary functions and Periodic functions – Basic properties (excluding proof) – Laplace transforms of derivatives and integrals – Initial and final value theorems.									CO3		
UNIT – IV	Inverse Laplace Transforms						Periods:12				
Definition of inverse Laplace Transforms – Convolution theorem (excluding proof) – Solutions of Linear Ordinary Differential Equations of second order with constant coefficients.									CO4		
UNIT – V	Z – Transforms						Periods:12				
Z-transforms – Elementary Properties – Inverse Z-transforms (using partial fraction and Residues) – Solution of difference equations using Z - transform.									CO5		
Lecture Periods: 45			Tutorial Periods: 15		Practical Periods: -			Total Periods: 60			
Text Books											
1. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 3 rd Edition, 2011.											
2. C. P. Gupta, Shree Ram Singh. M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2 nd Edition, 2016.											
3. H.K. Dass, "Advanced Engineering Mathematics", S. Chand, New Delhi, 22 nd Edition 2019.											
Reference Books											
1. N.P. Bali and Dr. Manish Goyal, "A Textbook of Engineering Mathematics", University Science Press, India, 8 th Edition, 2016.											
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearson India Education services Pvt. Ltd, India 1 st Edition, 2017.											
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10 th Edition, 2019.											



4. G. Balaji, "Engineering Mathematics - Transforms and Partial Differential Equations", G. Balaji Publishers, 18th Edition, 2022.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2017.

Web References

1. <https://nptel.ac.in/courses/111105121/>
2. <https://nptel.ac.in/courses/111105035/>
3. <https://nptel.ac.in/courses/11110711>
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. <https://nptel.ac.in/courses/111/103/111103021/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	-	1	-	-	-	-	1	1	-	-
2	3	2	1	1	-	1	-	-	-	-	1	3	-	-
3	3	2	1	1	-	1	-	-	-	-	1	3	-	-
4	3	2	1	1	-	1	-	-	-	-	1	3	-	-
5	3	2	1	1	-	1	-	-	-	-	1	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Computer Science and Engineering			Programme: B.Tech.							
Semester	I / II			Course Category: ES			*End Semester Exam Type: TE				
Course Code	U23CSTC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming in C			3	0	0	3	25	75	100	
(Common to All Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Comprehend the basics of Computers.								K2	
	CO2	Illustrate the concepts of control structures and looping.								K2	
	CO3	Implement programs using arrays and functions.								K3	
	CO4	Demonstrate programs using Structure and Pointers.								K3	
	CO5	Build the programs using Union and File management Operations.								K3	
UNIT-I	Introduction						Periods:09				
Generation and Classification of Computers - Block Diagram of a Computer –Categories of Software – Network Structure - Number System – Binary – Decimal – Conversion – Algorithm – Pseudo code – Flow Chart.											CO1
UNIT-II	C Programming Basics						Periods:09				
Introduction to ‘C’ Programming – Basic structure of a ‘C’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations – Decision Making and Branching – Looping statements.										CO2	
UNIT-III	Arrays and Functions						Periods:09				
Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion										CO3	
UNIT-IV	Structure and Pointers						Periods:09				
Structure Introduction – Structure definition – Structure declaration – Structure within a structure –Self Referential Structure. Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays -Pointer to Function –Pointer and Structure- Simple programs.										CO4	
UNIT-V	Unions and Files						Periods:09				
Union Introduction - Programs Using Structures and Unions – Introduction to File - File Operations - File Input and Output Functions - Random Access to Files - File System Functions - Command Line Arguments- Storage Classes - Pre-Processor Directives- Dynamic Memory Functions.										CO5	
LecturePeriods:45			Tutorial Periods:			Practical Periods:-			TotalPeriods:45		
Text Books											
1. Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill, 8thEdition,2019. 2. YashvantKanetkar, “Let us C”, BPB Publications, 16th Edition, 2017 3. Herbert Schildt, ” C: The Complete Reference”, McGraw Hill, FourthEdition,2014											
ReferenceBooks											
1. Vikas B. Agarwal Jyoti P. Mirani, “Computer Fundamentals , Nirali Prakashan Aug-2019, 2. Ashok N Kamthane, “Computer Programming”, Pearson education, 2 nd Impression,2012. 3. VikasVerma, “A Workbook on C “, Cengage Learning, 2 nd Edition,2012. 4. P.Visu, R.Srinivasan and S.Koteeswaran, “Fundamentals of Computing and Programming”, Sri Krishna Publications, 4 th Edition 2012. 5. PradipDev, ManasGhoush, “Programming in C”, Oxford University Press,2 nd Edition, 2011.											



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1. <https://www.programiz.com/c-programming>
2. <https://www.geeksforgeeks.org/c-language-set-1-introduction/>
3. <https://www.tutorialspoint.com/cprogramming>
4. <https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c>
5. <https://nptel.ac.in/courses/106/104/106104128/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	3	-	3
2	2	1	-	-	3	-	-	-	-	-	-	3	-	3
3	3	2	1	1	3	-	-	-	-	-	-	3	-	3
4	3	2	1	1	3	-	-	-	-	-	-	3	-	3
5	3	2	1	1	3	-	-	-	-	-	-	3	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme:B.Tech.						
Semester	II				Course Category:PC			*End Semester Exam Type:TE			
Course Code	U23BMT01				Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM			
Course Name	Electron Devices and Circuits				3	0	0	3	25	75	100
(Common to BME and ICE Branches)											
Prerequisite	Physics										
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)
	CO1	Explain the operation of basic semiconductor diodes and its applications									K2
	CO2	Classify the transistors configuration and analyze its characteristics									K3
	CO3	Distinguish the special semiconductor devices and its applications									K3
	CO4	Analyze the transistor using small signal model and understand the operation of different categories of amplifiers									K4
	CO5	Investigate the operation of different types of feedback amplifiers and oscillators									K3
UNIT-I	Diodes and their Applications							Periods:9			
Formation of P-N junction diode- forward and reverse biased P-N junction, V-I characteristics, diffusion and transient capacitance, Zener diode and its reverse characteristics, Zener breakdown, Avalanche breakdown, Rectifiers-half wave rectifier, full wave rectifier with and without filters, Clippers, Clampers, Voltage Regulator – Zener diode as Voltage regulator.										CO1	
UNIT-II	Bipolar Junction Transistor and Field Effect Transistor							Periods:9			
Bipolar Junction Transistor: Principle of operation –Current components, CE, CB, and CC Configurations, Input and output characteristics – Cut-off, active and saturation region, Transistor as a switch, Transistor as an amplifier.										CO2	
Field Effect Transistor: Classification - JFET and its characteristics – JFET parameters, MOSFET – principle of operation- Depletion and enhancement modes.											
UNIT-III	Special Semiconductor Devices							Periods:9			
Unijunction Transistor (UJT), Tunnel diode, Varactor diode, Schottky diode, Gunn diode, Light Emitting Diode (LED), Laser, PIN diode, Photo diode, Liquid Crystal Display (LCD), Silicon Control Rectifier (SCR), DIAC, TRIAC, Applications of SCR, DIAC, TRIAC.										CO3	
UNIT-IV	Amplifiers							Periods:9			
BJT small signal low frequency model using h parameter – Analysis of CE, CB and CC amplifiers, RC coupled amplifiers, Cascade amplifier, Power amplifiers –Class A, Class B, Class AB, Push Pull, Class C amplifiers.										CO4	
UNIT-V	Feedback Amplifiers and Oscillators							Periods:9			
Feedback amplifiers-Properties of negative feedback-voltage and current, Series and Shunt feedback, Positive feedback, Barkhausen Condition for oscillations, Classification of Oscillators, RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.										CO5	
Lecture Periods:45			Tutorial Periods:-			Practical Periods:-			TotalPeriods:45		
Text Books											
1. S.Salivahanan, N. Suresh Kumar, A. Vallavaraj, “Electronic Devices and Circuits”, Tata Mcgraw-Hill, 2nd Edition, 2017											
2. Jacob Millman,Chritos CHalkias,“Electronic Devices and Circuits”,McGrawHill, 4 th edition, 2015											
3. R S Sedha “A Textbook of Applied Electronics”S.Chand Publications, 2008											
Reference Books											
1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson, 9th Edition, 2013.											
2. ThomasL.Floyd,“Electronicdevices”PrenticeHall”, 10 th Edition,2018											

3. Kumar and Jain, "Electronic devices and Circuits" PHI learning, 2016
4. Bakshi, U. A., & Godse, A. P., "Electronic Devices and Circuits", Technical Publications, 2008
5. Anil Kumar Maini, Varsha Agrawal, "Electronic devices and circuits", Wiley, 2019

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1. <https://nptel.ac.in/courses/117/103/117103063/>
2. <https://nptel.ac.in/courses/108108122/>
3. <https://www.electronics-tutorials.ws/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	1	3
2	3	3	2	2	2	1	1	1	1	2	3	3	1	3
3	3	2	2	1	2	1	1	1	1	2	3	2	2	3
4	3	3	3	2	3	1	1	2	2	3	3	3	2	3
5	3	3	3	2	3	1	1	2	2	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	II			Course Category: PC			*End Semester Exam Type: TE				
Course Code	U23BMT203			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Biosensors and Transducers			3	0	0	3	25	75	100	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand various measurements and instruments								K2	
	CO2	Apply fundamental transduction and photo sensing principles using various sensors								K3	
	CO3	Distinguish transducers and electric sensors its application								K3	
	CO4	Analyze different types of electrodes in biological measurements								K3	
	CO5	Interpret various biochemical sensors used in physiological measurement								K3	
UNIT-I	Introduction To Measurements						Periods:09				
Measurement System–Instrumentation–Classification and Characteristics of Transducers– Static and Dynamic–Errors in Measurements– Calibration–Primary and secondary standards. Measurements using AC & DC Bridges										CO1	
UNIT-II	Displacement, Pressure and Temperature Sensors						Periods:09				
Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gauge, biomedical applications; strain gauge as displacement & pressure transducers: Capacitive transducer, Inductive transducer, LVDT, Passive types: RTD materials range, relative resistances. temperature characteristics, thermistor characteristics, biomedical applications of Temperature sensors. Active type: Thermocouple–Characteristics.										CO2	
UNIT-III	Transducers And Photoelectric Sensors						Periods:09				
Introduction to Transducers, Piezoelectric active transducer and biomedical applications as pressure& Ultrasound transducer comparison of photoelectric transducers, Spectro photometric applications of photoelectric transducers. Ionizing & Non-Ionizing radiation and its effects. Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photoconductive cells, photo diodes, phototransistor.										CO3	
UNIT- IV	Electrodes						Periods:09				
Recording Electrodes– Half cell potential and action potential, Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Surface Electrodes– Needle electrodes– Microelectrodes-Electrical conductivity of electrode. Measurement of Skin Resistance										CO4	
UNIT-V	Biochemical Transducers						Periods:09				
Biosensors– Chemoreceptor, hot and cold receptors, Baro receptors, sensors for smell, sound, vision, osmolality and taste. Transducers for the measurement of ions and dissolved gases. Ion exchange membrane electrodes– Measurement of pH– Glass pH electrodes. Measurement of pO2, Measurement of pCO2.ISFET for glucose.										CO5	
Lecture Periods: -		Tutorial Periods: -		Practical Periods: -			TotalPeriods:45				
Text Books											
1.A.K. Sawhney, “A Course in Electrical and Electronic measurements and Instruments”, Dhanpat Rai and Sons,2012. 2.Prof.PingWang and Dr. Qingjun Liu, “Biomedical Sensors and Measurement “,Springer Publications”, 1 st Edition,2011. 3.Tatsuo Tagawa, Toshio Tamura and Ake Oberg, “Biomedical Sensors and Instruments”, CRC Press Taylor and Francis Group, 2 nd Edition, 2011.											
Reference Books											
1.R. Anandanatarajan, “Biomedical Instrumentation nad measurements”, PHI Learning, 2 nd Edition,December20 2.Ernest O Doebelin and Dhanesh N Manik, “Measurement Systems, Applications and Design”, MCGraw-Hill, 5 th edition 2007. 3.MichaelJ.McGrath, Clíodhna Ní Scanail,“Sensor Technologies: Healthcare, Wellness and Environmental Applications, Apress,8 th Edition 2013.											

4. Richard S. C. Cobbold, "Transducers for Biomedical Measurements: Principles and Applications", John Wiley and Sons, 7th Edition, 2004.
 5. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation", PHI, 2nd Edition, 2013.

Web References

1. <http://www.gvpcew.ac.in/unit%202.pdf>
2. <http://www.123seminaronly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf>
3. <https://nptel.ac.in/courses/108/108/108108147/>
4. <https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf>
5. <https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	3	1	1	1	1	2	3	3	2	3
3	3	3	2	2	3	1	1	1	1	2	3	3	3	3
4	3	3	2	2	2	2	1	1	1	2	3	3	2	3
5	3	3	2	2	2	2	1	1	1	3	3	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	II				Course Category: HS		End Semester Exam Type: -					
Course Code	U23HSTC01				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Universal Human Values –II				2	0	0	2	25	75	100	
Prerequisite	UHV-I: Universal Human Values-Introduction											
Course Outcomes	The course will enable the student to									BT Mapping (Highest Level)		
	CO1	Aware of themselves, and their family, society and nature.									K2	
	CO2	Be responsible in life, and in handling problems while keeping human relationships and human nature in mind.									K2	
	CO3	Apply creativity in their education and develop holistic model.									K2	
	CO4	Apply what they have learnt to their real life.									K2	
	CO5	Be proficient to provide sustainable solutions to the problems in society and nature.									K2	
UNIT-I	Introduction to Value Education							Periods:09				
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) - Understanding Value Education - Self-exploration as the Process for Value Education -Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario- Method to Fulfil the Basic Human Aspirations											CO1	
UNIT-II	Harmony in the Human Being							Periods:09				
Understanding Human being as the Co-existence of the Self and the Body-Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self-Understanding Harmony in the Self-Harmony of the Self with the Body-Programme to ensure self-regulation and Health											CO2	
UNIT-III	Harmony in the Family and Society							Periods:09				
Harmony in the Family – the Basic Unit of Human Interaction- ‘trust’ – the Foundational Value in Relationship- ‘Respect’ – as the Right Evaluation-Other Feelings, Justice in Human-to-Human Relationship-Understanding Harmony in the Society-Vision for the Universal Human Order.											CO3	
UNIT-IV	Harmony in the Nature/Existence							Periods:09				
Understanding Harmony in the Nature-Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature-Realizing Existence as Co-existence at All Levels-The Holistic Perception of Harmony in Existence											CO4	
UNIT-V	Implications of the Holistic Understanding – a Look at Professional Ethics							Periods:09				
Natural Acceptance of Human Values-Definitiveness of (Ethical) Human Conduct:- A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics-Holistic Technologies, Production Systems and Management Models-Typical Case Studies-Strategies for Transition towards Value-based Life and Profession											CO5	
LecturePeriods:45			Tutorial Periods: -			Practical Periods: -			TotalPeriods:45			
Text Books												
A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019.												
Reference Books												
1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999												
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.												
3. The Story of Stuff (Book).												
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi												
5. Small is Beautiful - E. F Schumacher												
6. Slow is Beautiful - Cecile Andrews												
7. Economy of Permanence - J C Kumarappa												



8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	English			Programme: B.Tech.							
Semester	II			Course Category : HS			End Semester Exam Type:TE				
Course Code	U23ENBC02			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Communicative English - II			2	-	2	3	50	50	100	
(Common to ALL Branches except CSBS)											
Prerequisite	Basics of English Language										
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)	
	CO1	Draft effective written communication in professional environment								K2	
	CO2	Apply the mechanics of creative writing with precision and clarity								K3	
	CO3	Acquire language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation								K2	
	CO4	Develop language fluency and gain self-confidence								K3	
	CO5	Express thoughts and ideas with clarity and focus								K2	
UNIT-I	Business Correspondence						Periods:10				
Business Writing: Circular, Agenda, Memoranda, Notice, Instruction, Minutes, Email Writing ,Report Writing- Official and Demi Official Letters : Applying for Educational / Car / Home Loans / Joining Report, Leave Letter, Industrial Visit, In plant Training, Letter to the Editor, Calling for a quotation, Placing Order, Letter of Complaints, Letter seeking Clarification, Resume', Job Application Letter, Bio-data, CV										CO1	
UNIT-II	Functional Writing Skills						Periods:10				
Four Modes of Writing, Sentence Structure , Art of condensation: Summary Writing and Note Making, Use of phrase and clause in sentence, Principles of paragraph writing, Techniques of Essay Writing, Jumbled Sentence, Paraphrasing										CO2	
UNIT-III	Etiquettes						Periods:10				
Etiquette: Meaning, Kinds: Corporate Etiquette, Meeting Etiquette, Telephone Etiquette, Email Etiquette, Social Media Etiquette, Dining Etiquette, Communication Etiquette										CO3	
UNIT-IV	Communication Practice-II						Periods:15				
List of Exercises										CO4	
Listening: Letter writing tips											
Speaking: Just a Minute, Impromptu Speech, Contemporary Issues											
Reading: Variety of examples for Modes of Writing											
Writing: Different types of letters										CO5	
UNIT-V	Interpersonal Communication-II						Periods:15				
List of Exercises											
Listening: Videos on different types of Etiquettes											
Speaking: Team Presentation, Negotiation Skills											
Reading: Phrases and Clauses											
Writing: Free writing on any given topic, Paraphrasing Practice											
LecturePeriods:30			Tutorial Periods: -		Practical Periods:30			Total Periods:60			
Text Books											
1. PC Das, “Letter Writing including Official and Business Letters”, New Central Book Agency, 2020.											
2. Kumar, Sanjay, Pushpalatha,” Communication Skills”. Oxford University Press, 2018.											
3. Raman, Meenakshi&Sangeetha Sharma,” Communication Skills”, New Delhi: OUP,2018.											
Reference Books											
1. Sahukar, Nimeran , Bhalla, Prem,, “The book of Etiquettes and Manners”.PustakMahal Publisher, New Delhi; 1st Edition 2009.											

2. Gerson Sharon J, Steven M. Gerson, "Technical Writing Process and Product", Pearson Education Pvt. Ltd. 3rd Edition, 2009.
3. Grussendorf, Marion, "English for Presentations". Oxford University Press, Oxford, 2007.
4. Seely John, "The Oxford Guide to Writing and Speaking", Oxford University Press, 2006.
5. R.C. Sharma, Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill &Co.Ltd., New Delhi, 2001.

Web References

1. <https://www.indeed.com/career-advice/finding-a-job/how-to-write-an-application-letter>
2. <https://owlcation.com/humanities/Four-Types-of-Writing>
3. <https://targetstudy.com/languages/english/paragraph-writing.html>
4. <https://www.businessnewsdaily.com/8262-email-etiquette-tips.html>
5. <https://www.youtube.com/watch?v=UOceysteljo>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20(to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical					
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks
30(to be weighted for 10 marks)			30 marks		40
Listening (L)*	10		Listening (L)*	10	
Speaking(S)	5		Speaking(S)	5	
Reading(R)*	10		Reading(R)*	10	
Writing(W)*	5		Writing(W)*	5	

- LRW components of Practical can be evaluated through Language Lab Software



Department	Mechanical Engineering			Programme : B.Tech.							
Semester	I / II			Course Category: ES			*End Semester Exam Type: LE				
Course Code	U23ESPC03			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Graphics Using AutoCAD			0	0	2	1	50	50	100	
(Common to all Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Familiarize with the fundamentals and standards of engineering graphics.								K3	
	CO2	Perform drawing of basic geometrical constructions and multiple views of objects.								K2	
	CO3	Visualize the isometric and perspective sections of simple solids.								K3	
	CO4	Connect side view associate on front view.								K4	
	CO5	Correlate sectional views and lateral surface developments of various solids.								K4	
List of Experiments											
1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.											
2. Drawing a Title Block with necessary text and projection symbol.											
3. Drawing 2D sketch by applying modify tools like fillet, mirror, array, etc.,											
4. Drawing front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning.											
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. Simple stool, V-block, Mixie Base).											
6. Drawing a plan of residential building (Two bed rooms, kitchen, hall, etc.)											
7. Drawing sectional views of prism, pyramid, cylinder, cone, etc,											
8. Drawing lateral surface development of prism, pyramid, cylinder, cone, etc,											
9. Drawing isometric projection of simple objects.											
10. Creating 3D model of simple object and obtaining 2D multi-view drawings.											
11. Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.											
Lecture Periods: -			Tutorial Periods: -			Practical Periods: 30			Total Periods: 30		
Reference Books											
1. James D. Bethune, Engineering Graphics with AutoCAD A Spectrum book 1st Edition, Macromedia Press, Pearson, 2020.											
2. NS Parthasarathy and Vela Murali, Engineering Drawing, Oxford university press, 2015.											
3. M.B Shah, Engineering Graphics, ITL Education Solutions Limited, Pearson Education Publication, 2011.											
4. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017.											
5. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd., 7th Edition, New Delhi, 2016.											
6. C M Agrawal, Basant Agrawal, Engineering Graphics, McGraw Hill, 2012.											
7. Dhananjay A. Jolhe, Engineering Drawing: With An Introduction To CAD McGraw Hill, 2016.											
8. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.											
Web References											
1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php											



2. <http://www.nptelvideos.in/2012/12/computer-aided-design.html>
3. <https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/>
4. <https://autocadtutorials.com>
5. <https://dwgmodels.com>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	3	-	-	2	3	3	3
2	3	1	-	-	3	-	-	3	-	-	3	3	3	3
3	3	1	-	-	3	-	-	3	-	-	3	3	3	3
4	3	1	-	-	3	-	-	3	-	-	2	3	3	3
5	3	1	-	-	3	-	-	3	-	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Computer Science and Engineering			Programme:B.Tech.						
Semester	I / II			Course Category:ES			*End Semester ExamType:LE			
Course Code	U23CSPC01			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Programming In C Laboratory			0	0	2	1	50	50	100
(Common to all Branches)										
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Implement logical formulations to solve simple problems leading to specific applications.							K3	
	CO2	Execute C programs for simple applications making use of basic constructs, arrays and strings.							K3	
	CO3	Experiment C programs involving functions, recursion, pointers, and structures.							K3	
	CO4	Demonstrate applications using sequential and random access file processing.							K3	
	CO5	Build solutions for online coding challenges.							K3	
List of Exercises							Periods:09			
1. Create a C program to find the Area of the triangle. 2. Develop a C program to read a three digit number and produce output like 1 hundreds 7 tens 2 units For an input of 172. 3. Write a C program to check whether a given character is vowel or not using Switch – Case statement. 4. Print the numbers from 1 to 10 along with their squares using C program. 5. Demonstrate do—While loop in C to find the sum of ‘n’ numbers. 6. Find the factorial of a given number using Functions in C. 7. Write a C program to check whether a given string is palindrome or not? 8. Write a C program to check whether a value is prime or not? 9. Develop a C program to swap two numbers using call by value and call by reference. 10. Construct a C program to find the smallest and largest element in an array. 11. Implement matrix multiplication using C program. 12. Create a C program to perform various string handling functions like strlen, strcpy, strcat, strcmp. 13. Develop a C program to remove all characters in a string except alphabets. 14. Create a C program to find the sum of an integer array using pointers. 15. Write a C program to find the Maximum element in an integer array using pointers. 16. Construct a C program to display Employee details using Structures 17. Write a C program to display the contents of a file on the monitor screen. 18. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands. 19. Write a C program to create two files with a set of values. Merge the two file contents to form a single file 20. Create a C program to pass the parameter using command line arguments.										
Lecture Periods:			Tutorial Periods:			PracticalPeriods:30			TotalPeriods:30	
Reference Books										
1. Zed A Shaw, “Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)”, Addison Wesley,2016. 2. Anita Goel and Ajay Mittal,” Computer Fundamentals and programming in C”, Pearson Education, First edition, 2011. 3. Maureen Sprinkle Hubbard,” Problem Solving and Programming Concepts,” Pearson,9th Edition, 2011. 4. Yashwanth Kanethkar, “Let us C”, BPB Publications,13th Edition,2008. 5. B.W.Kernighan and D.M. Ritchie, “The C Programming Language”, Pearson Education, 2nd Edition, 2006.										



Web References

1. <https://alison.com/course/introduction-to-c-programming>
2. <https://www.geeksforgeeks.org/c-programming-language/>
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. <https://www.tenouk.com/clabworksheet/clabworksheet.html>
5. <https://fresh2refresh.com/c-programming/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	3	-	3
2	2	1	-	-	3	-	-	-	-	-	-	3	-	3
3	3	2	1	1	3	-	-	-	-	-	-	3	-	3
4	3	2	1	1	3	-	-	-	-	-	-	3	-	3
5	3	2	1	1	3	-	-	-	-	-	-	3	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme:B.Tech.						
Semester	II			Course Category:PC		*End Semester Exam Type:LE				
Course Code	U23BMPC01			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Electron Devices and Circuits Laboratory			0	0	2	1	50	50	100
(Common to ICE and BME Branches)										
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Demonstrate the characteristic of PN Junction diode and Zener diode							K3	
	CO2	Construct and analyze the applications of diodes							K4	
	CO3	Analyze the characteristics of different types of transistors and special diodes.							K4	
	CO4	Design the LC oscillators and analyze the frequency response of CE amplifier.							K4	
	CO5	Simulate the power amplifiers and feedback amplifiers.							K3	
List of Experiments:										
1. Characteristics of PN Junction Diode and Zener Diode. 2. Analysis of Half wave and Full wave Rectifiers. 3. Analysis of wave shaping circuits (Clippers and Clampers). 4. Characteristics of LED and Photo diode. 5. Characteristics of BJT in CB configuration 6. Characteristics of BJT in CE configuration 7. Characteristics of JFET 8. Negative resistance characteristics of UJT 9. Characteristics of Thyristors 10. Study the frequency response of CE Amplifier. 11. Design and Testing of LC Oscillators. 12. Simulation of Power Amplifiers and Feedback Amplifiers.										
Lecture Periods: -			Tutorial Periods: -			Practical Periods: 30		Total Periods:30		
Reference Books										
1. Srinivasa Murthy, "Electronic Devices and Circuits Laboratory Manual", 4 th Edition, October 2015 2. David A.Bell," Lab Manual For Electronic Devices & Circuits", Fourth edition, PHI learning private limited, January 2004 3. Robert Boylestad , Louis Nashelsky, Franz Monssen , " Lab Manual for Electronic Devices and Circuit Theory", Pearson, 11 th Edition, August 2012. 4. Maheswari. L.K and Anand.M.M.S, "Laboratory Manual for Introductory Electronic Experiments", New Age, 2010. 5. Muhammad H. Rashid "Introduction to PSpice using OrCAD for circuits and electronics,Pearson, 3 rd Edition , 2004.										
Web References										
1. www.allaboutcircuits.com 2. www.circuitstoday.com 3. www.tutorialspoint.com										

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	2	1	1	1	1	2	3	3	2	3
3	3	3	2	2	3	1	1	1	1	2	3	3	2	3
4	3	3	3	2	3	1	1	2	1	2	3	3	2	3
5	3	2	2	2	3	1	1	2	1	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	II			Course Category: PC			*End Semester Exam Type: LE				
Course Code	U23BMP203			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Biosensors and Transducers Laboratory			0	0	2	1	50	50	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)	
	CO1	Study the characteristics of instruments and measurements									K3
	CO2	Performance measurements of AC and DC bridges									K3
	CO3	Perform the displacement, temperature and pressure measurement using appropriate sensors / transducers									K4
	CO4	Study the characteristics of an LVDT, load cell and pH Electrodes									K4
	CO5	Perform torque measurement with strain gauge and bio transducers and bioelectrodes									K4
List of Experiments:											
1. Study of Instruments and Measurements. 2. Measurement of resistance using DC Bridges. 3. Measurement of Inductance using AC Bridges. 4. Measurement of Capacitance using AC Bridges 5. Temperature measurement using AD590IC sensor 6. Displacement measurement by using a capacitive transducer 7. Torque measurement Strain gauge transducer 8. Study and characterize Bio transducers–Pressure, Temperature, Humidity 9. Pressure and displacement measurement by using LVDT 10. Study and characterize Bioelectrodes–ECG, EMG, EEG 11. Study and Characterize pH electrodes 12. Measurement of change in temperature using thermocouple, thermistor and RTD 13. Measurement of optical variables with the aid of photo diodes and photo transistors.											
Lecture Periods:-			Tutorial Periods:-			Practical Periods: 30		TotalPeriods:30			
Reference Books											
1. A.E.G. Cass, “Biosensors: A Practical Approach “, Oxford University Press, 2 nd Edition, July 1990. 2. Jonathan Cooper, Anthony Cass, “Biosensors: Practical Approach”, OUP Oxford, 2 nd Edition, March 2004. 3. Robert S. Marks (Editor), Christopher R. Lowe, David C. Cullen, Howard H. Weetall, Isao Karube, “Handbook of Biosensors and Biochips”, Wiley, 1 st Edition, October 2007. 4. R. P. Areny and T. G. Webster, “Sensors and Signal Conditioning”, Wiley- Interscience, 2015 5. Albert D. Helfrick and William D. Cooper. “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007											
Web References											
1. uspas.fnal.gov/materials/04UW/Instrumentation.pdf 2. www.scilab.in/textbook_companion/generate_book/174 3. https://nptel.ac.in/courses/108/105/108105153/ 4. https://nptel.ac.in/courses/108/108/108108147/ 5. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf											

* TE – Theory Exam, LE – Lab Exam



COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	1	2	1	2	3	2	2	3
2	3	2	2	2	3	1	1	2	1	2	2	3	2	3
3	3	3	3	3	3	2	1	2	2	2	3	3	3	3
4	3	2	2	2	3	2	1	2	2	2	3	3	2	3
5	3	3	3	3	3	2	1	2	2	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	II	Course Category: AEC				*End Semester Exam Type: LE		
Course Code	U23BMC2XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course - II	0	0	4	-	100	-	100
Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods:-		Practical Periods: 50			Total Periods:50	

* TE – Theory Exam, LE – Lab Exam

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	II				Course Category: MC			End Semester Exam Type:-				
Course Code	U23BMM202				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Sports Yoga and NSS				0	0	2	Non-Credit	100	-	100	
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility and relaxation.										K2
	CO2	Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.										K2
	CO3	Develop understanding of psychological problems associated with age and lifestyle.										K2
	CO4	Recognize the importance of national service in community development.										K2
	CO5	Convert existing skills into socially relevant life skills.										K2
UNIT-I	Introduction To Physical Education							Periods: 06				
Definition, Aims and Objectives of Physical Education - Changing trends in Physical Education Physical Fitness, Wellness and Lifestyle: Importance of Physical Fitness and Wellness - Components of Physical fitness - Components of Health related fitness - Components of wellness - Preventing Health Threats through Lifestyle Change - Concept of Positive Lifestyle.												CO1
UNIT-II	Yoga And Lifestyle							Periods: 06				
Importance of Yoga - Elements of Yoga - Introduction - Asanas, Pranayama, Meditation and Yogic Kriyas - Yoga for concentration and related Asanas (Sukhasana, Tadasana, Padmasana and Shashankasana) - Relaxation Techniques for improving concentration - Yog-nidra. Asanas as preventive measures – Hypertension – Obesity - Back Pain-Diabetes - Asthema.												CO2
UNIT-III	Training And Planning In Sports							Periods: 06				
Training - Warming up and limbering down-Skill, Technique and Style - Objectives of Planning – Tournament - Knock-Out, League/Round Robin and Combination. Psychology and Sports - Important of Psychology in Physical Education and Sports - Differentiate Between Growth and Development - Adolescent problems and their Management - Emotion: Concept, Type and Controlling of emotions - Concepts and Types of Aggressions in Sports - Psychological benefits of exercise - Anxiety and Fear and its effects on Sports Performance - Motivation, its type and techniques - Understanding Stress and Coping strategies												CO3
UNIT-IV	Introduction To National Service Scheme							Periods: 06				
Orientation of NSS volunteers: History, motto, symbol, awards, structure and activities of NSS - Days of National and International Importance - Sensitizing about the thrust areas and awareness activities - Importance of tree plantation and voluntary blood donation - The role of SHGs and NGOs in community development – CSR - Life skills and youth development-extension activities in HEIs - various clubs and schemes like RRC, ELC, YRC, UBA, SBA, etc.,												CO4
UNIT-V	Community Issues And The Use Of Technology							Periods: 06				
Common Problems of rural India - Technology development and its suitability – Sustainability - Value addition to agricultural products - Service learning and youth volunteering – Shramdaan - Campus cleaning - Field visit to nearby communities - village survey - Initiatives to clean and green environment - preservation of water bodies in adopted villages.												CO5
Lecture Periods:-			Tutorial Periods:-			Practical Periods:30			Total Periods: 30			
1. Brar Ajmer Singh, Gill Jagtar Singh, Bains Jagdish, “Modern Textbook of Physical Education Health and Sports- I”, Kalyani i. Publishers , 6 th Edition, 2014 2. B.K.S. Iyengar, “Light on Yoga: The Definitive Guide to Yoga Practice”,Thorsons Publishers, Thorsons Classics edition, 2015 3. Joseph, Siby K, Mahodaya, “Bharat Essays on Conflict Resolution”, Institute of Gandhian Studies Publishers, 2007 4. Barman Prateeti , Goswami, “Document on Peace Education”, Triveni Akansha Publishing House, New Delhi, 2009 5. Prof R.B.S. Verma, “Field Work Practicum in Social Work-Emerging Concerns”,Rapid Publisher, Lucknow, 2020												

6. Sibereisen, K , Richard M, "Lerner Approaches to Positive Youth Development", Sage Publications, New Delhi, 2007
7. Hoshier Singh, "Administration of Rural Development in India", Sterling Publisher, the University of Michigan, 2009

Web References

1. <http://www.thebetterindia.com/140/national-service-scheme-nss>
2. <http://en.wikipedia.org/wiki/national-service-scheme> 19=<http://nss.nic.in/adminstruct>
3. <http://nss.nic.in>
4. <http://socialworknss.org/about.html>
5. Young Journal on Youth published by SAGE: <http://you.sagepub.com>

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



Department	Mathematics			Programme: B.Tech.						
Semester	III			Course Category Code:BS		*End Semester Exam Type:TE				
Course Code	U23MATC03			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Probability and Statistics			3	1	-	4	25	75	100
(Common to All Branches Except CSBS)										
Prerequisite	Basic Probability									
Course Outcome	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Apply the concept of probability.								K3
	CO2	Solve the problem on Random variables.								K3
	CO3	Evaluate the correlation and Regression.								K3
	CO4	Find Correlation between variables.								K3
	CO5	Analyze the problems in small samples.								K3
UNIT – I	Theory of Probability						Periods:12			
Random Experiments - Sample Space - Exhaustive events- Axioms of probability – Conditional probability – Total probability – Bayes theorem.										CO1
UNIT – II	Random Variables						Periods:12			
Moments–Moment generating functions and their properties. Binomial distribution – Poisson distribution – Exponential distribution – Normal distribution (Excluding Derivation of Mean, Variance and MGF)										CO2
UNIT – III	Design of Experiments						Periods:12			
Analysis of variance: One way and two-way classifications. Correlation – Rank correlation and Regression.										CO3
UNIT – IV	Large Samples						Periods:12			
Large Samples: Single Propositions – Difference of Proportions – Single Mean – Difference of Mean – Difference of Standard Deviations										CO4
UNIT – V	Small Samples						Periods:12			
Test for Mean – Test for Ratio of Variances – Chi-Square test for Goodness of Fit and Independence of Attributes.										CO5
Lecture Periods:45			Tutorial Periods:15			Practical Periods:-		Total Periods:60		
Text Books										
B.S. Grewal, “Higher Engineering Mathematics”, Khanna publishers, 3 rd Edition,2017.										
T. Veerarajan, “Probability, Statistics and Random Processes”, Tata McGraw-Hill, 3 rd Edition, 2008.										
A. Singaravelu, “Probability and Statistics”, Meenakshi Agency, 2019.										
Reference Books										
1. Ravish R. Singh, Mukul Bhatt “Engineering Mathematics”, McGraw-Hill, 1 st Edition, 2017.										
2. William Mendenhall, Robert J. Beaver and Barbara M. Beaver: “Introduction to Probability & Statistics”, Cengage Learning, 15 th Edition, 2019.										
3. Richard. A. Johnson, Irwin Miller and John E. Freund,” Probability and Statistics for Engineers”, Pearson Education, Asia, 9 th Edition, 2018.										
4. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, “An Introduction to Probability and Statistics”, Wiley, 3 rd Edition 2008.										
Web References										
1. www.stat110.net										
2. http://www.nptel.ac.in/courses/111105035 (R.V)										
3. http:// www.probabilitycourse.com.										



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4. www.edx.org/Probability5. <http://www2.aueb.gr/users/demos/pro-stat.pdf>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	1	1	1	1
2	3	2	1	1	-	-	-	-	-	-	1	1	1	1
3	2	2	-	-	-	1	-	-	-	-	1	1	1	1
4	3	2	1	1	-	1	-	-	-	-	1	1	1	1
5	3	2	1	1	-	1	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Artificial Intelligence and Data Science			Programme: B.Tech							
Semester	III			Course Category : ES			End Semester Exam Type: TE				
Course Code	U23ADTC01			Periods / Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Python			3	0	0	3	25	75	100	
(Common to All Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Interpret the basic concepts of Python programs.								K2	
	CO2	Articulate the concepts of Sets, Dictionaries and Object-Oriented concepts.								K2	
	CO3	Experiment with Numpy package.								K3	
	CO4	Apply and analyze Data Manipulation with Pandas.								K3	
	CO5	Illustrate programming concept for Visualization with Matplotlib.								K3	
UNIT-I	Introduction to Python						Periods: 09				
Structure of Python Program – Underlying mechanism of Module Execution – Branching and Looping – Problem Solving Using Branches and Loops – Functions – Lambda Functions – Lists and Mutability – Problem Solving Using Lists and Functions.										CO1	
UNIT-II	Sequence Datatypes and Object-Oriented Programming						Periods: 09				
Sequences – Mapping and Sets – Dictionaries. Classes: Classes and Instances – Inheritance – Exception Handling – Introduction to Regular Expressions using “re” module.										CO2	
UNIT-III	Using Numpy						Periods: 09				
Basics of NumPy – Computation on NumPy – Aggregations – Computation on Arrays – Comparisons – Masks and Boolean Arrays – Fancy Indexing – Sorting Arrays – Structured Data: NumPy’s Structured Array.										CO3	
UNIT-IV	Data Manipulation with Pandas						Periods: 09				
Introduction to Pandas Objects – Data indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Combining Data Sets. Aggregation and Grouping – Pivot Tables –Vectorized String Operations – Working with Time Series – High Performance Pandas – eval() and query().										CO4	
UNIT-V	Visualization With Matplotlib						Periods: 09				
Basic functions of Matplotlib – Simple Line Plot – Scatter Plot – Density and Contour Plots – Histograms – Binnings and Density – Customizing Plot Legends – Colour Bars – Three-Dimensional Plotting in Matplotlib.										CO5	
Lecture Periods: 45			Tutorial Periods:			Practical Periods:		Total Periods: 45			
Text Books											
1. Jake VanderPlas, “Python Data Science Handbook - Essential Tools for Working with Data”, O’Reily Media Inc, 2016. 2. Zhang.Y, “An Introduction to Python and Computer Programming”, Springer Publications, 2016. 3. Wesley J Chun, “Core Python Programming”, Pearson Education, 2 nd Edition, 2006.											
Reference Books											
1. John Paul Mueller, Luca Massaron, “Python for Data Science for Dummies”, 2 nd Edition, John Wiley& Sons, 2019. 2. Jesus Rogel-Salazar, “Data Science and Analytics with Python”, CRC Press Taylor and Francis Group, 2017. 3. Brian Draper, “Python Programming A Complete Guide for Beginners to Master and Become an Expert in Python Programming Language”, CreateSpace Independent Publishing Platform, 2016. 4. <u>Mark Lutz</u> , Laura Lewin, <u>Frank Willison</u> , “Programming Python”, O’Reilly Media, 3 rd Edition, 2006. 5. <u>Gowrishankar S</u> , <u>Veena A</u> , “Introduction to Python Programming”, CRC Press, 2018.											
Web References											
1. https://nptel.ac.in/courses/106/106/106106212/ 2. https://www.geeksforgeeks.org/data-analysis-visualization-python/ 3. https://www.coursera.org/learn/python-data-analysis											

4. <https://www.python.org/>
5. <https://www.programiz.com/python-programming>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	3	-	3
2	2	2	1	3	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	2	3	2	3
4	3	3	2	3	-	-	-	-	-	-	3	3	3	3
5	3	3	2	3	-	-	-	-	-	-	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Biomedical Engineering			Programme: B.Tech.							
Semester	III			Course Category Code: PC		*End Semester Exam Type: TE					
Course Code	U23BMT304			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Biosignals and Systems			2	1	-	3	25	75	100	
Prerequisite	-										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Distinguish the continuous and discrete-time signals and systems								K2	
	CO2	Capable of characterizing LTI-CT systems in the Transform domain								K3	
	CO3	Analyse the concepts of Z-transform and discrete Fourier transform								K4	
	CO4	Capable of characterizing LTI-DT systems in the Transform domain								K4	
	CO5	Apply DFT for the analysis of digital signals and systems								K4	
UNIT – I	Basics of Discrete and Continuous Time Signals and Systems						Periods:12				
Generation, Representation of discrete time signals and continuous time signals - Standard discrete time signals, Standard continuous time signals - Classification of signals: Continuous time (CT) Discrete time (DT) signals, Basic bio signals, Mathematical operations on CTS and DTS - Scaling, folding, time shifting, addition and multiplication. Classification of systems: static and dynamic systems - time invariant and time variant - linear and nonlinear systems - causal and non-causal systems, stable and unstable systems.										CO1	
UNIT – II	Linear Time Invariant Continuous Time Systems						Periods:12				
Impulse response - Convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series / parallel.										CO2	
UNIT – III	Transforms of Discrete Time Signals						Periods:12				
Z transform-properties-Region of convergence - Representation of poles and zeros in z transform, Inverse z transform - Power series expansion, Partial Fraction method, Discrete time Fourier transform - Properties, Relation between Z transform and DTFT										CO3	
UNIT – IV	Linear Time Invariant-Discrete Time Systems						Periods:12				
Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.										CO4	
UNIT – V	Discrete Fourier Transforms						Periods:12				
Discrete Fourier transforms (DFT) - Properties of DFT - Periodicity, Symmetry, Circular convolution. Linear filtering using DFT. Filtering long data sequences - Overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.										CO5	
Lecture Periods:45		Tutorial Periods:15		Practical Periods:			Total Periods:60				
Text Books											
1. P. Ramesh Babu, “Signals and Systems”, Fifth Edition, Scitech Publishers, 2014.											
2. Allan V. Oppenheim, Allan S.Willsky and S.HamidNawab, “Signals and Systems”, Second Edition, PHI Learning, New Delhi, 2010.											
3. B. P. Lathi, “Principles of Linear Systems and Signals”, Third Edition, Oxford University Press, 2012.											
Reference Books											
1. A. Anand Kumar, “Signals and systems”, Third edition PHI learning Pvt. Ltd., 2015.											
2. M.J. Roberts, “Signals and Systems: Analysis using transform methods and MATLAB”, Second edition, Tata McGraw Hill, 2012.											
3. Suresh R, Devashayam, “Signals and Systems in Biomedical Engineering”, Second edition, Springer US, 2013.											
4. Dr Chitode ”Signals and system”, Technical Publications 2014.											



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5. A.Nagoor Kani, "Digital Signal Processing", 2nd edition, McGraw Hill Education, 2016.

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1. <http://www.nptelvideos.in/2012/12/signals-and-system.html>
2. <http://freevidelectures.com/Course/3177/Signals-and-Systems>
3. <https://nptel.ac.in/courses/117/101/117101055/>
4. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home2.20.html
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home4.30.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	1	-	-	-	-	2	2	-
2	3	3	3	2	-	-	1	-	-	-	-	2	2	-
3	3	3	3	2	-	-	1	-	-	-	-	2	2	-
4	3	3	3	2	-	-	1	-	-	-	-	2	2	-
5	3	3	3	2	-	-	1	-	-	-	-	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

Department	Instrumentation and Control Engineering			Programme: B.Tech.							
Semester	III			Course Category: PC			End Semester Exam Type: TE				
Course Code	U23ICTC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Linear Integrated Circuits			3	0	0	3	25	75	100	
(Common to ICE & BME Branches)											
Prerequisite	Knowledge of electronic circuits										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Acquire knowledge on basic operation of op-amp								K2	
	CO2	Understand the different applications of Operational Amplifier and their design								K3	
	CO3	Gain knowledge on the comparators and waveform generators								K3	
	CO4	Demonstrate the basic concepts and design of active filters and data converters								K4	
	CO5	Gain knowledge on operation, applications of timers and describe the basic concepts of PLL and Voltage regulators.								K3	
UNIT – I	Op-Amp and its Characteristics						Periods:09				
Basics of operational amplifier (op amp) and its ideal characteristics, Internal Building Block, Inverting and non-inverting amplifier, Voltage follower, Differential Amplifier, DC characteristics and AC characteristics.											CO1
UNIT – II	Op-Amp Applications						Periods:09				
Basic Op Amp Applications- Summing Amplifier, Subtractor, Differentiator and Integrator, Half wave rectifier and Full wave rectifier, Peak detector, Clipper and Clamper, Sample and hold circuit, log amplifier, Instrumentation amplifier, V-I and I-V converter.											CO2
UNIT – III	Comparators and Waveform Generators						Periods:09				
Comparator and its applications - Schmitt trigger, Astable multivibrator, Monostable multivibrator, Triangular wave generator, Sawtooth wave generator, RC Phase shift oscillator, Wien bridge oscillator.											CO3
UNIT – IV	Active Filters and Data Converters						Periods:09				
Active Filters: First order low pass and high pass filter, Band Pass Filter, Band Stop Filter. Digital to Analog converters (DAC): Weighted Resistor DAC, R-2R ladder DAC, Inverted R-2R DAC. Analog to Digital converters (ADC): Flash type ADC, Successive approximation ADC, Dual slope ADC.											CO4
UNIT – V	Timer, PLL and Voltage Regulators						Periods:09				
555 timer IC pin diagram and functional diagram, 555 timer in monostable mode and its application as pulse width modulation, 555 timer in astable mode and its application as frequency shift keying (FSK), Phase Lock Loop IC 565. Voltage Regulators: Series op-amp regulator, LM78XX, 79XX fixed voltage regulator, 723 General Purpose Regulator, Switched Mode Power Supply.											CO5
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -			Total Periods: 45				
Text Books											
1. D Roy Choudhury and Shail Jain, “Linear integrated circuits”, New Age Science Limited, Fourth edition, 2018 2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, Fourth Edition, Prentice Hall / Pearson Education, 2015 3. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2010.											
Reference Books											
1. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Fourth Edition,Tata Mc Graw-Hill, 2016. 2. S.Salivahanan& V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”. Second Edition. TMH. 4th Reprint. 2016.											


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3. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2008.
4. B.S.Sonde, "System design using Integrated Circuits", Second Edition, New Age Pub, 2010
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2009.

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1. <http://www.ti.com/applications/industrial/medical/technical-documents.html>
2. <https://e-box.co.in/linear-integrated-circuits.shtml>
3. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

* TE – Theory Exam, LE – Lab Exam

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	2	-	-	-	-	-	-	-	2	3	1	-
2	3	2	2	-	-	-	-	-	-	-	1	3	1	-
3	3	3	3	-	-	-	-	-	-	-	1	3	1	1
4	3	2	2	-	-	-	-	-	-	-	2	3	1	-
5	3	3	3	1	2	-	-	-	-	-	2	3	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



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Department	Instrumentation and Control Engineering				Programme: B.Tech.							
Semester	III				Course Category: PC		End Semester Exam Type: TE					
Course Code	U23ICTC02				Periods/Week		Credit	Maximum Marks				
Course Name	Digital Logic Circuits				L	T	P	C	CAM	ESE	TM	
					2	1	0	3	25	75	100	
(Common to ICE & BME Branches)												
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Interpret the concepts of number systems and binary codes.									K2	
	CO2	Analyze the operations of Boolean algebra and logic gates.									K3	
	CO3	Design and implement combinational logic circuits									K3	
	CO4	Design and implement sequential logic circuits									K3	
	CO5	Understand the memory devices, programmable logic devices and Logic families									K3	
UNIT – I	Number Systems and Binary Codes							Periods:12				
Number Systems-Binary, Octal, Decimal, Hexadecimal. Number system conversions, Binary Arithmetic, Representation of signed binary numbers, 1s and 2s Complements.										CO1		
Binary Codes - Classification, Binary coded decimal (BCD), Weighted, non-weighted, Reflective, sequential, Alphanumeric codes. Error detection codes. Error correction codes.												
UNIT – II	Boolean Algebra and Logic Gates							Periods:12				
Boolean Algebra: Basic Theorems and Properties, Standard Forms of Boolean Expression-Sum of Product (SOP), Product of Sum(POS), Canonical and Standard forms, Simplification of Boolean expressions - Algebraic simplification, Karnaugh-Map simplification, Quine McClusky simplification.										CO2		
Logic gates: Basic logic gates; Universal gates; Implementation of Boolean function using gates												
UNIT – III	Combinational Logic Circuits							Periods:12				
Binary adders- Half adder, Full adder, Parallel Adder, Look ahead carry adder, Binary Subtractors - Half subtractor, Full subtractor, 1bit and 2bit Magnitude comparators, Code converters, Decoders and encoders, Multiplexers and Demultiplexers, Parity bit generator and checker.										CO3		
UNIT – IV	Sequential Logic Circuits							Periods:12				
Types of sequential circuits, Comparison between combinational and sequential circuits, Latches-RS latch; Flip flops (FF) – RS,D, JK, and T, JK Master/Slave FF, triggering of flip flops, Excitation tables, Flip flop conversions. Design of Counters- Asynchronous (Ripple) Counters, synchronous counters, Shift registers, Classification of shift registers, Universal Shift Register, Ring Counter, Johnson counter.										CO4		
UNIT – V	Memory, Programmable Logic Circuits and Logic Families							Periods:12				
Memory Classification- Random Access Memory (RAM), Static RAM, Dynamic RAM, Read Only Memory (ROM); PROM, EPROM, EEPROM.										CO5		
Programmable Logic Devices: Programmable ROM (PROM), Programmable Array Logic (PAL), Programmable Logic Array (PLA), Implementation of combinational circuits using PROM, PAL, PLA.												
Logic families: Characteristics - propagation delay, power dissipation, fan-in, fan-out, noise margin, TTL, ECL, CMOS.												
Lecture Periods: 60			Tutorial Periods: -			Practical Periods: -			Total Periods: 60			
Text Books												
1. M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.												
2. Anand Kumar, Fundamentals of Digital Circuits Prentice Hall of India, Pvt Ltd, New Delhi, Second Edition, 2014.												
3. R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.												


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Reference Books

1. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 6th Edition, TMH, 2003.
2. Charles H. Roth, Larry L. Kinney, Raghunandan G.H. Fundamentals of Logic Design, Cengage Learning India Pvt. Ltd.; 1st edition, 1 September 2019
3. William H. Gothmann, Digital Electronics Prentice Hall, 2001
4. John M. Yarbrough, Digital logic: Applications and Design Thomas Vikas Publishing House, 2002.
5. Ananda Natarajan R, Digital Design, Second edition, Eastern Economy Editions, PHI Learning Pvt. Ltd., 2015.

Web References

1. <https://nptel.ac.in/courses/117106086/>
2. <https://learn.ni.com/teach/resources/1104/digital-electronics>
3. <http://nptel.ac.in/courses/117106/117106086/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	-	-	-	3	1	1
2	3	2	2	-	-	-	-	-	-	-	-	3	1	1
3	3	2	2	-	-	-	-	-	-	-	-	3	1	1
4	3	-	1	-	-	-	-	-	-	-	-	3	1	1
5	3	2	1	-	-	-	-	-	-	-	-	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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Department	Biomedical Engineering			Programme: B.Tech						
Semester	III			Course Category: PC			End Semester Exam Type: TE & LE			
Course Code	U23BMB301			Periods / Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Pathology and Microbiology			2	0	2	3	50	50	100
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Understand the structural and functional aspects of living organisms							K2	
	CO2	Understand the importance of Fluid related disorders							K2	
	CO3	Describe the structure of Bacteria and virus							K3	
	CO4	Knowledge about the function of microscope							K3	
	CO5	Define methods involved in easing the pathological diseases							K3	
UNIT-I	Cell Degeneration, Repair and Neoplasia						Periods: 10			
Cell injury and Necrosis, Apoptosis – Intracellular accumulations – Pathological calcification, cellular adaptations of growth and differentiation – Inflammation and Repair including fracture healing, Neoplasia – Classification, Benign and Malignant tumours – carcinogenesis, spread of tumours – Autopsy and biopsy.										CO1
UNIT-II	Fluid and Hemodynamic Derrangements And Microscopes						Periods: 10			
Edema, normal hemostasis, thrombosis – disseminated intravascular coagulation – embolism, infarction, shock. Hematological disorders – Bleeding disorders, Leukaemias, Lymphomas. Microscopes: Light microscope – bright field, dark field, phase contrast, fluorescence – Electron microscope (TEM & SEM). – Preparation of samples for electron microscope – Staining methods – simple, gram staining and AFB staining.										CO2
UNIT-III	Microbial Cultures and Immunology						Periods: 10			
Morphological features and structural organization of bacteria – growth curve, identification of bacteria – culture media and its types – culture techniques and observation of culture. Immunology: Natural and artificial immunity – opsonization, phagocytosis, inflammation – Immune deficiency syndrome – antibodies and its types – antigen and antibody reactions – immunological techniques: immune diffusion, immuno electrophoresis – RIA and ELISA – monoclonal antibodies.										CO3
UNIT-IV	Pathology Lab Experiments						Periods: 15			
1. Sterilization techniques. 2. Preparation of culture media for micro-organisms. 3. ABO blood grouping and Cross matching of blood. 4. Hemoglobin estimation. 5. Bleeding time and clotting time. 6. Manual paraffin tissue processing and section cutting (Demonstration)										CO4
UNIT-V	Microbiology Lab Experiments						Periods: 15			
1. Study and handling of light microscope. 2. Total RBC count. 3. Peripheral smear study (i) Morphology (ii) WBC differential count. 4. Urine physical and chemical examination. 5. Identification of Bacterial morphology by phase contrast Microscopy/Live and dead bacterial cells by Fluorescence Microscopy (Demonstration) 6. Identification of bacteria using 16s-rRNA sequencing (Demonstration)										CO5
Lecture Periods: 30			Tutorial Periods:			Practical Periods: 30			Total Periods: 60	
Text Books										
1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, “Pathologic Basis of Diseases”, 10th edition, WB Saunders Co. 2020. 2. Prescott, Harley and Klein, “Microbiology”, 10th edition, McGraw Hill, 2021 3. Harsh Mohan: Text book of Pathology. Jaypee publishers. 9th edition. 2023										


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Reference Books

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 5th edition, 2010.
2. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 12/E ,2022.
3. Dubey RC and Maheswari DK. "A Textbook of Microbiology" Chand & Company Ltd, 5th edition ,2022
4. Vinay Kumar, Abul K. Abbas" Robbins Essential Pathology" Elsevier, 2020
5. Apurba S Sastry, Sandhya Bhat "Review of Microbiology & Immunology" Jaypee Brothers Medical Publishers Pvt. Limited, 2 Jun 2020

Web References

1. <https://tinyurl.com/ydcze6yx>
2. <http://www.rkmyat.in/up1/34/1629.pdf>
3. <http://moscmm.org/pdf/Ananthanarayan%20microbio.pdf>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	3	1	3	-	1	-	-	-	1	2	-	-
2	3	3	3	1	-	-	1	-	-	-	1	2	-	-
3	3	3	3	1	-	-	1	-	2	-	1	2	-	-
4	2	2	2	2	-	-	-	1	2	-	-	1	2	2
5	1	-	-	-	3	1	-	1	1	3	2	-	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical					
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks
30(to be weighted for 10 marks)			30 marks		40
Conduction of Practical	15 marks		Procedure / Algorithms	5 marks	
Report	10 marks		Experiment / Program Execution	10 marks	
Viva-Voce	5 marks		Result / Output	10 marks	
Total	30 marks		Viva-Voce	5 marks	



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Department	English		Programme: B.Tech.							
Semester	III		Course Category Code: HS				*End Semester Exam Type: LE			
Course Code	U23ENP301		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	General Proficiency- I		0	0	2	1	50	50	100	
(Common to ALL Branches except CSBS)										
Prerequisite	Basics of English Language									
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Interpret meaning and apply reading strategies in technical and non-technical context							K3	
	CO2	Develop interpersonal communication skills professionally							K4	
	CO3	Demonstrate various forms of formal writing							K3	
	CO4	Decode graphical data coherently							K2	
	CO5	Apply the techniques of verbal aptitude in competitive exams							K3	
UNIT- I	Comprehension Analysis					Periods:6				
Listening: Dialogue based on social contexts (IELTS based) - Speaking: Break the iceberg (IELTS based) Submitting Video Recording - Reading: Reading technical passage (IELTS based) - Writing: Writing Task: 2 (IELTS Academic) - Vocabulary: Synonyms (IELTS)									CO1	
UNIT- II	Personality Development					Periods:6				
Listening: Monologue about the everyday social issues (IELTS based) - Interview Videos - Speaking: Speak about the topic in the Flash Card (IELTS based) - Reading: British & American Vocabulary - Writing: SWOT Analysis - Vocabulary: Idioms and Phrases (IELTS)									CO2	
UNIT- III	Inferential Learning					Periods:6				
Listening: Conversation between 4 people regarding education (IELTS based), Anecdotes - Speaking: Structure Discussion (IELTS based) - Reading: Distinguish between facts & opinions (IELTS based), - Writing: Writing Conversation to different context - Vocabulary: Phrasal Verbs (IELTS)									CO3	
UNIT- IV	Interpretation And Functional Writing					Periods:6				
Listening: Monologue on an academic subject (IELTS based), Group Discussion videos - Speaking: Group Discussion Practice - Reading: Read and review (Books, Magazines) - Writing: Writing Task 1: (IELTS Academic: Graph/ chart/tables description) - Vocabulary: Collocations (IELTS)									CO4	
UNIT-V	Verbal Aptitude - I					Periods:6				
Language Enhancement: Articles, Preposition, Conjunction Verbal Ability Enhancement: Ordering of sentences, Blood Relation, Completing Statements- Cloze test, Spotting Errors - Sentence Improvement, Word Analogy, Word Groups (GATE)									CO5	
Lecture Periods: -		Tutorial Periods: -		Practical Periods:30			Total Periods:30			
Reference Books										
1.Lewis, Norman, “Word Power Made Easy”.Goyal Publishers and Distributors Pvt.Ltd., Latest Edition, 2020. 2.Patterson, Kerry, Joseph Grenny,Ron McMillan, Al Switzler, “Crucial Conversation Tools for talking when Stakes are High”, Kindle Publication,2nd Edition, 2011. 3.Comfort, Jeremy,et.al. “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge: Reprint 2011. 4.Agarwal, R. S. “A Modern Approach to Verbal & Non-Verbal Reasoning”. S. Chand, 2010. 5.Wren, Percival Christopher, and Wren Martin. “High School English Grammar and Composition”. S Chand, 2005.										
Web References										
1. https://www.ielts-exam.net/grammar/ 2. https://ieltsfocus.com/2017/08/02/collocations-ielts/ 3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers 4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/ 5. https://www.examsbook.com/word-analogy-test-questions-with-answers										


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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	1	-	3	-	2	1	1	1
2	1	-	-	-	-	-	1	-	3	-	2	1	1	1
3	1	-	-	-	-	-	1	-	3	-	2	1	1	1
4	1	-	-	-	-	-	1	-	3	-	2	1	1	1
5	1	-	-	-	-	-	1	-	3	-	2	1	1	1

Correlation Level: 1-Low, 2-Medium, 3-High**Evaluation Methods**

Practical					
Continuous Assessment Internal Evaluation			End Semester External Evaluation		Total Marks
50 marks			50 marks		100
Conduction of Practical (Assignment 1&2 -10 Marks Performance in practical classes - 5 Marks)	15		Listening (L)	20	
Record	5		Speaking(S)	10	
Viva	5		Reading(R)	10	
Model Practical Examination (Model Exam is conducted for 50 Marks that will be converted to 15 Marks)	15		Writing(W)	10	
Attendance	10				



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Department	Mathematics			Programme: B.Tech.							
Semester	III			Course Category Code: CC		*End Semester Exam Type: LE					
Course Code	U23MAPC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Engineering Mathematics Laboratory			0	0	2	1	50	50	100	
(Common to all Branches Except CSBS)											
Prerequisite	Matrices, Fourier Transforms, Laplace Transforms										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Perform and evaluate Matrix Operations								K3	
	CO2	Solve Differential and Integral Equations								K3	
	CO3	Construct Fourier series and Fourier Transforms of the given function								K3	
	CO4	Find the Measures of Central tendency								K3	
	CO5	Analyze Correlation and Regression lines								K3	
List of Experiments:											
1. Find the Inverse, Rank, Eigen values and Eigen Vectors of the matrix. 2. Solve the first order differential equation. 3. Find the integration of $\int_a^b f(x)dx$. 4. Find the Fourier series of f(x). 5. Find the Fourier Transform of f(x). 6. Find the Laplace Transform of f(x). 7. Find the Mean, Median and Mode. 8. Construct the Pie and Bar Diagram. 9. Find the Correlation coefficient. 10. Find the Regression lines.											
Lecture Periods:- Nil			Tutorial Periods:- Nil			Practical Periods: 3 0		Total Periods :30			
Reference Books											
1. T. Veerarajan, "Engineering Mathematics, Tata McGraw Hill Education (India) Private Limited Chennai 2nd Edition Paperback – 1 January 2018. 2. M.K. Venkataraman, "Engineering Mathematics, The National Publishing Company, Madras, 2016. 3. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback – 1, 2019.											
Web References											
1. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf 2. https://www.nrigroupindia.com/niist/wp-content/uploads/sites/6/2022/02/lab-manual-it406matlab.pdf 3. https://www.studocu.com/row/document/comsats-university-islamabad/signals-and-systems/lab-lab-manual/38332410											

* TE – Theory Exam, LE – Lab Exam



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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	-	-	-	-	1	1	1	1
2	3	2	1	1	-	1	-	-	-	-	1	1	1	1
3	2	1	-	-	-	1	-	-	-	-	1	1	1	1
4	2	1	-	-	-	1	-	-	-	-	1	1	1	1
5	3	2	1	1	-	1	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Dr. A.Vijayalakshmi

Department	Artificial Intelligence and Data Science		Programme: B.Tech							
Semester	III		Course Category : ES			End Semester Exam Type:LE				
Course Code	U23ADPC01		Periods / Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Python Laboratory		0	0	2	1	50	50	100	
	(Common to All Branches)									
Prerequisite	NIL									
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Describe common Python functionality and features used for data science.							K2	
	CO2	Query Data Frame structures for cleaning and processing.							K2	
	CO3	Configure your programming environment							K3	
	CO4	Experiment the concept using data visualization.							K3	
	CO5	Analyze real time datasets,							K3	
List of Exercises										
</										


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4. <https://www.python.org/>
5. <https://www.programiz.com/python-programming>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	2	2	1	3	-	-	-	-	-	-	2	2	2
2	2	3	2	2	3	-	-	-	-	-	-	2	3	2
3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Dr. A. Vijayalakshmi

Department	Biomedical Engineering			Programme: B. Tech.							
Semester	III			Course Category: PC			*End Semester Exam Type: LE				
Course Code	U23ICPC01			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Linear and Digital Integrated Circuits Lab			0	0	2	1	50	50	100	
(Common to ICE & BME Branches)											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Design various applications of op-amp.								K4	
	CO2	Able to design signal conditioning circuits necessary for instrumentation.								K3	
	CO3	Design various sequential digital circuits like shift registers, counters.								K3	
	CO4	Design asynchronous sequential circuits.								K3	
	CO5	Implement Multiplexer and demultiplexer								K2	
PART –A 1. Design and Testing of Inverting amplifier, Noninverting amplifier and Voltage Follower. 2. Design and Testing of Summer and Subtractor circuits. 3. Design and Testing of Differentiator and Integrator. 4. Design and Testing of Instrumentation amplifier. 5. Design and Testing of First order active filters (LPF, HPF). 6. Implementation of 4-bit DAC using OP AMP, ADC using op-amp. 7. Design and Testing of Astable and monostable multivibrators using 555 Timer.											
PART –B 8. Study of Logic Gates. 9. Design and implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor circuits. 10. Implementation of Code converters. 11. Implementation of Encoders and Decoders. 12. Verification of multiplexer and demultiplexer. 13. Implementation of Flip flops. 14. Design and implementation of counters. 15. Design and implementation of 4-bit shift registers.											
Lecture Periods:		Tutorial Periods:-			Practical Periods: 30			Total Periods: 30			
Reference Books											
1. D Roy Choudhury and Shail Jain, “Linear integrated circuits”, New Age Science Limited, Fourth edition, 2018. 2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, Fourth Edition, Prentice Hall / Pearson Education, 2015. 3. M. Morris Mano and Michael D. Cilette, Digital DesignII, Prentice Hall, Fifth Edition,2012 4. Thomas L Floyd, “Digital Fundamentals”, Prentice Hall, 11 th Edition, 2014. 5. Anand Kumar, Fundamentals of Digital CircuitsII, Prentice Hall of India, Pvt Ltd, New Delhi, 4th Edition, 2016.											
Web References											
1. https://www.electronics-lab.com/ 2. http://vlabs.iitkgp.ernet.in/be/# 3. https://nptel.ac.in/courses/122/106/122106025/											


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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	-	-	-	-	-	1	3	1	1
2	3	1	-	1	2	-	-	-	-	-	1	3	1	1
3	3	1	-	-	2	-	-	-	-	-	1	3	1	1
4	3	2	3	3	2	-	-	-	-	-	1	3	1	1
5	3	2	3	3	2	-	-	-	-	-	1	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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Department	Biomedical Engineering	Programme: B.Tech.						
Semester	III	Course Category: AE			*End Semester Exam Type: LE			
Course Code	U23BMC3XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – III	0	0	4	-	100	-	100
Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50		Total Periods:50		

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



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Department	Biomedical Engineering			Programme: B.Tech.							
Semester	III			Course Category: AE			*End Semester Exam Type: LE				
Course Code	U23BMS301			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Skill Enhancement Course 1*			0	0	2	-	100		100	
Prerequisite											
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Apply safety protocols in medical equipment troubleshooting.								K3	
	CO2	Execute preventive maintenance for optimal blood pressure monitors.								K3	
	CO3	Learn about the Shortcut keys, Formulae etc.								K3	
	CO4	Explore about power p[oint Presentation								K3	
	CO5	Learn various methods to design in power point presentation								K3	
Course Content:											
Testing and Troubleshooting of Medical Equipment											
1. Rules of Engagements											
a. Look at the device/procedure/process.											
b. Listen to the user/device/procedure/process.											
c. Applications for the device/procedure/process											
2. Blood Pressure Monitor Equipment (Manual)											
a. Preventive Maintenance											
b. Disassembling a Mercury Manometer											
c. Mercury handling protocol											
3. Centrifuge Equipment											
a. Preventive Maintenance											
b. Checking Motor Functions											
c. RPM Measurements											
d. Bypassing Interlock											
4. Microscope											
a. Preventive Maintenance											
b. Checking Light Source											
c. Adjustments of Knobs											
d. Ensuring the amount of Lubricants											
5. Sphygmomanometer											
a. Preventive Maintenance											
b. Mercury leakage											
c. Pressure check.											
d. Aneroid instrument pressure check.											
6. Stethoscopes											
a. Earpiece sound check.											
b. Tube connector check in headpiece.											
c. Parts damaged or faulty.											
Lecture Periods:			Tutorial Periods:			Practical Periods:30		Total Periods: 30			
Reference Books											
1. Justin Cooper and Alex Dahinten, "Medical Equipment Troubleshooting Flowchart Handbook" Published by: Engineering world health, Vesion- 6, 2013											



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Web References

1. <https://www.youtube.com/watch?v=whp2pnCBs6s>
2. <https://www.youtube.com/watch?v=EJJVrCm3YT4>
3. <https://www.youtube.com/watch?v=T0QmUe0bwL8>
4. <https://www.youtube.com/watch?v=3kXnL0AQhYA>
5. <https://www.usms.biz/preventive-maintenance-for-medical-devices/>

Masters in Microsoft Excel**Module I: Excel Basics****(6 Hrs)**

About Excel, The Excel environment, The Title Bar – The Ribbon – Scroll Bars – The MS Office Button – The Quick Access Toolbar – The Formula Bar – The Workbook Window – The Status bar – The Workbook View Buttons – The Zoom Slider – the Mini toolbar – Keyboard Shortcuts.

Module II: Data handling**(6 Hrs)**

Sorting & Filtering: Techniques for sorting and filtering data, including controlling the order of precedence in a sort, advanced filters, and an introduction to PivotTables. Using sorting and filtering to check and 'clean' data. Controlling user input: Controlling the way users can enter data into a spreadsheet to reduce risk of error and increase efficiency. Covers Data Validation and using IS- functions to trap errors. Working with Text: Entering and formatting text, extracting or combining parts of text. 'Cleaning' data for typos and bugs. Lookup & Reference: Looking up information in a basic table, and more flexibly. VLOOKUP() and the more flexible INDEX()/MATCH() combination. Advanced lookups.

Module III: Formatting**(6 Hrs)**

Cell Formatting - Basic font formatting, alignment – Including horizontal and vertical alignment, wrapping, merging, orientation, Alt-Return; consistent, sensible row heights & column. Number Formatting - Types of number (E.g., currency, %, decimal, negative numbers) – and Excel formats best employed. Custom number formats and how to maximise impact and clarity. Conditional Formatting - Changing the format of cells depending on their value. Graphical conditional formats. Writing conditional format formulas.

Module IV: Presentation**(6 Hrs)**

Graphs and Charts - Creating simple charts and editing them to control and improve formatting. Choosing the right chart Principles and guidelines for communicating well with charts. Sparkline's and Maps (when and how to use). Page & Print Setup - Displaying spreadsheets as pages. Page layout view, page breaks, print area, Printing from multiple Worksheets (and that default will be to print only from active Worksheet). Headers and footers. Adjusting page setup. Printing very large sheets of data and finally printing!

Module V: Advanced Excel Capabilities**(6 Hrs)**

Conditional formatting, importing data and text to columns, Functions – Mathematical, String, IF, AND, OR, Searching: match, search, vlookup, Dates, Misc, Pivot tables, Recording and editing Macros.

Lecture Periods:	Tutorial Periods:	Practical Periods:30	Total Periods: 30

Text Books

1. Michael Alexander, "Excel 2007 Dashboards and Reports for Dummies", John Wiley & Sons, 2011
2. Ellen Monk, Spring Davidson, Joseph Brady, "Problem Solving Cases in Microsoft Access and Excel", Cengage Learning, 2009
3. Colleen Conmy, Bill Hazlett, Bill Jelen, Adrienne Soucy, "Excel for Teachers", Tickling Keys, 2010

Reference Books

1. Noreen Brown, Barbara Lave, Julie Romey, "Beginning Excel 2019", Open Oregon Educational Resources, 2017
2. Greg Harvey, "Excel 2019 All-in-One For Dummies", John Wiley & Sons, 2018
3. John Walkenbach, "Excel 2007 Bible", John Wiley & Sons, 2011
4. Matthew MacDonald, "Excel 2010: The Missing Manual", O'Reilly Media, Inc., 2010
5. Rob Bovey, Stephen Bullen, Dennis Wallentin, John Green, "Professional Excel Development: The Definitive Guide to Developing Applications Using Microsoft Excel, VBA, and .NET", Addison-Wesley Professional, 2009



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Web References

1. <https://www.google.com/search?q=ms+excel+working&oq=MS+Excel+working&aqs=chrome.0.0i457j0l3j0i22i30l4.9421j0j4&sourceid=chrome&ie=UTF-8>
2. <https://www.investintech.com/resources/blog/archives/5430-excel-data-tips.html>
3. <https://edu.gcfglobal.org/en/excel2010/working-with-basic-functions/1/>
4. <https://www.online-tech-tips.com/ms-office-tips/microsoft-excel-basics-tutorial-learning-how-to-use-excel/>
5. <https://spreadsheets.com/how-to-use-excel/>

Power Point Presentation Design and Animation**Module I: Getting acquainted with PowerPoint****(6 Hrs)**

Understanding and working with the PowerPoint interface including: the Outline and Slides pane, the Ribbon, Quick Access toolbar, notes pane and the Status Bar.

Module II: Objects and Formatting**(6 Hrs)**

Working with objects in PowerPoint. Copying and moving objects. Formatting including the format painter. Fonts and effects. Inserting new slides. Slide layout. Selecting multiple objects. Grouping objects. The different objects that you can include on a slide. Six slides that demonstrate the six content types: Table, Chart, Graphic, Picture, Clip art, Media clip (movie).

Module III: Slide Design**(6 Hrs)**

Templates and Slide Masters, How to use themes, masters and templates to make slide design quick and consistent. Layouts and footers. Principles of slide design - Principles to guide good, clean design and formatting of slides. Making your slides clearer. Creating professional-looking slides with real impact.

Module IV: Making an Impact**(6 Hrs)**

When and why to use images. How to insert and edit images. Cropping, resizing and manipulating images. Screenshots and videos. Removing picture backgrounds. Applying artistic effects.

Module V: Animation**(6 Hrs)**

Adding and controlling transition effects between slides. Detailed animation and transition options. Animating individual elements of text boxes, charts and diagrams. Presenter tools and features. Custom slide shows. Annotating your slide during a talk. Navigating a presentation. Self-running presentations.

Lecture Periods:	Tutorial Periods:	Practical Periods:30	Total Periods: 30

Text Books

1. Joan Lambert, "Microsoft PowerPoint step by step 2016", Microsoft Press, 2016
2. Curtis Frye, Joan Preppernau, and Joyce Cox, "Microsoft® Office PowerPoint® 2007 Step by Step", Microsoft Press, 2015
3. John Walkenbach, Michael R. Groh, Herb Tyson, Faithe Wempen, "Office 2010 Library: Excel 2010 Bible, Access 2010 Bible, PowerPoint 2010 Bible, Word 2010 Bible", John Wiley & Sons, 2010

Reference Books

1. Joan Lambert, "Microsoft PowerPoint step by step 2019", Microsoft Press, 2019
2. David W. Beskeen, "Illustrated Course Guide: Microsoft PowerPoint 2013 Advanced" Cengage Learning, 2014
3. Joan Preppernau and Joyce Cox, "PowerPoint 2010", Microsoft Press, 2010
4. "Microsoft PowerPoint 2013", John Wiley and Sons, 2013
5. Ann Shaffer and Katherine T. Pinard, "New Perspectives Microsoft Office 365 & PowerPoint 2016: Intermediate", Course Technology, 2016

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1. <https://smallbusiness.chron.com/bibliography-powerpoint-40572.html>
2. <https://bookboon.com/en/powerpoint-ebooks>
3. <https://penandthepad.com/cite-book-powerpoint-8344519.html>
4. <https://www.bookdepository.com/category/1931/PowerPoint>



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Evaluation Method

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	Report	Presentation / Demo / Skill Test	
Marks	10	40	50	100



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Department	Biomedical Engineering	Programme: B.Tech.						
Semester	III	Course Category: MC				*End Semester Exam Type:-		
Course Code	U23BMM303	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Climate Change	0	2	0	-	100	-	100
UNIT- I	Atmosphere and its Components					Periods:6		
Importance of Atmosphere-Physical Chemical Characteristics of Atmosphere- Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability-Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.								
UNIT- II	Global Climate					Periods:6		
Account of past climate Environmental indicators and instrumental records Human Footprints on global warming- Predicting future climates- Temperature regime - Extreme climate events								
UNIT- III	Impacts of Climate Change					Periods:6		
Causes of Climate change: Change of Temperature in the environment-Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem - Water Resources Human Health Industry, Settlement and Society Methods and Scenarios - Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change - Risk of Irreversible Changes.								
UNIT- IV	Observed Changes and its Causes					Periods:6		
Climate change and Carbon credits- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks-The Montreal Protocol UNFCCC - IPCC Evidences of Changes in Climate and Environment on a Global Scale and in India.								
UNIT-V	Climate Change and Mitigation Measures					Periods:6		
Clean Development Mechanism -Carbon Trading- examples of future Clean Technology - Biodiesel Natural Compost Eco Friendly Plastic Alternate Energy Hydrogen Bio-fuels-Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices-Carbon sequestration - Carbon capture and storage (CCS) - International and Regional cooperation- Remedial measures.								
Lecture Periods: 30		Tutorial Periods: -		Practical Periods:			Total Periods:30	
Text Books 1. Joan Fitzgerald "Greenovation: Urban Leadership on Climate Change, Oxford University Press 2020. 2. J. David Neelin" Climate change and climate modelling" Cambridge University press (2011). 3. Robin Moilveen "Fundamentals of weather and climate" Oxford University Press (2nd Edition) (2010), 4. Andrew Dessler and Edward A. Parson "The Science and Politics of Global Climate Change" 2009 5. Dash Sushil Kumar, "Climate Change An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.								
Reference Books 1. Bill McKibben (2012), The Global Warming Reader: A Century of Writing About Climate Change,Penguin. 2. Jason Smerdon(2009) Climate Change: The Science of Global Warming and Our Energy Future, Columbia University 3. Adaptation (2006) and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge. 4. J.M. Wallace and P.V. Hobbs (2006) Atmospheric Science, Elsevier / Academic Press. 5. Jan C. van Dam, (2003) Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press								
Web References 1. https://nptel.ac.in/courses/105102089/ 2. https://www.warmheartworldwide 3. https://nptel.ac.in/content/storage								



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B.Tech. Biomedical Engineering

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



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Department	Mathematics		Programme : B.Tech.						
Semester	IV		Course Category Code: BS			End Semester Exam Type: TE			
Course Code	U23MATC04		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Numerical Methods and Optimization		3	1	-	4	25	75	100
(Common to EEE, ECE, ICE, BME, MECH, CIVIL & MECHATRONICS)									
Prerequisite	Basic Mathematics								
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Solve Algebraic and Transcendental equations						K2	
	CO2	Solve Simultaneous Equations by various Numerical Techniques.						K3	
	CO3	Apply the Numerical Techniques of interpolation in various Intervals.						K3	
	CO4	Solve Linear programming problems by using Optimization Techniques.						K3	
	CO5	Find the solution of Transportation and Assignment Problems.						K3	
UNIT – I	Solution of algebraic and transcendental equations					Periods:12			
Solution of Algebraic and Transcendental equations – Bisection method - Method of False position – Newton Raphson method (single only) – Eigen value and Eigen vector by Power method.									CO1
UNIT – II	Linear system of equations					Periods:12			
Solutions of Linear system of equations and Matrix Inversion – Gauss Elimination and Gauss - Jordan methods. Iterative methods – Gauss Jacobi – Gauss Seidel.									CO2
UNIT – III	Interpolation and solution of ordinary differential equations					Periods:12			
Interpolation by Newton’s Forward and Backward Difference formula for equal intervals – Lagrange’s method for unequal intervals. Integration by Trapezoidal and Simpson’s rules (Single integration only). Fourth order Runge-Kutta method for solving first order Differential Equations.									CO3
UNIT – IV	Linear programming problems					Periods:12			
Linear Programming Problems – Graphical Method – Simplex Method: Big M method – Two phase method.									CO4
UNIT – V	Transportation and assignment problems					Periods:12			
Transportation Problems – Initial basic feasible solution using North-West Corner rule, Least Cost Method, Vogel's Approximation Method – Optimality in Transportation Problem by Modified Distribution (MODI) Method. Assignment Problems – Solutions of Assignment Problems by Hungarian Method – Unbalanced Assignment Problems.									CO5
Lecture Periods:45		Tutorial Periods:15		Practical Periods: -			Total Periods:60		
Text Books									
1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, “Numerical Methods”, S. Chand Limited, 2008.									
2. R. Panneerselvam “Operations Research” Prentice Hall of India, 2 nd Edition,2004.									
3. P.K. Gupta, D.S. Hira, “Operations Research”, S. Chand, 5 th Edition, 2018.									
Reference Books									
1. Atul Goyal, Madhuchanda Rakshit Suchet Kumar, “Numerical Methods”, New India publishing Agency, 1 st Edition, 2019.									



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2. Rajesh Kumar Gupta, "Numerical Methods - Fundamental and Applications", Cambridge University Press, 1st Edition, 2019.
3. S.Kalavathy, "Operation Research", Vikas Publishing house, 4th Edition, 2012.
4. Kevin J. Hastings, "Introduction to the Mathematics of Operations Research with Mathematica", Taylor and Francis, 2nd Edition, 2019.
5. T. Veerarajan, "Operations Research", McGraw Hill, 1st Edition, 2018.

Web References

1. <https://nptel.ac.in/courses/111106101/>
2. <https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00>
3. <https://freecomputerbooks.com/Numerical-Methods-with-Applications.html>
4. <https://www.pphmj.com/journals/IJNMA.htm>
5. <https://nptel.ac.in/courses/106/108/106108056/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	1	1	2	2	2	1
2	3	3	2	2	2	-	-	-	1	1	2	2	2	1
3	3	3	2	2	2	-	-	-	1	1	2	2	2	1
4	3	3	3	2	3	-	-	-	1	2	2	2	3	2
5	3	3	3	2	3	-	-	-	1	2	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Computer Science Engineering		Programme : B.Tech							
Semester	IV		Course Category: ES			End Semester Exam Type: TE				
Course Code	U23CSTC03		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Data Structures		3	0	0	3	25	75	100	
(Common to All Branches except CSBS and FT)										
Prerequisite	Any Programming Knowledge									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Compute time and space complexity for given problems							K2	
	CO2	Demonstrate stack, queue and its operation.							K2	
	CO3	Illustrate the various operations of linked list.							K3	
	CO4	Use the concepts of tree for various applications.							K3	
	CO5	Outline the various Tables, Graphs and Sets techniques.							K3	
UNIT - I	Basic Terminologies of Data Structures					Periods:09				
Introduction: Basic Terminologies – Asymptotic Notations: Complexity analysis. Array and its operations - Searching: Linear Search and Binary Search Techniques. Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort. Performance and Comparison among the sorting methods.									CO1	
UNIT - II	Stack and Queue Operations					Periods:09				
Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.									CO2	
UNIT - III	Linked List Operations					Periods:09				
Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.									CO3	
UNIT - IV	Trees					Periods:09				
Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree- Red Black Tree.									CO4	
UNIT - V	Graphs, Tables and Sets					Periods:09				
Graph: Basic Terminologies and Representations – Graph traversal algorithms. Tables: Different types of tables – Hash Table and its operations - Applications. Sets: Representation of Sets- Operations and its applications.									CO5	
Lecture Periods:45			Tutorial Periods:		Practical Periods:-		Total Periods:45			
Text Books										
1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.										
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.										
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4 th Edition, 2009.										
Reference Books										
1. D. Samanta, "Classic Data Structures", Prentice-Hall of India, Second Edition, 2012.										
2. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c" . Prentice-Hall of India, Second Edition, 2007.										
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second. Edition,2006.										
4. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition, Addison-Wesley										



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- Publishing Company, 1995.
 5. Mark Allen Weiss, "Algorithms, Data Structures and Problem Solving with C++", Addison- Wesley Publishing Company, Illustrated Edition, 1995.

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1. <https://www.geeksforgeeks.org/data-structures/>
2. <https://www.javatpoint.com/data-structure-tutorial/>
3. <https://www.studytonight.com/data-structures/>
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. <https://www.w3schools.in/data-structures-tutorial/intro/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	1	1	2	2	2	1
2	3	2	2	1	3	-	-	-	1	1	2	2	2	2
3	3	2	2	2	3	-	-	-	1	1	2	2	2	2
4	3	2	2	2	3	-	-	-	1	2	2	2	3	2
5	3	3	2	2	3	-	--		1	2	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabu



Dr. A. Vijayalakshmi

Department	Biomedical Engineering			Programme: B.Tech.							
Semester	IV			Course Category: PC			End Semester Exam Type: TE				
Course Code	U23BMT405			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Biomechanics			3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the fundamental principles of biomechanics								K2	
	CO2	Analyse the deformability, strength of bone, modes of loading and failure								K3	
	CO3	Analyse the elasticity and deformation properties of soft tissues								K3	
	CO4	Explain the types and mechanics of skeletal joints								K2	
	CO5	Know the locomotion principles of human body								K2	
UNIT-I	Introduction to biomechanics					Periods: 9					
Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Biofluid mechanics, flow properties of blood.										CO1	
UNIT-II	Hard tissue biomechanics					Periods: 9					
Hard Tissues: Bone structure and composition mechanical properties of bone, cortical and cancellous bones,viscoelastic properties, Maxwell and Voight models — anisotropy. Electrical properties of bone, type of fractures, biomechanics of fracture healing.										CO2	
UNIT-III	Soft tissue biomechanics					Periods: 9					
Soft Tissues: Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle; Modelling: Cartilage, Tendon, Ligament, and Muscle.										CO3	
UNIT-IV	Joints biomechanics					Periods: 9					
Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle.										CO4	
UNIT-V	Movement biomechanics					Periods: 9					
Gait analysis, body and limbs- mass and motion characteristics actions, forces transmitted by joints. Joints forces results in the normal and disable human body, normal and fast gait on the level. Patterns: Push/Throw Continuum Biomechanics of push - like motions, Biomechanics of throw - like motions										CO5	
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -			Total Periods: 45				
Text Books											
1. Gerhard A. Holzapfel, Ray W. Ogden, “Mechanics of Biological Tissue”, Springer, 2010.											
2. Sean P. Flanagan and Flanagan, “Biomechanics: A case-based Approach”, Jones and Bartlett Publishers,2018.											
3. Carol A. Oatis, “The Mechanics and Pathomechanics of Human Movement”, Lippincott Williams and Wilkins, 2010.											
Reference Books											
1. Ozkaya, N, Leger, D, Goldsheyder, D, Nordin, M, “Fundamentals of Biomechanics: Equilibrium, Motion,and											



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- Deformation", 4th edition. Springer International Publishing, 2017.
- Donald R. Peterson and Joseph D. Branzino, "Biomechanics: principles and applications", third edition. CRC Press, 2011.
 - Ray W. Ogden, "Biomechanics of Soft Tissue in Cardiovascular Systems", Springer Vienna, 2014.
 - Subrata Pal, "Text book of Biomechanics", Viva education Private limited, New Delhi. 2009
 - Susan J. Hall, "Basics Bio Mechanics" 5th Edition, McGraw-Hill Publishing Co, Newyork, 2007.

Web References

- <https://tinyurl.com/y9bm4f9q>
- <https://tinyurl.com/y8osnq6d>
- <https://tinyurl.com/y78y4cvy>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	2	2	-	-	1	1	2	3	2	1
2	3	3	3	2	3	2	-	-	1	2	2	3	3	2
3	3	3	3	2	3	2	-	-	1	2	2	3	3	2
4	3	2	2	2	2	2	-	-	1	1	2	3	2	1
5	3	2	2	1	2	2	-	-	1	1	2	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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Department	Biomedical Engineering				Program: B.Tech.							
Semester	IV				Course Category: PC		End Semester Exam Type: TE					
Course Code	U23BMT406				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Biomedical Instrumentation				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Gain knowledge in electrodes and its functions.										K2
	CO2	Understand the different types of electrodes and its placement for various recordings.										K3
	CO3	Analyse bio amplifier and signal conditioning circuits.										K4
	CO4	Explain various techniques for non-electrical physiological measurements.										K3
	CO5	Investigate various assist and respiratory devices.										K3
UNIT – I	BIOPOTENTIAL ELECTRODES							Periods:9				
Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes											CO1	
UNIT – II	BIOPOTENTIAL MEASUREMENTS							Periods:9				
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven „s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG											CO2	
UNIT – III	SIGNAL CONDITIONING CIRCUITS							Periods:9				
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering											CO3	
UNIT – IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS							Periods:9				
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.											CO4	
UNIT – V	ASSIST DEVICES AND RESPIRATORY DEVICES							Periods:9				
Pacemakers - Defibrillators – Audiometry – Hearing aid, Ventilators, Spirometer, Lung Volume and capacities, Pneumo tachometers: different types											CO5	
Lecture Periods: 45			Tutorial Periods:			Practical Periods: -			Total Periods: 45			
Text Books												
1. R. S. Khandpur, “Biomedical Instrumentation Technology and Applications”, McGraw-Hill Professional, 2014.												
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd edition. PHI, 2008.												
3. Raja Rao, C and Guha S.K, “Principles of Medical Electronics and Biomedical Instrumentation”, Orient Longman Publishers, 2001												
Reference Books												
1. R. Anandanatarajan, “Biomedical Instrumentation”, 2nd edition, PHI Learning, 2016.												
2. Andrew G. Webb, “Principles of Biomedical Instrumentation”, Cambridge University Press, 2018.												
3. John G. Webster, “Medical Instrumentation: Application and Design”, 4th edition. John Wiley and Sons, New York, 2010.												



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4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, 2002.

Web References

1. <https://apm.iitm.ac.in/biomedical/sai/>
2. <https://www.youtube.com/watch?v=iK-6q4nnmtA>
3. <https://www.youtube.com/watch?v=8m8yNSaCMpg>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	2	2		1	1	2	3	2	1
2	3	2	2	1	2	2	2		1	1	2	3	2	1
3	3	3	3	2	3		2		1	1	2	3	3	2
4	3	3	3	2	3	2	2		1	2	2	3	3	2
5	3	3	3	2	3	2	2		1	2	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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Department	Biomedical Engineering		Programme: B.Tech.							
Semester	IV		Course Category Code: PC		*End Semester Exam Type: TE					
Course Code	U23BMB401		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Biosignal Processing		2	-	2	3	50	50	100	
Prerequisite										
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Design and implement IIR digital filters							K4	
	CO2	Design and implement FIR digital filters							K4	
	CO3	Identify the process of analyzing ECG & EEG Signals							K3	
	CO4	Implement the FIR and IIR filters in various applications							K3	
	CO5	Simulates and analyses Bio signals							K3	
UNIT-I		Infinite impulse response filters				Periods:10				
Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.								CO1		
UNIT-II		Finite impulse response filters				Periods:10				
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.								CO2		
UNIT-III		Biological signal processing				Periods:10				
Preprocessing of ECG signal, QRS detection Methods-Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms, Automated ECG analysis, Correlation. Detection of EEG Rhythms, Template matching for EEG spike and wave detection, Sleep EEG classification and epilepsy. Medical Applications of Adaptive Noise Cancellation, Speech signal analysis.								CO3		
UNIT- IV		Impulse response filters				Periods:15				
List of Experiments 1.Generation of Discrete and Continuous time signals 2.Linear and Circular Convolution 3.Frequency analysis using DFT 4. IIR Filter Design 5. FIR Filter Design 6. Spectrum analysis and noise removal of biomedical signals								CO4		
UNIT-V		ECG Signal Processing				Periods:15				
List of Experiments 1. ECG Data Compression techniques 2. Detection of QRS Component from ECG signal 3. Analysis of PCG Signal 4. Analysis of EEG Signal 5. Speech signal analysis 6. Down sampling and up-sampling of ECG signals								CO5		



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Lecture Periods:30	Tutorial Periods:-	Practical Periods:30	Total Periods:60
Text Books			
1. Rangayyan, R.M."Biomedical signal analysis (Vol. 33)", John Wiley & Sons,2015. 2. Reddy, D.C."Biomedical signal processing: principles and techniques". McGraw-Hill,2005 3. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012			
Reference Books			
1. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice",Oxford University Press, 2012. 2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2010. 3. StephaneMallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011. 4. Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group,LLC, Second edition. 2012 5. Li Tan , Jean Jiang "Digital Signal Processing fundamentals and Applications", Second edition,Academic Press, 2013			
Web References			
1. https://www.youtube.com/watch?v=S_U-s27nPLE 2. https://www.youtube.com/watch?v=bFeYjFtSsrg 3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles 4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069 5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf			

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	3	2	3	-	-	-	1	1	2	2	3	1
2	3	2	3	2	3	-	-	-	1	1	2	2	3	1
3	3	3	2	2	2	2	-	-	1	1	2	2	3	2
4	3	2	3	2	3	-	-	-	1	1	2	2	3	2
5	3	3	2	2	2	2	-	-	1	1	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	



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Practical			
Continuous Assessment Internal Evaluation		End Semester Internal Evaluation	
30(to be weighted for 10 marks)		30 marks	
Conduction of Practical	15 marks	Procedure / Algorithms	5 marks
Report	10 marks	Experiment / Program Execution	10 marks
Viva-Voce	5 marks	Result / Output	10 marks
Total	30 marks	Viva-Voce	5 marks
		40	



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Department	English			Programme: B.Tech.							
Semester	IV			Course Category: HS			*End Exam Type : LE				
Course Code	U23ENPC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	General Proficiency- II			0	0	2	1	50	50	100	
Prerequisite	Basics of English Language										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Infer ideas to attend international standardized test by broadening receptive and productive skills								K2	
	CO2	Interpret the types of writing in different state of affairs								K3	
	CO3	Acquire meticulous exposure in speaking and get rid of performance anxiety								K2	
	CO4	Articulate the ideas and opinions effectively and coherently								K2	
	CO5	Progress the skills to compete in various competitive exams like GATE, GRE, UPSC, etc.								K4	
UNIT- I	Career Skills						Periods:6				
Listening: Listening at specific contexts - Speaking: Demonstrative speaking practice using visual aids (charts, graphs, maps) - Reading: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) - Writing: Integrated Writing Task (TOEFL) - Vocabulary: Synonyms and Antonyms (IELTS)											CO1
UNIT- II	Corporate Skills						Periods:6				
Listening: Listening English news and reproducing in own words - Speaking: Team Presentation - Reading: Short texts and Longer Passages (cloze reading) - Writing: Analytical Writing: Analyzing an issue and Argument task (GRE based) - Vocabulary: Prefix and Suffix											CO2
UNIT- III	Functional Skills						Periods:6				
Listening: Listening TED Talks - Speaking: Brainstorming & Individual Presentation - Reading: Text Completion (GRE Based) - Writing: Picture Inference - Vocabulary: Word Formation											CO3
UNIT- IV	Transferrable Skills						Periods:6				
Listening: Listening Documentaries and making notes - Speaking: Mock Interview - Reading: Read texts on emerging trends - Writing: Agreeing & Disagreeing Essay (IELTS) - Vocabulary: Euphemism, Redundancy, Clichés and Intensifier.											CO4
UNIT-V	Verbal Aptitude - li						Periods:6				
Transformational Grammar: Tenses, Change of Voice, Concord Verbal Ability Enhancement: Letter Series, Coding &Decoding, Sentence Equivalence (GRE)Analytical Reasoning and Logical Reasoning (GATE), Syllogism, One-word Substitution, Jumbled Sentences											CO5
Lecture Periods: -			Tutorial Periods: -			Practical Periods:30			Total Periods:30		
Reference Books											
1. Cullen, Pauline, Amanda French, and Vanessa Jakeman. “The official Cambridge guide to IELTS for academic & general training”.Cambridge, 2014. 2. Prasad, Hari Mohan, Sinha, Uma Rani, “Objective English for Competitive Examinations”, Tata Mc Graw Hill: Noida,2010. 3. Lougheed, Lin. “Barron's Writing for the TOEFL IBT: With Audio CD”. Barron's Educational series, 2008. 4. Grussendorf, Marion, “English for Presentations”, Oxford University Press, Oxford, 2007. 5. Murphy, Raymond English Grammar in Use with answers: Reference and Practice for Intermediate students, Cambridge: CUP,2004.											
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1. <https://www.englishclub.com/grammar/nouns-compound.htm>
2. <https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/I3p1>
3. <https://www.grammarwiz.com/phrases-and-clauses-quiz.html>
4. <https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/>
5. <http://www.englishvocabularyexercises.com/general-vocabulary/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	2	2	-	-	1	2	-	3	2	2	-
2	2	3	-	2	1	-	-	-	3	-	2	2	2	-
3	1	2	-	1	-	-	2	3	3	2	2	-	-	-
4	2	2	-	2	-	-	2	2	3	2	2	-	-	-
5	3	3	-	3	2	-	-	1	2	2	3	3	3	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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Department	Computer Science Engineering			Programme: B.Tech.							
Semester	IV			Course Category: ES			*End Semester Exam Type: LE				
Course Code	U23CSPC02			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Data Structures Laboratory			0	0	2	1	50	50	100	
(Common to all Branches Except CSBS and FT)											
Prerequisite	Basic Programming Knowledge										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Analyse the algorithm's / program's efficiency in terms of time and space complexity.								K3	
	CO2	Solve the given problem by identifying the appropriate Data Structure.								K3	
	CO3	Solve the problems of searching and sorting techniques.								K3	
	CO4	Solve problems in linear Data Structures.								K4	
	CO5	Solve problems in non-linear Data Structures.								K4	
List of Exercises:											
1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.											
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.											
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT											
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. a) Delete an elementfrom list b) Search for a key element in list c) count number of nodes in list.											
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.											
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.											
7. Write a C program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree.											
8. Write a C program that use recursive functions to traverse the given binary tree in a) Preorder b) Inorder c) Postorder.											
9. Write a C program to perform the AVL tree operations.											
10. Write a C program to implement Graph Traversal Techniques.											
11. Write a C program to implement the Set operations.											
Union b) Intersection c) Difference.											
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods: 30		Total Periods: 30			
Reference Books											
1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd Edition, 2019.											
2. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st Edition, 2019.											
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st Edition, 2017.											
4. Reema Thareja, "Data structures using C", Oxford University, 2nd Edition, 2014.											



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Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st Edition, 2013.

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1. https://www.tutorialspoint.com/data_structures_algorithms/
2. <https://www.w3schools.in/data-structures-tutorial/intro/>
3. <https://nptel.ac.in/courses/106103069/>
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. <https://nptel.ac.in/courses/106103069>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	-	2	3	-	-	-	1	-	2	2	3	-
2	3	3	2	2	3	-	-	-	1	-	2	3	3	-
3	3	3	2	2	3	-	-	-	1	-	2	3	2	-
4	3	3	2	2	3	-	-	-	1	-	2	3	2	-
5	3	3	2	2	3	-	-	-	1	-	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practicalclasses			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Programme : B.Tech.					
Semester	IV			Course Category: PC		*End Semester Exam Type: LE			
Course Code	U23BMP404			Periods/Week		Credit	Maximum Marks		
				L	T	P	C	CAM	ESE
Course Name	Biomedical Instrumentation Laboratory			0	0	2	1	50	50
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Determine the heart axis in different leads and analyse the heart rate							K4
	CO2	Examine the blood pressure using sphygmomanometer							K4
	CO3	Investigate cardiac efficiency test, tuning fork tests for hearing							K4
	CO4	Explain the stimulation of eye, near point and near response							K3
	CO5	Demonstrate Artificial respiration and Cardio Pulmonary Resuscitation							K4
LIST OF EXPERIMENTS									
1. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle									
2. Recording of blood pressure using sphygmomanometer and stethoscope									
3. Measurement of Blood pressure using photo-plethysmography									
4. Measurements of various time intervals between each segment of ECG, Measurement of R-R interval and calculation of Heart Rate									
5. Cardiac Efficiency Test									
6. Measurement of Visually Evoked Potential									
7. Galvanic Skin Resistance (GSR) Measurement									
8. Peripheral pulse signal in different physical posture									
9. EMG Signal for different stress on the muscle									
10. Recording and interpretation of Heart sounds									
11. Demonstration of Artificial respiration and Cardiopulmonary Resuscitation									
12. Determination of Nerve conduction velocity									
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods: 30		Total Periods: 30	
Textbooks									
1. A.K.Sawhney ,”A Course in Electrical and Electronic measurements and Instruments” Dhanpat Rai and Sons, 2000.									
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd edition. PHI, 2018.									
3. Raja Rao, C and Guha S.K, “Principles of Medical Electronics and Biomedical Instrumentation”, Orient Longman Publishers, 2001									
Reference Books									
1. R. Anandanatarajan, Biomedical Instrumentation. PHI Learning, 2009.									
2. Andrew G. Webb, Principles of Biomedical Instrumentation. Cambridge University Press, 2018.									
3. John G. Webster, “Medical Instrumentation: Application and Design”, 4th edition. John Wiley and Sons, New York, 2010.									



4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, 2002.

Web References

1. <https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory>
2. <https://apm.iitm.ac.in/biomedical/sai/>
3. <https://www.electrical4u.com/introduction-to-biomedical-instrumentation/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	2	-	2	3	3	-
2	3	3	2	2	2	2	-	-	2	-	2	3	2	-
3	3	3	2	3	2	-	-	-	2	-	2	3	3	-
4	3	2	2	2	2	-	-	-	2	-	2	3	2	-
5	3	2	3	2	2	3	2	2	3	2	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	IV	Course Category: AEC				*End Semester Exam Type: LE		
Course Code	U23BMC4XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – IV	0	0	4	-	100	-	100
Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50			Total Periods:50	

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering			Programme: B.Tech.						
Semester	IV			Course Category: AEC			*End Semester Exam Type:			
Course Code	U23BMS402			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Skill Enhancement Course 2*			0	0	2	-		100	
Prerequisite										
Course Outcome	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Knowledge about electrical equipment that realize specified testing functions							K2	
	CO2	Analyze the different types of testing in medical equipment							K3	
	CO3	Understand the concept of PCB							K2	
	CO4	Gain adequate knowledge of PCB designing							K3	
	CO5	Acquire presentation skills using ICT							K2	
Course Content:										
Testing of Electronic and Medical Devices										
MODULE 1: Testing of Electrical Equipment (6 Hrs)										
AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires - Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring- Megger-Testing equipment and instruments.										
MODULE 2: Testing of Electronic Components (6 Hrs)										
Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse										
MODULE 3: Testing of Surgical Equipment (Coursera) (6 Hrs)										
Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.										
MODULE 4: Testing of ICU Equipment (Coursera) (6 Hrs)										
X-ray machines, Testing of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.										
MODULE 5: Life Cycle Management of Medical Equipment (6 Hrs)										
Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle, Case study.										
Lecture Periods:			Tutorial Periods:			Practical Periods: 30		Total Periods:		
Reference Books										
1. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York, 4th edition, 2008.										
2. Keith Willson, Keith Ison, Slavik Tabakov, “Medical equipment management”, CRC Press, UK, 2014.										
3. Jenny Dooley,John Lehnert Virginia Evans, “Career Paths: Medical Equipment Repair”, Express Publishing, UK,2018										
4. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation systems”, Cengage Learning Technology & Engineering, 2010.										
5. David Herres, “Troubleshooting and Repairing Commercial Electrical Equipment”, McGraw Hill Professional edition, 2013.										



Web References

1. <https://www.element.com/connected-technologies/electronics-test-methods>
2. <https://www.electronics-notes.com/articles/test-method>
3. <https://www.element.com/more-sectors/medical-device>
4. <https://www.metlabs.com/industries/medical-device-testing/>
5. <https://www.intertek.com/medical/>

PCB Board Designing:**MODULE 1: Introduction to PCB Designing Concepts****(6 Hrs)**

Introduction & Brief History - What is PCB, Difference between PWB and PCB, Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer), PCB Materials? Introduction to Electronic design Automation (EDA) - Brief History of EDA, Latest Trends in Market, How it helps and why it requires, Different EDA tools, Introduction to SPICE and PSpice Environment, Introduction and Working of PROTEUS.

MODULE 2: Component Introduction and their Categories**(6 Hrs)**

Types of Components - Active Components, Passive Components, Component Package Types - Through Hole Packages: Axial lead o Radial Lead, Single Inline Package (SIP), Dual Inline Package (DIP), Transistor Outline (TO), Pin Grid Array(PGA), Through Hole Packages: Metal Electrode Face(MELF), Leadless Chip Carrier(LCC), Small Outline Integrated Circuit(SOIC), Quad Flat Pack(QFP) and Thin QFP (TQFP), Ball Grid Array(BGA), Plastic Leaded Chip Carrier(PLCC)

MODULE 3: Introduction to Development Tools**(6 Hrs)**

Introduction to PCB Design using OrCAD tool, Introduction to PCB Design using PROTEUS tool

MODULE 4: Detailed Description and Practical of PCB Designing**(6 Hrs)**

PCB Designing Flow Chart - Schematic Entry, Net listing, PCB Layout Designing, Prototype Designing - Design Rule Check (DRC), Design for Manufacturing (DFM), PCB Making - Printing, Etching, Drilling, Assembly of components. Description of PCB Layers - Electrical Layers, Mechanical Layers, Documentation Layers, PCB Materials, Rules for Track, Study of IPC Standards

MODULE 5: Designing and Fabrication Process**(6 Hrs)**

Starting the PCB designing, Understanding the schematic Entry, Creating Library & Components, Drawing a Schematic, Flat Design / hierarchical Design, Setting up Environment for PCB, Design a Board Auto routing - Introduction to Auto routing, Setting up Rules, Defining Constraints, Auto router Setup, PCB Designing Practice, Post Designing & PCB Fabrication Process.

Lecture Periods:**Tutorial Periods:****Practical Periods: 30****Total Periods:****Reference Books**

1. Christopher T Robertson, Printed Circuit Board Designer's Reference; Basics, Prentice Hall Modern Semiconductor Design, 2003
2. Bosshart, Printed Circuit Boards: Design and Technology, Tata McGraw-Hill Education, 1983
3. R. S. Khandpur, Printed Circuit Boards, McGraw-Hills, 2005.
4. Charles A. Harper, High Performance Printed Circuit Boards, McGraw Hill Professional, 2000
5. Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002

Web References

1. https://www.electronics-notes.com/articles/analogue_circuits/pcb-design/how-to-design-pcb-board-basics.php
2. <https://www.circuitbasics.com/make-custom-pcb/>
3. <https://learn.sparkfun.com/tutorials/pcb-basics/all>
4. <https://www.pcbpower.com/>
5. <https://www.build-electronic-circuits.com/pcb-design/>



Presentation Skills using ICT:

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

CT skills

- Understand ICT work flow in cloud computing.
- Manage multitasking.
- Deal with main issues using technology in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Teaching tools

- Different ways to create audio visual activities.
- Handle audio visual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained on this course is not considered for CGPA calculation.

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	IV	Course Category: MC				*End Semester Exam Type:-		
Course Code	U23BMM404	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Right To Information and Good Governance	2	0	-	-	100	-	100
UNIT- I	Introduction				Periods:6			
Conceptual background - Right to know - Open Government - Transparency in governance and accountability - Right to information under the Indian Constitution - Article 19 (1)(a) and Article 21 of the Constitution - Role of NGOs and movement for right to information - Right to Information Act, 2005 - Scope and objectives.								
UNIT- II	Obligation of Public Authorities				Periods:6			
Obligations of public authorities: Section 4 Designation of Public Information Officers: Section 5 Disposal of request: Section 7 Exemption from disclosure of information: Section 8 Grounds for rejection to access in certain cases: Section 9 Severability: Section 10 Third party information: Section 11								
UNIT- III	Central and State Information Commission				Periods:6			
Constitution of Central and State Information Commissions Terms of office and conditions of service Removal of Chief Information Commissioner or Information Commissioner. Powers and functions of Information Commissions.								
UNIT- IV	Judiciary and Right to Information Act				Periods:6			
Protection of right to access the information - Role of the Supreme Court and High Courts Recent attempts of dilution of the right to information Law								
UNIT-V	Right to Information Act, 2005 and its relevance to other laws				Periods:6			
Public Records Act, 1993 Whistle Blowers Protection Act, 2014 Official Secrets Act, 1923								
Lecture Periods:-		Tutorial Periods: -		Practical Periods:50			Total Periods:50	

* TE – Theory Exam, LE – Lab Exam

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

PROFESSIONAL ELECTIVE - I

Department	Biomedical Engineering				Programme: B.Tech							
Semester	IV				Course Category: PE		End Semester Exam Type:- TE					
Course Code	U23BME401				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Medical Physics				3	0	0	3	25	75	100	
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Comprehend the significance and role of non-ionizing radiation in Medical Applications										K2
	CO2	Understand radioactive decay and production of radio nuclides.										K2
	CO3	Understand the concepts of different interaction of radiation with matter										K2
	CO4	Discuss the measurement of ionizing radiation										K3
	CO5	Enumerate the effect of ionizing radiation in human body										K3
UNIT-I	Nonionizing Radiation and its Medical Application							Periods: 09				
Light- Physics of light, Intensity of light color vision and limits of vision sound - Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) Interaction of Ultrasound with Materials- Reflection and Refraction – Absorption and Scattering Nonionizing Electromagnetic Radiation, Tissue as a leaky dielectric — Relaxation process- overview of non-ionizing radiation effects- low frequency effect- high frequencyeffect.											CO1	
UNIT-II	Principles of Radioactive Nuclides							Periods: 09				
Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positrondecay, 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 Radionuclide-fission and electron Capture reaction, radionuclide Generator-Milking process – Linearaccelerator.											CO2	
UNIT-III	Interaction of Radiation with Matter							Periods: 09				
Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of Gamma radiation with matter- Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.											CO3	
UNIT-IV	Principles of Radiation Detection and Dosimeters							Periods: 09				
Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge.											CO4	
UNIT-V	Radiation Effects							Periods: 09				
Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous system syndrome - Gastro intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation -Stochastic and Deterministic effects Late Deterministic effect in different organs and tissues.											CO5	
Lecture Periods: -45			Tutorial Periods: -			Practical Periods:			Total Periods: 45			
Text Books												
1. Gopal B. Saha “Physics and Radiobiology of Nuclear Medicine”, Fourth Edition, Springer, 2013. 2. ThayalanKuppusamy, “Basic Radiological Physics” Second Edition, Jaypee Brothers Medical Publishers, 2017. 3. Kwan Hoong Ng, “Problem and solutions in Medical Physics: Diagnostic imaging Physics”, Third volume, CRC press, 2011.												



Reference Books

1. Muhammad Maqbool, "An Introduction to Medical Physics", Springer, 2018.
2. SlavikTabakov, "Encyclopedia of Medical Physics", volume 1, CRC press, 2012.
3. Andrew Webb, Nadrine Barrie Smith, "Introduction to Medical Imaging: Physics, Engineering and Clinical Applications, Cambridge University press, 2010.
4. Faiz M Khan, "Khan's Lecture: Handbook of the Physics of Radiation Therapy", 2011.
5. Faiz M Khan, John P Gibbons, "Khan's the physics of Radiation Therapy" Fifth Edition, 2014.

Web References

1. <https://g.co/kgs/CBBKUU>
https://en.m.wikipedia.org/wiki/Medical_physics
2. <https://www.medphys.org/>
3. <https://physicsworld.com/c/medical-physics/>
4. <https://www.classcentral.com/course/medical-applications-particle-accelerato-12557>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	2	-	-	-	-	2	3	2	-
2	3	2	-	-	2	2	-	-	-	-	2	3	2	-
3	3	3	-	2	2	1	-	-	-	-	2	3	3	-
4	3	2	2	3	3	2	2	-	1	-	2	3	3	2
5	3	2	-	2	1	3	3	-	-	-	2	3	2	1

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	IV			Course Category: PE			End Semester Exam Type: TE				
Course Code	U23BME402			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Environmental Biotechnology			3	1	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Gain knowledge in the basic concepts of environmental biotechnology								K2	
	CO2	Familiarize with the biodegrading and bioremediation modules and its functions								K2	
	CO3	Describe the principles of microbiological treatment technologies to clean up contaminated environments.								K3	
	CO4	Explain the replacement of conventional treatment methodologies by using biocatalyst and bioreactors								K2	
	CO5	Understand the various bioproducts production and composting technology								K3	
UNIT – I	Introduction						Periods:9				
Biotechnology in the reduction of carbon dioxide emission- Microbial flora of soil - Microbial treatment of heavy Metal – bioleaching, bioaccumulation, biosorption and bioprecipitation Understand the various bioproducts production and composting technology of heavy metals - Soil, water and air - sources and effects - Removal of Pollutants.											CO1
UNIT – II	Biodegradation and Bioremediation						Periods:9				
Aerobic degradation of aliphatic and aromatics compounds - Anaerobic degradation of aromatic compounds - Biodegradation of herbicides and pesticides - Remediation Technologies - Bioventing, bio sparging and bio slurping, phytoremediation – Bio desulphurization of coal and oil - microbial treatment of oil pollution.											CO2
UNIT – III	Microbial Treatment of Waste and Waste Water						Periods:9				
Biological treatment of anaerobic and aerobic- methanogenesis, methanogenic, acetogenic- Use of genetically engineered organisms - Biotechnological Processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.											CO3
UNIT – IV	Biocatalysts and Bioreactors						Periods:9				
Enzymes isolation, whole cell systems - Biocatalytic Application - Advantages & Disadvantages- Design of activatedsludge process and anaerobic digestion system - Trickling Filter - Rotating biological contactors - Fluidized bed reactor - Up-flow anaerobic sludge blanket reactor (UASB) - High-rate anaerobic waste water treatment.											CO4
UNIT – V	Bioproducts and Renewable Sources						Periods:9				
Biofertilizers – Biopesticides - Biofuel production – Bioethanol – Biohydrogen – Biodiesel - Bioplastics and biopolymers - Composting technologies, composting systems, compost quality.											CO5
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45		
Text Books											
1. Bhattacharya B. C. and Banerjee R, “Environmental Biotechnology”, Oxford University Press, 2017.											
2. Jordening H. J. and Winter J., “Environmental Biotechnology: Concepts and Application”, Wiley ,2015.											
3. Bruce Rittmann and Perry McCarty,” Environmental Biotechnology”, McGraw-Hill, 2011.											
Reference Books											
1. W.D. Grant & P.E. Long, Blakie, Environmental Microbiology, Springer, 2019.											
2. H. Polasa, Microbial Gene Technology, South Asian Publishers, 2011.											
3. D. L. Wise, Biotreatment Systems. CRC Press, 2010.											
Web References											
1. https://en.wikipedia.org/wiki/Environmental_biotechnology											
2. http://dbtindia.gov.in/schemes-programmes/research-development/energy-environment-and-bio-resource-based-applications-0											
3. https://www.hindawi.com/journals/scientifica/si/269412/											

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	2	-	-	1	-	2	3	2	-
2	3	3	-	2	2	3	-	-	1	-	2	3	3	-
3	3	3	2	3	2	2	-	-	1	-	2	3	3	2
4	3	3	3	3	3	2	-	-	1	-	2	3	3	2
5	3	2	3	2	2	3	1	-	2	1	3	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	IV				Course Category: PE		End Semester Exam Type: TE					
Course Code	U23BME403				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Biometric Recognition Systems				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the knowledge of engineering principles underlying biometric systems									K2	
	CO2	Apply algorithms to model finger print									K3	
	CO3	Classify different face recognition and hand geometry pattern									K3	
	CO4	Analyze the design and performance of biometrics									K3	
	CO5	Explain various computations of authentication methods									K2	
UNIT – I	Introduction to Biometrics							Periods:9				
Introduction and background – biometric technologies – passive biometrics – active biometrics - Biometric systems — Enrollment — templates — algorithm — verification — Biometric applications — biometric characteristics- Authentication technologies –Need for strong authentication - Protecting privacy and biometrics and policy – Biometric applications — biometric characteristics.											CO1	
UNIT – II	Fingerprint Technology							Periods:9				
History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching											CO2	
UNIT – III	Face Recognition and Hand Geometry							Periods:9				
Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithms – Biometric fusion.											CO3	
UNIT – IV	Multimodal Biometrics and Performance Evaluation							Periods:9				
Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy – training and adaptability – examples of multimodal biometric systems – Performance Evaluation-Statistical Measures of Biometrics – FAR – FRR – FTE EER – Memory requirement and allocation.											CO4	
UNIT – V	Biometric Authentication							Periods:9				
Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines. Biometric authentication by fingerprint – biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication. Voice and Gait authentication.											CO5	
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Textbooks												
1. Joseph N. Pato, Lynette I. Millette, “Biometric Recognition: Challenges and Opportunities”, 2010.												
2. Zhenan Sun, Jianhuang Lai, Xilin Chen, Tieniu Tan, “ Biometric Recognition” Sixth Chinese conference, 2011.												
3. Anil Kumar Jain, Arun A Ross, KarthikNandakumar, “Introduction to Biometrics”, Springer, 2011.												
Reference Books												
1. Ravi Das, “Biometric Technology: Authentication, Biocryptography and cloud based architecture”, CRC Press, 2014.												
2. Sebastien Marcel, Mark S Nixon, Stan Z. Li, “Handbook of Biometric Anti- spoofing”, Springer, 2014.												
3. Mohammad S Obaidat, IssaTraoreIssacWoungang, “Biometric- Based Physical and cybersecurity systems”, Springer, 2018.												

4. Amine Nait-ali, "Hidden Biometrics when biometric security meets Biomedical Engineering", Springer, 2019.

5. Ted Dunstone, "Biometric system and Data Analysis", Springer, 2010.

Web References

1. <https://www.mooc-list.com/tags/biometric>

2. <https://www.coursera.org/lecture/usable-security/biometric-authentication-RXVog>

3. <https://www.udemy.com/course/biometrics/>

4. <https://nptel.ac.in/courses/106/104/106104119/>

5. http://www.scholarpedia.org/article/Biometric_authentication

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	1	-	2	3	2	-
2	3	3	2	2	3	-	-	-	1	-	2	3	3	2
3	2	3	2	2	3	-	-	-	1	-	2	3	3	2
4	2	3	3	3	3	-	-	-	1	-	2	3	3	2
5	2	3	2	3	3	2	1	-	2	1	3	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering		Programme: B.Tech.							
Semester	IV		Course Category: PE			End Semester Exam Type: TE				
Course Code	U23BME404		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Hospital Equipment Safety and Management		3	0	0	3	25	75	100	
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Assess practice-based learning and improvement in quality and health policies for patients							K2	
	CO2	Increase the trend for developing educational interventions in patient safety							K2	
	CO3	Know the necessity of improving standard and quality of the hospital							K2	
	CO4	Gain the roles and responsibilities of hospital staffs in various functions of hospital							K3	
	CO5	Able to reach the hospital management standard for the patient safety							K4	
UNIT – I	Clinical Engineering					Periods:9				
Clinical engineering program, Educational responsibilities, Role to be performed by them in hospital, Staff structure in hospital – HIS. Need for evolving health policy, Health organization in state, Health financing system, Health education, Health insurance, Health legislation.									CO1	
UNIT – II	Hospital and Industrial Organization					Periods:9				
Difference between hospital and industrial organization, Levels of training, Steps of training, Developing training program, Evaluation of training, Wages and salary, Employee appraisal method.									CO2	
UNIT – III	Standardization					Periods:9				
Necessity for standardization, Indian Standards, FDA, AERB, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.									CO3	
UNIT – IV	Strategic Management in Hospitals					Periods:9				
Nature and value of strategic management in hospitals - Awareness on the application of IT in Various functions of Hospital. Application of statistical tools in the areas of Health services. Introduction to support services — Disaster management, Ambulance services, Laundry services, Civil Assets.									CO4	
UNIT – V	Safety Measures					Periods:9				
Elements of Safety - Safety Publications and Standards Organizations - Orientation to Laboratory Safety - Types of risks in the hospitals - factors of environment - Safety showers and Eye Washes — Radiation hazards — radiation detection — safety measures — standards. Ergonomics - Flammables and Explosives — Formaldehydes - PEL Standards and Calculations - Material Safety - Organization of Safety in the hospitals.									CO5	
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -			Total Periods: 45			
Textbooks										
1. Joydeep Das Gupta, “Hospital Administration and Management: A Comprehensive Guide”, Jaypee Brothers Medical Publishers, 2015.										
2. Saxena.M, “Hospital Management”, CBS Publishing, First edition, 2016.										
3. Girdhar J Gyani and Alexander Thomas, “Handbook of Healthcare quality and patient safety” Second edition, Jaypee brothers medical publisher, 2019.										
Reference Books										
1. Sonu Dr. Goel, “Textbook of Hospital Administration”, Elsevier, 2014.										
2. William Charney, “Handbook of Modern Hospital Safety”, CRC press, Second edition, 2010.										
3. Ramani. K. V, “Hospital Management”, Pearson, 2011.										
4. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care ManagementII”, Sixth Edition, Cengage Learning, 2011.										
5. Cindy Taylor, “The Hospital Safety Professional’s Handbook”, Fifth Edition, 2015.										



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1. https://en.wikipedia.org/wiki/Medical_equipment_management
2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. <https://www.who.int/news-room/fact-sheets/detail/patient-safety>
4. <https://www.coursera.org/browse/health/healthcare-management>
5. <https://www.who.int/management/newitems/en/index1.html>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	2	-	3	2	1	2	2	3	2	-	-
2	2	2	-	-	-	3	2	1	2	1	3	2	-	-
3	2	3	2	2	1	3	2	1	2	2	3	3	1	-
4	2	2	2	2	2	2	1	3	3	3	3	2	-	2
5	2	2	3	2	1	3	2	2	3	3	3	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	IV				Course Category: PE		End Semester Exam Type: TE					
Course Code	U23BMECO1				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Communication Systems				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the various Analog modulation techniques									K2	
	CO2	Gain knowledge in Digital modulation techniques									K2	
	CO3	Knowledge about fiber optic and satellite communication systems									K2	
	CO4	Analyse spread spectrum and multiple access techniques									K3	
	CO5	Realize the importance of radio communication									K2	
UNIT – I	Analog Modulation						Periods:9					
Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM –Power relation – Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.												CO1
UNIT – II	Digital Modulation						Periods:9					
Principles of pulse modulation – sampling theorem, PAM, PWM, PPM, Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction todigital modulation systems – PCM, DPCM, Delta Modulation, ADM, ASK, FSK and PSK.												CO2
UNIT – III	Fiber Optic and Satellite Communication						Periods:9					
Need for fiber optics- principle of light transmission through a fiber- fiber classification-fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system - Power budget analysis for an optical link- Recent medical application of fiber optics.												CO3
Block diagram of a satellite communication system, Satellite Orbits, satellite parameters, satellite link model, GPS services.												
UNIT – IV	Spread Spectrum and Multiple Access Techniques						Periods:9					
Pseudo-noise sequence, DS spread spectrum, FH spread spectrum, multiple access techniques –TDMA andFDMA, source coding of speech for wireless communication.												CO4
UNIT – V	Radio Communication						Periods:9					
Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off- Introduction to 4G & 5G technologies												CO5
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Text Books												
1. Wayne Tomasi, “Advanced Electronic Communication Systems”, Sixth Edition, Pearson Education, 2010.												
2. Kennedy Davis, “Electronic Communication Systems”, Fifth Edition,Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2011.												
3. William C.Y. Lee, “Mobile Cellular Telecommunication Systems”, McGraw Hill International Edition, Third edition, 2008.												
Reference Books												
1. Simon Haykin, “Communication Systems”, Fourth Edition, John Wiley and Sons, 2009.												
2. Rappaport T.S, "Wireless Communications: Principles and Practice", Second Edition, PearsonEducation, 2010												
3. H.Taub, D L Schilling and G Saha, “Principles of Communication”, Third Edition, Pearson Education,2010												
4. B. P.Lathi, “Modern Analog and Digital Communication Systems”, Third Edition, Oxford University Press,2009												
5. Martin S.Roden, “Analog and Digital Communication System”, Fifth Edition, Prentice Hall of India, 2012.												



Web References

1. <https://nptel.ac.in/courses/108104091/>
2. <https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/>
3. <https://nptel.ac.in/courses/117/105/117105143/>
4. <https://nptel.ac.in/courses/108104091/>
5. <https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	1	-	2	3	-	-
2	3	2	-	-	2	-	-	-	1	-	2	3	2	-
3	3	2	2	2	3	1	-	-	1	-	2	3	2	2
4	3	3	2	3	3	-	-	-	1	-	2	3	3	2
5	3	2	-	-	2	2	-	1	2	1	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Management Studies			Programme : B.Tech.						
Semester	V			Course Category Code: HS		*End Semester Exam Type: TE				
Course Code	U23HSTC02			Periods/Week			Credit Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Research Methodology			2	0	0	2	25	75	100
(Common to All Branches)										
Prerequisite	Nil									
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Interpret the different types of research and explain how research methods can be used to address engineering problems.								K2
	CO2	Discuss the research problems, conduct comprehensive literature reviews, and utilize tools and services for effective information retrieval.								K2
	CO3	Apply appropriate methods to design experiments, analyze data, and interpret results using both numerical and graphical techniques.								K3
	CO4	Analyze and apply ethical guidelines to structure and write research papers and dissertations, ensuring academic integrity and avoiding plagiarism.								K4
	CO5	Examine the fundamentals of intellectual property rights to protect and enforce them, with emphasis on their role in fostering innovation and entrepreneurship in engineering.								K3
UNIT-I	Introduction to Research						Periods: 6			
Meaning and Importance of Research, Types of Research: Overview of Basic, Applied, and Developmental Research, Overview of the Research Process, Defining a Research Problem: Key Considerations, Setting Research Objectives and Research Questions, Introduction to Research Design: Basic Concepts, Approaches to Research: Quantitative vs. Qualitative.										CO1
UNIT-II	Problem Formulation and Literature Review						Periods: 6			
Identifying and Formulating Research Problems, conducting a Literature Review: Essential Steps, Referencing and Citation Methods: Basic Techniques. Sources of Information: Overview of Libraries and Online Databases.										CO2
UNIT-III	Research Methods and Data Analysis						Periods: 6			
Introduction to Experimental Research, Developing Hypotheses: Basic Approach. Data Collection Methods:Sampling and Surveys, Basics of Data Analysis: Numerical and Graphical Analysis, Introduction to Inferential Statistics.										CO3
UNIT-IV	Writing and Presenting Research						Periods: 6			
Preparing a Research Report: Key Sections (Abstract, Introduction, Methodology, Results, Discussion, Conclusion). Referencing and Citation: Brief Overview.										CO4
UNIT-V	Ethics and Legal aspects in research						Periods: 6			
Ethical Considerations in Research: Introduction to Scientific Misconduct. Basics of Intellectual Property Rights - Introduction to Patents, Copyrights, and Trademarks – Case studies on ethical dilemmas in research.										CO5
Lecture Periods: 30			Tutorial Periods:			Practical Periods:		Total Periods: 30		
Text Books										
1. Kumar, R. “Research Methodology: A Step-by-Step Guide for Beginners”, SAGE Publications, 5 th Edition 2019.										
2. Ram Ahuja,” Research methods “. Rawat Publications. 2 nd Edition ,2022										
3. Creswell, J. W., and Creswell, J. D. “Research Design: Qualitative, Quantitative, and Mixed Methods Approaches”, SAGE Publications, 5 th Edition, 2018.										
Reference Books										
1. Thiel, D. V. “Research methods for engineer”, Cambridge University Press”. 2014										
2. Ganesan,.R. “Research methodology for engineers”, MJP Publishers. 2024.										
3. Agarwal.C. & Sharma.V. "Research methodology in sociology" ,Common wealth Publishers,2012										
4. Thody, A."Writing and presenting research SAGE Study Skills Series", SAGE Publications,2006										
5. Kothari CR. Research methodology – methods and techniques. 5 th Edition, New Delhi: New Age International Publishers; 2023.										



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1. <https://conjointly.com/kb/>
2. https://owl.purdue.edu/owl/research_and_citation/conducting_research/writing_a_literature_review.html
3. <https://files.eric.ed.gov/fulltext/ED536788.pdf>
4. <https://researcheracademy.elsevier.com/>
5. <https://www.wipo.int/>
6. <https://www.scholastic.com/7-steps-to-successful-research-report.html>
7. <https://www.futurelearn.com/info/courses/business-research-methods-investigation>
8. <https://articles.manupatra.com/article-details/Patent-Types-Laws-related-to-them-in-India>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	-	2	-	-	-	-	-	-	2	3	-	-
2	3	3	-	3	2	-	-	-	-	-	2	3	2	-
3	3	3	2	3	3	-	-	-	-	-	2	2	3	2
4	-	-	-	-	-	-	3	-	2	-	-	-	-	-
5	-	-	-	-	-	2	-	-	-	3	3	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Information Technology			Programme: B.Tech.							
Semester	V			Course Category Code: ES		*End Semester Exam Type: TE					
Course Code	U23ITTC02			Periods / Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Java			3	0	0	3	25	75	100	
(Common to All Branches)											
Prerequisite	Basic knowledge of Object-Oriented Programming Principles										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Articulate the concept of Java fundamentals, OOPs and Strings								K2	
	CO2	Demonstrate the principles of inheritance, packages and interfaces with real time applications								K2	
	CO3	Create real time applications using exception handling and thread programming.								K3	
	CO4	Build distributed applications using Collections and IO streams								K3	
	CO5	Design and build simple GUI programs using AWT, Swings and build database applications								K3	
Unit- I	Introduction								Periods: 09		
Introduction: Java: History – Features – JVM - JRE – JDK – Java Compilation and Execution – Data Types - Variables, Types, Expressions, Assignment Statements, Input/Output Statements: Scanner/System class, Type Casting (Primitives to Primitives), Conditional and Iterative Control Structures - Arrays										CO1	
OOPs with Java: Introduction to OOPs Concepts - Class – Objects – Methods - Access Modifiers – Creating Class and Objects, Object Life-Cycle - Garbage Collection-Constructors - this – static – Array of Objects – Nested Classes.											
String: String Class– Built-in Methods – String Builder - String Buffer											
Unit- II	Inheritance, Interfaces and Packages								Periods: 09		
Inheritance: Types of Inheritance – is-a Relationship, has-a Relationship – super keyword – final keyword – Polymorphism - Method overloading and Method overriding – Abstract Class										CO2	
Interfaces: Define – Extend – Implement – Access - Interfaces vs Abstract classes, Type Conversions (Primitives to Objects vice-versa): Autoboxing and Auto unboxing											
Packages: Define – Create – Access – Import											
Unit- III	Exception Handling and Multithreading								Periods: 09		
Exception Handling: Exception Hierarchy – Checked and Unchecked Exceptions – try, catch, throws, throw and finally – User Defined Exceptions.										CO3	
Multithreading: Thread – Life cycle – Defining and Running – Implementation Types – Thread Priorities – Thread Synchronization - Inter-Thread Communication											
Unit- IV	Collections and I/O Streams								Periods: 09		
Collections: List: Array List and Linked List. Set: Hash Set and Tree Set. Map: HashMap – Stack – Queue. Lambda Expressions.										CO4	
I/O Streams: Streams – Byte Streams and Character Streams – File Input Stream and File Output Stream – File Reader and File Writer. Object Serialization : Object Input Stream and Object Output Stream											
Unit- V	GUI and JDBC								Periods: 09		
AWT: Components – Controls – Event Handling										CO5	
SWING: Swing Components – Layout Management.											
JDBC: JDBC Architecture – JDBC Driver Types – Implementation of JDBC.											
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45		

A. Vijayalakshmi

Text Books

1. Allen B. Downey and Chris Mayeld, "Think Java - How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2020
2. Herbert Schildt, "Java: The Complete Reference", TMH Publishing Company Ltd, 11th Edition, 2018.
3. H.M.Dietel and P.J.Dietel, "Java How to Program", 11th Edition, Pearson Education/PHI, 2017
4. Cay S. Horstmann, Gary Cornell, "Core Java Volume - I Fundamentals", 9th Edition, Prentice Hall, 2013.

Reference Books

1. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018.
2. Poaul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
3. P.J. Dietel and H.M Dietel, "Java for Programmers", Pearson Education, 9th Edition, 2011.
4. Steven Holzner, "Java 2 Black book", Dreamtech Press, 2011.

Web References

1. <https://www.javatpoint.com/java-tutorial>
2. <https://docs.oracle.com/en/java/>
3. <https://www.studytonight.com/java/>
4. <https://onlinecourses.nptel.ac.in/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Correlation Level: 1 - Low, 2 - Medium, 3 – High

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	2	-	2	3	-	-
2	3	2	2	-	2	-	-	-	2	-	2	3	2	-
3	3	2	3	2	3	-	-	-	2	-	2	3	3	2
4	3	2	2	3	3	-	-	-	2	-	2	3	3	2
5	3	2	3	2	3	2	-	-	3	3	2	3	3	3

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Program: B.Tech.							
Semester	V			Course Category: PC			End Semester Exam Type: TE				
Course Code	U23BMT507			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Microcontroller and its Medical Applications			3	0	0	3	25	75	100	
Prerequisite	Digital Logic Circuits										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the fundamental concepts of 8051 microprocessors								K2	
	CO2	Apply knowledge in programming and interfacing of devices with Microcontroller								K3	
	CO3	Interpret PIC Microcontroller based system design								K3	
	CO4	Elucidate about peripheral devices and interfacing for data communication								K4	
	CO5	Illustrate the applications of microcontroller in biomedical systems								K3	
UNIT – I	8051 Microcontroller						Periods:9				
Architecture of 8051 – Pin diagram – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Addressing modes – Instruction set – Assembly language programming.								CO1			
UNIT – II	Interfacing microcontroller						Periods:9				
Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD and Keyboard Interfacing – ADC, DAC and Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation.								CO2			
UNIT – III	PIC Microcontroller						Periods:9				
General Introduction – PIC 18F4X2 architecture – Von Neumann Architecture and Harvard Architecture – Memory Organization – Addressing Modes – Instruction Set.								CO3			
UNIT – IV	Peripherals and Interfacing						Periods:9				
GPIO programming – Timers Programming – Serial Communication – PWM programming– ADC, DAC and Sensor Interfacing - Stepper Motor								CO4			
UNIT – V	Medical Applications						Periods:9				
Physiological monitoring: Microcontroller based ECG Machine - Pulse oximeter circuit using microcontroller – Design of EOG based home automation – Design of Multipara monitoring system: Temperature - Blood Pressure and Respiration rate.								CO5			
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45					
Text Books											
1. A.K.Ray, K. M. Bhurchandi, “Advanced Microprocessor and Peripherals”, Tata McGraw Hill, 3 rd Edition, 2013											
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2 nd Edition, Pearson education, 2013											
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, ” PIC Microcontroller and Embedded Systems using Assembly and C for PIC18”, Pearson Education 2016											
Reference Books											
1. Krishna Kant, “Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096”, PHI, 2013											
2. DoughlasV.Hall, Microprocessors and Interfacing, Programming and Hardware”, TMH,2012											
3. Peatman J., “Embedded system Design using PIC18Fxxx”, Prentice Hall, 2013.											
4. Raj Kamal,” Microcontrollers: Architecture, Programming, Interfacing and System Design” Pearson,2011											
5. Martin P. Bates,” Programming 8-bit PIC Microcontrollers in C" Newnes,2008											
Web References											
1. https://www.youtube.com/watch?v=S1QCZW92fU4											
2. https://swayam.gov.in/nd1_noc20_ee42/microprocessors-and-microcontrollers/											



3. <https://www.classcentral.com/course/swayam>
4. <https://freevidelectures.com/course/3018/microprocessors>
5. <https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	2	3	-	-
2	3	3	3	2	3	-	-	2	2	2	2	3	3	3
3	3	3	3	2	3	-	-	-	2	2	2	3	3	3
4	3	3	2	3	3	-	-	-	2	2	2	3	3	3
5	3	3	2	2	3	2	-	-	2	2	2	3	3	3

Correlation level: 1 - Low 2 - Medium 3 - High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering		Programme: B.Tech							
Semester	V		Course Category: PC			*End Semester Exam Type: TE & LE				
Course Code	U23BMB502		Periods / Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Biocontrol Systems		2	0	2	3	50	50	100	
Prerequisite	Biosignals and Systems									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Explain the concepts of different modelling systems.							K3	
	CO2	Analyse the time response of different order systems, steady state error and frequency response using various plots							K4	
	CO3	Determine the stability and root locus concepts and Investigate the biomedical applications							K4	
	CO4	Demonstrate Transient analysis of signals							K4	
	CO5	Simulate the model of Biological Control System							K4	
UNIT-I	Modelling of Systems					Periods: 10				
Classification of control systems - Open loop and closed loop control systems - advantages and disadvantages, Transfer function, Modelling of electrical systems, Modelling of translational and rotational mechanical systems, Analogous systems, Block diagram reduction technique, Signal flow graph, conversion of block diagram to signal flow graph.									CO1	
UNIT-II	Time and Frequency Response Analysis					Periods: 10				
Standard test signals - step, ramp, parabolic and impulse type and order of a system, Time response of first order systems, Time response of second order systems, Transfer function-Time constant form and pole zero form, time domain specifications, Steady state error.									CO2	
Frequency Response Analysis: Frequency response - Frequency domain specifications, Polar plot, Bode plot.										
UNIT-III	Stability Analysis and Biological Control Systems					Periods: 10				
Stability criterion- necessary conditions for stability, Determining the stability by Routh and Hurwitz criterion, Root locus concepts, Rules for the construction of root locus. Effect of adding poles and zeros to a system.									CO3	
Biological control Systems - Cardiovascular Control System, Skeletal Muscle Servomechanism, Oculo - motor system, sugar level Control Mechanism, Lung mechanics model with proportional control										
UNIT-IV	Simulation of Transient and Stability Analysis					Periods: 15				
1. Generation of Periodic, Exponential, Sinusoidal, Step, Impulse, Ramp signals 2. Transient Analysis of Impulse Response 3. Transient Analysis of Step Response 4. Determine the Time response of Second Order system 5. Frequency Domain Analysis of Signals 6. Stability analysis (Bode, Root Locus) of Linear Time Invariant system.									CO4	
UNIT-V	Simulation of Biological Control Systems Modelling					Periods: 15				
1. State space model for classical transfer function 2. Pole Zero Configuration in S-plane for the given transfer function 3. ECG Signal Generation 4. Simple Lung Mechanics using Transfer Function 5. Blood Glucose Regulation using Simulink 6. Neuromuscular Regulation using Simulink									CO5	
Lecture Periods: 30		Tutorial Periods:-		Practical Periods:30			Total Periods: 60			
Textbooks										
1. Nagrath J and Gopal M, "Control system engineering", 5 th Edition, New Age International Publishers, 2011. 2. Rajeev Gupta, "Control systems engineering", 1 st Edition. Wiley India Pvt Ltd, 2011. 3. Michael C K Khoo. Physiological control systems-Analysis, simulation and estimation". Second Edition, India, 2018.										



Reference Books

1. Norman S Nice, "Control system engineering", 7th Edition, Wiley India Pvt Ltd, 2015.
2. K R Varmah, "Control systems", 1st Edition. Tata McGraw Hill, 2010.
3. Salivahanan, "Control systems Engineering", Pearson Education India, 2015
4. K. Padmanabhan, "Control systems", Wiley India Pvt Ltd, 2020
5. A. Anand Kumar, "Control systems", 2nd Edition. PHI Learning Pvt Ltd, 2015.

Web References

1. <https://nptel.ac.in/courses/107106081/>
2. <https://www.youtube.com/watch?v=QY9NTVh-Awo&list=PLDK4cGT3XCf3GovuGIqmp-mgfm8pXIPH6>
3. <https://www.youtube.com/watch?v=RJleGwXorUk>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	2	3	-	-
2	3	3	2	2	3	-	-	-	-	-	2	3	3	-
3	3	3	2	3	2	-	-	-	2	2	2	3	3	2
4	3	2	-	2	3	-	-	-	-	-	2	3	3	-
5	3	3	3	3	3	-	-	-	2	2	2	3	3	3

Correlation Level: 1 - Low, 2 -Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	
Practical						
Continuous Assessment Internal Evaluation			End Semester Internal Evaluation		Total Marks	
30(to be weighted for 10 marks)			30 marks		40	
Conduction of Practical		15 marks	Procedure / Algorithms	5 marks		
Report		10 marks	Experiment / Program Execution	10 marks		
Viva-Voce		5 marks	Result / Output	10 marks		
Total		30 marks	Viva-Voce	5 marks		

A. 

Department	Information Technology			Programme: B.Tech							
Semester	V			Course Category Code: ES		*End Semester Exam Type: LE					
Course Code	U23ITPC02			Periods / Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Programming in Java Laboratory			0	0	2	1	50	50	100	
(Common to All Branches)											
Prerequisite	Basic concepts of Object-Oriented Programming Principles										
Course Outcome	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Apply and practice logical formulations to solve simple problems leading to specific applications.								K3	
	CO2	Demonstrate the use of inheritance, interface and package in relevant applications								K3	
	CO3	Implement robust application programs in Java using exception handling and multithreading								K3	
	CO4	Build java distributed applications using Collections and IO streams.								K3	
	CO5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java.								K3	
LIST OF EXERCISES											
1. Develop simple programs using java 2. Develop a java program that implements class and object. 3. Write a java program to find the frequency of a given character in a string 4. Write a java program to demonstrate inheritance and interfaces. 5. Develop a java program that implements the Packages. 6. Create java applications using Exception Handling for error handling. 7. Develop a simple real life application program to illustrate the use of Multi-Threads. 8. Implement simple applications using Collections. 9. Develop application using the concept of I/O Streams 10. Write a Java Program to demonstrate AWT and Swing Components 11. Develop a simple application and use JDBC to connect to a back-end database.											
Lecture Periods:		-		Tutorial Periods:		-		Practical Periods: 30		Total Periods: 30	
Reference Books											
1. Allen B. Downey and Chris Mayeld, "Think Java - How to Think Like a Computer Scientist", Green Tea Press, 2nd Edition, 2020 2. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018 3. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Vol 2, Advanced Features, Pearson Education, 7th Edition, 2010											
Web References											
1. http://www.ibm.com/developerworks/java/ 2. http://docs.oracle.com/javase/tutorial/rmi/. 3. IBM's tutorials on Swings, AWT controls and JDBC. 4. https://www.edureka.co/blog. 5. https://www.geeksforgeeks.org.											

* TE – Theory Exam, LE – Lab Exam

A. Vijayalakshmi

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	-	2	-	2	3	2	-
2	3	2	3	-	3	-	-	-	2	-	2	3	3	-
3	3	2	3	2	3	-	-	-	2	2	2	3	3	2
4	3	2	2	2	3	-	-	-	2	2	2	3	3	2
5	3	2	3	-	3	-	-	-	3	3	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Evaluation Method							
Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering			Programme : B.Tech.					
Semester	V			Course Category: PC		End Semester Exam Type: LE			
Course Code	U23BMP505			Periods/Week		Credit	Maximum Marks		
				L	T	P	C	CAM	ESE
Course Name	Microcontroller and its Medical Applications Laboratory			0	0	2	1	50	50
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Develop Proficiency in Microcontroller Assembly Language Programming							K3
	CO2	Execute Assembly Language Programming for arithmetic operations							K4
	CO3	Analyze controller interfacing with external devices.							K4
	CO4	Implement Interfacing devices using Keil / Proteus Software							K4
	CO5	Interface memory and I/O device with controller.							K4
LIST OF EXPERIMENTS									
Part A: Experiments using 8051 Microcontroller									
1. Study of 8051 Microcontroller trainer kit.									
2. Assembly Language Program for addition of 8-bit numbers stored in an array.									
3. Assembly Language Program for Multiplication by successive addition of two 8-bit numbers.									
4. Assembly Language Program for finding largest no. from a given array of 8-bit numbers.									
5. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order.									
6. Stepper motor control by 8051 Microcontroller.									
7. Interfacing of 8-bit ADC 0809 with 8051 Microcontroller.									
8. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller and Waveform generation.									
Part B: Experiments with PIC microcontroller using Keil / Proteus Software									
9. Implementation of GPIO									
10. Implementation of ADC									
11. Interfacing of Stepper motor									
12. Interfacing of 7 Segment display									
13. Design of heart rate monitoring circuit using PIC microcontroller									
Reference Books									
1. A.K .Ray, K. M. Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3 rd Edition, 2013									
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2 nd Edition, Pearson education, 2013									
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey , " PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education 2016									
4. Krishna Kant, "Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096", PHI, 2013									
5. Doughlas V.Hall, Microprocessors and Interfacing, Programming and Hardware", TMH,2012									
Web References									
1. https://www.youtube.com/watch?v=S1QCZW92fU4									
2. https://swayam.gov.in/nd1_noc20_ee42/microprocessors-and-microcontrollers/									
3. https://www.classcentral.com/course/swayam									
4. https://freevideolectures.com/course/3018/microprocessors									
5. https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics									



* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	3	-	-	-	-	-	2	3	2	2
2	3	2	-	-	3	-	-	-	-	-	2	3	2	2
3	3	3	2	2	3	-	-	-	2	2	2	3	3	3
4	3	2	3	2	3	-	-	-	2	2	2	3	3	3
5	3	3	3	2	3	-	-	-	2	2	2	3	3	3

Correlation level: 1 - Low 2 - Medium 3 - High

Evaluation Method

Evaluation Method							
Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	V		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP506		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Hospital Training		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Apply principles of medical instrumentation to patient care.					K3	
	CO2	Analyze healthcare challenges using biomedical engineering techniques.					K3	
	CO3	Gain hands-on experience of radiological techniques in diagnosing orthopedic and neurological disorders.					K4	
	CO4	Evaluate effectiveness of biomedical engineering solutions in critical care units.					K5	
	CO5	Recognize the importance of inter-professional collaboration in healthcare.					K5	
Department Visit								
1. Cardiology 2. Ophthalmology 3. ENT 4. Orthopaedic and Physiotherapy 5. ICU/CCU 6. Operation Theatre 7. Neurology 8. Nephrology 9. Radiology 10. Nuclear Medicine 11. Pulmonology 12. Urology 13. Obstetrics and Gynaecology 14. Emergency Medicine 15. Biomedical Engineering Department 16. Histo Pathology 17. Biochemistry 18. Pediatric and Neonatal 19. Dental 20. Oncology 21. Medical records/Telemetry								
Text Books								
1. Girdhar J Gyani and Alexander Thomas, “Handbook of Healthcare quality and patient safety”, Jaypee brothers medical publisher, 2 nd Edition, 2019. 2. Shakti Kumar Gupta,Sunil Kant, R Chandrashekhar and Sidharth Satpathy,“Modern Trends in Planning & Designing of Hospitals: Principles and Practice”, Jaypee, 2007. 3. Dr Malhotra’s series, “Step by Step Hospital designing & planning”, Jaypee, 2007.								



Reference Books

1. Sonu Dr. Goel, "Textbook of Hospital Administration", Elsevier, 2014.
2. William Charney, "Handbook of Modern Hospital Safety", CRC press, 2nd Edition, 2010.
3. Cindy Taylor, "The Hospital Safety Professional's Handbook", HCPPro, BLR, 5th Edition. 2015.

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1. https://en.wikipedia.org/wiki/Medical_equipment_management
2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. <https://www.who.int/news-room/fact-sheets/detail/patient-safety>
4. <https://www.coursera.org/browse/health/healthcare-management>
5. <https://www.who.int/management/newitems/en/index1.html>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	3	2	2	3	3	-	2	2	2	3	2	3
2	3	3	2	3	2	2	2	-	2	2	2	3	3	3
3	2	2	-	3	3	2	-	-	2	-	2	3	3	3
4	3	3	3	3	2	3	3	2	2	2	2	3	3	3
5	2	-	-	-	-	3	3	3	3	2	3	2	2	2

Correlation level: 1 - Low 2 - Medium 3 - High

Evaluation Method

Evaluation Scheme							
Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering				Programme: B. Tech.							
Semester	V				Course Category Code: PA		*End Semester Exam Type: -					
Course Code	U23BMW501				Periods / Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Micro Project				0	0	2	1	100	-	100	
Prerequisite	Biomedical Instrumentation, Electronics											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Identify the problem statement for the micro project work through the literature survey									K2	
	CO2	Choose the proper components as per the requirements of the design/ system.									K2	
	CO3	Apply the acquainted skills to develop final model/system									K3	
There shall be a Micro Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the micro project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Micro-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team. The Micro Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Micro Project work with weightage as indicated evaluation Methods.												
Lecture Periods: -			Tutorial Periods: -			Practical Periods: 30			Total Periods: 30			

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	2	-	2	2	2	3	2	2
2	2	2	3	2	3	2	-	2	2	2	2	3	3	3
3	3	3	3	3	3	2	2	3	2	3	3	3	3	3

Correlation Level: 1 – Low, 2 – Medium, 3 - High


Evaluation Method

Assessment	Review 1			Review 2				Total Marks
	Novelty	Presentation	Viva	Presentation	Demonstration	Viva	Report	
Marks	10	20	10	20	20	10	10	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	V	Course Category: AEC			*End Semester Exam Type:			
Course Code	U23BMC5XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Certification Course – V	0	0	4	-	100	-	100
Prerequisite								
of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation. (i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks. (ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass. (iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.								
Lecture Periods:-		Tutorial Periods: -		Practical Periods: 50		Total Periods:50		

Evaluation methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	V			Course Category Code: MC		*End Semester Exam Type: -					
Course Code	U23BMM505			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Essence of Indian Traditional Knowledge			2	0	0	-	100	-	100	
Common to ALL Branches											
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Familiarize with the philosophy of Indian culture								K2	
	CO2	Distinguish the Indian languages and literature								K2	
	CO3	Describe the philosophy of ancient, medieval and modern India								K2	
	CO4	Illustrate the information about the fine arts in India								K2	
	CO5	Describe the contribution of scientists of different eras								K2	
UNIT- I	Introduction To Culture							Periods:06			
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India										CO1	
UNIT- II	Indian Languages, Culture and Literature							Periods:06			
Indian Languages and Literature - I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature										CO2	
UNIT- III	Religion and Philosophy							Periods:06			
Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)										CO3	
UNIT- IV	Fine Arts in India (Art, Technology and Engineering)							Periods:06			
Indian Painting, Indian handicrafts, Music, divisions of Indian classical music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India										CO4	
UNIT-V	Education System in India							Periods:06			
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India										CO5	
Lecture Periods:30			Tutorial Periods: -			Practical Periods: -		Total Periods:30			
Reference Books											
1. KapilKapoor, "Text and Interpretation:The India Tradition", ISBN:81246033375,2005											
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN13:978-8187276333,2007											
3. NCERT, "Position paper on Arts,Music,Dance and Theatre", ISBN 81-7450494-X,200											
4. S.Narain, "Examinations in ancient India", Arya Book Depot,1993											
5. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978 - 8120810990, 2014											
Web References											
1. https://nptel.ac.in/courses/109/104/109104102/											
2. https://nptel.ac.in/courses/101/104/101104065/											
3. https://nptel.ac.in/courses/109/108/109108158/											
4. https://nptel.ac.in/courses/109/106/109106059/											
5. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ae01/											

COs/POs/PSOs Mapping


Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	-	-	-	-	3	2	2	2	1	2	2	-	-
2	2	-	-	-	-	2	2	2	3	1	2	2	-	-
3	3	-	-	-	-	3	3	-	2	-	2	2	-	-
4	2	-	-	-	-	2	2	2	3	-	2	2	-	-
5	3	1	-	-	-	2	-	-	2	1	2	2	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100



PROFESSIONAL ELECTIVE – V

Department	Biomedical Engineering		Programme: B.Tech							
Semester	V		Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME505		Periods / Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Laser and Fiber Optics in Medicine		3	0	0	3	50	50	100	
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Understand the basic principles of optical fibers							K2	
	CO2	Analyse the characteristics and configurations of different laser types.							K4	
	CO3	Elucidate the use of laser systems in medicine							K4	
	CO4	Evaluate optical fiber techniques for measurements and applications.							K5	
	CO5	Analyse the applications of laser in medicine							K4	
UNIT-I	Optical Fibers and their Properties					Periods: 09				
Introduction to optical fiber - fiber characteristics - principles of light propagation through a fiber - Different types of fibers and their properties - Losses in the optical fiber - Dispersion - advantages and disadvantages of optical fibers									CO1	
UNIT-II	Laser Fundamentals					Periods: 09				
Laser Fundamentals: Introduction to lasers - Laser characteristics – Laser configuration – Three level and four level lasers – Q-switching – Mode locking – Types of lasers: Gas lasers, Solid lasers, Liquid lasers and Semiconductorlasers.									CO2	
UNIT-III	Laser Systems					Periods: 09				
Lasers used in medical practice: Ruby laser, CO2 laser, Nd-Y AG laser and related solid-state laser. Laser - issue Interaction: Terminology, spectral band designations, energy & power, irradiant & radiant exposure.									CO3	
UNIT-IV	Applications of Optical Fibers					Periods: 09				
Interferometer method of measurement of length – Moire fringes – Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope – Polarization maintaining fibers - Applications.									CO4	
UNIT-V	Laser Applications in Medicine					Periods: 09				
Application in general surgery-Dermatology, Ophthalmology, Cardiovascular &chest surgery, Dentistry, Neuro surgery, Otolaryngology & head and neck surgery, Laser Oncology, Gynecologic laser, Endoscopy, Laparoscopy.									CO5	
Lecture Periods: 45		Tutorial Periods:-		Practical Periods:-			Total Periods: 45			
Textbooks										
1. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic press Inc, 2012. 2. Helena Jelinkova, “Lasers for medical Applications”, Woodhead Publishing, 2013. 3. David A Boas. “Handbook of Biomedical Optics”. CRC Press. 2011.										



Reference Books

1. Tuan Vo-Dinh, "Biomedical Photonics Handbook", 3 volume set, 2018.
2. Tosi Daniele, "Fiber optics Sensor for Biomedical Applications", 2010.
3. KeyvanNouri, "Laser in Dermatology and Medicine", Springer, 2011.
4. Nagabhushana, "Laser and Optical Instrumentation", I.K International House Pvt Ltd. 2010.

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1. https://en.wikipedia.org/wiki/Fiber_laser
2. https://en.wikipedia.org/wiki/Optical_fiber
3. https://ethw.org/Fiber_Optics
4. <https://www.classcentral.com/course/swayam-fiber-optics-7913>
5. <https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	2	3	2	2
2	3	3	2	2	3	-	-	-	2	2	2	3	3	3
3	3	2	2	2	2	3	3	-	2	2	2	3	3	3
4	3	3	3	2	3	-	-	-	2	2	2	3	3	3
5	3	3	2	2	2	3	2	1	2	2	2	3	3	3

Correlation Level: 1 - Low, 2 -Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. Vijayalakshmi

Department	Biomedical Engineering			Program: B.Tech.						
Semester	V			Course Category: PE		*End Semester Exam Type: TE				
Course Code	U23BME506			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Computers In Medicine			3	0	0	3	25	75	100
Prerequisite	Biomedical Instrumentation									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Understand the fundamental principles of computer systems and their applications in healthcare							K2	
	CO2	Analyze the Biosignals and medical imaging data							K4	
	CO3	Gain the knowledge about patient monitoring using computers							K3	
	CO4	Evaluate the benefits and limitations of various medical computing technologies.							K3	
	CO5	Explore diverse applications of computational tools in healthcare solutions.							K4	
UNIT – I	Introduction to Computers in Medicine						Periods:9			
Introduction -Overview of computer systems-Medical computing history and evolution-Healthcare information systems-Medical informatics principles-Ethical considerations.								CO1		
UNIT – II	Medical Imaging and Data Analysis						Periods:9			
Multichannel computerized ECG, EMG and EEG-Medical imaging modalities -MRI, CT, PET-Image processing and analysis-Medical image informatics-Picture Archiving and Communication Systems (PACS)- Image-based diagnosis and decision support.								CO2		
UNIT – III	Computers in Patient Monitoring						Periods:9			
Physiological monitoring, automated ICU, computerized arrhythmia monitoring, information flow in a clinical lab, computer interfacing to HIS.								CO3		
UNIT – IV	Computers In Medical Systems Modeling						Periods:9			
Radiotherapy-types- drug design, drug delivery system, physiological system modeling and simulation.								CO4		
UNIT – V	Application of Computers in Medicine						Periods:9			
AI-driven diagnostics and predictive analytics-Applications of ML in personalized medicine, Applications in securing medical records and improving transparency								CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books										
1. R.D.Lee, “ Computers in Medicine: Progress in Medical Informatics ”, Tata McGraw-Hill, New Delhi, 2010										
2. J. G. L. Garcia Computers in Medicine" Tata McGraw-Hill, January 2006										
3. Dhiya Al-Jumeily Abir Hussain Conor Mallucci Carol Oliver, “Applied computing in medicine and health”, 1 st Edition, 2015.										
Reference Books										
1. David J. Brailer, David B. Kibbe “Computers In Medicine”, Springer-Verlag,1991										
2. Edward H. Shortliffe, James J. Cimino , “ Biomedical Informatics: Computer Applications in Health Care and Biomedicine ”, Springer, 2014										
3. Naval Kishore, “Computer in medicine”, S.Chand (G/L) & Company Ltd, 2003.										
Web References										
1. https://www.techwalla.com/articles/10-ways-computers-are-used-in-medicine										
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2233671/										
3. https://www.online-sciences.com/computer/computers-in-medicine-uses-advantages-and-disadvantages/										



COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	-	2	2	-	-	2	2	2	3	2	2
2	3	3	3	3	3	2	-	-	2	2	2	3	3	3
3	3	2	2	2	2	3	2	-	2	2	2	3	3	3
4	3	3	2	2	3	3	3	2	2	2	3	3	3	3
5	3	3	2	2	3	2	2	2	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Programme: B.Tech.							
Semester	V		Course Category Code: PE			*End Semester Exam Type: TE				
Course Code	U23BME507		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Transportation in living Systems		3	0	0	3	25	75	100	
Prerequisite	Human Anatomy and Physiology									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Develop and solve models of living system as a microvascular network							K2	
	CO2	Analyse how the living system characteristics depend on the underlying network structure							K4	
	CO3	Evaluate fluid transport systems through natural membranes.							K5	
	CO4	Apply concepts of lymph transportation in human systems.							K3	
	CO5	Provides clear idea about human system along with artificial organ							K2	
UNIT – I	Introduction					Periods:09				
Organization of the human body, cells, tissues, different organs, natural membrane system. Transport of momentum, heat and mass by molecular motion- Newton"s law of viscosity, Fourier"s law of heat conduction and Fick"s law of diffusion. Transport properties – Viscosity, Thermal conductivity and Mass diffusivity.								CO1		
UNIT – II	Heat Transport					Periods:09				
Body temperature regulation based on thermostate principle and its operation, transportation in tissues, muscle, skin and other organs in different environmental temperature.								CO2		
UNIT – III	Transportation of Fluids					Periods:09				
Blood transport through internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, diffusion, osmosis, electroosmosis, ultrafiltration, reverse osmosis through natural membrane systems, reverse osmosis through artificial synthetic membranes.								CO3		
UNIT – IV	Transportation of Lymph					Periods:09				
Transportation of lymph through internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, problems on lymph transfer in human body.								CO4		
UNIT – V	Mass Transfer					Periods:09				
Constituents of blood, urine, mass transfer in kidney, skeletal, nervous, gastro intestine system, cardio pulmonary system,comparison with artificial organs.								CO5		
Lecture Periods:45		Tutorial Periods:		Practical Periods: -			Total Periods:45			
Textbooks										
1. David O.Cooney, “An introduction to fluid, heat & mass transport process-Principles”, Marcel Dekker Inc., Vol.1, 2 nd Edition, 2007										
2. Richard P. Menninger, “Best and Taylor's Physiological Basis of Medical Practice”, LippinCott Williams and Wilkins, 2008										
3. RB Bird, WE Stewart and EN Lightfoot,” Transport Phenomena”, Second Edition, John Wiley and Sons, 2007.										
Reference Books										
1. Kim Barrett, Susan Barman, Jason Yuan, Heddwen Brooks, “Ganong's Review of Medical Physiology”, McGraw-Hill Education, 2019.										
2. SujitK.Chaudhuri, “Concise Medical Physilogy” New Central Book agency, 6 th Edition, 2011.										
3. Patrick Tabeling, “Introduction to Microfluidics”, Oxford University Press, 2005.										
4. Edwin N Lightfoot, “Transport phenomena and living systems; Biomedical aspects of momentum and mass transport”, Wiley; 1 st Edition,1974.										
5. Truskey and Yuan and Katz, “Transport Phenomena in Biological Systems “, Pearson Prentice Hall 2009.										



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2. https://link.springer.com/content/pdf/10.1007/978-1-349-14068-8_6.pdf
3. <https://secondarytwojyssscience.weebly.com/transport-system-in-living-things.html>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	1	1	2	3	2	2
2	3	3	2	2	2	2	-	-	1	1	2	3	2	2
3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
4	3	2	2	2	2	2	2	-	2	2	2	3	3	3
5	3	3	3	2	3	3	3	2	2	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Program: B.Tech.						
Semester	V		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME508		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Medical Informatics		3	0	0	3	25	75	100
Prerequisite	-								
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Discuss about health informatics and the function of Hospital Information Systems							K2
	CO2	Analyze medical standards							K4
	CO3	Explain about storage of medical data							K2
	CO4	Understand the basic concepts of bioinformatics							K2
	CO5	Discuss about the application of medical informatics							K3
UNIT – I	Medical Informatics					Periods:9			
Introduction, Medical Informatics, Bioinformatics, Health Informatics, Structure of Medical Informatics, Functional capabilities of Hospital Information System, On-line services and off-line services, History taking by computer, Dialogue with the computer								CO1	
UNIT – II	Medical Standards					Periods:9			
Evolution of Medical Standards, IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics Patient Records, Healthcare Standard Organizations, JCAHO (Join Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation), Evidence Based Medicine, Bioethics.								CO2	
UNIT – III	Medical Data Storage and Automation					Periods:9			
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, Data mining.								CO3	
UNIT – IV	Health Informatics					Periods:9			
Bioinformatics Databases, Bio, information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training								CO4	
UNIT – V	Recent Trends in Medical Informatics					Periods:9			
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment, Surgical simulation, Radiation therapy and planning , Telemedicine , virtual Hospitals , Smart Medical Homes , Personalized ehealth services , Biometrics , GRID and Cloud Computing in Medicine								CO5	
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. R.D.Lele, —Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd, New Delhi,2005									
2. H. K. Huang , “PACS and Imaging Informatics: Basic Principles and Applications”, 2010									
3.Oleg S. Pinykh, “Digital Image Quality in Medicine”, Springer. 2014									
Reference Books									
1. Mohan Bansal, —Medical informatics, Tata McGraw Hill Publishing Computers Ltd, New Delhi,2003									
2. N.Mathivanan, —PC-Based Instrumentation, Prentice Hall of India Pvt Ltd , New Delhi , 2007									
3. Orpita Bosu and Simminder KaurThukral, —Bioinformatics Databases, Tools and Algorithms, Oxford University press, , New Delhi,2007									
4. Yi , Ping Phoebe Chen, —Bioinformatics Technologies, Springer International Edition, New Delhi,2007									
5. Wager, K. A., Lee, F. W., & Glaser, J. P, “Health care information systems: A practical approach for health care management”,4 th Edition, 2017									
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1. https://www.springer.com/series/1114/books?srsIid=AfmBOopn8yFsNpXa7zA9V11RiO62iZvVTroR29Sn-VsktB5wjCYnYtK									



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3. <https://elearn.nptel.ac.in/shop/nptel/data-integration-interoperability-in-healthcare/?v=c86ee0d9d7ed>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	3	2	1	2	2	2	3	2	2
2	3	3	2	2	3	3	2	-	2	2	2	3	3	3
3	3	2	2	1	3	2	-	-	2	2	2	3	2	3
4	3	2	2	2	2	2	-	-	1	2	3	3	2	2
5	3	3	2	2	2	2	2	1	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Programme: B.Tech.							
Semester	V			Course Category: PE		*End Semester Exam Type: TE					
Course Code	U23BME509			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	VLSI Systems			3	0	0	3	25	75	100	
Prerequisite	Digital Electronics										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the analysis of CMOS digital electronics circuits								K2	
	CO2	Knowledge about moderately sized CMOS circuits that realize specified digital functions								K2	
	CO3	Apply CMOS technology in sequential circuit design								K3	
	CO4	Apply the concepts of CMOS in designing Memory structures								K3	
	CO5	Implement different design approach of programmable logic devices								K4	
UNIT – I	Introduction TO VLSI Design Styles and CMOS Logic						Periods:9				
Introduction to VLSI Design, Different types of VLSI design styles Full custom, VLSI Design flow. operation of MOS transistors, CMOS logic: PMOS, NMOS and CMOS, Electrical characteristics, stick diagram										CO1	
UNIT – II	Combinational MOS Logic Design						Periods:9				
Static MOS design; Complementary MOS, Rationed logic, Pass Transistor logic, complex logic circuits, Dynamic MOS Design, Dynamic Logic Families and Performances.										CO2	
UNIT – III	CMOS Sequential Circuit Design						Periods:9				
CMOS Sequential circuits: Static latches and Registers, Dynamic latches and Registers, Sense Amplifier Based Register Pipelining, Schmitt Trigger, Monostable Sequential Circuits, A stable Sequential Circuits.										CO3	
UNIT – IV	Design of Arithmetic Building Blocks						Periods:9				
Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Static and Dynamic Adder circuits - The Array Multiplier - Multiplier structures-Baugh-Wooly – Booth Multiplier - Barrel shifter.										CO4	
UNIT – V	Design Approach of Programmable Logic Devices						Periods:9				
Design approach of Programmable logic devices - PLA, PAL and FPGA. FPGA Building Block Architectures, FPGA Interconnect Routing Procedures, ASIC – Types of ASICs, Programmable ASICs.										CO5	
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -		Total Periods: 45			
Text Books											
1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective",, Pearson, 2 nd Edition,2016.											
2. Wayne wolf, “Modern VLSI Design: System on Chip Design”, Prentice Hall of India, 2012.											
3. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, A system Perspective, Addison Wesley, McGraw-Hil, 4 th Edition, 2010.											
Reference Books											
1. Neil H. E. Weste, Kamran Eshraghian, "CMOS Digital Integrated Circuits Analysis and Design", 4 th Edition,2011,											
2. E.Eshranghian, D.A.Pucknelland S.Eshraghian, “Essentials of VLSI circuits and systems”, PHI, 2009.											
3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI DESIGN”, Prentice Hall of India, 3 rd Edition, 2007.											
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2019											
5. Deba Prasad Das, “VLSI Design”, Oxford University Press, 2012.											
Web References											
1. www.cmosvlsi.com											
2. www.vlsi-world.com											

TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	1	1	2	3	2	2
2	3	3	3	2	3	-	-	-	1	2	2	3	3	2
3	3	3	3	2	3	-	-	1	1	2	2	3	3	3
4	3	3	3	2	3	-	-	1	1	2	2	3	3	3
5	3	3	3	2	3	-	-	1	1	2	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT608		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Diagnostic and Therapeutic Equipment		3	0	0	3	25	75	100
Prerequisite	Biomedical Instrumentation								
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Understand Ultrasonic Techniques							K2
	CO2	Describe the patient monitoring and Biotelemetry							K3
	CO3	Understand the classification of Diathermy							K3
	CO4	Interpret special diagnostic techniques							K4
	CO5	Acquire knowledge in patient's safety							K3
UNIT – I	Ultrasonic Techniques					Periods:9			
Diagnosis-Basic principles of Echo technique - display techniques A, B and M mode - Application of ultrasound technique- Echocardiogram, abdomen - obstetrics and gynecology, contrast-enhanced ultrasound,3D and 4D ultrasound imaging.								CO1	
UNIT – II	Patient Monitoring System					Periods:9			
ICU/CCU Equipment - Infusion pumps - bed side monitors - wearable health monitoring - Central consoling controls - Radio Telemetry (single, multi) - Portable and Landline Telemetry unit, - Applications in ECG and EEG Transmission.								CO2	
UNIT – III	Diathermy					Periods:9			
IR and UV lamp and its application - Thermography - Recording and clinical application - short wave diathermy -ultrasonic diathermy - Microwave diathermy - Electro surgery machine - Current waveforms, Tissue Responses -Electro surgical current level, Radiofrequency Ablation.								CO3	
UNIT – IV	Special Diagnostic and Therapeutic Techniques					Periods:9			
Endoscopy, Laparoscopy, Optical Coherence Tomography (OCT), CT-700,EECP(Enhanced External Counter pulsation) -Need for heart lung machine - functioning of bubble - disc type and membrane type oxygenators - finger pump - roller pump - electronic monitoring of functional parameter – Haemo Dialyzer unit – Lithotripsy- Principles of Cryogenic technique and application								CO4	
UNIT – V	Patient Safety					Periods:9			
Physiological effects of electricity - important susceptibility parameters -Macro shock – Micro shock hazards – Patient's electrical environment - Isolated Power system – Conductive surfaces - Electrical safety codes and standards- Basic Approaches to protection against shock - Protection equipment design - Electrical safety analyzer - Testing the Electric system								CO5	
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. Leslie Cromwell,” Biomedical Instrumentation and Measurement”, 2 nd Edition, Prentice Hall, 2015.									
2. John G. Webster, “Medical Instrumentation Application and Design”, 5th Edition, John Wiley and sons,2020.									
3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”,3rd Edition, John Wiley and sons, New York, 2003									
Reference Books									
1. Khandpur,R.S,”Handbook of Biomedical Instrumentation ”,2nd Edition. Tata Mc Graw Hill, 2003									
2. Rick Krohn, David Metcalf, Patricia Salber, “Health-e Everything: Wearables and The Internet of Things for Health, 2013									
3. Principles of Applied Biomedical Instrumentation L. A Geddas and L.E.Baker – 2004.									

4. John G. Webster, "Medical Instrumentation: Application and Design", 4th Edition. John Wiley and Sons, New York, 2010.
5. Samuel A. Fricker, Christoph Thümmler, Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015

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1. <https://www.nap.edu/read/21794/chapter/7>
2. <https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems>
3. [https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206 Diagnostic and Therapeutic Equipment Training.pdf](https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206%20Diagnostic%20and%20Therapeutic%20EquipmentTraining.pdf)

* TE - Theory Exam, LE - Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	1	1	1	2	1	3	3	1
2	3	2	2	2	3	2	1	1	2	2	1	2	3	2
3	3	2	3	2	3	2	1	2	2	2	2	3	3	2
4	3	2	3	3	3	2	2	2	2	2	2	3	3	2
5	3	3	2	2	3	3	2	3	1	2	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT609		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Embedded Systems for Healthcare		3	0	0	3	25	75	100
Prerequisite	Microcontroller								
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Gain in-depth knowledge about embedded processor, its hardware and Instruction set						K2	
	CO2	Analyze memory management and debugging tools for embedded processors.						K4	
	CO3	Familiarize with various Embedded networking protocols						K3	
	CO4	Design embedded systems using EDLC models and hardware-software co-design						K4	
	CO5	Design a Real time embedded system for biomedical applications						K5	
UNIT – I	Introduction to Embedded System and ARM Architecture					Periods:9			
Introduction to Embedded Systems – Embedded system design process. Embedded processors – ARM processor – Architecture, ARM and Thumb Instruction sets								CO1	
UNIT – II	Embedded Computing Platform Design					Periods:9			
Structural units in Embedded processor Structural unit of embedded system - DMA – Memory management methods - Timer and Counting devices, Watchdog Timer - Real Time Clock - In circuit emulator - Target Hardware Debugging.								CO2	
UNIT – III	Embedded Networking					Periods:9			
Embedded Networking: Introduction, I/O Device Ports and Buses– Serial Bus communication protocols –RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers								CO3	
UNIT – IV	Embedded Firmware Development Environment					Periods:9			
Embedded Product Development Life Cycle- objectives - different phases of EDLC - Modelling of EDLC - issues in Hardware-software Co-design - Data Flow Graph - state machine model - Sequential Program Model - concurrent Model - object oriented Model.								CO4	
UNIT – V	Real Time Health Care applications					Periods:9			
Biomedical application- Pulmonary, Patient monitoring system, Body temperature measurement, Mobile phone based bio signal recording								CO5	
Lecture Periods: 45		Tutorial Periods: -		Practical Periods: -		Total Periods: 45			
Text Books									
1. RajKamal, “Embedded Systems Architecture, Programming and Design”, Tata McGrawHill ,Second Edition, 2014									
2. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.									
3. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, Mc Graw Hill 1997									
Reference Books									
1. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.									
2. Tim Wilhurst, “An Introduction to the Design of Small Scale Embedded Systems,Palgrave, 2004									
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2005.									
4. Jonathan Valvano, "Embedded Systems: Real-Time Interfacing to Arm Cortex-M3",CreateSpace Independent Publishing Platform,2011									
5. David Simon,"Embedded Systems: A Contemporary Design Tool",Wiley,2009									



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2. <https://nptel.ac.in/courses/108102045>
3. <https://www.amoriabond.com/en/insights/blog/real-time-applications-of-embedded-systems/>
4. <https://www.youtube.com/watch?v=S-daLDfkoyY>
5. <https://www.youtube.com/watch?v=7LqPJGnBPMM>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	-	1	-	1	-	3	2	1
2	3	2	2	2	3	3	-	-	-	-	-	3	3	-
3	3	3	2	3	1	2	-	1	1	1	1	3	3	2
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering			Program: B.Tech.							
Semester	VI			Course Category: PC			*End Semester Exam Type: TE				
Course Code	U23BMT610			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Medical Internet of Things			3	0	0	3	25	75	100	
Prerequisite	Biomedical Instrumentation										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the architecture of IoT and its associated protocols								K2	
	CO2	Apply cloud service models in networked IoT systems								K3	
	CO3	Analyze the impact of IoT in healthcare and focusing on patient monitoring								K3	
	CO4	Evaluate IoT integration in surgical equipment monitoring.								K4	
	CO5	Describe wearable technologies and applications of M-IOT								K4	
UNIT-I	Introduction to IoT						Periods: 09				
Brief History of IoT – Architectural Layers of IoT – Bluetooth – Zigbee - Wi-Fi - IP-Based Protocols – UPnP – CoAP – MQTT – XMPP – SCADA - Authentication protocols - IEEE 802.15.4.60.								CO1			
UNIT-II	Cloud Integration						Periods: 09				
Network layer – Cloud - Network Technologies - Types of Networks – BAN - Cloudterminologies - Types of Cloud - Service Models - Fog and edge customization - BigData								CO2			
UNIT-III	IoT in Healthcare						Periods: 09				
Introduction to Raspberry Pi – Implementation of IoT with Raspberry Pi – Wearable Technologies and IOT - Electronic tattoos - Smart lenses for diabetics - Bio-monitoring drugs - Baby Monitoring system- Aging in place - Wireless patient Monitoring								CO3			
UNIT-IV	IoT in Surgery						Periods: 09				
Perception Layer – RFIDs – cameras – Sensors - Introduction to ASICs - pulse oximeters, instrumentation amplifiers - Surgical equipment and dependencies - Surgery and its types - role of IOT in surgery.								CO4			
UNIT-V	Applications of IoT						Periods: 09				
Ventilators - Wearable Technologies - Smart watches - Remote patient monitoring systems- Smart Care technology Systems								CO5			
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45					
Text Books											
1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra “Medical Big Data and Internet of Medical Things”, CRC Press, 1st Edition, 2018											
2. P. B. Pankajavalli, G. S. Karthick“Incorporating the Internet of Things in Healthcare Applications and Wearable Devices,Advances in Medical Technologies and Clinical Practice(AMTCP)”, IGI Global, 1st Edition, 2019											
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015											
Reference Books											
1. Valentia E.Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar “Internet of Things in Biomedical Engineering”, Academic Press, 2019											
2. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014											
3. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad “A Handbook of Internet of Things in Biomedical and Cyber Physical System” Springer International Publishing,2019											
4. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues “Internet of Medical Things for Smart Healthcare” Springer Singapore,2019											
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1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/											

2. <https://www.digimat.in/nptel/courses/video/108105091/L01.html>
3. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7113786>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT611		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Artificial Intelligence and Machine Learning in Healthcare		3	0	0	3	25	75	100
Prerequisite	-								
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Define the various characteristics of intelligent agents							K2
	CO2	Describe the different search strategies in AI							K3
	CO3	Apply the particular agent strategy to solve a given problem							K3
	CO4	Classify the different machine learning techniques							K3
	CO5	Acquire knowledge on applications of AIML in biomedical applications							K4
UNIT – I	Introduction					Periods:9			
Introduction–Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach, Artificial Intelligence in Medicine.									CO1
UNIT – II	Problem Solving Methods					Periods:9			
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation.									CO2
UNIT – III	Knowledge Representation					Periods:9			
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining,Data Preprocessing-Data cleaning, handling missing values, normalization, data augmentation									CO3
UNIT – IV	Machine Learning for Healthcare					Periods:9			
Supervised learning algorithms for healthcare prediction - Unsupervised learning techniques in healthcare - Evaluation and validation of machine learning models in healthcare									CO4
UNIT – V	Healthcare Applications					Periods:9			
Predictive modelling for disease diagnosis and prognosis - Healthcare resource allocation and optimization - Fraud detection and anomaly detection in healthcare data. - Case studies in cancer treatment, neurodegenerative diseases									CO5
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. Lei Xing, Maryellen L. Giger, James K. Min “Artificial Intelligence in Medicine Technical Basis and Clinical Applications” Elsevier Science 2020.									
2. Bratko, “PrologProgramming for Artificial Intelligence”, Fourth Edition, Addison-Wesley Educational Publishers,2011.									
3. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall,2009,									
Reference Books									
1. Gerhard Weiss, “Multi Agent Systems”, 2nd Edition, 2013, MIT Press.									
2. David L. Poole and Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, 4th Edition Cambridge University Press, 2010									
3. Richard Szeliski, “Computer Vision: Algorithms and Applications”, 1st Edition, 2010, Springer									
4. Simon J.D. Prince, “Computer vision: models, learning and inference”, 1 st Edition, Cambridge University Press,2012									
Web References									
1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/									
2. https://sigmoidal.io/artificial-intelligence-and-machine-learning-for-healthcare/									
3. https://link.springer.com/book/10.1007/978-981-16-0811-7									

* TE – Theory Exam, LE – Lab Exam

A. 

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	2	1	1	1	1	-	-	-	-	-	2	1	1	1
2	3	3	2	3	1	-	-	-	-	-	2	1	1	1
3	2	3	2	3	-	1	-	-	-	-	2	1	1	1
4	2	3	2	2	-	1	-	-	-	-	2	1	1	1
5	2	2	1	1	-	1	-	-	-	-	2	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	VI		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP607		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Diagnostic and Therapeutic Equipment Laboratory		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Experiment the analysis of ECG, EEG and EMG signals.					K3	
	CO2	Simulate ECG signals and Pacemaker.					K4	
	CO3	Conduct investigation using Defibrillator simulator.					K3	
	CO4	Describe shortwave and ultrasonic diathermy.					K3	
	CO5	Demonstrate the protection equipment's for electrical safety measures.					K3	
LIST OF EXPERIMENTS								
1. Recording and analysis of ECG signals 2. Recording and analysis of EEG signals 3. Recording - Fatigue test of EMG signals 4. Simulation of ECG – detection of QRS complex and heart rate 5. Operation and analysis of a Pacemaker and Defibrillator simulator 6. Analyze the functioning and safety aspects of surgical diathermy, shortwave and ultrasonic diathermy 7. Transmission and Reception of biological signal using a telemetry system 8. Study of Endoscopy and Laparoscopy equipment's 9. Electrical safety measurements 10. Auditory system checkup using Audiometer 11. Measurement of Oxygen Saturation and Heart Rate using Pulse-oximeter 12. Study of heart lung machine model.								
Reference Books								
1. Richard Aston, “Principles of Biomedical Instrumentation and Measurement”, Merrill Publishing Company, 2007. 2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 3rd Edition, New Delhi, 2003. 3. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, Mc Graw Hill, 2003. 4. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008. 5. Antony Y.K.Chan, “Biomedical Device Technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.								
Web References								
1. https://www.nap.edu/read/21794/chapter/7 2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems . 3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206								

* TE – Theory Exam, LE – Lab Exam

A. V. J.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	VI		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP608		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Embedded Systems for Healthcare Laboratory		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Write programs in ARM for a specific Application					K2	
	CO2	Interface memory, A/D and D/A convertors with ARM system					K3	
	CO3	Write program for interfacing keyboard, display, motor and sensor.					K3	
	CO4	Generate PWM signals for motor control applications					K3	
	CO5	Formulate a mini project using embedded system					K4	
LIST OF EXPERIMENTS								
1. Study of ARM evaluation system								
2. Flashing of LEDS								
3. Interfacing Buzzer								
4. Interfacing ADC								
5. Interfacing DAC								
6. Interfacing Seven segment display								
7. Interfacing real time clock								
8. Interlinking Keyboard and LCD								
9. Interfacing of stepper motor								
10. Interfacing DC motor								
11. Interfacing of PWM based LED lighting board								
12. Interfacing Temperature sensor								
Text Books								
1. 1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGrawHill ,2nd Edition, 2008								
2. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 3rd Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.								
3. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997								
4. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", 3rd Edition Cengage Learning, 2012.								
5. Jonathan Valvano, "Embedded Systems: Real-Time Interfacing to Arm Cortex-M3",CreateSpace Independent Publishing Platform,2011								
6. David Simon,"Embedded Systems: A Contemporary Design Tool",Wiley,2009								
Web References								
1. https://www.youtube.com/watch?v=uFhDGagZzjs								
2. https://nptel.ac.in/courses/108102045								
3. https://www.amoriabond.com/en/insights/blog/real-time-applications-of-embedded-systems/								
4. https://www.youtube.com/watch?v=S-daLDfkoyY								
5. https://www.youtube.com/watch?v=7LqPJGnBPMM								
6. https://www.youtube.com/watch?v=uFhDGagZzjs								

* TE – Theory Exam, LE – Lab Exam

A. 

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



Department	Biomedical Engineering		Programme : B.Tech.					
Semester	VI		Course Category: PC			*End Semester Exam Type: LE		
Course Code	U23BMP609		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE
Course Name	Medical Internet of Things Laboratory		0	0	2	1	50	50
Prerequisite								
Course Outcomes	On completion of the course, the students will be able to						BT Mapping (Highest Level)	
	CO1	Gain knowledge in Programming for embedded applications.					K3	
	CO2	Realize human fall detection, ECG system, and surgical system.					K4	
	CO3	Familiarize with ThingSpeak cloud.					K3	
	CO4	Integrate Raspberry pi and ThingSpeak.					K3	
	CO5	Analyze smart systems					K4	
LIST OF EXPERIMENTS								
Conduct the Experiments using Arduino / Raspberry pi								
1. Study of Raspberry pi, UART Communication								
2. To interface LED/Buzzer and write a program to 'turn ON' LED for 1 sec after every 2 seconds.								
3. To interface Push button/Digital sensor (IR/LDR) and write a program to 'turn ON' LED when push button is pressed or at sensor detection.								
4. Study of REST and HTTP protocols, PUSH, PUT and GET commands, Linux CLI, Raspberry OS								
5. Human Fall detection system using an Accelerometer sensor								
6. Study of ECG system, which gets Heart beat sensor reading from different modes								
7. Surgical automation system, which runs 2 motor using a Servo Motor based inputs given on console in pc and operates the motor operation.								
8. Baby Monitoring system, to prevent sudden infant death syndrome								
9. Clinical Management system consisting of RFIDs tags and cards which constantly uploads inpatient and outpatient details to ThingSpeak. Server								
10. Smart Ventilator system to control through various modes of ventilator connected to ThingSpeak. server,and remotely operated.								
11. Waste Management system consisting of moisture and Gas sensor connected to server and remotely indicating the recycle process of medical waste								
12. Smart watch system, to indicate and alert users of their routine works and also monitor the pulse and temperature readings.								
Reference Books								
1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra "Medical Big Data and Internet of Medical Things" CRC Press, 1st Edition, 2018								
2. P. B. Pankajavalli, G. S. Karthick"Incorporating the Internet of Things in Healthcare Applications and Wearable Devices,Advances in Medical Technologies and Clinical Practice(AMTCP)", IGI Global, 1st Edition, 2019								
3. Valentia E.Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar "Internet of Things in Biomedical Engineering", , Academic Press, 2019								
4. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad "A Handbook of Internet of Things in Biomedical and Cyber Physical System" Springer International Publishing,2019								
5. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues "Internet of Medical Things for Smart Healthcare"								



Springer Singapore, 2019

Web References

1. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/>
2. <https://www.digimat.in/nptel/courses/video/108105091/L01.html>
3. <https://www.jmir.org/2020/11/e20135/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	3	3	3	2	-	2	2	-	3	3	1	1
2	3	3	3	3	3	2	-	2	2	-	3	3	1	1
3	3	3	3	3	3	2	-	2	2	-	3	3	1	1
4	3	3	3	3	3	2	-	2	2	-	3	3	1	1
5	3	3	3	3	3	2	-	2	2	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 -High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

A. 

Department	Biomedical Engineering	Programme: B. Tech.						
Semester	VI	Course Category Code: PA			*End Semester Exam Type: -			
Course Code	U23BMW602	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	MINI PROJECT	0	0	2	1	100	-	100

Prerequisite	Biomedical Instrumentation, Electronics, C Programming							
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)
	CO1	Identify the problem statement for the mini project work through the literature survey						K2
	CO2	Choose the proper components as per the requirements of the design/ system.						K2
	CO3	Apply the acquainted skills to develop final model/system						K3

There shall be a Mini Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the mini project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Mini-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Mini Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Mini Project work with weightage as indicated evaluation Methods.

Lecture Periods: -	Tutorial Periods: -	Practical Periods: 30	Total Periods: 30

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	3	3	-	1	1	1	1
2	3	3	3	2	2	2	2	3	3	3	1	2	2	2
3	3	2	2	1	-	2	-	3	3	3	1	2	2	2

Correlation Level: 1 – Low, 2 – Medium, 3 – High

A. 

Evaluation Method

Assessment	Review 1			Review 2				Total Marks
	Novelty	Presentation	Viva	Presentation	Demonstration	Viva	Report	
Marks	10	20	10	20	20	10	10	100



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering	Programme: B. Tech.						
Semester	VI	Course Category: AEC			End Semester Exam Type: -			
Course Code	U23BMC6XX	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	CERTIFICATION COURSE - VI	0	0	4	-	100	-	100
Prerequisite	-							

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

- (i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.
- (ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.
- (iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	10	90	100



Department	Biomedical Engineering			Programme: B. Tech.							
Semester	VI			Course Category: MC		End Semester Exam Type :					
Course Code	U23BMM606			Periods/Week		Credit	Maximum Marks				
				L	T	P	C	CAM	ESE	TM	
Course Name	Gender Equality			2	0	0	-	100	-	100	
Prerequisite	-										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Describe the general identity, social construction of gender roles.								K2	
	CO2	Illustrate the causes and issues of gender discrimination in Indian society.								K2	
	CO3	Describe the workplace discrimination, media influences on gender and culture.								K2	
	CO4	Familiarize with international and Indian frameworks on gender equality.								K2	
	CO5	Illustrate the current challenges in gender equality, including the glass ceiling and the role of technology.								K2	
UNIT – I	Introduction to Gender Equality						Periods:06				
Gender equality – exploring gender identity and expression, Understanding the social construction of general roles and norms, historical perspectives on gender roles, Analyzing key milestones in the fight for gender equality.										CO1	
UNIT – II	Gender Inequality and Its Manifestations						Periods:06				
Gender discrimination in Indian society – causes of gender inequality – Illiteracy, patriarchal set up, lack of awareness, social beliefs, practice and custom – Issues of gender discrimination – Child marriage, child domestic work, poor education and health, violence and exploitation in workplace.										CO2	
UNIT – III	Gender and Culture						Periods:06				
Workplace discrimination, Media influences on gender and culture, Gender and power dynamics in society. Strategies for promoting gender equality and cultural understanding.										CO3	
UNIT – IV	Promoting Gender Equality						Periods:06				
Gender Equality and Human Rights – International frameworks and Conventions on Gender Equality – Equality under the Indian Constitution – Policies and initiatives for gender mainstreaming – Strategies for promoting Gender Equality in various contexts.										CO4	
UNIT – V	Contemporary Challenges and Future Directions						Periods:06				
Current challenges and emerging issues in gender equality – Glass ceiling – role of technology in continuing or challenging gender inequality – Exploring possibilities for transformative change and envisioning a gender-equal future.										CO5	
Lecture Periods: 30		Tutorial Periods: -		Practical Periods: -			Total Periods: 30				
Text Books											
1. "Gender and Society" by Raewyn Connell – This book provides a comprehensive overview of gender roles, power dynamics, and the social construction of gender.											
2. "The Second Sex" by Simone de Beauvoir – A historical and philosophical examination of women's oppression and gender inequality.											
3. "Women and Gender in the Indian Society" by Neera Desai and Usha Thakkar – Focuses on the context of gender roles, inequality, and feminist movements in India.											
Reference Books											



1. Woman in early Indian societies, New Delhi: Manohar Publications. Sita A. Raman (2009).
2. A social and Cultural history, Volume1. Connecticut: Oxford: Praeger. Sita Raman (2009).
3. A social and Cultural history, Volume2. Connecticut: Oxford: Praeger.
4. Iftikhar R. (2016). Indian Feminism: Class, Gender and Identity in Medieval Ages. Chennai: Notion Press. Iftikhar, R. (2012).

Web References

1. <https://www.unwomen.org>
2. <https://ncw.nic.in>
3. <https://en.unesco.org/themes/gender-equality>
4. <https://www.weforum.org/reports>
5. <https://wcd.nic.in>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	3	-	1	1	-	1
2	1	-	-	-	-	-	-	-	3	-	1	1	-	1
3	1	-	-	-	-	-	-	-	3	-	1	1	-	1
4	1	-	-	-	-	-	-	-	3	-	1	1	-	1
5	1	-	-	-	-	-	-	-	3	-	1	1	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

A. 

PROFESSIONAL ELECTIVE-VI

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VI		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME610		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Troubleshooting and Quality Control in Medical Equipment		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Apply troubleshooting techniques to identify equipment failures.						K3	
	CO2	Describe the testing procedures of active and passive components.						K3	
	CO3	Analyze the fault diagnosis in analog circuits and digital ICs.						K4	
	CO4	Identify the problems in common biomedical equipment in hospitals when it is not working and provide a suitable solution.						K4	
	CO5	Describe the various quality measures & standards adapted for medical systems						K3	
UNIT – I	Fundamental Troubleshooting Testing Procedures				Periods:9				
Equipment failure and its cause-Functional block diagram of a troubleshooting system-Troubleshooting process & fault-finding aids-Troubleshooting techniques and their correction action-Testing of active and passive components: resistor, capacitor, inductor, BJT, JFET, & MOSFET							CO1		
UNIT – II	Fault Diagnosis in Analog & Digital Integrated Circuits				Periods:9				
Characteristics of ideal op-amps, typical op-amp based medical circuits-Fault diagnosis in op-amp circuits-Digital troubleshooting methods-Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator-Circuit board Troubleshooting.							CO2		
UNIT – III	Biomedical Equipment Troubleshooting				Periods:9				
Troubleshooting- ECG Machine, EEG Machine- defibrillator, electrosurgical unit Troubleshooting- anesthesia machine, autoclaves & sterilizers- endoscope, incubators, nebulizer- oxygen concentrators, sphygmomanometers, suction machine- X-ray machine.							CO3		
UNIT – IV	Medical Device Design Quality				Periods:9				
Definition of quality, essence of quality-Quality operating system and the device life cycle-Evolution of quality Business excellence: a value proposition-Health care quality.							CO4		
UNIT – V	Design For Six Sigma and Medical Device Regulation				Periods:9				
Global Perspective on medical device regulations, medical device classification (USA, Europe & GHTF-Medical device safety, medical device quality management systems requirements-Medical device regulation throughout the product development life cycle-Purpose of ISO 9001:2001&ISO 13485.							CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Textbooks									
1. Khandpur R S, “Troubleshooting Electronic Equipment- Includes Repair & Maintenance”, 2nd Edition, Tata McGrawHill, 2009.									
2. Basem S EL-Haik& Khalid S Mekki, “Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness”, 1st Edition, John Wiley & Sons 2008.									
3. Gopalakrishna, P. Purchasing and Materials Management, Tata MC.Graw Hill, New Delhi, 2017.									
Reference Books									
1. Nicholas Cram & Selby Holder, “Basic Electronic Troubleshooting for Biomedical Technicians”, 2nd Edition, 2010, TSTC Publishing.									
2. Dan Tomal& Neal Widmer, “Electronic Troubleshooting”, 3rd Edition, McGraw Hill ,2004,.									
3. Richard Fries, “Reliable Design of Medical Devices”, 2nd Edition, CRC Press., 2006									



4. Joseph J Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment", 2nd Edition, Charles C Thomas Publisher Ltd. , 2005
5. Gopalakrishna, P., Materials Management, Prentice Hall, New Delhi, 2015.

Web References

1. https://www.who.int/medical_devices/publications/en/MD_Regulations.pdf
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924127/>
3. <https://www.ncbi.nlm.nih.gov/pubmed/7613571>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	-	-	-	-	1	2	2	3
2	3	2	1	1	2	1	-	-	-	-	1	2	2	3
3	3	3	2	1	2	1	-	-	-	-	1	2	2	3
4	3	3	2	1	2	1	-	-	-	-	1	2	1	1
5	3	3	2	1	2	1	-	-	-	-	1	2	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Instrumentation and Control Engineering		Programme: B.Tech.							
Semester	VI		Course Category Code: PE				*End Semester Exam Type: TE			
Course Code	U23ICEC02		Periods/Week		Credit		Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Soft Computing Techniques		3	0	0	3	25	75	100	
(Common to ICE, ECE and BME Branches)										
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Familiarize in the neural network architecture.							K2	
	CO2	Impart knowledge on various training algorithm of neural network and its application							K3	
	CO3	Illustrate the fuzzy sets and the properties of fuzzy logic							K2	
	CO4	Comprehend fuzzy logic controllers and its applications.							K2	
	CO5	Understand the concepts of optimization algorithms.							K2	
UNIT – I	Introduction to Neural Network					Periods:9				
Introduction to neural networks – Biological neural networks, Artificial Neural network: Single and Multi-layer feed forward network- Activation function, types (step and sigmoid function), threshold function- Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.										CO 1
UNIT – II	Neural Networks Control					Periods:9				
Back propagation neural net: standard architecture, algorithm -Hopfield net: architecture and algorithm- Kohonnen's Self Organizing map- Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control - Applications of neuro controller.										CO2
UNIT – III	Introduction to Fuzzy Logic					Periods:9				
Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations linguistic variables – Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.										CO3
UNIT – IV	Fuzzy Logic Control System					Periods:9				
Introduction to Fuzzy logic controller: Architecture – Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification - Applications of Fuzzy logic controller.										CO4
UNIT – V	Optimization					Periods:9				
Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton"s Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithm – Simulated Annealing – Random Search – Downhill Simplex Search.										CO5
Lecture Periods:45			Tutorial Periods:45		Practical Periods:-			Total Periods:45		
Text Books										
1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions,2010										
2. Laurene Fausett, "Fundamentals of Neural Networks" Pearson Education, 2008										
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic ". Prentice Hall, USA .2015										
Reference Books										
1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019										
2. Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall										
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education 2007										
4. W.T.Miller, R.S.Sutton and P.J.Webrose, Neural Networks for Control, MIT Press, 2001.										
5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw Hill Education, 1st Edition, 2017.										



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1. <https://lecturenotes.in/subject/922>.
2. <https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf>.
3. <https://nptel.ac.in/courses/106/105/106105173/>.

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	-	-	3	2	1
2	3	3	-	3	3	2	-	-	-	-	-	2	2	1
3	3	3	2	3	3	2	-	-	-	-	-	2	2	1
4	3	2	3	3	3	2	-	-	-	-	-	2	2	1
5	3	3	3	2	2	2	-	-	-	-	-	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	VI				Course Category: PE		*End Semester Exam Type: TE					
Course Code	U23BME611				Periods/Week			Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM	
Course Name	Physiological System Modeling				3	0	0	3	25	75	100	
Prerequisite	Human Anatomy and Physiology											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Explain the application of Physiological models and vital organs									K2	
	CO2	Formulate the methods and techniques for analysis and synthesis of dynamic models									K3	
	CO3	Describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software									K2	
	CO4	Describe nonlinear models of physiological systems									K2	
	CO5	Compute the Simulation of physiological systems									K3	
UNIT – I	Introduction to Physiological Modeling							Periods:9				
Approaches to modelling: The technique of mathematical modelling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modelling.										CO1		
UNIT – II	Modeling of Dynamic Physiological System							Periods:9				
Dynamic systems and their control, modelling and block diagrams, The Circulatory System -Blood flow, circulation, arterial pulse. The Endocrine System - Pituitary gland, insulin and glucose. The pupil control systems (Human Eye), the dynamic response characteristics of the pupil control system, The Inner Ear - Frequency tuning, models of the cochlea, resonance in hair cells.										CO2		
UNIT – III	Nonlinear Models of Physiological Systems							Periods:9				
Nonparametric Modelling-Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modelling- Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.										CO3		
UNIT – IV	Compartmental Physiological Model							Periods:9				
Modelling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modelling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.										CO4		
UNIT – V	Simulation of Physiological Systems							Periods:9				
Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: -Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.										CO5		
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Textbooks												
1. Michel C Khoo, “Physiological Control Systems -Analysis, simulation and estimation”, Prentice Hall of India, 2021.												
2. Marmarelis, “Nonlinear Dynamic Modelling of Physiological Systems”, Wiley-IEEE Press, 2004.												
Reference Books												
1. Benjamin C Kuo, “Automatic control systems”, Tenth Edition, McGraw-Hill Education, 2017.												
2. David.T Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003.												
3. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,“ Advanced Computational Methods in Life System Modelling and Simulation”, Springer,2017												
4. Mathematical Modeling in Systems Biology, by Brian Ingalls (ISBN: p780262315623)												
Web References												
1. https://nsec.lab.uconn.edu/home/courses-2/bme-3100-physiological-modeling/												
2. https://lcp.mit.edu/pdf/HeldtLNM10Ch2.pdf												



3. <https://www.sciencedirect.com/topics/engineering/physiological-models>

TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	1	1	1	-
2	3	1	1	-	-	-	-	-	-	1	1	1	1	-
3	3	-	1	-	-	-	-	-	-	-	1	1	1	-
4	3	3	3	2	1	-	-	-	-	-	1	1	1	-
5	3	2	3	2	3	-	-	-	-	-	1	1	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllab



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Program: B.Tech.							
Semester	VI		Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME612		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Hospital Engineering and Information Systems		3	0	0	3	25	75	100	
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Provide good academic ambience by adopting best information system							K2	
	CO2	Achieve the best possible support from patient and administration							K3	
	CO3	Deliver efficient delivery of high-quality health services							K2	
	CO4	Develop decision support systems, health information standards and information systems acquisitions							K3	
	CO5	Identify problems and alternate solutions related to records management in the healthcare environment							K3	
UNIT – I	Health System					Periods:9				
Concept of Hospital Management - Roles and Responsibilities of Administrator - Hospital Design - Health organization of the country, state, and cities, Health Financing System, Health policies and regulations								CO1		
UNIT – II	Hospital Organisation					Periods:9				
Organization of Out-Patient Services - Problems encountered in functioning of O.P Department – Organization of In- Patient Services - Casualty & Emergency Services - Organization and management of Operation theatres, Medical Records Department								CO2		
UNIT – III	Hospital Services					Periods:9				
Engineering department - maintenance management- clinical engineering- electrical system- air conditioning system- water supply and sanitary system- centralized medical gas system-communication system, Biomedical Waste Management								CO3		
UNIT – IV	Infection Control and Waste Management					Periods:9				
Importance of infection control-hand hygiene-clinical laboratory standards to infection control-health care workers safety-solid waste management and transportation, Sterilization Techniques								CO4		
UNIT – V	Integrated Medical Information System					Periods:9				
Integration of inter and intra hospital information system. Role of expert systems-web based Multimedia information system- introduction of a computerized HIS Automation of medical record-cost and Benefits of HIS Modems and Networking in Hospitals, Electronic Health Records (EHRs).								CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books										
1. Dr. L.L. Rao, “Hospital Management”, Annamalai University Press, 2nd Edition, 2013 2 3.										
2. R. D. Lele, “Computers in Medicine”, Tata McGraw Hill, 3rd Edition, 2005										
3. Mohan Bansal, “Medical informatics”, Tata McGraw Hill. 2nd Edition, 2005.										
Reference Books										
1. Gupta, Kant, Chandrashekhar, Satpathy,” Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM”, JaySpee Medical publishers, 1st Edition,2007.										
2. Sharma, “Essentials for Hospital Support Services and Physical Infrastructure”, Jaypee Medical Publishers, 1 st Edition, 2003										
3. Ramani.K.V.,”Hospital Management”, Pearson, 2011.										
4. Sakharkar, “Principles of Hospital Administration and Planning”, Jaypee Medical, 1st Edition, 2004.										
5. Harold E. Smalley, “Hospital Management Engineering – A guide to the improvement of hospital management system “, PHI, 1st Edition, 1982.										

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1. https://en.wikipedia.org/wiki/Hospital_information_system
2. <https://www.ncbi.nlm.nih.gov/books/NBK22862>
3. https://en.wikipedia.org/wiki/Healthcare_engineering

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	-	1	3	-	-	-	-	1	3	1	1
2	3	2	1	-	1	3	-	-	-	-	1	3	1	1
3	3	2	1	-	1	3	-	-	-	-	1	3	1	1
4	2	2	1	-	1	3	-	-	-	-	1	3	1	1
5	3	2	1	-	1	3	-	-	-	-	1	3	1	1

Correlation Level: 1 - Low, 2 -Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Program: B.Tech.						
Semester	VI			Course Category: PE		*End Semester Exam Type: TE				
Course Code	U23BME613			Periods/Week		Credit	Maximum Marks			
				L	T		P	C	CAM	ESE
Course Name	Biotelemetry and Telemedicine			3	0	0	3	25	75	100
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Understand telemetry basics and its classification								K2
	CO2	Gain knowledge about telemetry and telemedicine applications								K2
	CO3	Describe the applications of Biotelemetry								K3
	CO4	Acquire clear idea about the fundamentals of telemedicine								K2
	CO5	Explain the Applications of telemedicine in various fields								K3
UNIT – I	Introduction to Telemetry						Periods:9			
Basic system - Classification - Nonelectrical telemetry systems - Mechanical and Pneumatic type, Voltage and Current telemetry systems - Local transmitters and Converters - Frequency telemetry system - Power Line carrier communication (PLCC).										CO1
UNIT – II	Biotelemetry Systems and Components						Periods:9			
Sensors and Transducers: Types and functions. Signal Acquisition: Methods for collecting physiological signals.Data Transmission: Wireless technologies and protocols.										CO2
UNIT – III	Application of Biotelemetry						Periods:9			
Wireless Telemetry - Single Channel and Multi-channel Telemetry systems - Multi Patient Telemetry – Implantable Telemetry Systems - Ambulatory patient monitoring. .										CO3
UNIT – IV	Fundamentals of Telemedicine						Periods:9			
History and advancements in telemedicine - Benefits of telemedicine – Functional Block of a telemedicine system - Use of computers in distance mode of healthcare delivery - Familiarizing with technology of telemedicine – scanner, electro stethoscope - data reception equipment - Scope for telemedicine - Limitations of telemedicine.										CO4
UNIT – V	Applications of Telemedicine						Periods:9			
Tele radiology: Basic parts of Teleradiology system -Telemedicine in Neuroscience - Telecardiology – Telepathology — Telepediatrics – Telepharmacy – Telepsychiatry and mental health – Veterinary.										CO5
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45				
Text Books										
1. Konstantina S.Nikita, "Handbook of Biomedical Telemetry", 1st Edition, 2014										
2. Charles J.Amlaner and David W. Macdonald, "A Handbook on biotelemetry and Radio Tracking", 1st Edition,2013										
3. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine", 5th Edition, 2006, Royal Society of Medicine Press Ltd.										
Reference Books										
1. Bemmell, J.H. van, Musen, M.A. (Eds.), "Handbook of Medical Informatics", 2nd Edition, 2002, Springer.										
2. Olga (EDT), Ferre Roca, M. Sosa (EDT, "Handbook of Telemedicine", 3rd Edition, 1998, IOS press										
3. Ferrer-Roca, O., Sosa-ludicissa, , "Handbook of Telemedicine", 12th Edition, 2002, IOS Press										
4. Norris, A.C, "Essentials of Telemedicine and Telecare", 8th Edition, 2002, Wiley.										
5. Bashshur , R. L. , Sanders, J. H and Shannon, G, "Telemedicine: Theory and Practice", 6th Edition, 1999, Springer.										
Web References										
1. https://en.wikipedia.org/wiki/Biotelemetry										
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf										



3.. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	2	1	2	1	1	2	-	-
2	3	2	1	-	1	2	2	1	2	1	1	2	-	-
3	3	2	2	-	2	2	2	1	2	2	1	3	1	-
4	3	1	-	-	1	1	1	1	2	1	1	3	-	-
5	3	1	1	-	1	2	1	1	2	1	1	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Open Elective – I / Open Elective – II

Department	Biomedical Engineering		Programme: B.Tech.						
Semester	V / VI		Course Category Code: OE			*End Semester Exam Type: TE			
Course Code	U23BMOC01		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	MEDICAL ELECTRONICS		3	-	-	3	25	75	100
Prerequisite	-								
Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, MCTR, AI&DS,CSBS/CSEBS									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Know the human body electro- physiological parameters and recording of bio-potentials						K2	
	CO2	Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.						K3	
	CO3	Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators						K3	
	CO4	Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods						K4	
	CO5	Know about recent trends in medical instrumentation						K4	
UNIT – I	Electro-Physiology and Bio-Potential Recording					Periods:9			
Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics.							CO1		
UNIT – II	Bio-Chemical and Non-Electrical Parameter Measurement					Periods:9			
pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.							CO2		
UNIT – III	Assist Devices					Periods:9			
Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.							CO3		
UNIT – IV	Physical Medicine and Biotelemetry					Periods:9			
Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.							CO4		
UNIT – V	Recent Trends in Medical Instrumentation					Periods:9			
Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.							CO5		
Lecture Periods:45		Tutorial Periods:-		Practical Periods: -		Total Periods:45			
Textbooks									
1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007									
2. M. Arumugam, “Biomedical Instrumentation”,Anuradha Agencies Publishers, 2002.									
3. Andrew Webb, “Introduction to Biomedical Imaging”, 2nd Edition, Cambridge University Press, United Kingdom, 2018									
Reference Books									
1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA Mc Graw-Hill, New Delhi, 2003.									
2. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2004.									
3. Onkar N. Pandey, Rakesh Kumar, “Bio-Medical Electronics and Instrumentation”, 3rd Edition, Katson Books, 2002.									
4. Michael R. Neuman, “Biomedical Sensors and Instruments”, 3rd Edition, CRC Press, Boca Raton, 2023.									

A. V. J.

5. **Barbara Christe**, *"Introduction to Biomedical Instrumentation: The Technology of Patient Care"*, 2nd Edition, Cambridge University Press, 2022.

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1. <https://www.sciencedirect.com/topics/engineering/medical-electronics>
2. https://en.wikipedia.org/wiki/Electronics_for_Medicine
3. <https://www.scribd.com/document/378058078/Medical-Electronics-Lecture-Notes-Study-Material-and-Important-Questions-Answers>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	2	1	2	1	1	3	2	3
2	3	2	1	-	1	2	2	1	2	1	1	3	3	2
3	3	2	2	-	2	2	2	1	2	2	1	3	3	3
4	3	1	-	-	1	1	1	1	2	1	1	3	3	3
5	3	1	1	-	1	2	1	1	2	1	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering		Programme: B.Tech.							
Semester	V / VI		Course Category: OE			Course Category: TE				
Course Code	U23BMOC02		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	BIOMETRIC SYSTEMS		3	0	0	3	25	75	100	
Prerequisite	-									
Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL, MCTR, AI&DS, CSBS/CSEBS										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Explain the fundamentals of biometric systems							K2	
	CO2	Describe the various fingerprint technologies							K3	
	CO3	Distinguish different face recognition and hand geometry pattern							K3	
	CO4	Analyze the multimodal biometrics and performance evaluation of biometrics							K4	
	CO5	Recognize various Biometric authentication methods							K3	
UNIT – I	Introduction to Biometrics					Periods:9				
Introduction– biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification –Need for strong authentication - Protecting privacy and biometrics policy – Biometric applications – biometric characteristics.								CO1		
UNIT – II	Fingerprint Technology					Periods:9				
History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching- Hand geometry.								CO2		
UNIT – III	Face Recognition					Periods:9				
Introduction to face recognition - face recognition from correspondence maps - scanning - feature extraction - Adaptive Classifiers - Visual Based feature extraction and Pattern Classification -types of algorithm - Retina scan -Iris scan - Biometric fusion.								CO3		
UNIT – IV	Multimodal Biometrics and Performance Evaluation					Periods:9				
Introduction to multimodal biometric system: Physiological biometrics –Behavioral biometrics - Voice scan - Integration strategies - Architecture -level of fusion - combination strategy – training and adaptability - examples of multimodal biometric systems - Performance evaluation - Statistical Measures of Biometrics- FAR - FRR - FTE - EER -Memory requirement and allocation.								CO4		
UNIT – V	Biometric Authentication					Periods:9				
Introduction - Biometric Authentication Methods - Authentication technologies- Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines- Biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.								CO5		
Lecture Periods:45		Tutorial Periods:-		Practical Periods: -			Total Periods:45			
Textbooks										
1. Anil K. Jain, Arun Ross, and KarthikNandakumar “Introduction to Biometrics”, Springer,2011										
2. Richard O. Duda, David G.Stork,Peter E. Hart “Pattern Classification”, Wiley 2007										
3. S.Y.Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach”, Prentice Hardcover September 2004										
Reference Books										
1. Anil K. Jain, Patrick Flynn, and Arun A. Ross,” Handbook of Biometrics” Springer, 2008										



2. John Chirillo, Scott Blaul, "Implementing Biometric Security": John Wiley, 2003.
3. John R. Vacca, "Biometric Technologies and Verification System", Elsevier Inc, 2007
4. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems "Technology Design and Performance Evaluation" Springer, 2005
5. Nikolaos V. Boulgouris, Konstantinos N. Plataniotis, Evangelia Micheli-Tzanakou, "Biometrics" Theory, Methods, and Applications, Wiley 2009

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1. <http://www.findbiometrics.com/Pages/glossary.html>
2. <http://www.biometrics.gov/Documents/privacy.pdf>
3. http://zing.ncsl.nist.gov/biouda/docs/Usability_and_Biometrics_final2.pdf
4. User Interface, System Design
5. http://www.cesg.gov.uk/site/ast/biometrics/media/BEM_10.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	1	2	2	-
2	3	2	2	1	1	2	-	-	-	-	1	3	3	-
3	3	2	2	1	2	2	-	-	-	-	1	3	3	-
4	3	1	1	1	1	1	-	-	-	-	1	3	3	-
5	3	1	2	1	2	2	-	-	-	-	1	3	3	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. 

Department	Biomedical Engineering				Programme: B.Tech							
Semester	VII				Course Category: PC		End Semester Exam Type: TE					
Course Code	U23BMT712				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course name	BIOMATERIALS AND ARTIFICIAL ORGANS				3	0	0	3	25	75	100	
Prerequisite	Human Anatomy and Physiology											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the basic knowledge about the biomaterials.									K2	
	CO2	Distinguish the types of Biomaterials									K2	
	CO3	Analyze the tissue implant materials used in the medical applications.									K4	
	CO4	Gain adequate knowledge of artificial organs									K3	
	CO5	Explain the artificial organs implanted in the human body.									K3	
UNIT-I	Overview of Biomaterials							Periods:9				
Introduction to biomaterials – uses of biomaterials – biomaterials in organ and body systems – materials used in the body – performance of biomaterials. Metallic biomaterials – Introduction – stainless steel – Cobalt – chromium alloy - Titanium alloy – Titanium nickel alloy - dental metals – Corrosion of metallic implant, manufacturing of implant.										CO1		
UNIT-II	Types of Biomaterials							Periods:9				
Biomaterials types – Ceramic - non absorbable/relatively bioinert, bio ceramics, biodegradable, bio reactive ceramic – deterioration of ceramics, Polymeric –basic structure, polymers used as biomaterials, sterilization, Composite – Structure - bounds on properties an isotropy of composites - particulate composites - fibrous composites, porous materials and biocompatibility, biodegradable polymer materials.										CO2		
UNIT-III	Tissue Materials and Tissue Replacement							Periods:9				
Structure and properties of collagen and collagen rich tissue, Resorbable collagen based medical implant, Types of transplants by stem cell, sutures, surgical tapes, Tissue adhesive/glue, effect of materials selection – effect of surface properties. Preservation techniques –non-freezing storage – freeze thaw technology – freeze drying.										CO3		
UNIT-IV	Artificial Organs							Periods:9				
Introduction – Outlook of organ replacement – Design, consideration and evaluation process – overview – immunological consideration – blood transfusion – individual organs – kidney, liver, heart, lungs, bone marrow, cornea.										CO4		
UNIT-V	Artificial Organ Implants							Periods:9				
Neural and neuromuscular implants – heart valves implant – heart and lungs assist devices – artificial heart, cardiac pacemakers – artificial kidney – dialysis membrane and artificial blood - gastrointestinal system – dentistry – maxillofacial and craniofacial replacement – soft tissue replacement and augmentation.										CO5		
Lecture Periods:45			Tutorial Periods:			Practical Periods:			Total Periods: 45			
Textbooks												
1. Lysaght M, Webster T J., “Biomaterials for artificial organs”, Woodhead Publishing Limited, 1st edition, 2011												
2. Hench L, Jones J., “Biomaterials, artificial organs and tissue engineering”, Woodhead Publishing Limited, 1st edition, 200S5.												
3. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain., “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2015												



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Reference Books

1. Joseph D. Bronzino, Donald R. Peterson., "Biomedical engineering fundamentals", CRC Press, 4th edition, 2014.
2. R S Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2003
3. David Williams, "Essential biomaterials science", Cambridge University Press, 1st edition, 2014
4. Yannas, I. V, "Tissue and Organ Regeneration in Adults", New York, NY: Springer, 2001.
5. Donatella Duraccio , Federico Mussano, Maria Giulia Faga., "Biomaterials for dental implants: current and future trends", Journal of Materials Science, 2015.

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1. <https://youtu.be/JVj1xE5FUMI>
2. <https://youtu.be/XqFSIG6WKO0>
3. <https://youtu.be/DsAvyykwB8>
4. <https://nptel.ac.in/courses/106/105/106105077/>
5. <https://nptel.ac.in/courses/102/101/102101068/>

*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	3	2	1	-
2	3	2	2	-	-	-	-	-	-	2	3	3	2	-
3	3	1	1	-	-	-	-	-	-	1	3	3	1	-
4	3	1	2	-	-	-	-	-	-	1	3	3	3	2
5	3	1	1	-	-	-	2	-	-	2	2	3	1	2

Correlation Level: 1-Low, 2-Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving /Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VII		Course Category: PC			*End Semester Exam Type: TE			
Course Code	U23BMT713		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	REHABILITATION ENGINEERING		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Understand the quality and safety standards in design of devices for user needs						K2	
	CO2	Describe the applications of different orthosis and prosthesis for various disabilities						K3	
	CO3	Compare the different therapeutic exercises and design an orthopedic wheelchair						K2	
	CO4	Interpret the techniques and aids for impairments related to sensory and motor functions.						K4	
	CO5	Explore the use of Robots and Virtual Reality tool in rehabilitative curative care.						K4	
UNIT – I	Fundamentals of Rehabilitation					Periods:9			
Introduction to Rehabilitation Engineering - Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Impairment disability handicap, Primary & secondary Disabilities-Rehabilitation team, Classification of members-The human component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles.							CO1		
UNIT – II	Prosthetic and Orthotics Devices					Periods:9			
Prosthetics: Hand and Arm replacement, body-powered prosthetics, externally powered limb prosthetics, Myoelectric hand and arm prosthetics - FES System: Restoration of hand function; restoration of standing and walking. Orthotics: General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO.							CO2		
UNIT – III	Therapeutic Devices and Wheelchairs					Periods:9			
Therapeutic exercise: Co-ordination exercises, Frenkel's exercises, Gait -Pathological Gaits, Gait Training, Relaxation exercises, Methods for training Relaxation, Strengthening exercises - Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.							CO3		
Wheelchair: History and Categories of Wheelchairs, Seating Assessment, Wheelchair Structure and Component Design, Ergonomics of wheel chair propulsion, Power Wheelchair Electrical System- Wheel chair transportation.									
UNIT – IV	Management of Communication Impairments					Periods:9			
Speech Impairment: Introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Speech Augmentative Devices and Text-to-Speech (TTS) Systems.							CO4		
Visual impairment: Categories of visual impairment - Cortical & retinal implants - Auditory Information Display, Blind mobility aids, reading writing & graphics access, Braille Reader, Tactile devices for visually challenged.									
Auditory impairment: Hearing functional assessment, Types of deafness - Surgical and non-surgical hearing aids, Cochlear implants									
UNIT – V	Recent trends in Rehabilitation					Periods:9			
Rehabilitation Robots- Automated gait training devices, Automated training devices for the upper extremities, Therapeutic and Learning Support Virtual Reality Applications- virtual environments in the treatment of motor skills impairments- VR based tele-rehabilitation.							CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -			Total Periods: 45		
Text Books									
1. Dr. S. Sunder, “Textbook of Rehabilitation”, 4 th Edition, Jaypee Medical Publications, New Delhi. 2019.									
2. Joseph D.Bronzino,“The Biomedical Engineering Handbook”, 3 rd Edition, CRC Press, 2006.									
3. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.									



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Reference Books

1. Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visually impaired and blind people", Springer Publications, First edition, 2008.
2. Sashi S Kommu; Rehabilitation Robotics, 1 edition, CRC Press, 2007.
3. Suzanne Robitaille, "The illustrated guide to Assistive technology and devices—Tools and gadgets for living independently", Demos Health New York, First edition, 2010.
4. Patrice L. (Tamar) Weiss, Emily A. Keshner, Mindy F. Levin, "Virtual Reality for Physical and Motor Rehabilitation", 2014.
5. Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007

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1. https://en.wikipedia.org/wiki/Rehabilitation_engineering
2. <https://www.embs.org/about-biomedical-engineering/our-areas-of-research/rehabilitation-engineering/>
3. <https://bme.unc.edu/rehabilitation-engineering/>
4. <https://youtu.be/-y2jDL-diz0>
5. <https://youtu.be/s3rEAlwLEXM?t=2>

*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	1	2	1	-	2	1	1	1	-	-	-	-	1
2	3	3	3	2	2	2	2	2	1	1	1	3	3	3
3	3	3	3	2	2	2	2	2	1	1	-	1	2	1
4	3	3	3	3	2	2	2	2	2	2	1	1	3	2
5	2	2	2	2	3	2	2	2	2	2	-	1	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Programme: B.Tech							
Semester	VII		Course Category Code: PC			*End Semester Exam Type: TE				
Course Code	U23BMT714		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	MEDICAL IMAGE PROCESSING		3	0	0	3	25	75	100	
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Gain knowledge in fundamentals of digital image processing.							K2	
	CO2	Examine image enhancement techniques in medical images.							K3	
	CO3	Execute restoration and segmentation techniques in medical images							K3	
	CO4	Apply the compression Techniques in medical images							K3	
	CO5	Describe the representations of features and recognize the images							K2	
UNIT-I	Fundamental of Digital Image Processing					Periods:09				
Introduction, Steps in Digital Image Processing -Components –Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization -Relationships between pixels - colour models. Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering.									CO1	
UNIT-II	Frequency domain Enhancement					Periods:09				
Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth andGaussian filters, Wavelets -Sub band coding, Wavelets based image processing.									CO2	
UNITIII	Medical Image Restoration And Segmentation					Periods:09				
Image Restoration: Noise Model – Notch Filters– Inverse Filtering – Wiener filtering. Image Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Region Growing, Region Splitting, Morphological processing- erosion and dilation – Watershed algorithm.									CO3	
UNIT -IV	Medical Image Compression					Periods:09				
Image Compression models–Error Free Compression–Variable Length Coding–Bit-Plane Coding–Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding –Discrete wavelet transform for image compression-Compression Standards-JPEG, Image Registration (Multimodal Image Registration)									CO4	
UNIT- V	Medical Image Representation and Recognition					Periods:09				
Boundary representation- Chain Code-Polygonal approximation, signature, boundary segments-Boundary description – Shape number - Regional Descriptors – Topological feature, Texture –Patterns and Pattern classes. Image Recognition: Digital Imaging and Communication (DICOM) in Medicine, Various modalities of Medical Imaging-CT, MRI, PET, Thermography, Angiography.									CO5	
LecturePeriods:45		Tutorial Periods:		Practical Periods: -		TotalPeriods:45				
Text Books										
1 G.R. Sinha, Bhagwati Charen Patel, “Medical Image Processing: Concepts and Applications”, PHI Learningprivatelimited.2014										
2 Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw HillPvt.Ltd.,2011										
3 Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing”,2 nd Edition, CRC Press,2005.										
Reference Books										
1 Anil JainK.“Fundamentals of Digital Image Processing”,PHI Learning Pvt.Ltd.,2011.										
2 E.R.Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press,2012.										
3 MalayK.Pakhira, “Digital Image Processing and Pattern Recognition”,1 st Edition, PHI Learning Pvt.Ltd.,2011.										
4 Geoff Dougherty, “Medical Image Processing: Techniques and Applications”, Springer Science & BusinessMedia,2011										
5 IsaacN.Bankman,“Hand book of Medical Image Processing and Analysis”,Science Direct,2 nd Edition,2009.										



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1	https://youtu.be/xUCsfKA8bi0
2	https://youtu.be/0SIPA8TvCbU
3	https://youtu.be/8fBZFjiHw3I
4	https://youtu.be/PqBS3tFZYI8
5	https://m.youtube.com/watch?v=i8a2LdyenoY

*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	-	3	2	-
2	3	3	2	-	3	-	-	-	-	1	-	3	3	2
3	2	3	3	3	3	-	-	-	-	2	-	2	3	3
4	3	3	2	2	3	-	-	-	-	1	-	3	3	2
5	2	3	2	2	3	-	-	1	1	3	1	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus



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B.Tech. Biomedical Engineering

Department	Biomedical Engineering				Programme: B.Tech.							
Semester	VII				Course Category Code: PC *End Semester Exam Type: LE							
Course Code	U23BMP710				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	3D PRINTING IN BIOMEDICAL APPLICATIONS LABORATORY				0	0	2	1	50	50	100	
Prerequisite	-											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand 3D printing principles, techniques, and biomedical applications.									K2	
	CO2	Operate and calibrate FDM/SLA printers for biomedical model production.									K3	
	CO3	Analyze print parameters' effects on mechanical properties and accuracy.									K4	
	CO4	Design patient-specific biomedical models using 3D scanning and modeling.									K5	
	CO5	Evaluate surface quality and enhance prints with post-processing techniques.									K6	
List of Experiments:												
1. Study of FDM 3D Printer Operation and Calibration 2. 3D Scanning of Biomedical Model of ear and finger Using a Handheld Scanner 3. Scanning and Reconstruction of an artificial Dental Model Using an Intraoral Scanner 4. Conversion of DICOM Images to 3D Printable STL Files 5. Design and Printing of a Patient-Specific Skull Model 6. Study of Layer Thickness and Print Orientation on Mechanical Properties 7. Fabrication of a Dental Crown Using SLA Printing 8. 3D Printing of a Custom Prosthetic Finger Using Flexible Filament 9. Development of a 3D-Printed Microfluidic Device for Biofluid Analysis 10. Evaluation of Surface Roughness in SLA vs. FDM Printing 11. Design and Printing of a Patient-Specific Surgical Guide for nose Placement 12. Fabrication of a 3D-Printed Rehabilitative Orthopedic Cast with Ventilation												
Lecture Periods: -0			Tutorial Periods: -0			Practical Periods:30			TotalPeriods:30			
Textbook												
1. Prosenjit Saha, “3D Bioprinting from Lab to Industry” , Wiley , 2023. 2. Mohamad Zaki Hassan and Ilyas Aufa, “Handbook of 3D Printing in Biomedical Applications”, CRC Press , 2022. 3. Neeta Raj Sharma, Karupppasamy Subburaj, Kamalpreet Sandhu, and Vivek Sharma , “Applications of 3D Printing in Biomedical Engineering”, Springer , 2021.												
Reference Books												
1. Mohanan, P. V., editor. Compendium of 3D Bioprinting Technology. CRC Press, 2025. 2. BioCraft: Unleashing the Future of Bioprinting. Independently published, 2024. 3. Narayan, Roger J., editor. Advances in 3D Bioprinting. CRC Press, 2024. 4. Crook, Jeremy M., editor. 3D Bioprinting: Principles and Protocols. Humana Press, 2020. 5. Guvendiren, Murat, editor. 3D Bioprinting in Medicine: Technologies, Bioinks, and Applications. Springer												
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1. https://link.springer.com/book/10.1007/978-1-0716-0520-2 2. https://en.wikipedia.org/wiki/3D_bioprinting 3. https://www.iipseries.org/assets/docupload/rsl2024F767C1609A33C6E.pdf 4. https://youtu.be/yLaXBQgMdR8												



*TE –Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	1	-	-	-	-	3	2	2
2	2	2	2	2	3	-	-	-	2	2	2	3	3	3
3	2	3	2	2	3	-	-	-	2	2	1	3	3	3
4	3	3	3	3	3	1	1	-	3	3	3	3	3	2
5	3	2	2	2	3	-	1	2	3	3	2	3	3	3

Correlation Level: 1-Low, 2- Medium, 3 –High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100



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B.Tech. Biomedical Engineering

Department	BIOMEDICAL ENGINEERING			Programme: B.Tech.							
Semester	VII			Course Category: PC			*End Semester Exam Type: LE				
Course Code	U23BMP711			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	MEDICAL IMAGE PROCESSING LABORATORY			0	0	2	1	50	50	100	
Prerequisite	MATLAB Basics, Image Processing, Mathematics, Signal Processing, Computer Vision.										
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Describe digital image fundamentals								K3	
	CO2	Examine image enhancement techniques in medical images								K4	
	CO3	Execute restoration and segmentation techniques in medical images								K4	
	CO4	Apply various transforms to the images								K3	
	CO5	Describe the representations of features and recognize the images								K3	
List of Exercises:											
1. Image sampling and quantization. 2. Analysis of spatial and intensity resolution of images. 3. Intensity transformation of images 4. DFT analysis of images 5. Transforms (Walsh, Hadamard, DCT, Haar). 6. Histogram Processing. 7. Image Enhancement-Spatial filtering. 8. Image Enhancement- Filtering in frequency domain 9. Image segmentation – Edge detection, line detection and point detection 10. Basic Morphological operations 11. Basic Thresholding functions 12. Analysis of images with different color models 13. Watershed Algorithm for Image Segmentation.											
Lecture Periods:		-	Tutorial Periods:		-	Practical Periods:30		TotalPeriods:30			
Text Books											
1. G.R. Sinha, Bhagwati Charen Patel, "Medical Image Processing: Concepts and Applications", PHI Learning private limited,2014. 2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", 3rdEdition, Tata McGraw Hill Pvt.Ltd., 2011.Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", CengageIndia1st Edition, 2017. 3. Kayvan Najarian and Robert Splinter,"Biomedical Signal and Image Processing", 2nd Edition, CRC Press,2005.											
Reference Books											
1. AnilJainK."Fundamentals of Digital Image Processing",PHI Learning Pvt Ltd,2011. 2. E.R. Davies,"Computer& Machine Vision", 4th Edition, Academic Press,2012. 3. MalayK.Pakhira,"Digital Image Processing and Pattern Recognition", 1st Edition,PHI Learning Pvt Ltd,2011. 4. Geoff Dougherty, "Medical Image Processing: Techniques and Applications", Springer Science & BusinessMedia,2011. 5. Isaac N. Bankman, "Handbook of Medical Image Processing and Analysis", Science Direct, 2nd Edition,2009.											
Web References											
1. https://youtu.be/0UPoSdBF48 2. https://youtu.be/6mXXN1-vHQQ 3. https://youtu.be/8fBZFjiHw3I 4. https://youtu.be/PqBS3tFZYI8 5. https://m.youtube.com/watch?v=i8a2LdyenoY											



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*TE–Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	3	-	-	-	-	-	-	3	2	-
2	2	3	2	-	3	-	-	-	-	2	-	3	3	2
3	2	3	3	3	3	-	-	-	-	2	-	3	3	3
4	3	2	2	2	3	-	-	-	-	2	-	3	3	2
5	3	2	2	2	3	-	-	2	2	3	1	3	3	2

Correlation Level: 1-Low, 2-Medium, 3-High**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE)Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Viva				
Marks	15	5	5	15	10	50	100



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B.Tech. Biomedical Engineering

Department	BIOMEDICAL ENGINEERING	Programme: B.Tech.						
Semester	VII	Course Category: PA				*End Semester Exam Type: LE		
Course Code	U23BMW703	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	PROJECT PHASE - I	0	0	4	2	50	50	100
Prerequisite								

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester.

In the phase I of the project work, the progress of the work carried out in the 7th semester will be monitored and assessed. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment. The project work and the report will be evaluated by the internal assessment committee by conducting three reviews for a total of 50 marks. The end semester examination which carries a total of 50 marks will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner

CAM and ESM break-up for Project Phase-I

Sl. No	Description			Weightage
1	Continuous Assessment Marks			
a	Review1	Review Committee	10	15
		Supervisor	5	
b	Review2	Review Committee	10	15
		Supervisor	5	
c	Review3	Review Committee	15	20
		Supervisor	5	
	Total CAM			50
2	End Semester Marks			
	Evaluation of Phase I Report and Viva-voce	Report	15	50
		Presentation and Viva	20	
		Demonstration	15	
	Total ESM			50
	Total Marks			100



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Department	BIOMEDICAL ENGINEERING	Programme: B.Tech.						
Semester	VII	Course Category: PA			*End Semester Exam Type: LE			
Course Code	U23BMW704	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	INTERNSHIP/ INPLANT TRAINING	0	0	2	1	100	-	100
Prerequisite								

Students may undergo Inplant training or internship during summer / winter vacation at Industry/ Research organization for a period of two weeks to four weeks. Students are also permitted to undergo internships during their seventh semester after the theory classes are over. Each student has to submit a detailed report on In-Plant Training which He / She have undergone. The department committee will assess the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of Inplant training or internship.

Assessment method for Industrial Training/Internship

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Report	Presentation	
Marks	50	50	100



PROFESSIONAL ELECTIVE –IV
(Offered in Semester VII)

Department	Biomedical Engineering			Program: B.Tech.							
Semester	VII			Course Category: PE			*End Semester Exam Type: TE				
Course Code	U23BME714			Periods/Week			Credit	Maximum Marks			
Course Name	VIRTUAL BIOINSTRUMENTATION			L	T	P	C	CAM	ESE	TM	
				3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Understand the basic concepts of Virtual instrumentation								K2	
	CO2	Realize the programming language used in VI								K3	
	CO3	Analyze the concept of data acquisition using VI								K3	
	CO4	Interpret the interfacing concept used in LabVIEW								K3	
	CO5	Apply the concept of VI for medical applications								K4	
UNIT – I	Introduction						Periods:9				
History of Virtual Instrumentation, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, LabVIEW basics – graphical programming, LabVIEW environment											
UNIT – II	Programming Techniques						Periods:9				
VIS and sub-VIS, loops and charts, arrays, clusters, graphs, case and sequence structures, formula modes, local and global variable, string and file input. Publishing measurement data in the web.											
UNIT – III	Data Acquisition						Periods:9				
Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input / Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements											
UNIT – IV	Instrument Interfaces						Periods:9				
Current loop, GPIB, System basics, interface basics: USB, PCMCIA, networking basics for office and industrial application VISA and IVI, image acquisition and processing, Motion Control, waveform generator.											
UNIT – V	Biomedical Applications						Periods:9				
Biofeedback systems and its components, Virtual applications for ECG, EEG, EMG signals, Air Flow and Lung Volume, Non-invasive Blood Pressure Measurement, Virtual Reality and 3D graphical modelling, Virtual Prototyping.											
Lecture Periods: 45			Tutorial Periods:			Practical Periods: -		Total Periods: 45			
Text Books											
1. Jon B. Olansen, Eric Rosow, “Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW” Prentice Hall PTR, 2001											
2. Gary Johnson, “LABVIEW Graphical Programming”, 4 th Edition, McGraw Hill, 2006.											
3. Ronald W. Larsen, “LabVIEW for Engineers”, Pearson , 1 st Edition, 2010											
Reference Books											
1. Robert H. Bishop,” Learning with LabVIEW” , Pearson, First edition, 2014											
2. Jerome, “Virtual Instrumentation Using LabView”, PHI, 2010.											
3. Sanjay Gupta and Joseph John, ” Virtual Instrumentation using LabVIEW”, Tata Mc Graw – Hill Publishing Company Limited New Delhi, 1 st Edition, 2005.											
4. John Essick,” Hands-on Introduction to LabVIEW for Scientists and Engineers “.Oxford University Press, 4 th Edition,2018											
5. Kevin James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control”, Newnes, 2000.											
Web References											
1. https://youtu.be/_2IZVC902kg											
2. https://youtu.be/78dZ8ljJ52M											
3. https://youtu.be/fly6XT3CdPQ											
4. https://youtu.be/U0bQBOEiBQY											
5. https://youtu.be/Q8rFSpaa84Q											



*TE–Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	3	-	-	-	-	1	-	3	2	-
2	3	2	-	-	3	-	-	-	-	2	-	3	2	1
3	3	3	2	2	3	-	-	-	-	2	-	3	3	3
4	3	3	2	2	3	-	-	-	-	2	1	3	3	3
5	3	3	3	3	3	1	1	2	2	3	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 -High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. Vijayalakshmi

Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering				Program: B.Tech.							
Semester	VII				Course Category: PE *End Semester Exam Type: TE							
Course Code	U23BME715				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	NANOTECHNOLOGY IN MEDICINE				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Understand the basic concept of nanomaterial synthesis										K2
	CO2	Analyze the mechanisms involved in biological nanoparticle formation.										K3
	CO3	Evaluate blood-biomaterial interactions, including heparin effects										K3
	CO4	Explain the characterization techniques used in nanomaterials										K3
	CO5	Assess vascular and lymphatic targeting strategies for nanoparticle drug delivery.										K4
UNIT – I	Physical and Chemical Process							Periods:9				
Chemical processes: Chemical precipitation and co-precipitation, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Microwave assisted synthesis, Core-Shell nanostructure, Physical Methods: Inert gas condensation, Arc discharge, RF- plasma, Plasma arc technique, Laser ablation, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD) method.										CO1		
UNIT – II	Biological Methods of Synthesis							Periods:9				
Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magneto tactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the nanostructured materials; synthesis process and application, Role of plants in nanoparticle synthesis.										CO2		
UNIT – III	Biological Interactions with Materials							Periods:9				
Introduction, Biocompatibility, Toxicity, Cytotoxicity, Hypersensitivity, Carcinogenicity, Interaction of Materials with Soft Tissues, Inflammation, Granulation Tissue Formation, Foreign Body Reaction, Fibrosis, Modification of Blood-Biomaterial Interactions, Interaction with Blood by Heparin, Interactions with Proteins, Cell Adhesion, Interactions with Hard Tissues, The Vroman Effect, Adhesion of Osteoblasts, Osseointegration, Fibrous Capsule Formation,										CO3		
UNIT – IV	Characterization Techniques							Periods:9				
Nanostructured materials Characterization Techniques X-ray diffraction (XRD), SEM, EDAX, TEM, Elemental mapping, FTIR, UV-Visible spectrophotometer, Nanomechanical Characterization using Nanoindentation, Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermo gravimetric Analysis (TGA), TEM, X-ray Photoelectron Spectroscopy (XPS), ICP-AES chemical analysis.										CO4		
UNIT – V	Biological Transport for Targeted Drug Delivery							Periods:9				
Drug transport mechanisms – Passive and active targeting – Nanocarriers (liposomes, dendrimers, polymeric nanoparticles) – Nanobots for precision medicine – Stimuli-responsive drug delivery – Controlled release systems – Tumor-targeted therapy – Blood-brain barrier penetration – Real-time tracking and monitoring of drug delivery.										CO5		
Lecture Periods: 45				Tutorial Periods:			Practical Periods: -		Total Periods: 45			
Text Books												
1 Harry F. Tibbals, “Medical Nanotechnology and Nanomedicine”, 1st Edition, CRC Press, 2011.												
2 Hossein Hossein Khani, “Nanomaterials in Advanced Medicine”, Wiley, 2019.												
3 Kirthi, A. Vishnu, Karthik, L., Janarthanan, Pushpamalar, “Nanotechnology in Medicine”, Springer, 2021.												
Reference Books												
1. BIOMEDICAL NANOSTRUCTURES. Edited by Kenneth E. Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair, WILEY-INTERSCIENCE A JOHN WILEY & SONS, INC., PUBLICATION, 2008												
2. Z.L Wang ,” Characterization of Nanophase materials”, 1 st Edition, Wiley-VCH, 2000.												
3. G. Schmidt, “Nanoparticles: From theory to applications”, 2 nd Edition, Wiley Weinheim, 2004.												
4. Zoraida Aguilar, “Nanomaterials for Medical Applications”, 1 st Edition,Elsevier, 2012.												
5. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemama 2009.												

Web References

1. <https://en.wikipedia.org/wiki/Nanomedicine>
2. <https://www.medicalnewstoday.com/articles/244972>
3. <https://www.azonano.com/article.aspx?ArticleID=4840>
4. <https://youtu.be/ZS1QPndpD2w>
5. https://youtu.be/iiT_KJJ1Uhs

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	1	-	-	1	-	3	2	-
2	3	3	2	2	2	-	-	-	-	2	-	3	3	-
3	3	3	2	3	2	3	2	2	-	2	-	3	3	2
4	3	3	2	2	3	-	-	-	-	2	-	3	2	2
5	3	3	3	2	3	2	2	2	1	3	2	3	3	2

Correlation Level: 1-Low, 2-Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering				Programme: B.Tech							
Semester	VII				Course Category Code: PE		*End Semester Exam Type: TE					
Course Code	U23BME716				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	DYNAMICS OF BIOFLUID				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand to apply the fluid mechanics principles in bio fluid studies									K2	
	CO2	Gain adequate knowledge about the Vascular Mechanics									K2	
	CO3	Comprehend the physical, chemical and rheological properties of blood									K2	
	CO4	Analyze cardiovascular dynamics, fluid flow, pressure, compliance, elastance, and modeling.									K4	
	CO5	Comprehend dynamics of cerebrospinal fluid, alveolar mechanics, and synovial fluid.									K3	
UNIT–I	Fundamentals of Biofluid Mechanics							Periods:09				
Intrinsic Fluid Properties: Density, Viscosity, Compressibility, Surface Tension, Hydrostatics -Macroscopic Balances of Mass and Momentum - Microscopic Balance of Mass and Momentum – The Bernoulli Equation - Dimensional Analysis - Fluid Mechanics in a Straight Tube - Flow Stability and Related Characteristics - Effect of Flow Pulsatility - Boundary Layer Separation.										CO1		
UNIT–II	Vascular Mechanics							Periods:09				
Anatomical Organization of the Vasculature, Mechanical Properties of Blood Vessels, Functional Properties of Blood, Control Aspects of the Vascular System, Hemodynamic of Large Arteries, Heart Valves, Ventricular Outflow and the Aorta, Pressure-Flow Relations and Vascular Impedance, Wave Propagation Phenomena- Wave Reflection Phenomena.										CO2		
UNIT–III	Rheology of Blood							Periods:09				
Physical Properties of Blood - Viscous Behavior of Blood - Pressure–Flow Relationship for Non-Newtonian Fluids- Viscometry and Theory for Capillary - Capillary Viscometer - Coaxial Cylinder Viscometer - Cone and Plate Viscometer - Hemolysis and Platelet Activation with Fluid – Structural Components of the Blood Vessel - Material Behavior of Blood Vessels.										CO3		
UNIT –IV	Computation Fluid Dynamics							Periods:09				
Cardiovascular system – Ventricular pressure -volume diagram, Blood flow in arteries-blood vessel bifurcation-Uniform shear hypothesis -Two-element – Electric analogy model for two, three and four element model-Wave Propagation-Review concepts of compliance and Elastance- in arterial circulation-pressure changes in different distance from heart.										CO4		
UNIT– V	Bio-fluid Dynamic of Human Brain, Respiratory and Orthopedic							Periods:09				
Cerebro Spinal Fluid – Cerebral blood flow – Blood brain barrier – Brain diseases. Alveoli mechanics – Interaction of Blood and Lung P-V curve of Lung – Breathing mechanism – Airway resistance – Physics of Lung diseases, Pleural Fever. Synovial joint – Synovial fluid – Diseases affecting synovium.										CO5		
Lecture Periods:45			Tutorial Periods:			Practical Periods: -			Total Periods:45			
Text Books												
1. Goyal, M.R., Bhowmik, A., & Chauhan, A. (Eds.). (2025). Biofluid Dynamics of Human Body Systems: Expanded and Revised Edition (1st ed.). Apple Academic Press.												
2. Goyal, Megh R., et al. "Introduction and Properties of Biofluids in the Human Body Systems." Biofluid Dynamics of Human Body Systems. Apple Academic Press 1-52.												
3. Nithiarasu, P. "Biofluid Dynamics." Chapter 2 (2022): 20-21.												
4. Lauga, Eric. The fluid dynamics of cell motility. Vol. 62. Cambridge University Press, 2020.												
5. David A. Rubenstein, Weiyin, Mary D. Frame, “Biofluid Mechanics- An Introduction to fluid Mechanics, Macrocirculation and Microcirculation”, 2015, 1st Edition, Academic Press, Massachusetts, New York.												
Reference Books												

1. Taylor, R. L., and P. Nithiarasu. The finite element method for fluid dynamics. Elsevier, 2024.
2. Chin, Wilson C., and Jamie A. Chin, eds. Biofluids Modeling: Methods, Perspectives, and Solutions.
3. Grotberg, James B. Biofluid mechanics: analysis and applications. Cambridge University Press, 2021.

*TE –Theory Exam, LE–Lab Exam

Web References

1. https://en.wikipedia.org/wiki/Biofluid_dynamics
2. <http://www.dicat.unige.it/rrepetto/linked-files/biofluid-dynamics.pdf>
3. <https://www.maths.gla.ac.uk/~xl/Arasu-biofluid.pdf>
4. <https://www.youtube.com/watch?v=6ABq269ALFk>
5. <https://youtu.be/L4eZ0IOafvc>
6. <https://youtu.be/emmf2JYAD-0>
7. <https://youtu.be/NILy-u61yyk>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	2	2	-	1	-	-	1	-	3	2	-
2	3	2	2	2	2	2	-	-	-	1	-	3	3	-
3	3	3	-	2	3	1	-	2	-	1	-	3	3	2
4	3	3	3	3	3	1	-	-	-	2	-	3	3	2
5	3	2	2	2	2	2	2	1	-	2	-	3	3	2

Correlation Level: 1-Low, 2-Medium, 3– High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

A. Vijayalakshmi

Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering			Programme: B.Tech.						
Semester	VII			Course Category Code: PE		*End Semester Exam Type: TE				
Course Code	U23BME717			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	MEDICAL SAFETY AND STANDARDS			3	0	0	3	25	75	100
Prerequisite	-									
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)	
	CO1	Gain knowledge about hospital safety devices necessary for health care system							K2	
	CO2	Understand the techniques to shield patient from electrical hazards							K3	
	CO3	Gain knowledge in radiation safety and control measures							K2	
	CO4	Apply the various methods to monitor and assess quality in healthcare							K3	
	CO5	Apply the guidelines for medical standards in hospitals							K3	
UNIT-I	Hospital Safety					Periods:09				
Security and Safety of Hospital -Property, Staff & Patients, Safety precautions, Safe medical devices - device requirements - devices for varying age – initial inspection –maintenance-Safe handling and operation Reporting- Bed rails- Flawed mechanics- removable parts and packaging. Personal protective Equipment.									CO1	
UNIT-II	Electrical Safety					Periods:09				
Physiological effects of electricity - Electrical faults in medical devices - Leakage Current-Electrical isolation - Grounding system -Emergency power system - Uninterrupted power supply. IEC Standards for Electrical Safety.									CO2	
UNIT-III	Radiological Safety					Periods:09				
Fundamentals of radiation detection-Classification of radiation - Biological effects of Ionizing and Non-Ionizing radiation - Hazards associated with UV radiation - UV monitor and control measures, LASER - radiation hazards - control measures, Guidelines for CT installations, MRI safety guidelines.									CO3	
UNIT-IV	Quality Assessment in Healthcare					Periods:09				
Quality management-risk management- types of responsibilities – CSR, Individual and institutional Responsibility-MDRA and medical device standards - ICRP regulations for radiation safety- Methods Adopted to monitor the standards, Evaluation of hospital services – Quality Assurance in Hospitals Sop's -TQM in Health care organization- Quality assurance methods.									CO4	
UNIT-V	Hospital Accreditation and Standards					Periods:09				
Accreditation- JCI Accreditation & its Policies, Patient centered standards, ISO standards and CDSCO Standards for medical safety. Healthcare Organization management standards, Life Safety Standards- Protecting Occupants, Protecting the Hospital from Fire, Smoke, and Heat, Providing and Maintaining Fire Alarm Systems, Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste.									CO5	
Lecture Periods:45		Tutorial Periods:		Practical Periods: -			Total Periods:45			
Textbooks										
1. Barbara J. Youngberg, " Patient Safety Handbook "Jones& Bartlett Learning, 2 nd Edition, 2013										
2. Peter Lachman, Moira Stewart, and Siobhan McQuillan," Safety and Improvement in Primary Care: The Essential Guide", Radcliffe Publishing, 1 st Edition,2012.										
3. Hani H. Abujudeh, "Quality and Safety in Radiology", Oxford University Press, 1 st Edition, 2010.										
4. Ronda Hughe, "Patient Safety and Quality: An Evidence-Based Handbook for Nurses" , Agency for Healthcare Research and Quality, 1 st Edition, 2008.										



Reference Books

1. Peter Lachman, Moira Stewart, and Siobhan McQuillan, "Safety and Improvement in Primary Care: The Essential Guide", Radcliffe Publishing, 1st Edition, 2012.
2. Lucian L. Leape, "Making Healthcare Safe: The Story of the Patient Safety Movement", Springer, 1st Edition, 2021
3. Pascale Carayon, "Handbook of Human Factors and Ergonomics in Health Care and Patient Safety", CRC Press, 2nd Edition, 2011.
4. Robert Wachter and Kiran Gupta, "Understanding Patient Safety", McGraw-Hill Education, 3rd Edition, 2017

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1. www.wma.net/what-we-do/education
2. www.medvarsity.com/courses/certificationcourse
3. www.medscape.com/courses/business
4. www.onlinecourses.swayam2.ac.in
5. www.healthcentral.com/healthcare

*TE–Theory Exam, LE– Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	2	3	2	2	1	2	1	3	2	3
2	3	3	2	2	3	3	2	2	1	2	1	3	2	3
3	3	2	2	2	3	3	3	3	-	2	1	3	3	2
4	3	3	3	2	2	2	2	2	1	3	2	3	2	2
5	3	3	3	2	2	3	3	3	2	3	2	3	2	2

Correlation Level: 1-Low, 2-Medium, 3-High Evaluation**Evaluation Method**

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus

A. V.

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VII		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME718		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	CRYPTOGRAPHY AND NETWORK SECURITY		3	0	0	3	25	75	100
Prerequisite	Network Essential								
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)
	CO1	Explain the fundamentals of cryptography, including security attacks, encryption techniques, and steganography, to understand data protection principles.							K3
	CO2	Compare and analyze symmetric and asymmetric cryptographic algorithms							K4
	CO3	Demonstrate knowledge of authentication techniques and their applications in secure communication							K3
	CO4	Describe IP security principles and key management strategies for secure networks							K2
	CO5	Implement various network security protocols to mitigate security threats.							K4
UNIT – I	Introduction					Periods:9			
Introduction To Cryptography - Security Attacks - Services And Mechanism - Conventional Encryption -Classical Encryption Techniques - Substitution Ciphers And Transposition Ciphers – Cryptanalysis – Steganography.								CO1	
UNIT – II	Symmetric and Asymmetric Cryptography					Periods:9			
Symmetric key Ciphers: Block ciphers principles - Data Encryption Standard (DES) - strength of DES - triple DES – Advanced Encryption Standard (AES)								CO2	
Asymmetric key Ciphers: Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - Elliptic curve cryptography									
UNIT – III	Message Authentication and Integrity					Periods:9			
Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions								CO3	
Integrity: Message Digest Algorithm (MD5) - Secure Hash Algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - Digital Signature Standards (DSS)									
UNIT – IV	Ip Security and Authentication Algorithms					Periods:9			
IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management. Authentication Applications: Kerberos and X.509.								CO4	
UNIT – V	Web and System Security					Periods:9			
Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - electronic mail security-pretty good privacy (PGP).								CO5	
System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems									
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books									
1. William Stallings: “Cryptography and Network Security”- Principles and Practice, 5th Edition, Pearson/PHI, 2011.									
2. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw-Hill,2017									
3. Wenbo Mao, —"Modern Cryptography-Theory and Practise", First Edition Pearson Education 2004									
Reference Books									
1. William Stallings, “Network Security Essentials (Applications and Standards)”, 4th Edition, Pearson Education. ,2012									
2. Atul Kahate, “Cryptography and Network Security”, 4th edition, Tata Mc Grawhill, 2019									
3. V.S. Bagad and I.A Dhotre, “Cryptography & Network Security”, 1 st edition, 2020.									
4. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, “Security in Computing”, Fifth Edition, Prentice Hall, New Delhi, 2015.									
5. Buchmann: “Introduction to Cryptography”, 2nd Edition, Springer, 2004									



Web References

1. <https://www.geeksforgeeks.org/cryptography-introduction/>
2. http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf
3. <https://nptel.ac.in/courses/106105031>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	1	3	1	2	1	3	2	1
2	3	3	2	2	2	-	-	3	-	2	-	3	2	-
3	3	3	2	2	2	2	1	3	2	2	2	3	2	1
4	3	3	2	2	3	2	1	3	-	2	2	3	2	1
5	3	3	2	2	3	2	2	3	1	3	2	3	3	2

Correlation Level: 1-Low, 2-Medium, 3-High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented/Problem solving/Design/Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

OPEN ELECTIVE –III
(Offered in Semester VII)

Department	BIOMEDICAL ENGINEERING					Programme: B.Tech.						
Semester	VII					Course Category: OE		End Semester Exam Type: TE				
Course Code	U23BMOC03					Periods/Week		Credit	Maximum Marks			
						L	T	P	C	CAM	ESE	TM
Course Name	MEDICAL ROBOTICS					3	0	0	3	25	75	100
(Common to EEE,ECE,CSE,IT,ICE,CCE,MECH, MCTR,AI&DS,CSEBS)												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Understand the basics of robotic systems.										K2
	CO2	Explore workspace and related motion of the Robots										K3
	CO3	Analyse and extract information from the image using Robots										K3
	CO4	Design of task planning and simulating the task.										K4
	CO5	Construct Robots for Medical applications										K4
UNIT-I	INTRODUCTION							Periods: 9				
Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot -Five-axis robot - Six-axis robot.												CO1
UNIT-II	KINEMATICS							Periods: 9				
Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations-Robotic Manipulator – Continuous path motion – Interpolated motion – Straight-line motion.												CO2
UNIT-III	ROBOT VISION							Periods: 9				
Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.												CO3
UNIT-IV	PLANNING							Periods: 9				
Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.												CO4
UNIT-V	MEDICAL APPLICATIONS							Periods: 9				
Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.												CO5
Lecture Periods: 45			Tutorial Periods: -			Practical Periods: -			Total Periods: 45			
Text Books												
1. Robert Schilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall, January 2019.												
2. Paula Gomes,“Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications”,Woodhead Publishing,2012.												
3. Klafter, Chmielewski and Negin, “Robotic Engineering - An Integrated approach”,, PHI, first edition, 2009.												
Reference Books												
1. J.J.Craig, “Introduction to Robotics”, Pearson Education, 2019.												
2. Fu, Lee and Gonzalez., “Robotics, control vision and intelligence”, McGraw Hill International, 2nd edition, 2007												
3. John J. Craig, “Introduction to Robotics”, Addison Wesley Publishing, 3rd edition, 2010.												
4. Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, Prentice Hall, 2001.												
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, “Robotics”, McGraw Hill, 2008.												
Web References												
1.https://nptel.ac.in/courses/112/105/112105249/												
2.https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_robotic_surgery												



3. https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
 4. https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
 5. <https://www.worldscientific.com/worldscinet/jmrr>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	1	2	1	-
2	3	2	-	1	1	1	-	-	-	-	1	2	1	-
3	3	2	-	1	1	1	-	-	-	-	1	2	1	-
4	3	1	1	1	1	1	-	-	-	-	1	2	1	-
5	2	1	1	-	1	1	-	-	-	-	1	3	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	BIOMEDICAL ENGINEERING		Programme: B.Tech.							
Semester	VII		Course Category:OE			End Semester Exam Type: TE				
Course Code	U23BMOC04		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	TELEHEALTH TECHNOLOGY		3	0	0	3	25	75	100	
Prerequisite										
(Common to EEE,ECE,CSE, IT,ICE,CCE,CIVIL,AI&DS,CSEBS)										
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Understand the history and evolution of telemedicine.							K2	
	CO2	Understand the principles of multimedia communication, including text, audio, video, and data.							K2	
	CO3	Learn about medical information storage and management in telemedicine, including patient information, medical history, test reports, and medical images.							K3	
	CO4	Analyze the security and confidentiality concerns regarding medical records in telemedicine and understand the relevant cyber laws.							K2	
	CO5	Focusing on the applications of telemedicine in specialized areas like telecardiology, tele oncology, and neurosciences.							K3	
UNIT-I	Telemedicine and Health					Periods:9				
History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.								CO1		
UNIT -II	Telemedical Technology					Periods:9				
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.								CO2		
UNIT -III	Mobile Telemedicine					Periods:9				
Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system								CO3		
UNIT -IV	Telemedical Standards					Periods:9				
Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine								CO4		
UNIT-V	Telemedical Applications					Periods:9				
Telemedicine – health education and self-care. · Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.								CO5		
Lecture Periods:45			Tutorial Periods: -		Practical Periods: -		Total Periods:45			
TextBooks										
1. Haux, R., Heidrich, J.P., & Schleyer, T. "Introduction to Telemedicine", Springer, 2017										
2. Krishna, S., & Liss, A. "Telemedicine: A Practical Guide for Professionals", Springer, 2005										
3. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002										
Reference Books										
1. Goetz, S.K. "Telemedicine: The Electronic Practice of Medicine", Springer, 2011										
2. Krupinski, C. & Rhoads, J.M. "Telemedicine: Technology and Applications", CRC Press, 2019										
3. Ramakrishnan, S. & Chaturvedi, A. "Telemedicine: A Guide to Assessing Telecommunications for Healthcare", Wiley, 2006										
4. Gajendra, J.A. & Williams, A.J. "Telemedicine Technologies: Principles and Applications", Wiley, 2008										
5. McGonigle, D. & Mastrian, K.G. "Health Informatics: An Interprofessional Approach", Elsevier, 2020										
Web References										
1. https://www.who.int/health-topics/telemedicine										



2. <https://www.telemedicine.org>
3. <https://www.youtube.com/watch?v=TaOu0NB2dsc>

*TE–Theory Exam, LE–Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	-	1	1	1	-	-	-	-	1	3	1	1
2	3	2	-	1	1	1	-	-	-	-	1	2	1	1
3	3	2	2	2	1	1	-	-	-	-	1	3	1	1
4	3	3	2	2	2	1	-	-	-	-	1	3	1	2
5	2	3	3	3	2	1	-	-	-	-	2	3	1	2

Correlation Level: 1- Low,2- Medium,3 –High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Master of Business Administration		Programme : All B.Tech							
Semester	VIII		Course Category Code:			*End Semester Exam Type:				
Course Code	U23HSTC03		Periods/Week			Credit	Maximum Marks			
			L	T	P	C	CAM	ESE	TM	
Course Name	Entrepreneurship and Business Management		3	0	0	3	25	75	100	
Prerequisite	Nil									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)		
	CO1	Students will gain knowledge, Skills and competencies related to entrepreneurship and the entrepreneur.							K2	
	CO2	Students will be able to identify and evaluate innovative business ideas and opportunities.							K3	
	CO3	Students will be able to develop and design a comprehensive business plan.							K6	
	CO4	Students will be able explore various sources of finance and support systems for entrepreneurs							K4	
	CO5	Students will understand core concepts and functions of business management.							K2	
UNIT-I	Introduction to Entrepreneurship					Periods: 9				
Entrepreneurship: meaning, importance of entrepreneurship, concepts, Characteristics, Theories of entrepreneurship, Challenges of entrepreneurs in India, Entrepreneurial Competencies, Entrepreneurial mobility, Entrepreneur v/s intrapreneur, Functions of Entrepreneurs, Types of Entrepreneurs, IPR related issues for Entrepreneur.									CO1	
UNIT-II	Business Idea Development					Periods: 9				
Creativity and innovation, Opportunity Sensing and Idea Generation, Techniques of Idea generation; Invention, Innovation and Imitation, identifying sources of opportunities, Business opportunity in India, RAMP Model for Opportunity Evaluation, Mullin' Seven Domains Model, Feasibility Analysis, Prototype, laboratory and market test, Pitching the Business Idea									CO2	
UNIT-III	Business Plan Development					Periods: 9				
Business Plan: Meaning, Importance, Components, Preparation, SWOT analysis, competitor analysis, Operation and Financial plan., Market assessment, technology search, production capacity, Infrastructure requirement, Pitching the Business Plan, Business Incubation and development, Concepts of Incubation, Activities of incubation center									CO3	
UNIT-IV	Entrepreneurial Finance and MSME Schemes					Periods: 9				
Bank Loans, Project finance, Seed Funding, Angel Investment, Venture capital, Crowd funding, Government Grants and Subsidies, Overview of MSME, Policies, Role of MSME, Schemes for entrepreneurial development: PMMY, PMKVY, GeM, ESDP, TUFS, MSME Champions Scheme, MSME Hackathons 4.0, Make in India									CO4	
UNIT-V	Business Management					Periods: 9				
Meaning and definition of business management, Features of business management, Nature of business management, Significance of Management, levels of Management, Functions of management, POSDCORB Concept, role of strategic planning in entrepreneurship, Types of Business Ownership, Social Responsibility of Business									CO5	
Lecture Periods: 45		Tutorial Periods:			Practical Periods:		Total Periods: 45 Periods			
Text Books										
1. Scarborough, N. M., & Cornwall, J. R. (2015). Essentials of entrepreneurship and small business management, Global Edition (8th ed.). Pearson Education Limited.										
2. Barringer, B. R. (2015). <i>Preparing Effective Business Plans: An Entrepreneurial Approach</i> (2nd ed.). Pearson Education.										
3. Koontz, H., & Weihrich, H. (2019). Essentials of Management: An International, Innovation and Leadership Perspective (10th ed.). McGraw Hill Education.										
Reference Books										
1. Morris, M. H., Kuratko, D. F., & Covin, J. G. (2011). Corporate entrepreneurship & innovation (3rd ed.). Cengage Learning.										
2. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2016). Entrepreneurship (10th ed.). Tata McGraw Hill.										
3. Binion, K. D. (2014). Startups Made Easy: Fundamentals for Entrepreneurs. K Works Publication, Michigan.										
4. Mahawar, M. K., Mungi, A., Raul, H. G., & Gupta, M. K. (2023). Entrepreneurship and Small Business Management (1st										



ed.). AG Publishing House.

5. Desai, V. (2021). Dynamics of Entrepreneurial Development and Management (Revised ed.). Himalaya Publishing House.

6. Tripathi, P. C., & Reddy, P. N. (2023). Principles of Management (6th ed.). Tata McGraw Hill.

Web References1. <https://www.shiksha.com/online-courses/articles/entrepreneurship-development/>2. <https://www.sidbi.in/institutional-finance>3. <https://msme.gov.in/prime-minister-employment-generation-programme-and-other-credit-support-schemes>4. <https://www.msmetamilnadu.tn.gov.in/tansidco.php#chart-line>5. <https://www.msmetamilnadu.tn.gov.in/aabcs.php>**COs/Pos Mapping**

Course Outcomes (COs)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	2	1	1	1	1	-	-
CO2	1	1	2	2	2	1	1	2	2	2	2	2	1	1
CO3	1	1	2	2	2	1	-	2	1	2	2	2	2	1
CO4	1	1	1	2	2	1	-	2	1	1	2	2	1	1
CO5	-	-	-	-	1	1	-	2	1	1	1	1	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Internal Assessment Marks (IAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

A. V.

PROFESSIONAL ELECTIVE –V
(Offered in Semester VIII)

Department	Biomedical Engineering				Programme: B.Tech.							
Semester	VIII				Course Category: PE		End Semester Exam Type: TE					
Course Code	U23BME819				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Modeling and Designing of Implants				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)		
	CO1	Understand the fundamentals of biomedical implants and biocompatibility.									K2	
	CO2	Identify and select appropriate biomaterials for implant applications.									K3	
	CO3	Apply biomechanical principles in implant design.									K3	
	CO4	Model and analyze implants using CAD and simulation tools.									K4	
	CO5	Appreciate manufacturing methods, clinical requirements, and regulatory aspects of medical implants.									K2	
UNIT - I	Introduction to Biomedical Implants							Periods:09				
Overview of biomedical implants – Classification of implants – Biological environment – Implant–tissue interaction – Biocompatibility – Corrosion and degradation of implant materials- AI-Based Biocompatibility Prediction-AI for Corrosion and Degradation Analysis											CO1	
UNIT - II	Biomaterials for Implants							Periods:09				
Metallic implant materials: stainless steel, titanium alloys, cobalt–chromium alloys – Polymeric implant materials – Ceramic and composite materials – Material properties – Selection criteria for implant materials - AI-Assisted Biomaterial Selection System- Machine Learning for Material Property Optimization.											CO2	
UNIT - III	Biomechanics and Design Considerations							Periods:09				
Biomechanics of bones and joints – Mechanical properties of bone – Load transfer mechanisms – Stress–strain behaviour – Fatigue and wear in implants – Safety factors and reliability in implant design - AI-Based Stress–Strain Prediction Models- AI for Fatigue and Wear Life Estimation											CO3	
UNIT - IV	Modelling and Simulation of Implants							Periods:09				
Computer-aided design (CAD) of implants – Medical imaging data for implant modelling – Introduction to finite element analysis (FEA) – Stress and deformation analysis – Optimization of implant geometry-AI-Integrated Finite Element Analysis (FEA)- AI-Based Implant Geometry Optimization											CO4	
UNIT - V	Manufacturing and Clinical Considerations							Periods:09				
Manufacturing techniques for implants – Additive manufacturing and 3D printing – Surface modification techniques – Sterilization methods – Regulatory standards – Clinical evaluation and testing of implants- AI in Additive Manufacturing and 3D Printing of Implants-AI-Based Clinical Outcome Prediction											CO5	
Lecture Periods:45				Tutorial Periods: -			Practical Periods: -		Total Periods:45			
Text Books												
1. Ratner, B. D., Hoffman, A. S., Schoen, F. J., Lemons, J. E., Biomaterials Science: An Introduction to Materials in Medicine , 3rd Edition, Elsevier, 2013.												
2. Black, J., Hastings, G., Handbook of Biomaterial Properties , Springer, 2013.												
3. Viceconti, M., Taddei, F., Biomechanics of the Musculoskeletal System , Springer, 2016.												
Reference Books												
1. Park, J. B., Lakes, R. S., Biomaterials: An Introduction , 3rd Edition, Springer, 2007.												
2. Roesler, J., Harders, H., Bäker, M., Mechanical Behaviour of Engineering Materials , Springer, 2007.												
3. Cook, S. D., Implant Design and Manufacturing , Academic Press, 2015.												
4. Li, Q., Mai, Y.-W. (Editors), Biomaterials for Implants and Scaffolds , Springer, 2017												
5. Gupta, S., Saviour, C. M., Pal, B., Chanda, S, Biomechanics of Joints and Implants: Concepts to Applications ,2025												



Web References

1. <https://www.coursera.org/learn/biomaterials>
2. <https://www.nptel.ac.in/courses/102/103/102103076>
3. <https://www.elsevier.com/books/biomaterials-science>
4. <https://www.fda.gov/medical-devices>
5. <https://www.iso.org/committee/53560.htm>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	-	-	2	-	2	-	-	-	3	2	1
2	3	3	2	-	1	2	-	2	-	-	-	3	3	2
3	3	3	3	2	-	2	-	2	-	-	-	3	3	2
4	3	3	3	3	2	1	-	2	-	-	-	3	3	3
5	2	2	2	1	2	3	2	3	2	1	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering			Program: B.Tech.						
Semester	VI / VIII			Course Category: PE		*End Semester Exam Type: TE				
Course Code	U23BMECO2			Periods/Week		Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM
Course Name	Wearable Technology			3	0	0	3	25	75	100
Prerequisite										
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Acquire knowledge about sensors in wearable systems.								K2
	CO2	Gain knowledge on signal processing for wearable systems								K3
	CO3	Elucidate the usage of energy techniques for wearable devices								K3
	CO4	Gain knowledge about wireless health technology								K3
	CO5	Analyse the applications of wearable systems								K3
UNIT – I	Introduction to Wearable Systems and Sensors						Periods:9			
Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, E-Textiles - AI-based Activity Recognition Systems - AI-enabled Smart Textiles										CO1
UNIT – II	Signal Processing						Periods:9			
Wearability issues -physical shape and placement of sensor, technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information - AI-based Noise and Artifact Removal-Edge AI Signal Processing										CO2
UNIT – III	Energy Harvesting for Wearable Devices						Periods:9			
Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles - AI-optimized Energy Management Systems - AI-assisted Hybrid Energy Harvesting Control										CO3
UNIT – IV	Wireless Health Technology						Periods:9			
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture, Wireless communication techniques -AI-based Anomaly Detection in BANs- AI-driven Secure Communication										CO4
UNIT – V	Applications of Wearable Systems						Periods:9			
Medical Diagnostics - Medical monitoring of patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording-AI-based Predictive Health Analytics-AI-enabled Clinical Decision Support Systems										CO5
Lecture Periods: 45			Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Text Books										
1. Helena Jelinkova, “Lasers for medical applications: Diagnostics, Therapy and Surgery”, 1st edition, Woodhead Publishing, 2013.										
2. Markolf. H.Neimz, “Laser tissue interactions-Fundamentals and applications”, 3rd edition, Springer, 2014.										
3. Subhas Chandra Mukhopadhyay and Tarikul Islam, “Wearable Sensors Applications, design and implementation”, IOP Publishing Ltd, 2017.										
Reference Books										
1. Orazio Svelto and David C. Hanna, “Principles of lasers”, 5th edition, Springer, 2010.										
2. William T. Silfvast, “Laser fundamentals”, 2nd edition, Cambridge University Press, 2009.										
3. Bonfiglio, Annalisa, De Rossi, Danilo, “Wearable Monitoring Systems”, 1st Edition, Springer US, 2011.										
4. Hang, Yuan-Ting, “wearable medical sensors and systems” , Springer – 2013.										
5. Mehmet R. Yuce, Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation and Applications”, Pan Standard Publishing, Singapore, 2012.										
Web References										
1. https://en.wikipedia.org/wiki/Smart_wearable_system										
2. https://www.ncbi.nlm.nih.gov/pubmed/15227552										
3. https://www.researchgate.net/publication/232811306_Smart_wearable_systems_Currentstatus_and_future_challenges										



4. <https://m.youtube.com/watch?v=Mj1aH7CkNCw>5. <https://youtu.be/tpTnraEagw4>

* TE – Theory Exam, LE – Lab Exam

COs/POs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	3	1	1	1	3	2	2	3	2	2
2	3	3	2	2	3	1	1	1	3	3	2	3	2	2
3	3	3	2	3	2	1	1	1	3	3	3	3	2	2
4	3	3	2	3	3	2	1	1	3	3	3	3	2	2
5	3	3	2	3	3	2	1	1	3	3	3	3	2	2

Correlation Level: 1- Low; 2 - Medium; 3 – High.

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. V.

Department	Biomedical Engineering			Program: B.Tech.						
Semester	VIII			Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME820			Periods/Week			Credit	Maximum Marks		
				L	T	P	C	CAM	ESE	TM
Course Name	Tissue Engineering			3	0	0	3	25	75	100
Prerequisite	Pathology and Microbiology									
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)
	CO1	Understand the fundamentals of tissue engineering and cell migration								K2
	CO2	Explain cell types and cell culture								K2
	CO3	Gain knowledge based on molecular cell biology								K2
	CO4	Develop the skills needed for scaffold engineering								K3
	CO5	Specify the different types of biodegradable biomaterials that can be used in tissue engineering applications								K3
UNIT-I	Introduction						Periods: 09			
Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, development and use in therapeutic - AI-based Histopathological Image Analysis - AI-driven Cell Migration Prediction										CO1
UNIT-II	Cell Culture						Periods: 09			
Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, 3-D architecture and cell incorporation – Bioreactors- AI-based Automated Cell Counting and Viability Analysis - AI-guided Stem Cell Differentiation Control										CO2
UNIT-III	Molecular Biology						Periods: 09			
Cytokines, growth factors and hormone - Cell signaling, growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers- AI-based Signaling Pathway Modeling - AI-assisted Biomolecule Interaction Prediction										CO3
UNIT-IV	Scaffold Engineering						Periods: 09			
Biomaterials for tissue engineering, Properties: porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver-AI-based Scaffold Design Optimization - AI-assisted 3D Bioprinting Control Systems										CO4
UNIT-V	Case Studies						Periods: 09			
Case study: transplantation for liver, musculoskeletal, cardiovascular, neural, tissue engineering. Ethical, FDA and regulatory issues of tissue engineering - AI-based Clinical Outcome Prediction - AI-assisted Regulatory and Trial Data Analysis										CO5
Lecture Periods: 45			Tutorial Periods:			Practical Periods: -		Total Periods: 45		
Text Books										
1.Clemens van Blitterswijk, "Tissue Engineering", Academic Press, 2008.										
2. Robert. P. Lanza, Robert Langer &William L. Chick, "Principles of Tissue Engineering", 5 th Edition, Academic press, 2020.										
3. Anthony Atala, Robert Lanza, Tony Mikos, Robert Nerem, "Principles of Regenerative Medicine, 5 th Edition, Academic press, 2018.										
Reference Books										
1. Endarle, Blanchard &Bronzino, "Introduction to Biomedical Engineering", Academic press.										
2. B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino, "Tissue Engineering", CRC- Taylor & Francis.										
3. Clemens A. Van Blitterswijk and Jan De Boer, "Tissue Engineering", 2 nd Edition, Academic Press, 2015.										
4. John P. Fisher,Antonios G. Mikos, Joseph D. Bronzino, "Tissue Engineering",1 st Edition, CRC Press, 2007										
5. BojanaObradovic, "Cell and Tissue Engineering", 1 st Edition, Springer-Verlag Berlin Heidelberg Press, 2012.										
Web References										



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2.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2475566/
3.	https://www.nature.com/subjects/tissue-engineering
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5.	https://youtu.be/uLexdKS8pcw

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	-	-	3	3	-	-
2	3	3	2	2	3	-	-	-	-	-	3	3	-	-
3	3	3	2	2	3	-	-	-	-	-	3	3	-	-
4	3	3	2	2	3	-	-	-	-	-	3	3	-	-
5	2	3	2	2	3	-	-	-	-	-	3	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme: B.Tech.							
Semester	VIII				Course Category: PE		End Semester Exam Type: TE					
Course Code	U23BME821				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Pattern Recognition and Expert Systems in Medicine				3	0	0	3	25	75	100	
Prerequisite												
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Explain the basic concepts and components of pattern recognition systems.										K2
	CO2	Apply statistical pattern recognition techniques for classification problems.										K3
	CO3	Analyze patterns using syntactic and structural approaches.										K3
	CO4	Describe the fundamentals of Artificial Intelligence and knowledge representation										K2
	CO5	Apply expert system concepts for solving medical diagnostic problems.										K4
UNIT - I	Pattern Recognition: Basic Concepts							Periods:09				
Overview of Pattern Recognition – Pattern recognition system – Feature extraction – Training and learning – Classification of pattern recognition techniques – Statistical, syntactic and neural approaches – Discriminant functions in pattern recognition systems-AI-based Feature Selection Tools-AI-driven Pattern Classification Systems.											CO1	
UNIT - II	Statistical Pattern Recognition							Periods:09				
Parametric estimation – Supervised learning – Maximum likelihood estimation – Bayesian parameter estimation – non-parametric approaches – Parzen window method – k-Nearest Neighbor (k-NN) estimation – Unsupervised learning – Clustering concepts-AI-based Probabilistic Disease Diagnosis Models-AI-powered Clustering for Medical Data Analysis											CO2	
UNIT - III	Syntactic Pattern Recognition							Periods:09				
Grammar-based approaches – Elements of formal grammars – Parsing concepts – Parsing algorithms – Transition networks – Higher dimensional grammars – Stochastic grammars – Graphical approach – Graph isomorphism – Attributed graphs-AI-based Structural Pattern Recognition in Medical Images - AI-enabled Graph-based Disease Modelling											CO3	
UNIT - IV	Artificial Intelligence							Periods:09				
Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms - AI-based Network Traffic Prediction and Optimization - AI-assisted QoS Management for Telemedicine											CO4	
UNIT - V	Expert Systems in Medical Applications							Periods:09				
Expert system concepts – Expert system architecture – non-production system architecture – Medical expert systems – MYCIN and EMYCIN – Development of medical expert systems – Heart disease diagnosis – Categories of heart diseases – Knowledge base – Database information – Handling uncertain and chaotic data – Sample expert system design - AI-based Clinical Decision Support Systems (CDSS) - AI-driven Heart Disease Prediction Systems											CO5	
Lecture Periods:45				Tutorial Periods: -			Practical Periods: -		Total Periods:45			
Text Books												
1. Duda, R. O., Hart, P. E., Stork, D. G. Pattern Classification, 2nd Edition, Wiley, 2012. 2. Bishop, C. M. Pattern Recognition and Machine Learning, Corrected 2nd Printing, Springer, 2016. 3. Russell, S., Norvig, P.Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.												
Reference Books												
1. Webb, A. R., Copsey, K. D. Statistical Pattern Recognition, 3rd Edition, Wiley, 2011. 2. Theodoridis, S., Koutroumbas, K. Pattern Recognition, 4th Edition, Academic Press (Elsevier), 2009. 3. Nilsson, N. J. Principles of Artificial Intelligence, Reprint Edition, Morgan Kaufmann, 2014. 4. Jackson, P. Introduction to Expert Systems, 3rd Edition, Addison-Wesley, 2019. 5. Paul Fieguth, An Introduction to Pattern Recognition and Machine Learning, 1st Edition, Springer Nature, 2022.												



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3. <https://youtu.be/-vsCj0ijP4U>
4. <https://youtu.be/gXpi1czz5NA>
5. <https://youtu.be/C-ZmfZNP5ns>

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	2	2	-	-	-	-	-	-	3	3	2
2	3	1	2	2	2	-	-	-	-	-	-	3	2	1
3	3	2	1	2	2	-	-	-	-	-	-	2	3	1
4	3	2	2	3	2	2	-	-	-	-	-	3	3	1
5	3	2	1	3	2	2	-	-	-	-	3	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering				Programme:B.Tech.							
Semester	VIII				Course Category:PC		*End Semester Exam Type:TE					
Course Code	U23BME822				Periods/Week		Credit	Maximum Marks				
					L	T	P	C	CAM	ESE	TM	
Course Name	Bio MEMS				3	0	0	3	25	75	100	
Prerequisite	Physics											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)	
	CO1	Determines various MEMS design techniques.										K1
	CO2	Elucidate explain different types of fabrication techniques.										K3
	CO3	Able to gain different actuators and their principles of operation at the micro-Scale level.										K2
	CO4	Acquire knowledge about microfluidic systems.										K2
	CO5	Performs MEMS in different field of medicine.										K2
UNIT-I	MEMS Design							Periods:9				
Mechanics for MEMS design – scaling laws in MEMS, stress–strain relations at microscale, static bending of thin beams and plates, mechanical vibration, thermo-mechanics, fracture mechanics and thin-film mechanics. Mechanical sensors and actuators – beams and cantilevers, microplates and membranes, strain, pressure, flow measurement. - AI-based MEMS Structure Optimization - AI-assisted Failure and Fatigue Prediction												CO1
UNIT-II	MEMS Fabrication							Periods:9				
Materials for MEMS – active substrate materials: silicon and its compounds, silicon piezo resistors, gallium arsenide, quartz, polymers and bio-compatible materials. Micromachining techniques – photolithography, thin-film deposition (PVD, CVD), oxidation, diffusion and ion implantation, etching. Bulk micromachining, wafer bonding, LIGA process, introduction to CMOS-MEMS integration-AI-driven Process Parameter Optimization - AI-based Defect Detection in MEMS Fabrication												CO2
UNIT-III	Bio-MEMS Sensors							Periods:9				
Bio-MEMS microsensors and actuators – Inertial sensors, pressure sensors, flow sensors, tactile sensors. Electrostatic actuators – comb drive actuators. Piezoelectric sensors and actuators – inchworm motor, flow sensors. Bio-compatibility considerations and signal transduction mechanisms in BioMEMS sensors - AI-based Signal Interpretation in BioMEMS Sensors - AI-assisted Multi-sensor Data Fusion												CO3
UNIT-IV	Microfluid Dynamics							Periods:9				
Fluid dynamics – continuity equation, momentum equation, equation of motion. Fluid flow in micro conduits, microscale fluid. Expression for liquid flow in microchannels. Fluid actuation methods – electro-osmotic flow, pressure-driven flow, dielectrophoretic. Microfluid dispensers, microneedles, micromixers, micropumps, continuous-flow microfluidic systems-AI-based Microfluid Flow Prediction Models-AI-optimized Micromixer and Micropump Design												CO4
UNIT-V	Bio-MEMS Applications							Periods:9				
Micro Total Analysis Systems (µTAS) – detection and measurement methods. Microsystem approaches to PCR. DNA and protein sensors. MEMS-based drug delivery systems. BioMEMS chips, Sensors. Implantable devices. Microprobe arrays for biomedical applications. Wearable and environmental BioMEMS applications. Ethical, safety and regulatory aspects of BioMEMS-AI-powered Point-of-Care Diagnostic Systems-AI-based Personalized Drug Delivery Control												CO5
Lecture Periods:45			Tutorial Periods: -			Practical Periods: -			TotalPeriods:45			
Text Books												
1. Albert Folch, “Introduction to BioMEMS”, CRC Press, 2012												
2. Wanjun Wang, Stephen A.Soper, “BioMEMs: Technologies and Applications”, 1st Edition, CRC Press, 2007.												
3. Mauro Ferrari, Rashid Bashir, Steven Wereley, “BioMEMS and Biomedical Nanotechnology, Vol IV Biomolecular Sensing, Processing and Analysis” Springer US, 1st Edition, 2007.												
Reference Books												
1. Marc J. Madou , “Fundamentals of Microfabrication: The Science of Miniaturization”, 2nd Edition, CRC Press, 2002.												
2. S Nihtianov A. Luque, “Smart Sensors and MEMS Intelligent Sensing Devices and Microsystems for Industrial Applications”, 2nd Edition, Woodhead Publishing, 2018.												
3. Guang-Zhong Yang, "Body Sensor Networks", 1st Edition, Springer, 2006.												
4. Teena James, Manu Sebastian Mannoor, Dentcho V. Ivanov, “BioMEMS –Advancing the Frontiers of Medicine”, MDPI Publication, 2008.												



5. Siva Yellampalli, "MEMS Sensors", Intechopen, 2018.

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1. <https://en.wikipedia.org/wiki/Bio-MEMS>
2. <http://www.isssonline.in/journal/03paper12.pdf>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4719786/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	3	2	1	2	-	2	2	3	3	2	2
2	3	2	2	3	3	2	1	2	-	2	2	3	3	2	2
3	3	2	2	3	3	2	1	2	-	2	2	3	3	2	2
4	3	2	2	3	3	2	1	2	-	2	2	3	3	2	2
5	3	2	2	3	3	2	1	2	-	2	2	3	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. Vijayalakshmi

PROFESSIONAL ELECTIVE –VI
(Offered in Semester VIII)

Department	Biomedical Engineering			Programme:B.Tech.							
Semester	VIII			Course Category:BS			*End Semester Exam Type:TE				
Course Code	U23ME823			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Clinical Engineering			3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to									BT Mapping (Highest Level)	
	CO1	Explain the fundamentals and evolution of clinical engineering in healthcare systems.									K2
	CO2	Interpret the structure and implementation of national health policies in hospitals.									K3
	CO3	Analyse the principles, phases, and regulatory aspects of clinical trials.									K3
	CO4	Demonstrate quality management concepts and accreditation standards in healthcare.									K3
	CO5	Apply clinical engineering concepts in hospital administration and healthcare technology management.									K3
UNIT-I	Introduction						Periods:9				
Evolution of clinical engineering – scope and objectives – hospital organization – role of clinical engineer – clinical engineering programs – equipment management – safety practices – staff structure in hospitals – preventive maintenance – biomedical equipment calibration – technology assessment – equipment life-cycle management – documentation and record keeping. AI-Based Biomedical Equipment Management System - Predictive Maintenance of Medical Equipment Using Artificial Intelligence										CO1	
UNIT-II	National Health Policy						Periods:9				
Need for health policy – national health policy overview – health organizations at state and central levels – health financing system – health education – health insurance – health legislation – public health programs – primary healthcare system – national digital health mission – healthcare indicators – role of NGOs in healthcare-Role of Artificial Intelligence in National Digital Health Mission (NDHM/ABDM) - AI Applications in Public Health Planning and Healthcare Financing										CO2	
UNIT-III	Clinical Trials						Periods:9				
Glossary of clinical trial terms – history of clinical trials – new drug development process – need and selection of drug compounds – screening of compounds – translational medicine – preclinical studies – goals of clinical trials – target population and patient selection – phases of clinical trials – clinical trial protocol – ethics committee – informed consent – adverse drug reactions - Artificial Intelligence in Drug Discovery and Development - AI-Based Patient Selection and Monitoring in Clinical Trials										CO3	
UNIT-IV	Quality Management in Health Care						Periods:9				
Quality management in hospitals and laboratories – need for standardization – quality assurance and control – NABH and NABL standards – FDA – Joint Commission – ICRP and other standard organizations – clinical audit – risk management – patient safety – incident reporting – continuous quality improvement – biomedical waste management-AI in Hospital Quality Assurance and NABH/NABL Accreditation-Artificial Intelligence for Patient Safety and Risk Management										CO4	
UNIT-V	Application in Health Care						Periods:9				
Computer applications in healthcare – ICU systems – hospital information system – PACS for radiology department – clinical laboratory administration – patient data and medical records – hospital communication systems – telemedicine – electronic health records – decision support systems – healthcare networking – medical data security-AI-Based Clinical Decision Support Systems in Healthcare - Applications of Artificial Intelligence in Telemedicine and Smart Hospitals										CO5	
LecturePeriods:45			Tutorial Periods: -			Practical Periods: -			TotalPeriods:45		
Text Books											
1. Ernesto Iadanza, “Clinical Engineering Handbook (Biomedical Engineering)”, Academic Press, 3rd Edition, 2023. 2. Joseph Dyro, “Clinical Engineering Handbook”, Elsevier Academic Press, Reprint Edition, 2020. 3. Samantha Jacques and Barbara Christe, “Introduction to Clinical Engineering”, Academic Press, 1st Edition, 2020.											



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1. Shein-Chung Chow and Jen-Pei Liu, "Design and Analysis of Clinical Trials: Concepts and Methodologies", John Wiley & Sons, 4th Edition, 2022.
2. Eleanor McFadden, "Management of Data in Clinical Trials", Wiley Publishers, 3rd Edition, 2019.
3. Susanne Prokscha, "Practical Guide to Clinical Data Management", CRC Press (Taylor & Francis), 4th Edition, 2020.
4. Richard K. Rondel, Sheila A. Varley and Colin F. Webb, "Clinical Data Management", Wiley Publications, 3rd Edition, 2015.
5. World Health Organization, "Handbook for Good Clinical Research Practice (GCP)", WHO Press, Updated Edition, 2023.

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2. <https://www.youtube.com/playlist?list=PLelwGZPgiz5Q4R5Y6HY4mXZmgWhWdiQQ>
3. https://nptel.ac.in/courses/109106095?utm_source=chatgpt.com

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	2	1	3	2	-	-	-	-	1	3	3	3
2	3	1	1	-	-	2	-	-	-	-	-	2	2	2
3	3	2	1	-	2	2	-	-	-	-	-	3	3	2
4	3	3	2	-	-	2	-	-	-	-	-	3	3	3
5	3	3	3	-	3	2	-	-	-	-	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Department	Biomedical Engineering		Program: B.Tech.						
Semester	VIII		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME824		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Virtual Reality in Medicine		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Apply troubleshooting techniques to identify equipment failures						K3	
	CO2	Describe the testing procedures of active and passive components						K3	
	CO3	Analyze the fault diagnosis in analog circuits and digital ICs						K4	
	CO4	Identify the problems in common biomedical equipment in hospitals when it is not working and provide a suitable solution						K4	
	CO5	Describe the various quality measures and standards adapted for medical systems						K3	
UNIT – I	Introduction to Virtual Reality in Medicine					Periods:9			
Virtual Reality (VR) – Definition and scope – Applications of VR in Medicine – Principles of Virtual Reality – Forms of Reality (Virtual Reality, Augmented Reality, Mixed Reality) – Reality Systems – Concepts of Immersion and Presence – Illusions of Presence – Reality Trade-offs – Basic Design Guidelines for Medical VR Systems-AI-driven Adaptive VR Environments - AI-based User Behavior Analytics in VR								CO1	
UNIT – II	Visual And Auditory Response in Medical VR					Periods:9			
Human Visual Sense and Perception – Visual Display Technologies (HMDs, stereoscopic displays) – Rendering Techniques in Computer Graphics – Applications of Visual Display in Medical VR – Human Auditory Sense and Perception – Auditory Display Technologies – Auditory Rendering Techniques – Applications of Auditory Display in Medical VR - AI-based Real-time Rendering Optimization - AI-powered Spatial Audio Generation								CO2	
UNIT – III	Virtual Reality for Rehabilitation and Medical Training					Periods:9			
Rationale for the Use of VR in Rehabilitation – VR-supported Physiotherapy – VR-supported Psychotherapy – Introduction to VR in Medical Training – Tool-based VR Applications – Phantom-based VR Applications – Skill Acquisition and Performance Assessment-AI-assisted Personalized Rehabilitation Systems-AI-based Skill Evaluation and Feedback Systems								CO3	
UNIT – IV	Medical Model Operation and Simulation					Periods:9			
Medical Imaging Modalities – Image Segmentation Techniques – Model Conversion – Mesh Reduction and Smoothing – Modeling Organ Variability – Integration of Pathologies – Generation of Vascular Structures – Biomechanical Parameters – Organ Texture Generation-AI-based Automatic Image Segmentation-AI-driven Anatomical Model Generation.								CO4	
UNIT – V	VR For Planning and Intraoperative Support					Periods:9			
Surgical Planning Using VR – Augmented Reality in Surgery – Image-guided Surgery – Mass Spring Models (MSM) – Continuum Mechanics – Finite Element Method (FEM) – Advantages and Disadvantages of MSM and FEM – Clinical Applications in Surgical Simulation and Decision Support-AI-assisted Surgical Planning and Risk Prediction-AI-powered Intraoperative Decision Support								CO5	
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Textbooks									
1. Robert Reiner & Matthias Harder, Virtual Reality in Medicine, Springer, 2012.									
2. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, Association for Computing Machinery & Morgan & Claypool Publishers, 2016.									
3. Matthias Harder, Surgical Scene Generation for Virtual Reality Based Training in Medicine, Springer, 2008.									
Reference Books									
1. John Vince, Introduction to Virtual Reality, Springer-Verlag Ltd., 2004.									
2. William R. Sherman & Alan B. Craig, Understanding Virtual Reality: Interface, Application, Design, Morgan Kaufmann Series, 2003.									
3. C. Burdea & Philippe Coiffet, Virtual Reality Technology, Second Edition, John Wiley & Sons, Inc., 2008.									



Dr. A.Vijayalakshmi

B.Tech. Biomedical Engineering

4. Andrew Davison, Killer Game Programming in Java, O'Reilly SPD, 2005.
5. Paul Mealey, Virtual and Augmented Realities for Dummies, John Wiley & Sons, 2018.

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1. <https://youtu.be/Nq3mPFgpREE?t=7>
2. <https://youtu.be/J2uQ19baVYM?t=3>
3. <https://youtu.be/pJnvYjn42fE>
4. https://youtu.be/OyB1fkJ_rY?t=9
5. <https://youtu.be/taUqCm6Lcmo?t=6>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	-	-	-	-	1	2	2	3
2	3	2	1	1	2	1	-	-	-	-	1	2	2	3
3	3	3	2	1	2	1	-	-	-	-	1	2	2	3
4	3	3	2	1	2	1	-	-	-	-	1	2	1	1
5	3	3	2	1	2	1	-	-	-	-	1	2	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

A. V.

Department	Biomedical Engineering			Programme :B.Tech.							
Semester	VIII			Course Category:PE			*End Semester Exam Type: TE				
Course Code	U23BME825			Periods/Week			Credit	Maximum Marks			
				L	T	P	C	CAM	ESE	TM	
Course Name	Brain Computer Interface and Applications			3	0	0	3	25	75	100	
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to								BT Mapping (Highest Level)		
	CO1	Apply the fundamental concepts of brain-computer interfaces to analyze system structure and signal types								K4	
	CO2	Evaluate brain signal acquisition and activation patterns effectively.								K5	
	CO3	Develop signal processing and feature extraction pipelines for BCI.								K3	
	CO4	Apply machine learning to classify and decode brain signals.								K4	
	CO5	Develop various application using BCI								K2	
UNIT-I	Introduction to BCI						Periods:9				
Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI - Partially Invasive BCI - Non-Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI- AI-based Brain Signal Interpretation Systems-AI-driven Adaptive BCI Calibration										CO1	
UNIT-II	Brain Activation						Periods:9				
Brain activation patterns - Spikes, Oscillatory potential and ERD, slow cortical potentials, Movement related potentials - Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks-AI-based Automatic Artifact Removal-AI-driven Feature Learning										CO2	
UNIT-III	Feature Extraction Methods						Periods:9				
Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering - Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence-Deep Learning-based BCI Classifiers-AI-based Transfer Learning for BCI										CO3	
UNIT-IV	Machine Learning Methods for BCI						Periods:9				
Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis-AI-assisted Neural Decoding for Prosthetic Control-AI-driven Closed-loop Neuroprosthetic Systems										CO4	
UNIT-V	Applications of BCI						Periods:9				
Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection, Ethics of Brain Computer Interfacing-AI-based Emotion and Cognitive State Recognition-AI-powered Intelligent Assistive Systems										CO5	
LecturePeriods:45			TutorialPeriods:15			Practical Periods: -			TotalPeriods:45		
Text Books											
1. Rajesh.P.N.Rao, “Brain-Computer Interfacing: An Introduction”, 1st Edition, Cambridge University Press, 2013. 2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, “Brain Computer Interfaces: Principles and practice”, 1 st Edition, Oxford University Press, 2023. 3. Chang S. Nam, Anton Nijholt, Fabien Lotte (Eds.), “Brain-Computer Interfaces Handbook: Technological and Theoretical Advances”, CRC Press (Taylor & Francis), 1st Edition, 2018											
Reference Books											
1. Ildar Rakhmatulin, Ganesh R. Naik, “EEG Signal Processing with Python: Machine Learning Techniques for Brain-Computer Interface Development”, Springer Singapore, 1st Edition, 2026. 2. Faridoddin Shariaty, Sanjiban Sekhar Roy, “MATLAB® for Brain-Computer Interface Systems: Computation and Data Processing, CRC Press”, 1st Edition, 2025 3. Aboul Ella Hassianien, Ahmad Taher Azar (Eds.), “Brain-Computer Interfaces Current Trends and Applications”, Springer, 2015. 4. Dipali Bansal, Rashima Mahajan, “EEG-Based Brain-Computer Interfaces: Cognitive Analysis and Control Applications”, Elsevier, 1st Edition, 2019											



5. Narayan Panigrahi, "Brain Computer Interface: EEG Signal Processing", CRC Press, 1st Edition, 2024.

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2. <https://youtu.be/jn2E62Y>
3. <https://youtu.be/gmli6EyiNRw>
4. <https://youtu.be/5Q0gemu-h3Q>
5. <https://youtu.be/Qv-H6QSYKhA>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	1	1	2	3	2	2	3
2	3	3	2	2	2	1	1	1	1	2	3	3	2	3
3	2	3	2	2	2	1	1	1	1	2	2	3	2	2
4	3	3	2	3	2	1	1	1	1	2	3	3	2	3
5	3	3	3	2	3	2	2	2	2	3	3	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. A. Vijayalakshmi

B.Tech. Biomedical Engineering

Department	Biomedical Engineering		Program: B.Tech.						
Semester	VIII		Course Category: PE			*End Semester Exam Type: TE			
Course Code	U23BME826		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	Medical Ethics and Intellectual Property Rights		3	0	0	3	25	75	100
Prerequisite									
Course Outcomes	On completion of the course, the students will be able to							BT Mapping (Highest Level)	
	CO1	Understand fundamental concepts of medical ethics and professionalism						K2	
	CO2	Explain ethical frameworks and moral principles relevant to healthcare						K3	
	CO3	Apply ethical decision-making in health and research contexts						K4	
	CO4	Comprehend Intellectual Property Rights (IPR) concepts and their relevance						K3	
	CO5	Analyze IPR procedures and protection mechanisms in biomedical innovation						K4	
UNIT – I	Introduction to Medical Ethics					Periods:9			
Definition, scope and importance of medical ethics – Professional ethics in healthcare – Code of medical ethics (AMA/CMA) – Roles and responsibilities in healthcare delivery – Rights and duties of patients and healthcare professionals – Confidentiality and informed consent – Ethical decision-making in clinical practice-AI-based Clinical Ethics Decision Support Systems-AI-powered Patient Consent Management Systems							CO1		
UNIT – II	Ethical Theories, Moral Principles and Cases					Periods:9			
Basic ethical theories (Deontology, Utilitarianism, Virtue ethics) – Moral principles (autonomy, beneficence, non-maleficence, justice) – Ethical dilemmas in healthcare – End of life care – Euthanasia – Organ transplantation ethics – Clinical trials and human subject research ethics – Case studies from biomedical context-AI-based Ethical Scenario Simulation Tools-AI-assisted Risk–Benefit Analysis in Clinical Trials							CO2		
UNIT – III	Ethics in Biomedical Research and Public Health					Periods:9			
Research ethics and misconduct – Publication ethics – Plagiarism – Conflict of interest – Institutional Ethics Committees – Guidelines (ICMR/Declaration of Helsinki) – Privacy and data protection in health research – Social and cultural dimensions of bioethics-AI-powered Plagiarism and Research Integrity Tools-AI-based Public Health Ethics Monitoring Systems							CO3		
UNIT – IV	Introduction to Intellectual Property Rights					Periods:9			
Concept of IPR – Need and importance in technology & healthcare – Types of IPR: patents, copyright, trademarks, industrial design, trade secrets, geographical indications – Overview of national & international IP regime (WTO, WIPO, TRIPS, Paris Convention) – Patentable subject matter including biomedical inventions and life-science innovations-AI-based Prior Art Search Tools-AI-driven Patent Classification and Mapping Systems							CO4		
UNIT – V	IPR Protection and Procedures in Biomedical Context					Periods:9			
Patent filing procedures in India – Specification, claims, examination and grant – Rights of patentee and infringement – Licensing and commercialization – Case studies on medical device and pharmaceutical patents – Copyrights and designs in healthcare publications and software-AI-assisted Patent Drafting and Claim Optimization Tools-AI-based IP Portfolio Management Systems							CO5		
Lecture Periods: 45		Tutorial Periods:		Practical Periods: -		Total Periods: 45			
Textbooks									
1. N. G. Udayashankar & Sangeeta Srivastava, Medical Ethics and Professionalism, Cambridge University Press, 2021.									
2. David I. Levine, Medical Ethics and Law: A Handbook for Clinical Practice, Springer, 2020.									
3. WIPO, Intellectual Property Handbook: Policy, Law and Use, 3rd Edition, WIPO Publications, 2019.									
Reference Books									
1. Beauchamp & Childress, Principles of Biomedical Ethics, 8th Edition, Oxford University Press, 2019.									
2. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, Cengage Learning, 2016.									
3. V. K. Ahuja, Law Relating to Intellectual Property Rights, 3rd Edition, LexisNexis, 2020.									



4. S. G. Bineesa & T. Sibi, Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship, S. Publications, 2020.
5. ICMR Ethical Guidelines for Biomedical Research on Human Participants, Government of India.

Web References

1. <https://www.wipo.int/about-ip/en/>
2. <https://www.ipindia.nic.in/>
3. https://icmr.gov.in/ethical_guidelines.html
4. <https://www.who.int/ethics>
5. <https://tripsonline.org/>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	–	–	–	1	–	2	2	3
2	3	2	1	1	2	1	–	–	–	1	–	2	2	3
3	3	3	2	1	2	1	–	–	–	1	–	2	2	3
4	3	3	2	1	2	1	–	–	–	1	–	2	1	1
5	3	3	2	1	2	1	–	–	–	1	–	2	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering				Programme:B.Tech.						
Semester	VIII				Course Category:PC		*End Semester Exam Type:TE				
Course Code	U23BME827				Periods/Week		Credit	Maximum Marks			
					L	T	P	C	CAM	ESE	TM
Course Name	Acoustics and Optical Imaging				3	0	0	3	25	75	100
(Common to BME and ICE Branches)											
Prerequisite											
Course Outcomes	On completion of the course, the students will be able to										BT Mapping (Highest Level)
	CO1	Understand the basic knowledge of acoustic									K2
	CO2	Gain knowledge about the principle of optics.									K3
	CO3	Explain about the necessity of bio imaging.									K3
	CO4	Apply the concept of optical imaging in therapeutic application.									K4
	CO5	Explain the diagnostic application in optical imaging.									K3
UNIT-I	Acoustic Basics							Periods:9			
Acoustics – Definition and scope – Types of acoustics – Biomedical acoustics – Applications of acoustics in healthcare – Acoustic environment in hospitals – Medical acoustic equipment – Sound absorption and acoustic materials – Noise sources in clinical settings – Noise reduction and control strategies – Mechano-transduction effect – Acoustic sensors and transducers – Primary acoustic issues affecting patient care teams – Acoustic measurements and standards – Design strategies for improved acoustic performance in healthcare facilities-AI-based Hospital Noise Monitoring Systems-AI-assisted Acoustic Signal Analysis Tools											CO1
UNIT-II	Principle of Optics							Periods:9			
Nature and properties of light – Electromagnetic spectrum – Interaction of light with molecules – Interaction of light with bulk biological matter – Optical properties of tissues – Fundamentals of spectroscopy – Principle and instrumentation – Types of spectroscopy: Conventional, Fourier Transform, Michelson interferometer – Electronic absorption spectroscopy – Vibrational spectroscopy (IR and Raman) – Fluorescence spectroscopy – Applications in biomedical diagnostics-AI-based Spectral Pattern Recognition Systems-AI-driven Tissue Optical Property Estimation											CO2
UNIT-III	Bio Imaging							Periods:9			
Introduction to optical bio-imaging – Imaging contrast mechanisms – Optical microscopy – Principle and classification – Fluorescence microscopy – Confocal and scanning microscopy – Inverted and upright microscopes – Multiphoton microscopy – Total Internal Reflection Fluorescence (TIRF) microscopy – Fluorescence Resonance Energy Transfer (FRET) – Fluorescence Lifetime Imaging Microscopy (FLIM) – Advantages and limitations of optical imaging – Bio-imaging fluorophores – Green Fluorescent Protein (GFP) and applications-AI-based Automated Image Segmentation and Analysis-AI-enhanced Super-Resolution Imaging											CO3
UNIT-IV	Therapeutic Application							Periods:9			
Phototherapy – Principles and biological effects – Photodynamic Therapy (PDT) – Mechanism of action – Photosensitizers – Light sources for PDT – Oncological applications of PDT – Non-oncological applications – Image-guided phototherapy – Bio stimulation and photo biomodulation effects – Clinical applications in wound healing, pain management and tissue regeneration-AI-guided Personalized Phototherapy Planning-AI-based Treatment Outcome Prediction Systems											CO4
UNIT-V	Diagnostic Application							Periods:9			
Optical Coherence Tomography (OCT) – Principle and biomedical applications – Elastography – Optical elastography techniques – Raman imaging – Fluorescence Lifetime Imaging (FLIM) in diagnosis – X-ray diagnostic techniques – Near-field optical imaging – Photoacoustic imaging – Emerging optical diagnostic techniques in biomedical applications-AI-based Multimodal Image Fusion Systems-AI-assisted Computer-Aided Diagnosis (CAD)											CO5
Lecture Periods:45			Tutorial Periods: -			Practical Periods: -			TotalPeriods:45		
Text Books											
1. Paras N. Prasad, “Introduction to Bio photonics, A. John Wiley and sons, Inc”, Publications, 2nd Edition, 2016.											
2. Alexander D. Mehta & Vadim Backman (Editors), Biomedical Optical Imaging,Oxford University Press, 2020.											
3. R S Sedha “A Textbook of Applied Electronics”S.Chand Publications, 2008											

Reference Books

1. Irving J. Bigio & Sergio Fantini, Quantitative Biomedical Optics, Cambridge University Press, 2016;
2. Gerd Keiser, Biophotonics: Concepts to Applications, 1st Edition, 2022
3. Reda R. Gharieb, "Photoacoustic Imaging - Principles, Advances and Applications", 2020
4. Tuan Vo-Dinh (Editor), Biomedical Photonics Handbook: Fundamentals, Devices, and Techniques, 2nd Edition, CRC Press (Taylor & Francis), 2015
5. Wenfeng Xia (Editor), Biomedical Photoacoustics: Technology and Applications, 1st Edition, Springer Cham, 2024

Web References

1. <https://nptel.ac.in/courses/117/103/117103063/>
2. <https://nptel.ac.in/courses/108/108122/>
3. <https://www.spiedigitallibrary.org/>
4. <https://www.nature.com/subjects/biophotonics>

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	2	1	-
CO2	3	2	1	-	2	-	-	-	-	-	-	2	2	-
CO3	2	3	1	-	2	1	-	-	-	-	-	3	2	-
CO4	2	2	3	2	3	1	-	-	-	-	-	3	3	1
CO5	2	3	2	2	3	1	-	-	-	-	-	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100



Department	Biomedical Engineering	Programme: B.Tech.						
Semester	VIII	Course Category: PA			*End Semester Exam Type: LE			
Course Code	U23BMW805	Periods/Week			Credit	Maximum Marks		
Course Name	Project Phase - II	L	T	P	C	CAM	ESE	TM
Prerequisite		0	0	4	2	50	50	100
Each batch of 2 or 3 students shall continue the project work initiated in Project Phase – I under the supervision of the same guide. The Project Phase – II work shall be carried out during the 8th semester and must be completed by the end of the semester. In Project Phase – II, the emphasis shall be on implementation, experimentation, result analysis, validation, and documentation of the proposed work. Students are expected to demonstrate substantial progress beyond Phase – I, leading to a complete and functional project outcome. The progress of the project shall be monitored and evaluated through periodic reviews conducted by an internal assessment committee consisting of the Project Guide, the Head of the Department, and one additional faculty member nominated by the department.								

CAM and ESM break-up for Project Phase-II

Sl. No	Description			Weightage
1	Continuous Assessment Marks			
a	Review1	Review Committee	10	15
		Supervisor	5	
b	Review2	Review Committee	10	15
		Supervisor	5	
c	Review3	Review Committee	15	20
		Supervisor	5	
	Total CAM			50
2	End Semester Marks			
	Evaluation of Phase II Report and Viva-voce	Report	15	50
		Presentation and Viva	20	
		Demonstration	15	
	Total ESM			50
	Total Marks			100

