

 Estd. 1962 "A++" Accredited by NAAC (2021) With CGPA 3.52	SHIVAJI UNIVERSITY, KOLHAPUR 416 004, MAHARASHTRA PHONE : EPABX - 2609000, BOS Section - 0231-2609094, 2609487 Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७ वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in	 स्वतंत्रता अमृत महोत्सव	 स्वतंत्रता अमृत महोत्सव
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SU/BOS/Sci & Tech/ 183

Date: 10/06/2026

The Principal / Director,
 All Concerned Affiliated Colleges / Institutions,
 Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech. degree Programme (Affiliated Colleges)** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of Question paper and equivalence of B. Tech. degree programme under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

Sr. No.	B. Tech Course Syllabus	
1	Civil Engineering	Part-III
2	Mechanical Engineering	Part-III
3	Mechanical and Mechatronic Engineering (Additive Manufacturing)	Part-III
4	Electrical Engineering	Part-III
5	Electrical and Computer Engineering	Part-III
6	Electronics and Telecommunication Engineering	Part-III
7	Electronics & Computer Science Engineering	Part-III
8	Computer Science and Engineering	Part-III
9	Computer Science and Engineering (Artificial Intelligence & Machine Learning) (AIML)	Part-III
10	Computer Science and Engineering (Data Science) (DS)	Part-III
11	Computer Science and Engineering (Artificial Intelligence & Data Science) (AIDS)	Part-III
12	Electronics and communication Engineering (Bio-Medical Engineering)	Part-II

This Syllabus, nature of question and equivalence shall be implemented from the academic year **2026-27** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website www.unishivaji.ac.in > Syllabus > Syllabus as per NEP-2020.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2026 & March / April 2027. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,



Dy. Registrar

Copy to: for Information and necessary action

1	The I/c Dean, Faculty of Science & Technology	7	Appointment A & B Section
2	Director, Board of Examinations & Evaluation	8	Affiliation (T.1) (T.2) Section
3	The Chairperson, Respective Board of Studies	9	P.G. Admission Section,
4	Other Exam 4 Section,	10	P.G Seminar Section
5	Eligibility Section,	11	Computer Centre/ IT Cell
6	Internal Quality Assurance Cell (IQAC)		



Shivaji University

Kolhapur

Syllabus

**S. Y. B. Tech.
Electronics and Communication
Engineering
(Bio-Medical Engineering)**

To be implemented

From Academic Year 2026-27.



Exit Course for Electronics and Communication Engineering (Bio-Medical Engineering) After First Year

Exit option: Award of UG certificate in Major with 44 credits and an additional 8 credits from
Following Exit Courses

Sr. No	Course Code	Course Title	Mode	Credits
1	BM-EC-0201	Basics of Bio-Medical Engineering	Analogous Online/offline certification Course or project of total 8 credits	8
		OR		
2	BM-EC-0202	Fundamental Human Anatomy and Physiology		8

Earning of additional 2 mandatory credits for direct second year admitted students to Electronics & Communication Engineering (Bio-Medical Engineering) branch.

Sr. No.	Semester	Course Code	Subject	Credit
1	III	BM-EC-0203	Basics of Bio-Electronics	2

Distribution of the credits:

For students admitted directly into the second year of a program (at the entry level) from a different program, earning an additional 2 credits is mandatory.

Examination scheme for direct second year entry students:

Students admitted directly into the second year of a program from another program are required to complete a 2-credit entry-level course as per the prescribed curriculum. This course should be completed at their own pace to ensure alignment with the program foundational requirements. End Semester Examination (ESE) of 100 marks will be conducted at the institute level. It is mandatory to organize the examination and evaluate the performance of such students at the institute level during the third semester ESE. The evaluation report must be submitted to the Examination Section, Engineering and Technology, Shivaji University, Kolhapur.

Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Corse Code : Course Name : Basics of Bio-Electronics				
Teaching Scheme		Examination Scheme		
Lectures	--	MSE	--	
Tutorials	--	ISE	--	
Total Credits	2	ESE	--	
Prerequisite : Fundamentals of Basic Electronics				
Course Outcomes (CO): Students will be able to				
CO.1	Identify and describe key electronic concepts and components (resistors, capacitors, diodes, transistors).			
CO.2	Identify series, parallel, electronics circuits.			
CO.3	Explain the use of testing, measuring equipment's.			

CO.4	Understand safety, ethical considerations, and identify common applications of bio-electronics in healthcare.		
	Course Contents	CO	Hours
Unit 1	Introduction to Electronics Engineering: Definition and scope of electronics engineering, Overview of electronics and its applications. Basic concepts: Voltage, current, resistance, and power.	--	--
Unit 2	Electronic Components and Their Working: Passive Components: Resistors, capacitors, inductors, Working principles, symbols, and color codes. Active Components: Diodes, transistors (BJT, FET), Basic working and applications of PN junction diode, Transistor types and their applications.	--	--
Unit 3	Basic Electronic Circuits: Series and parallel circuits, Analyzing simple resistive circuits, Voltage and current dividers.	--	--
Unit 4	Semiconductor Devices and Applications: Semiconductors: Intrinsic and extrinsic properties, PN junction, forward and reverse biasing, Bipolar Junction Transistor (BJT): Working and characteristics for common emitter configurations.	--	--
Unit 5	Introduction to Digital Electronics: Digital vs. analog signals, Binary number system and logic gates (AND, OR, NOT)	--	--
Unit 6	Safety, Ethics & Applications of Bio-Electronics Electrical safety in medical equipment, Patient safety concepts, Macroshock and microshock (basic idea), Grounding and isolation (conceptual), Ethical considerations in biomedical systems, Common biomedical instruments (ECG, patient monitor), Future scope of bio-electronics	--	--
Text Books:			
1.	Ramakanth N. Basic Electronics Engineering. Pearson.		
2.	Malvino A. P., & Leach, D. P. Digital Principles and Applications. McGraw-Hill Education.		
3	Hambley A. R. Electronics for Engineers: An Introduction to Electrical and Electronics Engineering. Pearson.		
Reference Books:			
1	Boylestad R. L., & Nashelsky, L. Electronic Devices and Circuit Theory. Pearson.		

2	Grob B., & Schultz, M. Basic Electronics: A Text-Lab Manual. McGraw-Hill Education.
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SCHEME OF INSTRUCTION & SYLLABI

Name of Programme: Electronics and Communication Engineering (Bio-Medical Engineering)

Scheme of Instructions: Second Year B.Tech.in Electronics and Communication Engineering (Bio-Medical Engineering)

Semester – III

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	BM0231	Human Anatomy and Physiology	3	--	--	3	3	30	10	60	100
2	PCC	BM0232	Analog and Linear Integrated Circuits	3	--	--	3	3	30	10	60	100
3	PCC	BM0233	Electrical Circuits	3	--	-	3	3	30	10	60	100
4	PCC	BM0234	Mathematics for Biomedical Engineering	2	--	--	2	2	30	10	60	100
5	EL	BM0235	Human Anatomy and Physiology Lab	--	--	2	2	1	--	25	25	50
6	MDM	BM0236	Multi-disciplinary Minor-01	2	--	--	2	2	30	10	60	100
7	OE	BM0237	Open Elective -01	3	--	--	3	3	30	10	60	100
8	HSSM	BM0238	Universal Human Values	2	--	--	2	2	--	25	--	25
9	CEP/FP	BM0239	Analog and Linear Integrated Circuits Lab	--	--	2	2	1	--	25	--	25
10	HSSM	BM0240	Soft Skill Development	1	--	--	1	1	--	25	--	25
11	OE	BM0241	Open Elective -01 Lab	--	--	2	2	1	--	25	25	50
				19	--	6	25	22	180	185	410	800

L-Lecture

T-Tutorial

P-Practical

MSE-Mid Semester Examination ISE/CA-In Semester Evaluation/Continuous Assessment ESE-End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective other than particular (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular And Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	16	16	--	--	--	06	04	--	02
Semester Credits	--	--	11	--	06	--	03	01	--
Cumulative Sum	16	16	11	--	06	06	07	01	02

PROGRESSIVE TOTAL CREDITS: 44 + 22 = 66

SCHEME OF INSTRUCTION & SYLLABI

Name of Programme: Electronics and Communication Engineering (Bio-Medical Engineering)

Scheme of Instructions: Second Year B.Tech.in Electronics and Communication Engineering (Bio-Medical Engineering)

Semester– IV

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	BM0242	Medical Instrumentation	3	--	--	3	3	30	10	60	100
2	PCC	BM0243	Biomedical Sensors and Transducers	3	--	--	3	3	30	10	60	100
3	PCC	BM0244	Biochemistry	3	--	--	3	3	30	10	60	100
4	MDM	BM0245	Multi-disciplinary Minor-02	2	--	--	2	2	30	10	60	100
5	OE	BM0246	Open Elective -02	2	--	--	2	2	30	10	60	100
6	HSSM	BM0247	Employability Enhancement Skill	2	--	--	2	2	--	25	--	25
7	HSSM	BM0248	Professional Ethics	2	--	--	2	2	--	25	--	25
8	PCC	BM0249	Medical Instrumentation Lab	--	--	2	2	1	--	25	50	75
9	VEC	BM0250	Biomedical Sensors and Transducers Lab	--	--	2	2	1	--	25	50	75
10	VEC	BM0251	Biochemistry Lab	--	--	2	2	1	--	25	--	25
11	BSC	BM0252	Environmental Sciences	2	--	--	2	Audit	30	10	60	100
12	VSEC	BM0253	Electronics Workshop-I (Service and maintenance of Biomedical equipment)	1	--	2	3	2	--	50	25	75
			Total	20	--	8	28	22	180	235	485	800+100 (Audit)

L-Lecture

T-Tutorial

P-Practical

MSE-Mid Semester Examination ISE/CA-In Semester Evaluation/Continuous Assessment ESE-End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective Other than Particular program (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular And Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	16	16	11	--	06	06	07	01	02
Semester Credits	--	--	10	--	04	04	04	--	--
Cumulative Sum	16	16	21	--	10	10	11	01	02

PROGRESSIVE TOTAL CREDITS : 66 + 22 = 88

Exit Course for Electronics and Communication Engineering (Bio-Medical Engineering) After Second Year

Exit option: Award of UG Diploma in Major with 88 credits and an additional 8 credits from Following Exit Course				
Sr. No.	Course Code	Course Title	Mode	Credits
1	BM-EC-0204	Biomedical Instruments Maintenance	Online/offline certification Course or project of total 8 credits	8

[I] List of Electives: Verticals

Specialization	Healthcare Automation	IoT/Embedded System/Communication	AIML/CSE/IT/Programming	Communication Engineering
PEC-I	Medical Optics and Laser Application	IoT Communication Protocol	Software Design tools for Bio-sensing and Control	Computer Networks
PEC-II	Biomedical Equipment's	Internet of Things in Healthcare	Machine Learning	Bio-Control Systems
PEC-III	Invasive and Non-Invasive Medical Diagnostic Technique	Advanced Embedded Systems	Data Science using Python	Optoelectronics
PEC-IV	Mechatronics	Medical Informatics and Expert System	Brain Computer Interface	Wireless Sensor Network
PEC-V	Robotics and Automation in Medicine	CAD for VLSI (ASIC)	Cloud Computing	Mobile and Satellite Communication
PEC-VI	Artificial Organs	Advance Processors and Design	Neural Engineering	Communication Technology

[II] List of Open Electives

- To be decided commonly

Open Elective	Name of Subject
OE-01	Solid and e-Waste Management
OE-02	Hospital Safety and Management
OE-03	Green Electronics

[III] List of Minor in Emerging Areas Courses (18 to 20 Credits)

Emerging Course with Maximum of 18- 20 Credit					
Sr. No	Semester	Course Code	Course Title	Mode	Credits
1	III	BM-EMR-0211	Recent Trends in Biomedical Equipment's	Online/offline certification Course of total 18 credits	3
2	IV	BM-EMR-0221	Biomedical Data Science & Health Informatics		3
3	V	BM-EMR-0311	Medical & Rehabilitation Robotics		3
4	VI	BM-EMR-0321	Medical Robotics		3
5	VII	BM-EMR-0411	Radio Imaging and Therapeutics		3
6	VIII	BM-EMR-0421	Artificial Organs and Implants		3

[IV] List of Multi-disciplinary Minor (14 Credits)

Multi-disciplinary Minor of 14 Credit starting from SEM-III (14 Credits)							
Sr. No	Semester	Code	Course Offered	L	P	Hrs.	Credits
1	III	MDM-01	Data Analytics for Healthcare System	02	--	02	02
2	IV	MDM-02	Environmental Management in Healthcare	02	--	02	02
3	V	MDM-03	MEMS-Based Biomedical Sensors	03	02	05	04
4	VI	MDM-04	Medical Equipment Planning & Maintenance	02	--	02	02
5	VII	MDM-05	Ethics, Standards & IPR in Biomedical Engineering	02	--	02	02
6	VIII	MDM-06	Rehabilitation Robotics & Assistive Systems	02	--	02	02

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Shivaji University, Kolhapur					
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code : BM0231					
Corse Name : Human Anatomy and Physiology					
Teaching Scheme			Examination Scheme		
Lectures	03		MSE	30	
Tutorials	--		ISE	10	
Total Credits	03		ESE	60	
			Total	100	
Prerequisite : Biology, Chemistry, and sometimes Physics					
Course Outcomes (CO): Students will be able to					
C01	Describe the structural organization and physiological functions of cellular organelles				
C02	Explain the physiology of bone formation and the structural divisions of the human skeleton.				
C03	Describe the anatomical parts and physiological processes of the cardiovascular system and respiratory system.				
C04	Elaborate the anatomical parts and physiological processes of the alimentary system & renal system.				
C05	Describe the structure and functions of nervous system, eye and skin along with the secretions and functions of all endocrine glands.				
	Course Contents			CO	Hours
Unit 1 Basic Elements Of Human Body	Cell – Cell Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane - Action potential (Nernst, Goldman equation), Homeostasis. Tissue: Types, functions.			C01	(06)
Unit 2 Skeletal And Muscular System	Skeletal: Types of Bone and function – Physiology of Bone formation – Division of Skeleton -Types of joints and function – Types of cartilage and function. –Types of muscles – Structure and Properties of Skeletal Muscle- Changes during muscle contraction- Neuromuscular junction			C02	(06)
Unit 3 Blood and	Cardiovascular System: Structure – Conduction System of heart – Cardiac Cycle – Cardiac output. Blood: Composition – Functions - Haemostasis – Blood groups and			C03	(08)

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Cardiovascular And Respiratory System	typing. Blood Vessels – Structure and types - Blood pressure - Respiratory system: Parts of respiratory system – Respiratory physiology – Lung volumes and capacities – Gaseous exchange.		
Unit 4 Digestive And Excretory Systems	Structure and functions of gastrointestinal system - secretory functions of the alimentary tract - digestion and absorption in the gastrointestinal tract - structure of nephron - mechanism of urine formation - skin and sweat gland - temperature regulation.	C04	(06)
Unit 5 Nervous And Sensory System	Structure and function of nervous tissue – Brain and spinal cord – Functions of CNS – Nerve conduction and synapse – Reflex action – Somatic and Autonomic Nervous system. Physiology of Vision, Hearing, Integumentary, Olfactory systems. Taste buds.	C05	(06)
Unit 6 Special Senses and Endocrine System	Structure of the eye; Structure and functions of the skin. Endocrine System: All Glands of the endocrine system, their secretions, and functions.	C05	(04)
Text Books			
1.	Elaine.N. Marieb, “Essential of Human Anatomy and Physiology”, Ninth Edition, Pearson Education, New Delhi, 2018.		
2.	Gopal B. Saha “Physics and Radiobiology of Nuclear Medicine”, Third edition Springer, 2006. (Unit 2,3,4)		
3.	Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York		
4.	Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.		
5.	Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA		
6.	Textbook of Practical Physiology by C.L. Ghai, Jaypee brother’s medical publishers, New Delhi.		
Reference Books			
Guyton, “Physiology of the Human Body”, Prism Book			
William Ganong,” Review of Medical Physiology”, Prentice Hall Int.			
Tortora and Grabowski, “Principles of Anatomy and Physiology” Harper Collin Pub.			
Elaine N Marieb, “Anatomy and Physiology”, Pearson			

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Corse Name: Human Anatomy and Physiology Lab Corse Code : BM0235				
Laboratory Scheme:			Examination Scheme:	
Practical	02		ISE	25
Total Credits	01		ESE	25
			TOTAL:	50
Course Contents				
Experiment 1	To study bones of axial and appendicular skeleton			
Experiment 2	To measure blood pressure using a sphygmomanometer.			
Experiment 3	To find the total red blood cell count using pre-prepared slides.			
Experiment 4	To estimate HB level of your own blood by sahli's Method			
Experiment 5	To estimate blood group of your own blood by ABO blood grouping system.			
Experiment 6	To find the total white blood cell count using pre-prepared slides.			
Experiment 7	To study the conduction system of the heart.			
Experiment 8	To study the twelve-lead electrode scheme and operation of the ECG Machine.			
Experiment 9	To record ECG and measure its various parameters (amplitude, intervals/segment).			
Experiment 10	To record lung volumes and capacities using a spirometer.			
Experiment 11	Visit to the anatomy department of a hospital to view specimens (cardiovascular & respiratory systems).			
Experiment 12	Visit to the anatomy department of a hospital to view specimens (alimentary & renal systems).			
Experiment 13	Visit to the anatomy department of a hospital to view specimen (nervous system).			

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Experiment 14	Present a case study on a given disease/abnormality that requires medical instruments for Diagnosis/treatment.
List of Submission:	
Minimum number of Experiments :08	

Shivaji University, Kolhapur					
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code : BM0232					
Course Name : Analog and Linear Integrated Circuit					
Teaching Scheme			Examination Scheme		
Lectures	03		MSE	30	
Tutorials	--		ISE	10	
Total Credits	03		ESE	60	
			Total	100	
Prerequisite : Fundamentals of Basic Electronics					
Course Outcomes (CO): Students will be able to					
CO.1	Analyse & Design Different types of filters & Voltage Regulators				
CO.2	Analyse & Design Different types of linear, nonlinear wave shaping circuits & Design Single & Multistage RC coupled amplifier				
CO.3	Analyse & Design Different types of Oscillators				
CO.4	Analyse & Design Different types of Multi-vibrators				
CO.5	Apply Op-Amps for comparators, and timers in biomedical signal processing and instrumentation				
CO.6	Design biomedical applications using Op-amp (ECG amplifiers, bio-signal filters, instrumentation amplifiers, medical data converters).				
	Course Contents			CO	Hours
Unit 1	Filters & Voltage Regulators Analysis of centre tap full wave Rectifier for parameters: Vdc, Idc, Vrms, Irms, PIV, TUF, efficiency, ripple factor, form factor, Peak Factor etc. Types of filters: capacitor, inductor, LC, CLC, Design of unregulated power supply with filter using full wave rectifier (C, L filters), Need of voltage regulator, Types of Voltage Regulators, IC voltage regulators: IC's :78XX, 79XX			CO.1	06

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Unit 2	Wave Shaping Circuits & Amplifiers Need & significance of wave shaping circuits, clipping circuits: Classifications, Clipping operation of Simple & Biased Clippers, Clamping circuit: Clamping theorem, Classification, clamping operations, different types of clampers. Significance of H-Parameters, Hybrid model for transistor (CE, CB& CC Configuration), CE Amplifier equations for Voltage Gain, Current gain, Input resistance & Output resistance Design of single stage amplifier, Multistage amplifier: Need, Significance, types of multistage amplifiers, Two stage RC coupled amplifier	CO.2	08
Unit 3	Oscillators: Barkhausen’s criteria, Frequency and amplitude stability, Classification, RC oscillators: analysis & design of RC phase shift Oscillator & Wein bridge oscillator. LC oscillators: analysis & design of Colpitt’s & Hartley’s oscillators, Crystal oscillator (Concept No Derivation).	CO.3	05
Unit 4	Multivibrators: Transistor as a switch, Different transistor switching parameters, classification of multivibrators, Analysis and design of collector coupled: Astable, Bi-stable, Mono-stable, fixed bias and self-bias binary Multivibrator.	CO.4	05
Unit 5	Operational Amplifiers: Characteristics, ideal vs practical op-amp, differential amplifier, CMRR, biomedical applications (ECG amplifier, EMG amplifier).	CO.5	05
Unit 6	Op-amp Applications in Biomedical Engineering: Op-amp based filters (low-pass, high-pass, band-pass for bio-signals), instrumentation amplifier for medical sensors, active filters for ECG/EEG, comparators, Schmitt trigger, 555 timer in pacemaker circuits, DAC/ADC for medical data acquisition.	CO.6	07
Text Books			
1.	NC. Goyal & R.K. Khetan, “A Monograph on Electronics Design Principles”, Khanna Publishers		
2.	Allen Mottershed, “Electronic Devices & Circuits”, Prentice- Hall India		
3	G. K. Mittal, “Electronic Devices & Circuits”		
4.	J. B. Gupta, “Electronic Devices & Circuits”, Kataria Publications.		
5	Ramakant A. Gayakwad, <i>Op-Amps and Linear Integrated Circuits</i> (for LIC applications in biomedical systems).		

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Reference Books	
1	Robert L. Boylestad, Louis Nashelsky, "Electronic Devices & Circuit Theory", Pearson Education
2	J. Millman & C.Halkias, "Electronic Devices & Circuits", Tata McGraw Hill Publication
3	Salivahanan, N Sureshkumar, "Electronic Devices & Circuits", Tata McGraw Hill Publication
4	David A. Bell, "Electronic Devices & Circuits", Oxford University

Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Code:- BM0239				
Lab Name:- Analog and Linear Integrated Circuits Lab				
Laboratory Scheme:			Examination Scheme:	
Practical	02		ISE	25
Total Credits	01		ESE	--
			TOTAL:	25
Course Contents				
Experiment 1	Design and Study of full wave rectifier with capacitive filter.			
Experiment 2	Design and Study of IC78XX			
Experiment 3	Study of different types of clipper circuits			
Experiment 4	Study of different types of clamping circuits			
Experiment 5	Design and study of RC phase shift oscillator using BJT			
Experiment 6	Design and study of Colpitts oscillator using BJT			
Experiment 7	Design and study of Hartley oscillator using BJT			
Experiment 8	Design and study of Astable multivibrator			
Experiment 9	Design and study of Monostable multivibrator using BJT			

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Experiment 10	Design and study of Bistable multivibrator using BJT
Experiment 11	Design and study of Op-Amp in inverting & non-inverting amplifier configuration
Experiment 12	Design and study of Op-Amp based active filters (low-pass, high-pass, band-pass) for biomedical signals (ECG/EEG)
Experiment 13	Design and study of Instrumentation Amplifier for biomedical sensor applications (ECG/EMG acquisition)
Experiment 14	Design and study of Comparator & Schmitt Trigger circuits using Op-Amp
Experiment 15	Design and study of 555 Timer applications in biomedical circuits (pulse generator, pacemaker simulation)
Experiment 16	Design and study of DAC/ADC interfacing for biomedical data acquisition systems
Experiment 17	Simulation based experiments on above syllabus (Any 2)
List of Submission:	
Minimum number of Experiments :08	

	Shivaji University, Kolhapur				
	Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
	Corse Code: BM233				
	Course Name: Electrical Circuits				
Teaching Scheme			Examination Scheme		
Lectures	03		MSE		30
Tutorials	--		ISE		10
Total Credits	03		ESE		60
			Total		100
	Prerequisite: Fundamentals of Network Elements				
	Course Outcomes (CO): Students will be able to				
C01		Explain the graph theory and solve problems related to graph theory and different basic laws and network theorems.			
C02		Demonstrate two port networks and significance of its parameters			
C03		Analyze and design prototype LC filters.			
C04		Explain series and parallel resonance and address problems related to resonance.			

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

C05		Identify and study types of transient responses.		
Unit No.	Course Contents		CO	Hours
Unit 1	Network Fundamentals: KVL & KCL, Mesh & Super mesh analysis, Node & Super node Analysis, Graph Theory: graph of network & its parts, tree & co-tree, incidence matrix, Tie Set matrix, cut sets. (Numerical are expected.)		C01	06
Unit 2	Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Compensation theorem, Duality theorem, Millman's Theorem. (Numerical are expected.)		C01	06
Unit 3	Two Port Network & Network Functions: Z, Y, ABCD, h and Interrelation of different parameters, Interconnections of port network (Series, Parallel, Cascaded, Series-Parallel) Network functions for one port & two port networks, Driving point impedance & admittance function, Transfer function, Concept of complex Frequency. Introduction to Bode Plots. (Numerical are expected.)		C02	06
Unit 4	Filters: Definitions, classification & characteristics of different filters, filter fundamental such as attenuation constant (O), phase shift (N) propagation constant (S) characteristic impedance (Zo). Design & analysis of constant K, M derived filters (low pass, high pass, band pass & band stop filters): T & Pi sections. (Numerical are expected.)		C03	06
Unit 5	Resonance: Introduction to AC circuits and phasor representations, steady state analysis of RL, RC and RLC circuits. Series resonance: Properties, Bandwidth, Q factor. Parallel resonance: Properties, Bandwidth, Q factor. (Numerical are expected.)		C04	06
Unit 6	Transient Response: Network Solution using Laplace transforms, Initial Conditions of elements. Steady state & transient response (Voltage & Current) DC response of RL circuit. DC response of RC circuit. DC response of RLC circuit. (Numerical are expected.)		C05	06

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Text Books	
1.	A. Sudhakar, Shyammohan S.Palli 'Circuits & Networks, 5th Edition –McGraw Hill Publication.
2.	Ravish Singh, "Networks Analysis & Synthesis", McGraw Hill Publication.
3.	A. Chakrabarti 'Circuit Theory (Analysis & Synthesis)', 3rd Edition, Dhanpat Rai & Co.
4.	William H. Hayt, Jack E Kimmerly and Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill
Reference Books	
1.	D. Roy Choudhury 'Networks & Systems' - New Age International Publisher
2.	Soni Gupta 'Electrical Circuit Analysis' Dhanpat Rai & Co.
3.	Boylestad 'Introductory Circuit Analysis, Universal book stall, New Delhi
4.	M.E. Van Valkenburg 'Network Analysis', 3rd Edition , Pearson Education / PHI
5.	Josheph Edministrar 'Theory & Problems of Electronic Circuit (Schaum's series), McGraw Hill, Publication
6.	R.G .Kaduskar, S.O.Rajankar, T.S. Khatavkar, Network Fundamentals and Analysis, Wiley

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Shivaji University, Kolhapur					
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Course Title :Mathematics for Biomedical Engineering Corse Code : BM0234					
Teaching Scheme			Examination Scheme		
Lectures	02		MSE	30	
Tutorials	--		ISE	10	
Total Credits	02		ESE	60	
Prerequisite: complex algebra, derivative and its properties. Integration and its Basic properties					
Course Outcomes (CO): Students will be able to					
C01	Apply Binomial, Poisson, and Normal distribution formulas to calculate probabilities for discrete and continuous variables in given scenarios.				
C02	Execute linear correlation and regression analysis on datasets to quantify the strength of relationships between variables in a data analysis context.				
C03	Compute the Fourier coefficients to generate the Fourier series expansion of periodic functions over a specified interval.				
C04	Apply Fourier transforms to solve problems involving periodic and non-periodic functions.				
C05	Apply Laplace and Inverse Laplace transforms for a variety of elementary and composite functions.				
	Course Contents			CO	Hou rs
Unit 1 Probability Distribution	Random variables, Discrete probability distribution, Continuous probability distribution, Binomial Distribution, Poisson Distribution, Normal Distribution.			C01	(06)
Unit 2 Statistical Techniques	Correlation: Covariance, Karl Pearson’s Correlation Coefficient. Spearman’s rank correlation coefficient, Regression lines, fitting of curves.			C02	(06)

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Unit 3 Fourier Series	Introduction, Definition, Euler's formulae, Dirichlet's conditions, Change of interval, Expansions of odd and even functions.	C03	(06)
Unit 4 Fourier Transforms	Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.	C04	(06)
Unit 5 Laplace Transform	Definition of Laplace transform Laplace Transform (L) of Standard Functions, Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, Multiplication by t, Division by t, Laplace Transform of derivatives and integrals (All Properties are without proofs).	C05	(06)
Unit 6 Inverse Laplace Transform	Evaluation of integral using Laplace Transform. Formulae of Inverse Laplace Transform, Laplace Inverse using partial fraction, Properties of Inverse Laplace Transform, convolution Theorem (without proofs).	C05	(06)
Text Books:-			
01 B. S. Grewal 'Higher Engineering Mathematics', Khanna Publication, Delhi.			
02 H. K. Das 'Advanced Engineering Mathematics', S. Chand Publication.			
Reference Book :-			
03 Jack Goldberg 'Advanced Engineering Mathematics', Oxford University Press.			
04 Navneet D. Sangale 'Applied Mathematics', Cengage Publication..			
05 Erwin Kreyszig 'Advanced Engineering Mathematics', Wiley India.			
06 B.V.Ramana 'Higher Engineering Mathematics', McGraw-Hill			

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Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Code :- BM0236 Corse Name: (Data Analytics for Healthcare System)				
Teaching Scheme				Examination Scheme
Lectures		02	MSE	30
Tutorials		--	ISE	10
Total Credits		02	ESE	60
Prerequisite : Basic knowledge of statistics and probability, Fundamentals of programming, Introductory understanding of databases, Awareness of healthcare systems and medical terminology				
Course Outcomes (CO): Students will be able to				
C01	Describe the structure of healthcare systems and identify types of healthcare data.			
C02	Apply basic data preprocessing techniques to organize and prepare healthcare datasets for analysis.			
C03	Analyze healthcare data using exploratory data analysis and interpret patterns.			
C04	Develop simple predictive models and evaluate their role in clinical decision-making.			
C05	Assess ethical, legal, and security issues related to healthcare data analytics.			
C06	Demonstrate the ability to communicate analytical findings through reports.			
	Course Contents			CO Hours
Unit 1	Introduction to Data Analytics in Healthcare Overview of healthcare systems, Role of data analytics in modern healthcare, Types of healthcare data: Clinical data, Administrative data, Public health and population data, Introduction to Electronic Health Records, Benefits and challenges of healthcare data analytics, Case study example			C01 (05)
Unit 2	Healthcare Data Collection and Management Sources of healthcare data - Hospitals, labs, Wearable devices and sensors, Data quality issues in healthcare, Missing data, inconsistencies, duplicates, Basics of data pre-processing, Data cleaning and transformation, Introduction to healthcare databases, Basics of healthcare data standards			C02 (05)
Unit 3	Exploratory Data Analysis and Visualization Introduction to Exploratory Data Analysis (EDA), Descriptive statistics for healthcare data, Mean, median, variance, distributions, Identifying trends, patterns, and outliers in health data, Introduction to data visualization, Common charts used in healthcare analytics, Bar charts, line graphs, histograms, dashboards, Different Tools - Excel, Python, etc.			C03 (05)

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Unit 4	Predictive Analytics in Healthcare Introduction to predictive analytics, Types of predictive models in healthcare, Basic concepts of machine learning, Applications of predictive analytics, Disease risk prediction, Hospital readmission prediction, Model evaluation concepts, Accuracy, precision, recall, Case study example	C04	(05)
Unit 5	Healthcare Operations and Population Health Analytics Analytics for healthcare operations, Patient flow analysis, Resource utilization and scheduling, Introduction to population health analytics, Risk stratification and segmentation, Cost analytics and outcome measurement, Analytics for preventive healthcare and public health planning, Case study example	C05	(04)
Unit 6	Ethics, Privacy, and Future Trends in Healthcare Analytics Ethical issues in healthcare data analytics, Data privacy and confidentiality, Overview of healthcare data regulations, Cybersecurity challenges in healthcare systems, Responsible and ethical use of healthcare data, Emerging trends - AI in healthcare, Telemedicine and remote monitoring, Personalized and precision medicine	C06	(04)
Text Books			
1.	Health Care Data Analytics – Chandan K. Reddy & Charu C. Aggarwal, Taylor & Francis, 2015.		
2.	Healthcare Analytics: From Data to Knowledge to Healthcare Improvement – Hui Yang & Eva K. Lee, Wiley, 2016.		
Reference Books			
01 Applied Predictive Modeling – Kuhn & Johnson			
02 Practical Statistics for Data Scientists – Peter Bruce & Andrew Bruce			
03 Machine Learning for Healthcare Analytics – Arxiv articles on advanced analytics models in healthcare applications.			

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Shivaji University, Kolhapur					
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code: BM0237					
Course Name: Solid and e Waste Management					
Teaching Scheme		Examination Scheme			
Lectures	03	MSE	30		
Tutorials	--	ISE	10		
Total Credits	03	ESE	60		
		Total	100		
Prerequisite: Knowledge of pollution, ecosystems, and sustainable development.					
Course Outcomes (CO): Students will be able to					
CO1	Identify various types of solid waste and explain their physical/chemical characteristics and impacts on human health.				
CO2	Describe different disposal techniques like composting (Indore/Bangalore methods) and summarize the factors for landfill site selection.				
CO3	Explain the sources of biomedical and industrial waste and explain basic energy recovery concepts like Biofuels and RDF				
CO4	Identify the salient features of the 2016 Management Rules and identify the roles of the CPCB, MPCB, and local Gram Panchayats.				
CO5	Explain the hazardous components of e-waste and state the primary requirements of the E-Waste (Management) Rules, 2022				
	Course Contents			CO	Hours
Unit 1	<u>Unit - I Introduction to Solid Waste Management-</u> Overview of Solid Waste- Definition, types and sources of– Domestic Waste, Commercial waste, Industrial waste, Market waste, Agricultural waste, Biomedical waste, E-waste, Institutional waste. Characteristics of Solid Waste: Physical, Chemical, and Biological properties, Classification of solid waste Hazardous waste and Non-hazardous waste. Impact of Solid Waste on Environment and Human health. Solid waste management hierarchy: Prevent, Reduce, Reuse, Recycle, Recover and Dispose			C01	(06)
Unit 2	<u>Unit - II Treatment and Disposal of Solid Waste -</u> Solid waste disposal methods and its importance-Composting, Landfill, Incineration and Energy Generation Concept, Principles, and Factors affecting the composting ,Methods of composting: Manual Composting – Bangalore method, Indore Method, Vermicomposting ,Land filling techniques, methods and Factors to be considered for site selection of landfills. ,Land filling methods :Area method, Trench method, Ramp method, Advantages and disadvantages of landfill method			C02	(06)

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Unit 3	<u>Unit - III Waste Management Systems-</u> Biomedical Waste Management Definition, Sources and generation of Biomedical waste, Classification and Management technologies for Biomedical waste. , Industrial Waste Management Definition, Sources and generation of Industrial Waste, classification and Management technologies for Industrial Waste, Energy Recovery Methods: Heat recovery Units, Power generation, Biofuels, Refuse-Derived Fuel (RDF), Recent Developments: Modern WTE plants, small-scale decentralized systems.	C03	(06)
Unit 4	<u>Unit - IV Legal Aspects of Solid Waste Management</u> Role of agencies in management of solid waste from various sources : Central Pollution Control Board Maharashtra Pollution Control Board Municipal Corporations, Nagar Panchyat, Gram Panchayat etc, Municipal Solid Waste Management Rules, 2016 , Biomedical Waste Management Rules, 2016, Hazardous and other wastes Management Rules, 2016, Plastic Waste Management Rules, 2016, Role of NGO's and community participation in Solid waste management	C04	(06)
Unit 5	<u>E- Waste; composition and generation.</u> E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management.	C05	(06)
Unit 6	<u>E-waste (Management and Handling)-</u> E-waste Management and Handling Rules, 2011,E-Waste (Management) Rules, 2022 - Salient Features and its implications.	C05	(06)
Text Books			
1.	Author -Ashok K. Rathoure Title - Zero Waste: Management Practices for Environmental Sustainability		
2.	Author -M.S. Bhatt and Asheref Illiyan Title -Solid Waste Management: An Indian Perspective		
3.	Author -Sasikumar K Title - Solid Waste Management		
Reference Books			
01 Author -Dr. Ranjita Roy Sarkar Title -Waste to Energy Efficient Municipal Solid Waste Management			
02 Author -Dr. Harshita Jain, Dr. Renu Dhupper Title -Sustainable Solid Waste Management			

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Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Code: BM0241				
Lab Name: Solid and e Waste Management				
Laboratory Scheme:			Examination Scheme:	
Practical	02		ISE	25
Total Credits	01		ESE	25
			TOTAL:	50
Course Contents				
Experiment 1	Prepare a report on the improper solid waste management and its impact on human health focusing on the effects of waste exposure, pollution, and disease transmission in rural/urban.			
Experiment 2	Arrangement of Visit on working of Vermicomposting plant in your city.			
Experiment 3	Prepare a report along with photographs and comments on working of Bio gas plant in your City.			
Experiment 4	Prepare a report along with relevant photographs on disposal of bio medical waste in bio-medical waste plant in your City.			
Experiment 5	Prepare a report along with relevant photographs on the disposal of E-waste.			
Experiment 6	Arrangement of Visit on disposal of Industrial waste in your city.			
Experiment 7	Prepare a report on recent energy recovery methods from solid waste, highlighting the various technologies and processes used to convert waste into energy.			
Experiment 8	Compile the relevant provisions of Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) pertaining to solid waste management.			
Experiment 9	Prepare a report on Waste Management Software based on Data tracking, optimization, and monitoring tools.			
Experiment 10	Prepare a report on Smart cities waste management using Integration of IoT, AI, and big data.			
Minimum number of Experiments :08				

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Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Corse Code: BM0238 Course Name: Universal Human Values				
Teaching Scheme		Examination Scheme		
Lectures	02	MSE	--	
Tutorials	--	ISE	--	
Total Credits	02	ESE	25	
		Total	25	
Prerequisite: Meaning of Values, Ethics, Happiness, etc.				
Course Outcomes (CO): Students will be able to				
CO1	Become more aware of themselves, and their surroundings (family, society and nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.			
CO2	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).			
CO3	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.			
CO4	Positively impact common graduate attributes like: 1. Holistic vision of life 2. Socially responsible behavior 3. Environmentally responsible work 4. Ethical human conduct 5. Having Competence and Capabilities for Maintaining Health and Hygiene 6. Appreciation and aspiration for excellence (merit) and gratitude for all			
	Course Contents			
		CO	Hours	
Unit 1	Introduction to Value Education : 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	02	

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Unit 2	Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, Understanding Harmony in the Self.	CO2	02
Unit 3	Harmony in the Family and Society : 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.	CO2	02
Unit 4	Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels.	CO3	02
Unit 5	Implications of the Holistic Understanding : A Look at Professional Ethics: 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.	CO4	02
Reference Books			
1.	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. ISBN 978-93-87034- 47-1		
2.	The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana.		
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.		
B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.			
Web links and Video Lectures (e-Resources):			
Value Education websites:			
• https://www.uhv.org.in/uhv-ii, • http://uhv.ac.in, • http://www.uptu.ac.in • Story of Stuff, • http://www.storyofstuff.com • Al Gore, An Inconvenient Truth, Paramount Classics, USA • Charlie Chaplin, Modern Times, United Artists, USA • IIT Delhi, Modern Technology – the Untold Story • Gandhi A., Right Here Right Now, Cyclewala Productions • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw			

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- https://fdp-si.aicte-india.org/8dayUHV_download.php
- <https://www.youtube.com/watch?v=8ovkLRYXlJE>
- <https://www.youtube.com/watch?v=OgdNx0X923I>
- <https://www.youtube.com/watch?v=nGRcbRpvGoU>
- <https://www.youtube.com/watch?v=sDxGXOgYEKM>

Shivaji University, Kolhapur					
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code: BM0240					
Course Name: Soft Skill Development					
Teaching Scheme		Examination Scheme			
Lectures	01		MSE	--	
Tutorials	--		ISE	25	
Total Credits	01		ESE	--	
			Total	25	
Prerequisite: Communication skills, self-awareness, a willingness to learn, and a positive attitude.					
Course Outcomes (CO): Students will be able to					
C01	Demonstrate effective communication through verbal/written communication and improved listening skill.				
C02	Exhibit effective communication in group discussion/meetings/interviews, prepare & presentations.				
C03	Demonstrate effective communication in multi-disciplinary and heterogeneous teams through the knowledge of team work, inter-personal relationships, conflict management and leadership quality.				
C04	Write precise briefs or reports and technical documents.				
C05	Identify and analyze sources and signs of stress, apply effective stress and time management strategies, and evaluate personal and organizational practices such as prioritization, smart work, and open communication to enhance well-being and productivity.				
C06	Demonstrate professional ethics, etiquette, technology and dressing etiquettes, and analyze the importance of work ethics and their impact on professional behavior and organizational effectiveness.				
	Course Contents			CO	Hours
Unit 1	Understanding Soft and Communication Skills: Importance of Soft Skills, Attributes regarded as Soft Skills, Verbal Communication-Effective Communication-Active listening Articulation Paraphrasing- Feedback Non-Verbal Communication- Body Language of self and others- LSRW Skills			C01	02

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Unit 2	Behavioral Skills /Self Development: Process of Knowing Self, SWOT Analysis, Confidence improvement, values, positive attitude, Developing Positive attitude, positive thinking and self-esteem	C01	02
Unit 3	Leadership and Team Building: Culture and Leadership- Salient Features of Corporate Culture, Leadership Styles, Leadership Trends, Team Building- Team Development Stages, Types of Teams, Attributes of a successful team – Barriers involved, Managerial Skills	C03	02
Unit 4	Developing Writing skills: E-mail writing, report writing, resumes writing, practice.	C04	02
Unit 5	Stress and Time Management: Stress in Today’s Time- Identify the Stress Source, Signs of Stress, Ways to Cope with Stress. Healthier Ways to Combat Stress, Steps to be taken in the Organizations: Open communication, Time Management, Working towards Your Goals, Smart Work, Prioritize your Tasks	C05	02
Unit 6	Professional Skill: Ethics, Etiquette and Mannerism-All types of Etiquette (at Meetings, Etiquette at Dining. Involuntary Awkward Actions, Public Relations Office(PRO)’s Etiquettes) Technology Etiquette: Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette. Dressing Etiquettes: for Interview, offices and social functions. Ethical Values: Importance of Work Ethics, Problems in the Absence of Work Ethics.	C06	02
Text Books			
1	Dr. K. Alex , ‘Soft Skills-Know Yourself and Know the world’- S. Chand & Company Pvt. Ltd. New Delhi.		
2	Gajendra Singh Chauhan, Sangeeta Sharma ‘Soft Skills – An Integrated Approach to Maximize Personality,’ Dhanpat Rai & Co.		
3	Krishna Mohan and Meera Banerji ‘Developing Communication Skills’, MacMillan India Ltd., Delhi.		
4	Ludlow and Panthon, ‘Essentials of Effective Communication’, Prentice Hall of India.		
5.	Gopalaswamy Ramesh, Mahadevan Ramesh, ‘The ACE of Soft Skills: Attitude, Communication and Etiquette for Success’, Pearson India Education Services Pvt. Ltd.		
Reference Books			
	Indrajit Bhattacharya, ‘An Approach to Communication Skills’, Dhanpat Rai, Delhi.		
	Dr. M. Sambaiah, ‘Technical English’ Network Fundamentals and Analysis, Wiley India Pvt.		

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	Ltd. New Delhi.
	Prof. M. S. Rao 'Soft Skills for Young Manager' Ar Emm International, New Delhi.
	Prin. A. R. D'Souza, Prin. G. V. Kulkarni, 'Enriching Oral Communication' Phadke Prakashan, Kolhapur.

Shivaji University, Kolhapur			
Second Year (Sem - IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)			
Course Name : Medical Instrumentation Course Code : BM0242			
Teaching Scheme		Examination Scheme	
Lectures	3	MSE	30
Tutorials	--	ISE	10
Total Credits	3	ESE	60
Prerequisite : Analog Circuits and Op-Amp, Human Anatomy and Physiology			
Course Outcomes (CO): Students will be able to			
C01	Describe the physiological mechanisms behind the origin of bio-potentials		
C02	Explain the frequency and amplitude ranges of ECG signals		
C03	Discuss the principles of transformer and optical isolation		
C04	Describe the function of pressure amplifiers and illustrate how detector circuits identify systolic, diastolic, and mean arterial pressure values.		
C05	Identify the emission principles of Flame Photometry for electrolytes (Na ⁺ , K ⁺).		
C06	Describe the Coulter principle for automated RBC, WBC, and platelet counting.		
	Course Contents	CO	Hours
Unit 1 Electrode Configurations	Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode-skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.	C01	(06)

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Unit 2 Bio-signal Characteristics	Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.	C02	(06)
Unit 3 Bio-amplifiers	Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier, Chopper amplifier. Power line interference	C03	(06)
Unit 4 Measurement Of Bio Signals	Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements	C04	(06)
Unit 5 Biochemical And Biosensors	Definition and classification of biochemical sensors, Principles of chemical and biological sensing, pH sensor: glass electrode, reference electrode, working principle, applications, pO ₂ sensor: Clark electrode, oxygen diffusion and electrochemical reaction. Sensor performance characteristics: sensitivity, selectivity, response time, stability. Blood glucose sensors: enzymatic (glucose oxidase), electrochemical and optical methods, Continuous glucose monitoring systems (CGMS).	C05	(06)
Unit 6 Clinical Diagnostic And Analytical Instruments	Role of analytical instruments in clinical diagnosis, Blood gas analyzers: measurement of pH, pO ₂ , and pCO ₂ , Components and working principles of blood gas analyzers, Sample handling and calibration procedures, Colorimeter: principle, components, applications in biochemical analysis, photometer: emission principle, electrolyte measurement (Na ⁺ , K ⁺ , Ca ²⁺), Blood cell counter: Coulter principle and optical counting	C05	(06)

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	methods, Parameters measured: RBC, WBC, platelets, hemoglobin, Auto analyzers: continuous flow and discrete systems.		
Text Books			
1.	Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.		
2.	John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.		
3.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.		
Reference Books			
John Enderle, Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, second edition, Academic Press, 2005.			
Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2000			

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Shivaji University, Kolhapur				
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Name : Medical Instrumentation Course Code : BM0249				
Laboratory Scheme:			Examination Scheme:	
Practical	02		ISE	25
Total Credits	01		ESE	50
			TOTAL:	75
Experiment 1	Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's			
Experiment 2	Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.			
Experiment 3	Design of EMG amplifier			
Experiment 4	Design a suitable circuit to detect QRS complex and measure heart rate			
Experiment 5	Design of frontal EEG amplifier			
Experiment 6	Design of EOG amplifier to detect eye blink			
Experiment 7	Design a right leg driven ECG amplifier.			
Experiment 8	Design and study the characteristics of optical Isolation amplifier			
Experiment 9	Design a Multiplexer and De-multiplexer for any two bio-signals.			
Experiment 10	Measurement of pulse-rate using Photo transducer.			
Experiment 11	Measurement of pH and conductivity.			
Experiment12	Measurement of blood pressure using sphygmomanometer.			
Experiment13	Measurement and recording of peripheral blood flow			
Experiment14	Design a PCB layout for any bio amplifier using suitable software tool.			
List of Submission:				
Minimum number of Experiments :8				

Shivaji University, Kolhapur			
Second Year (Sem. - IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)			
Corse Code : BM0243 Course Name : Biomedical Sensors and Transducers			
Teaching Scheme		Examination Scheme	
Lectures	3	MSE	30
Tutorials	---	ISE	10
Total Credits	3	ESE	60
		Total	100
Prerequisite : Basic Electrical Engineering, Analog Electronics, Signals and Systems, Human Physiology			
Course Outcomes (CO): Students will be able to			
CO1	Explain the structure, functioning, and characteristics of bio-medical measurement systems and classify sensors and transducers used in healthcare applications.		
CO2	Analyze bioelectric signal generation and evaluate the performance of different bio-electrodes used for physiological signal acquisition.		
CO3	Apply the principles of physical sensors to measure biomedical parameters such as displacement, force, and pressure.		
CO4	Select and justify appropriate temperature, pressure, flow, and motion sensors for specific biomedical measurement applications.		
CO5	Explain the working principles and applications of chemical sensors and biosensors for clinical diagnostics.		
CO6	Identify and assess recent advancements in biomedical sensors, including wearable, implantable, and smart sensing technologies.		
	Course Contents	CO	Hours
Unit 1	Introduction to Biomedical Sensors and Measurement Systems Overview of biomedical instrumentation systems, Generalized measurement system: sensor, transducer, signal conditioning, display, Classification of biomedical sensors and transducers, Static characteristics: accuracy, precision, sensitivity, linearity, hysteresis, drift, Dynamic characteristics: time constant, frequency response, bandwidth		(05)
Unit 2	Bioelectrodes and Biopotential Measurement Origin of bioelectric potentials (ECG, EEG, EMG), Electrode–electrolyte interface and polarization, Types of electrodes: surface, needle, microelectrodes, Ag/AgCl electrodes: construction and characteristics, Motion artifacts, noise sources, and reduction techniques		(05)

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Unit 3	Physical Sensors for Biomedical Applications Resistive sensors: strain gauges, potentiometers, Inductive sensors: LVDT and variable reluctance transducers, Capacitive sensors and their biomedical applications, Piezoelectric sensors for pressure and vibration measurement, Biomedical applications: respiration, force, displacement measurement		(05)
Unit 4	Temperature, Pressure, Flow, and Motion Sensors Temperature measurement: RTDs, thermistors, thermocouples, Blood pressure measurement: invasive and non-invasive methods, Flow measurement: electromagnetic, ultrasonic, and pneumotachometers, Plethysmography and cardiac output measurement, Motion and acceleration sensors in rehabilitation and prosthetics		(05)
Unit 5	Chemical Sensors and Biosensors Principles of chemical and electrochemical sensors, pH, pO ₂ , and pCO ₂ electrodes, Enzyme-based biosensors and glucose sensors, ISFET, immune-sensors, and DNA biosensors		(04)
Unit 6	Advanced Biomedical Sensors and Recent Trends Optical and fiber-optic biomedical sensors, Implantable sensors and telemetry, Wearable health monitoring sensors, Introduction to BioMEMS and nano-biosensors		(04)
Text Books			
1.	John G. Webster, Medical Instrumentation: Application and Design, Wiley		
2.	R.S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill		
Reference Books			
01	Leslie Cromwell, <i>Biomedical Instrumentation and Measurements</i> , Pearson		
02	Joseph J. Carr & John M. Brown, <i>Introduction to Biomedical Equipment Technology</i> , Pearson		
03	Geddes & Baker, <i>Principles of Applied Biomedical Instrumentation</i> , Wiley		
04	Skoog et al., <i>Principles of Instrumental Analysis</i>		

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Shivaji University, Kolhapur				
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Code : BM0250 Lab Name : Biomedical Sensors and Transducers Lab				
Laboratory Scheme:			Examination Scheme:	
Practical	02		ISE	25
Total Credits	01		ESE	50
			TOTAL:	75
Pre-Requisite: Basic Electrical and Electronics Engineering, Analog Electronics, Human Physiology				
Course Outcomes (CO):				
CO1	Demonstrate the characteristics of basic biomedical sensors and transducers.			
CO2	Measure physiological parameters using appropriate sensors and instrumentation.			
CO3	Analyze experimental data related to biomedical measurements.			
CO4	Select suitable sensors for specific biomedical applications and justify their use.			
Course Contents				CO
Experiment 1	Study and calibration of temperature sensors (RTD, Thermistor, Thermocouple).			
Experiment 2	Characteristics of resistive transducers – strain gauge and potentiometer.			
Experiment 3	Measurement of displacement using LVDT / inductive transducer.			
Experiment 4	Characteristics of capacitive and piezoelectric transducers			
Experiment 5	Measurement of physiological signals using surface electrodes (ECG/EMG – demonstration or simulation).			
Experiment 6	Study of pressure measurement techniques using biomedical pressure sensors.			

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Experiment 7	Measurement of flow using electromagnetic / ultrasonic flow sensor (demonstration/simulation).	
Experiment 8	Study of optical sensors used in biomedical applications (LDR, photodiode, phototransistor).	
Experiment 9	Characteristics of pH sensor / chemical sensor (simulation or kit-based).	
Experiment 10	Study of biosensors (glucose sensor / enzyme sensor – demonstration or virtual lab).	
Experiment 11	Case study on selection of biomedical sensors for a given clinical application.	
List of Submission:		
Minimum number of Experiments :8		

Shivaji University, Kolhapur				
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Corse Code : BM0244				
Course Name : Biochemistry				
Teaching Scheme		Examination Scheme		
Lectures	3	MSE		30
Tutorials	--	ISE		10
Total Credits	3	ESE		60
Prerequisite : Basic of Chemistry				
Course Outcomes (CO): Students will be able to				
C01	Understand the Basic Units Give Rise to Large Molecules Such as Proteins, Carbohydrates, Lipids, Nucleic Acids			
C02	Describes the Structure, Function and Classifications of Biomolecules.			
C03	Illustrates the Various Types of Weak Interactions between the Biomolecules			
C04	Summarize the Structure, Function and Classification of Vitamins and Minerals			
C05	Investigate the Biological Importance of Vitamins and Minerals			
C06	Enumerates the Structure of Amino Acids and Protein			
	Course Contents		CO	Hours

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Unit 1 Enzymes	Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions	CO1	(06)
Unit 2 Carbohydrates	Introduction. Classification, Properties and Biological importance. Isomers, epimers, enantiomers, mutarotation, open chain and closed chain structures of glucose, glycolysis, TCA cycle.	CO2	(06)
Unit 3 Amino-acids And Proteins	Amino acids and peptides: Definition, structure, classification- essential and non-essential amino acids, protein and non-protein amino acids, Zwitterions. Amino acids as ampholytes. Structure of proteins: primary, secondary, tertiary and quaternary biological significance. Concept of isoelectric point and its significance.	CO3	(06)
Unit 4 Lipids	Introduction, Classification, Simple lipids – Physical and chemical properties of fats and biological importance. Fatty acid nomenclature and structure, Lipids in cell membrane, Steroids, Compound lipids – Structure and function of phospholipids, glycolipids and lipoproteins. Derived lipids. Hormones - structure and function.	CO4	(06)
Unit 5 Nucleic Acids	Introduction- Nitrogenous bases - Purines and Pyrimidines - Nucleosides and Nucleotides -- Structure of nucleic acids- DNA, RNA: m-RNA, t-RNA, r-RNA- Biological importance of nucleic acids, nucleic acid sequencing. 16srRNA and its significance.	CO5	(06)
Unit 6 Vitamins And Minerals	Vitamins: fat soluble and water-soluble vitamins – sources, structure and physiological functions. Minerals: Essential micro and essential macrominerals – sources and functions. Biological importance of vitamin and minerals, deficiency symptoms.	CO6	(06)
Text Books			

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1.	Lehninger, Nelson and Cox, "Principles of Biochemistry", 6th edition, W.H. Freeman & Company, 2018
2.	Dr. U. Satyanarayana, Dr. U. Chakrapani, "Biochemistry" (with Clinical Concepts & Case Studies), 4th revised edition, Elsevier, 2018
3.	Textbook of Biochemistry by Rama Rao
4.	Textbook of Biochemistry by Deb
Reference Books	
Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.	
Principles of Biochemistry by Lehninger.	
4. Biochemistry by Stryer.	

Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Name : Biochemistry Lab				
Course Code : BM0251				
Laboratory Scheme:		Examination Scheme:		
Practical	02	ISE	25	
Total Credits	01	ESE	--	
		TOTAL:	25	
Course Contents				CO
Experiment 1	Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)			
Experiment 2	General tests for carbohydrates, proteins and lipids.			
Experiment 3	Preparation of serum and plasma from blood.			
Experiment 4	Estimation of blood glucose			
Experiment 5	Estimation of creatinine			
Experiment 6	Estimation of urea			
Experiment 7	Estimation of cholesterol			
Experiment 8	Assay of SGOT/SGPT			

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Experiment 9	Separation of proteins by SDS electrophoresis	
Experiment 10	Separation of amino acids by thin layer chromatography	
Experiment 11	Separation of DNA by agarose gel electrophoresis	
List of Submission:		
Minimum number of Experiments :8		

Shivaji University, Kolhapur					
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Course Code :-BM0245 (Environmental Management in Healthcare)					
Teaching Scheme			Examination Scheme		
Lectures	2		MSE-30		
Tutorials	---		ISE- 10		
Total Credits	2		ESE- 60		
Prerequisite : Basic knowledge of statistics and probability, Fundamentals of programming, Introductory understanding of databases, Awareness of healthcare systems and medical terminology					
Course Outcomes (CO): Students will be able to					
CO1	Describe the basic concepts of environmental management, environmental health, and sustainability in healthcare systems.				
CO2	Explain environmental laws, policies, and biomedical waste regulations applicable to healthcare organizations				
CO3	Apply standard procedures for segregation, handling, treatment, and disposal of healthcare waste in healthcare facilities.				
CO4	Apply pollution control and resource conservation practices in healthcare facilities to minimize environmental impact.				
CO5	Explain the concepts and components of environmental management systems and environmental assessment methods used in healthcare institutions.				
CO6	Apply sustainable healthcare practices and modern environmental management techniques in healthcare settings.				
	Course Contents			CO	Hou rs

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Unit 1	CHAPTER 1: INTRODUCTION TO ENVIRONMENTAL MANAGEMENT IN HEALTHCARE Environment: Definition, scope and importance – Concept of environmental health – Relationship between environment and human health – Role of healthcare institutions in environmental protection – Environmental hazards in healthcare settings – Principles of environmental management – Sustainable development in healthcare – Environmental ethics and responsibilities of healthcare professionals.	CO1	(04)
Unit 2	CHAPTER 2: ENVIRONMENTAL LAWS, POLICIES AND REGULATORY FRAMEWORK Environmental legislation: Need and objectives – National environmental policies – Environmental Protection Act – Water (Prevention and Control of Pollution) Act – Air (Prevention and Control of Pollution) Act – Biomedical Waste Management Rules – Role of regulatory authorities – Environmental compliance in hospitals – Environmental audits, reporting, legal liabilities and penalties.	CO2	(04)
Unit 3	CHAPTER 3: HEALTHCARE WASTE MANAGEMENT Healthcare waste: Definition and classification – Biomedical waste categories – Waste segregation, collection, storage and transportation – Treatment and disposal methods (incineration, autoclaving, chemical treatment, deep burial) – Liquid waste management – Radioactive and chemical waste – Occupational health and safety – Infection control and risk management.	CO3	(04)
Unit 4	CHAPTER 4: POLLUTION CONTROL AND RESOURCE MANAGEMENT IN HEALTHCARE Sources of pollution in healthcare facilities – Air, water, noise and chemical pollution – Pollution prevention and control techniques – Water conservation methods – Wastewater treatment in hospitals – Energy management – Green procurement practices – Renewable energy use – Eco-friendly healthcare technologies.	CO4	(04)
Unit 5	CHAPTER 5: ENVIRONMENTAL MANAGEMENT SYSTEMS AND ASSESSMENT Environmental Management Systems (EMS): Concept and importance – ISO 14001 standards – Environmental Impact Assessment (EIA) – Environmental risk assessment – Environmental monitoring and indicators – Environmental performance evaluation – Continuous improvement strategies – Case studies in hospital environmental management.	CO5	(04)
Unit 6	CHAPTER 6: SUSTAINABLE HEALTHCARE AND MODERN PRACTICES Sustainable healthcare: Concept and principles – Green hospitals – Climate change and its impact on health – Disaster preparedness and environmental safety – Community participation and awareness – Corporate Social Responsibility (CSR) in healthcare – Future trends in environmental health management – Digital tools for environmental monitoring.	CO6	(04)

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| 1. | M . Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009. |
| 2. | K oontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010. |
| 3. | |

Reference Books

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| 01 Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987 |
| 02 Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009. |
| 03 S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994. |

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04 Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012

Shivaji University, Kolhapur					
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code : BM0246					
Course Name: Hospital Safety and Management					
Teaching Scheme			Examination Scheme		
Lectures	3		MSE	30	
Tutorials	--		ISE	10	
Total Credits	3		ESE	60	
Prerequisite : Basic knowledge of hospital operations, healthcare safety practices, and biomedical equipment handling.					
Course Outcomes (CO): Students will be able to					
C01	Explain the structure of health care systems, hospital organization, and the role of clinical engineering programs in modern hospitals.				
C02	Describe health financing mechanisms, insurance systems, and healthcare legislations relevant to hospital operations.				
C03	Apply principles of human resource management, training methods, and performance appraisal techniques in hospital environments.				
C04	Explain the importance of standardization, accreditation bodies, and quality assurance practices in healthcare institutions.				
C05	Apply safety, security, and risk management practices including radiation, laboratory, fire, and environmental safety in hospitals				
	Course Contents			CO	Hours
Unit 1 Health Policy and Hospital Organization	- Clinical engineering program: scope and current relevance - Educational responsibilities and roles of clinical engineers in hospitals - Hospital staff structure and Hospital Information System (HIS) - Need for evolving health policy in India - Organization of health services at central, state, and district levels.			CO-1	(06)

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Unit 2 Health Financing, Insurance, and Legislation	• Health financing systems and funding models. • Public and private healthcare financing. • Health education and awareness programs. • Health insurance systems (government and private). • Health legislation and regulatory acts related to hospitals.	CO-2	(06)
Unit 3 Human Resource Management and Training in Hospitals	• Difference between hospital organization and industrial organization. • Levels and methods of training in hospitals. • Steps in developing a training program. • Evaluation of training effectiveness. • Wages, salary structure, and employee appraisal methods.	CO-3	(06)
Unit 4 Standards, Accreditation, and Quality Assurance	• Need for standardization in healthcare • Role of FDA, AERB, ICRP, NABH / Joint Commission Accreditation. • Medical equipment regulations and compliance. • Quality assurance and patient safety standards. • Methods for monitoring and auditing standards.	CO-4	(06)
Unit 5 Strategic Management, IT, and Support Services	• Nature and value of strategic management in hospitals. • Application of IT in hospital functions (HIS, EMR, telemedicine basics). • Use of statistical tools in healthcare services. • Introduction to hospital support services: ○ Disaster management ○ Ambulance services	CO-5	(06)

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	○ Laundry, CSSD, civil and utility services		
Unit 6 Safety, Security, and Environmental Management	• Elements of safety and safety management systems. • Safety publications and standards organizations. • Laboratory safety and types of hospital risks. • Radiation hazards, detection methods, and safety measures. • Ergonomics, fire safety, flammables, explosives, and chemical safety. • Material safety, PEL standards, and organization of safety in hospitals.	CO-5	(06)
Text Books			
1.	P.E.Stanley, Handbook of hospital safety, CRC Press.		
2.	Arun Kumar, Hospital Management, Anmol Publications Pvt. Ltd., Jan 2000.		
3.	Michael J. Reilly & David S. Markenson- Practical guide covering incident management and response planning in healthcare emergencies. Health-Care Emergency Management: Principles and Practice		
Reference Books			
1.	William Charney, Handbook of Modern Hospital Safety, CRC press.		
2.	Webster J.C. and Albert M.Cook, “Clinical Engineering Principle and Practice”, Prentice Hall Inc., Englewood Cliffs.		
3.	Goyal R.C., “Handbook of hospital personal management”, Prentice Hall of India.		
4.	Syed Amin Tabish (Oxford University Press, New Delhi), Hospital and Health Services Administration: Principles and Practices.		

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Shivaji University, Kolhapur			
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)			
Course Code :-BM0247			
Corse Name:- Employability Enhancement Skill			
Teaching Scheme			Examination Scheme
Lectures	02		MSE---
Tutorials	---		ISE- 25
Total Credits	02		ESE- --
Prerequisite : Basic Communication Skills			
Course Outcomes (CO): Students will be able to			
C01	Self-Reflection and SWOC Analysis: Students will be able to conduct self-reflection and perform a SWOC analysis to assess their strengths, weaknesses, opportunities, and challenges for personal and professional growth.		
C02	Effective Communication: Students will develop the ability to communicate clearly and effectively in verbal, written, and non-verbal forms across various platforms and overcome communication barriers.		
C03	Professional Writing Proficiency: Students will be able to write professional documents, including resumes, emails, and reports, with clarity and effectiveness, following industry standards.		
C04	Leadership and Teamwork: Students will demonstrate an understanding of leadership qualities and team dynamics and will be able to collaborate effectively in group settings and manage team-based projects.		
C05	Professional Ethics and Interview Skills: Students will apply professional ethics and etiquette in interviews, group discussions, and workplace interactions, ensuring proper conduct and communication.		
C06	Problem-Solving and Analytical Skills: Students will be able to solve quantitative and logical problems effectively and apply critical thinking strategies to tackle real-world challenges		
	Course Contents		CO
Unit 1	Foundations of Self-Discovery and Personal Growth Self-Reflection and SWOC (Strengths, Weaknesses, Opportunities, Challenges) Analysis. Importance of Soft Skills in Personal and Career Development. Cross-Disciplinary and Global Relevance of Soft Skills. Setting Personal and Career Goals. Aligning Career Aspirations with Skill Sets. Self-Esteem Evaluation and Self-Assessment Techniques.		CO1
			Ho urs
			03

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

Unit 2	Mastering Communication Essentials Basics of Communication and Its Importance, Types of Communication (Verbal, Written, Visual), Identifying and Addressing Barriers to Communication, Non-Verbal Communication and Its Role in Effective Interaction, Techniques for Group Discussions, Digital Communication: Email Etiquette and Online Presentation Skills	C02	03
Unit 3	Professional Language and Effective Writing Enhancing Spoken English and Business Vocabulary, Developing Professional Emails and Letters, Resume Writing: Chronological, Functional, and Hybrid Formats, Structuring Career Objectives in Resumes, Key Traits of an Effective Resume and Common Mistakes, Basic Technical Writing and Structuring Formal Documents	C03	03
Unit 4	Leadership, Teamwork, and Presentation Skills Corporate Culture and Essential Leadership Qualities, Differences Between Leaders and Managers, Decision-Making Skills: 4-Ds (Do, Delay, Delegate, Drop), Effective Team Dynamics: Positivity, Respect, Trust, Goal Focus, Support, Planning and Preparing Professional Presentation, Delivering Presentations and Handling Q&A	C04	03
Unit 5	Professional Ethics and Interview Preparation Importance of Professional Ethics, Telephone and Travel Etiquette, Netiquette and Social Media Guidelines, Types of Interviews and Preparation Steps, Group Discussions, Panel Discussions, and Debates Non-Verbal Communication in Interviews and Group Discussions	C05	03
Unit 6	Quantitative Skills and Strategic Problem Solving Introduction to Aptitude Tests and Preparation Strategies, Quantitative Aptitude: Number Sequences, Squares, Roots, LCM, HCF, Logical Reasoning: Matching, Selection, and Arrangement Problems, Problem-Solving Techniques: Define, Gather, Evaluate, Act, Cognitive and Analytical Skills: Brainstorming, Learning from Mistakes, Test-Taking Strategies and Time Management for Aptitude Exams	C06	03

Text Books:

1.	Soft Skills: An Integrated Approach to Maximize Personality by Ghosh B. K.
2.	Essentials of Business Communication by Mary Ellen Guffey and Dana Loewy
3.	Technical Communication: Principles and Practice by Meenakshi Raman and Sangeeta Sharma
4.	The 7 Habits of Highly Effective People by Stephen R. Covey
5.	Developing Soft Skills by Robert M. Sherfield, Patricia J. Moody, and Rhonda J. Montgomery
6.	Quantitative Aptitude for Competitive Examinations by R.S. Aggarwal

Reference Books:

1.	Developing Soft Skills by Robert M. Sherfield, Patricia J. Moody, and Rhonda J. Montgomery
2.	How to Win Friends and Influence People by Dale Carnegie
3.	The Art of Communicating by Thich Nhat Hanh
4.	Business Etiquette: A Guide for the Indian Professional by Shital Kakkar Mehra

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Shivaji University, Kolhapur			
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)			
Course Code :-BM0248 Professional Ethics			
Teaching Scheme		Examination Scheme	
Lectures	02		MSE- --
Tutorials	---		ISE- 25
Total Credits	02		ESE- --
Prerequisite : Basic Communication Skills			
Course Outcomes (CO): Students will be able to			
CO1	Create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.		
CO2	Understand Engineering Ethics		
CO3	Create an awareness of seeing Engineering as Social Experimentation		
CO4	Understand Safety, Responsibilities and Rights		
CO5	Creating an awareness on Global Issues		
	Course Contents	CO	Hours
Unit 1	Human Values Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.	CO1	03
Unit 2	Engineering Ethics Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.	CO2	03
Unit 3	Engineering As Social Experimentation Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.	CO3	03

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Unit 4	Safety, Responsibilities and Rights Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination.	CO4	03
Unit 5	Global Issues Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility.	CO5	03

Text Books:

1.	Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2.	Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

Reference Books:

Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004
Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013

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Shivaji University, Kolhapur			
Second Year (Sem - IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)			
Course Code :-BM0252			
Corse Name:- Environmental Sciences (DECIDED BY UNIVERSITY)			
Teaching Scheme		Examination Scheme	
Lectures	02		MSE- 30
Tutorials	---		ISE- 10
Total Credits	02		ESE- 60
Prerequisite :			
Course Outcomes (CO): Students will be able to			
C01	Understand the importance of Environmental Studies and recognize significance of ecosystem.		
C02	Classify the values of natural resources with associated problems for sustainable lifestyles.		
C03	Describe the social and global environmental issues		
C04	Make aware of Pollution issues with its mitigation measures.		
C05	Familiarize the basics of Biodiversity and concerned issues in the context of Western Ghats.		
C06	Acquaint with the role of environmental laws and regulations in conservation efforts.		
Course Contents			
		CO	Hours
Unit 1	Nature of Environmental Studies and Importance of ecosystems Definition, scope and importance, Multidisciplinary nature of environmental studies, Need for public awareness. Ecosystem Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Food chains, food webs and ecological pyramids,, Introduction, types, characteristics features, structure and function of the following ecosystem- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Degradation of the ecosystems and it's impacts.	C01	04
Unit 2	Natural Resources and Associated Problems Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources. Food resources: World food problem, changes caused by agriculture, effect of modern agriculture, fertilizer-pesticide problems. Energy resources: Growing energy needs, renewable and non- renewable energy resources, use of alternate energy sources. Solar energy, Biomass energy. Land	C02	04

S.Y.B-Tech. Electronics and Communication Engineering (Bio-Medical Engineering) w. e. f. Academic Year 2026-27, as per NEP 2.1

	resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of individuals in conservation of natural resources. Equitable use of resources for sustainable lifestyles		
Unit 3	Social Issues and the Environment Human population growth and impact on environment. Environmental ethics: Role of Indian religious traditions and culture in conservation of the environment. Environmental movements- Chipko Movement, Appiko Movement, Silent Valley Movement. Resettlement and rehabilitation of people; its problems and concerns. Water conservation, rain water harvesting. Disaster management: floods, earthquake, cyclone, tsunami and landslides, Case studies.	C03	04
Unit 4	Environmental Pollution Definition: Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Global warming, acid rain, ozone layer depletion. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Solid waste management, control& rules, Role of an individual in prevention of pollution	C04	04
Unit 5	Biodiversity and its conservation: Introduction- Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. India as a mega-diversity nation. Western Ghat as a biodiversity region. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man- wildlife conflicts, Conservation of biodiversity: In-situ and Ex- situ conservation of biodiversity.	C05	04
Unit 6	Environmental Protection-Policies and practices Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wildlife Protection Act Forest Conservation Act National and International Conventions and agreements on environment.	C06	04

Reference Books:

1.	Raut P.D , “Environmental Studies”, Shivaji University Press, 2021
2.	Gleick, H.,1993, “Water in crisis, Pacific Institute for studies in Dev. ”, Environment& Security. Stockholm Env. Institute. Oxford Univ. Press 473p
3.	Hawkins R.E, “Encyclopedia of Indian Natural History”, Bombay Natural History Society, Bombay (R)
4.	Heywood, V.H.& Watson, R.T.1995, “Global Biodiversity Assessment”, Cambridge Univ. Press 1140p.
5.	Jadhav, H.& Bhosale, V.M.1995, “Environmental Protection and Laws”, Himalaya Pub. House, Delhi 284p

Shivaji University, Kolhapur					
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code: BM0253 Course Name: Electronics Workshop-I (Service and maintenance of Biomedical equipment)					
Teaching Scheme			Examination Scheme		
Lectures	01		MSE	--	
Tutorials	--		ISE	50	
Total Credits	01		ESE	25	
Prerequisite : Basic knowledge of electronics, electrical circuits, and biomedical instrumentation.					
Course Outcomes (CO): Students will be able to					
C01	Explain biomedical equipment components, safety practices, and preventive maintenance.				
C02	Describe soldering, testing, and calibration techniques for biomedical devices.				
C03	Analyze common faults in biomedical equipment and propose corrective actions.				
C04	Evaluate biomedical equipment performance, safety compliance, and calibration accuracy.				
C05	Explain fundamentals of Arduino programming and Raspberry Pi applications in biomedical engineering.				
	Course Contents			CO	Hours
Unit 1	Introduction to Biomedical Equipment & Safety Practices: Safety protocols, precautions, safe handling of devices			C01	(02)
Unit 2	Basics of Soldering & De-soldering: Tools, techniques, PCB fault repair, and soldering quality			C02	(02)
Unit 3	Troubleshooting of Biomedical Circuits: Power supply, bio-potential amplifier units, corrective measures			C03	(02)
Unit 4	Preventive Maintenance of Biomedical Equipment: ECG, EEG, EMG, patient monitors, defibrillators, infusion pumps.			C04	(02)

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Unit 5	Case Studies: Case Studies & Recent Trends in Biomedical Equipment Maintenance	C04	(02)
Unit 6	Introduction to Arduino & Raspberry Pi: Basic programming, interfacing sensors in biomedical applications	C05	(02)
Text Books			
1.	R.S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill.		
2.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall.		
Reference Books			
01 Joseph J. Carr & John M. Brown, Introduction to Biomedical Equipment Technology.			
02 Richard C. Dorf, The Biomedical Engineering Handbook.			

Shivaji University, Kolhapur			
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)			
Corse Code: BM0253			
Course Name: Electronics Workshop-I (Service and maintenance of Biomedical equipment)			
Laboratory Scheme:		Examination Scheme:	
Practical	2	ISE	50
Total Credits	2	ESE	25
		TOTAL:	75
Pre-Requisite: Basic knowledge of electronics, electrical circuits, and biomedical instrumentation.			
Course Outcomes (CO): After studying this course, students will be able to;			
CO1	Identify and understand biomedical equipment components, safety practices, and preventive maintenance		
CO2	Apply electronics workshop skills (soldering, testing, calibration) to biomedical devices.		
CO3	Analyze faults in biomedical equipment and propose corrective actions		
CO4	Evaluate biomedical equipment performance, safety compliance, and calibration accuracy.		

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C05	Apply foundational knowledge of Arduino programming and Raspberry Pi
Course Contents	
Experiment 1	Introduction to Biomedical Equipment & Safety Practices. (Identify safety protocols, explain precautions, and demonstrate safe handling of devices.)
Experiment 2	Soldering & De-soldering Practice (Demonstrate soldering skills, repair PCB faults, and evaluate soldering quality.)
Experiment 3	Troubleshooting of Biomedical Power Supply/Bio potential amplifier Units etc (Identify faults, repair circuits, and justify corrective measures.)
Experiment 4	Preventive Maintenance of ECG/EEG/EMG Machine (Perform inspection, cleaning, and functional checks; interpret test results.)
Experiment 5	Troubleshooting & Calibration of Patient Monitor (Diagnose faults, calibrate sensors, and justify corrective actions.)
Experiment 6	Service & Maintenance of Defibrillator (Inspect paddles, test battery, and validate safety compliance.)
Experiment 7	Testing & Maintenance of Infusion Pump (Calibrate flow rate, verify alarms, and assess operational accuracy.)
Experiment 8	Preventive Maintenance of Ultrasound Scanner (Basic Level: Inspect probes, cables, and assess image quality.)
Experiment 9	Service & Maintenance of Suction Apparatus (Inspect tubing, motor, and calibrate vacuum pressure.)
Experiment 10	Testing and maintenance of Spirometer (Measurement of lung capacity)/ audiometers/ Pulse Oximeter
Experiment 11	Develop program to interface applications using Arduino Uno: (interfacing components like LEDs, sensors and debug to ensure proper communication and functionality within the Arduino platform.
Experiment 12	Develop simple interfacing applications using Raspberry Pi.
List of Submission:	
Minimum number of Experiments: 8	

Shivaji University, Kolhapur				
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Corse Code : BM-EMR-0221		Course Name Biomedical Data Science & Health Informatics		
Teaching Scheme		Examination Scheme		
Lectures	3	MSE	30	
Tutorials	--	ISE	10	
Total	3	ESE	60	

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Credits					
Prerequisite : Fundamentals of Basic Electronics					
Course Outcomes (CO): Students will be able to					
C01	Explain fundamentals of biomedical data science and data types.				
C02	Describe health information systems used in healthcare.				
C03	Apply healthcare data standards and data management techniques.				
C04	Analyze biomedical datasets using statistical and ML methods.				
C05	Perform biomedical signal and image analysis.				
C06	Evaluate ethical, privacy, and security issues				
	Course Contents			CO	Hours
Unit 1	Introduction to Biomedical Data Science Types of biomedical data (clinical, imaging, signal, genomic, public health) Applications of biomedical data science in healthcare engineering			C01	6
Unit 2	Health Information Systems Electronic Health Records (EHR) and Electronic Medical Records (EMR) Hospital Information Systems (HIS) Laboratory Information Systems (LIS) Telemedicine and remote healthcare systems			C02	6
Unit 3	Health Data Standards and Management Healthcare data standards: HL7 and FHIR Clinical coding systems: ICD, SNOMED CT, LOINC Health data preprocessing techniques Data storage, databases, and data warehousing			C03	6
Unit 4	Statistical and Machine Learning Methods Descriptive and inferential statistics, Regression techniques Classification, algorithms Model validation and evaluation metrics			C04	6
Unit 5	Biomedical Signal and Image Analytics Biomedical signals: ECG, EEG, EMG Signal acquisition and preprocessing Feature extraction from biomedical signals Medical image processing fundamentals Basics of genomic data analysis			C05	6
Unit 6	Ethics, Privacy, and Applications Ethical issues in biomedical data usage Privacy, confidentiality, and data security Regulatory and compliance aspects, Real-world healthcare case studies			C06	6
Text Books					
1	Shortliffe, E. H., & Cimino, J. J., <i>Biomedical Informatics</i> , Springer				
2	Butte, A. J., <i>Biomedical Data Science</i> , Oxford University Press				
Reference Books					

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1	Szolovits, P., <i>Artificial Intelligence in Medicine</i> , CRC Press
2	IGI Global, <i>Health Information Systems</i>

Shivaji University, Kolhapur				
Second Year (Sem – III) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Corse Title : Recent Trends in Biomedical Equipment Course Code: BM-EMR-0211				
Teaching Scheme		Examination Scheme		
Lectures		MSE		
Tutorials		ISE		
Total Credits	03	ESE		
Prerequisite: Engineering Mathematics, Basic Electrical and Electronic Circuits, Basic Analog and Digital Electronics. Fundamentals of Sensors and Transducers, Human Physiology (introductory level)				
Course Outcomes (CO): Students will be able to				
C01	Understand the fundamentals, classification, and regulatory standards of biomedical equipment.			
C02	Explain recent advances in diagnostic biomedical instruments and imaging systems.			
C03	Analyze modern therapeutic and life-support biomedical equipment.			
C04	Describe wearable, implantable, and assistive biomedical devices and their applications.			
C05	Apply concepts of IoT, AI, and digital health in biomedical equipment systems.			
C06	Identify future trends, challenges, and research directions in biomedical engineering.			
Course Contents			CO	Hours
Unit 1	Introduction to Biomedical Equipment and Healthcare Technology Overview of biomedical engineering and healthcare systems. Classification of biomedical equipment: diagnostic, therapeutic, monitoring, and life-support systems. Evolution of biomedical instrumentation. Role of electronics, sensors, and signal processing in medical devices. Standards and regulations for biomedical equipment (FDA, IEC, ISO). Ethical issues, patient safety, and reliability considerations.		C01	--

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Unit 2	Recent Trends in Diagnostic Biomedical Equipment Advances in medical imaging systems: digital X-ray, CT, MRI, PET, and ultrasound. AI-assisted diagnostic systems. Point-of-care diagnostic devices. Wearable diagnostic sensors (ECG, EEG, EMG, SpO ₂). Lab-on-chip and microfluidic diagnostic systems. Smart biosensors for early disease detection.	C02	--
Unit 3	Therapeutic and Life-Support Equipment – Emerging Technologies Recent advances in therapeutic equipment: pacemakers, defibrillators, dialysis machines, ventilators, and infusion pumps. Robotic-assisted surgery systems. Laser and ultrasound-based therapy systems. Smart prosthetics and implantable devices.	C03	--
Unit 4	Wearable, Implantable, and Assistive Biomedical Devices Wearable health monitoring systems. Implantable biomedical devices and materials. Brain-computer interfaces (BCI). Assistive devices for rehabilitation. Smart exoskeletons and neuro-prosthetics. Power management and biocompatibility issues.	C04	--
Unit 5	Digital Health, IoT, and AI in Biomedical Equipment Internet of Medical Things (IoMT). Remote patient monitoring and telemedicine systems. Smart medical devices and sensor-based health monitoring systems. Artificial intelligence and machine learning applications in biomedical equipment.	C05	--
Unit 6	Future Trends, Challenges, and Case Studies Emerging trends in biomedical equipment: nanotechnology in medicine, 3D printing of medical devices and organs, digital twins in healthcare. Sustainable and low-cost medical devices. Challenges in deployment and commercialization. Case studies of modern biomedical equipment. Future scope and research directions in biomedical engineering.	C06	--
Text Books			
1	R.S. Khandpur, Biomedical Instrumentation: Technology and Applications, McGraw-Hill.		
2	John G. Webster, Medical Instrumentation: Application and Design, Wiley.		
3	C. R. Rao and S. K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press.		
4	R. Ananda Natarajan, Biomedical Instrumentation and Measurements, PHI Learning.		
5	Mandeep Singh, Introduction to Biomedical Instrumentation, PHI Learning.		
6	Shakti Chatterjee, Biomedical Instrumentation Systems, Cengage India.		
Reference Books			
01 Robert B. Northrop, Introduction to Biomedical Signal Processing			
02 Joseph D. Bronzino & Donald R. Peterson, Biomedical Engineering Fundamentals			

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03 G. S. Sawhney, Biomedical Electronics and Instrumentation Made Easy, New Age International.
04 Soumya K. Manna and Soumi Ganguly, Biomedical Engineering and Assistive Devices, Springer.

Shivaji University, Kolhapur				
Second Year (Sem - IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)				
Course Name : Biomedical Instruments Maintenance Corse Code: BM-EC-0204				
Teaching Scheme		Examination Scheme		
Lectures	---	MSE	---	
Tutorials	---	ISE	----	
Total Credits	---	ESE	---	
Prerequisite : Basic measurement and instrumentation, Electrical and electronic circuits				
Course Outcomes (CO): Students will be able to				
CO.1	Explain the classification, working environment, and life-cycle management of biomedical equipment,			
CO.2	Apply electrical safety principles and standards to evaluate medical equipment for electrical hazards			
CO.3	Analyse the functioning of diagnostic biomedical instruments and carry out calibration, preventive maintenance,			
CO.4	Demonstrate maintenance procedures for therapeutic biomedical equipment and diagnose common operational faults using standard service practices.			
CO.5	Implement preventive maintenance and quality control procedures for laboratory and life-support equipment to ensure accuracy, reliability, and patient safety.			
CO.6	Manage biomedical equipment systems in hospitals by planning maintenance strategies, maintaining records, and complying with regulatory and quality assurance requirements.			
	Course Contents		CO	Hours
Unit 1 Introduction to Biomedical Equipment & Maintenance Concepts	Overview of biomedical equipment used in hospitals, Classification of biomedical instruments, Role of biomedical equipment technician/engineer, Equipment life cycle and maintenance strategies Installation, commissioning, and acceptance testing, Documentation: manuals, service records, logbooks, Safety standards and regulations (IEC, FDA, ISO, BIS)		CO1	6

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Unit 2 Electrical Safety & Testing of Medical Equipment	Electrical hazards in medical equipment, Shock hazards: macroshock and microshock, Grounding, isolation, and leakage currents, Electrical safety standards for medical devices, Safety analyzers and test equipment, Preventive electrical safety checks, Troubleshooting common electrical faults	C02	6
Unit 3 Maintenance of Diagnostic Equipment	Maintenance of ECG machines. EEG and EMG equipment ,X-ray systems: basic maintenance and safety precautions, Ultrasound imaging systems, Patient monitoring systems, Calibration and performance verification, Common faults and corrective maintenance	C03	6
Unit 4 Maintenance of Therapeutic Equipment	Defibrillators and pacemakers, Ventilators and anesthesia machines, Infusion pumps and syringe pumps, Dialysis machines, Physiotherapy equipment Routine inspection and servicing, Fault diagnosis and repair procedures	C04	6
Unit 5 Maintenance of Laboratory & Life Support Equipment	Blood analyzers and hematology equipment, Biochemistry analyzers, Sterilization equipment (autoclaves, EO sterilizers), Incubators and neonatal care equipment, Oxygen delivery systems and concentrators, Preventive maintenance schedules, Quality control and calibration	C05	6
Unit 6 Hospital Equipment Management & Quality Assurance	Biomedical equipment management systems (BEMS),Preventive vs breakdown maintenance, Inventory management and spare parts control, Risk management and equipment audits, Maintenance cost analysis, Biomedical waste handling related to equipment, Documentation, reporting, and regulatory compliance	C06	6
Text Books			
1.	Biomedical Instrumentation and Measurements – Leslie Cromwell, Erich A. Pfeiffer & Fred J. Weibell — Classic textbook covering instrumentation principles and measurements.		
2.	Handbook of Biomedical Instrumentation – R. S. Khandpur — Detailed coverage of biomedical devices, transducers, imaging and safety principles.		
3	Introduction to Biomedical Instrumentation and Its Applications – Sudip Paul et al. — Good for understanding device applications and systems in healthcare.		
Reference Book			
1	Biomedical Equipment: Use, Maintenance and Management – Joseph J. Carr — Practical guide emphasizing preventive maintenance and safety practices		
2	<i>Biomedical Electronics and Instrumentation Made Easy</i> – G. S. Sawhney — Simplified textbook helpful for electronics and instrumentation basics.		

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3	Compendium of Biomedical Instrumentation – Raghbir Singh (3 Volumes) — Comprehensive reference covering a very wide range of devices.
4	Biomedical Instrumentation Systems – Shakti Chatterjee — Practical focus including maintenance, repair, and diagnostic procedures.