

 शिवाजी विद्यापीठ कोल्हापूर जैनमैवामृतम् 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		
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SU/BOS/Sci & Tech/ 

Date: 08/09/2025

To,

The Principal,
All Affiliated Engineering Colleges/ Institute,
Shivaji University, Kolhapur.

Subject: Regarding Minor Changes in syllabus of B.Tech. Part –II Electronics and Communication Engineering (Bio-Medical Engineering) as per NEP 2020 degree programme under the Faculty of Science and Technology.

Ref: No. SU/BOS/Science/183 Date: 10/06/2026.

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 Minor Changes in syllabi, (Nature of Question paper, equivalence etc.) of B.Tech. Part –II (Sem III & IV) Electronics and Communication Engineering (Bio-Medical Engineering) as per NEP 2020 degree programme under the Faculty of Science and Technology.

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 NEP-2020@suk (Online Syllabus).

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:

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



Shivaji University Kolhapur

Revised Syllabus
as per

National Education Policy 2020

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

To be implemented from
Academic Year 2026-27



First Year Exit: Teaching Methodology, Assessment and Evaluation

[I] As per R. R. B. Tech. 12.1 Rule: Award of Degree

If a student passes all the courses of first year and earns the requisite number of credits, the student will become entitled to Undergraduate Certificate (One year or two semesters) in the programme of his/her major subject. If he/she wants to exit, can exit the programme with UG Certificate. However, for the award of one year UG Certificate in Major with 44 credits, an additional 8 credits are required to earn.

[II] First Year Exit Course:

Methodology 1:

1. The students should complete two online certification courses (NPTEL) related to their programme, each of 3 credits. In addition to this, they will also need to complete 2 credits worth of two Virtual Lab work related to online certification courses. These additional 8 credits earn by students shall be based upon skill based vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study or programme. The skill based vocational courses shall be analogous to the Baskets/Areas provided by the concerned BoS.
3. The student must complete two virtual lab work that adds 2 credits to simulate practical or experimental learning experiences in a controlled virtual environment.

4. **Examination scheme:** The marks gained from the two NPTEL Courses (3 credits each) are converted to a total of 100 marks. The report for the two Virtual Lab work of 2 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of the virtual lab experiments conducted, encompassing the methodology, results, and conclusions.
5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website <https://swayam.gov.in> and create their account. Log in the account and join the required course and follow the instructions to compete the course. Similarly, for Virtual Lab, the students are required to visit to website <https://www.vlab.co.in> and create their account. Log in the account and join the required lab and follow the instructions to compete the course (need to perform all listed experiments under that Lab). To fulfill the requirement of 06 credits, students can go for two courses each of 12 weeks.

Methodology 2:

1. The students should complete two online certification courses (NPTEL) related to their programme, each carrying 2 credits. In addition to this, they will also need to complete 4 credits worth of two physical internship/Apprenticeship (each of 40 hrs) work from relevant

industry. These additional 8 credits earned by the students shall be based upon skill based vocational courses or internship/Apprenticeship.

2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study/programme. The skill-based vocational courses shall be analogous with the list provided by the concerned BoS.
3. The student should complete two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices that adds 4 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (2 credits each) are converted to a total of 100 marks. The report for the performed two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices of 4 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of two physical internship/Apprenticeship (each of 40 hrs) work along with certificate of internship/Apprenticeship from relevant industrial practices conducted, encompassing the methodology, results, and conclusions.
5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute.

The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website <https://swayam.gov.in> and create their account. Log in the account and join the required course and follow the instructions to compete the course.

Direct Second Year Entry: Teaching Methodology, Assessment and Evaluation

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

[II] **As per R. R. B. Tech. 13.3 Rule**, For direct second year admitted students (at entry level) to concern programme, the earning of additional 2 credits is mandatory. It is required to conduct examination and evaluation for same at institute level at the time of third semester ESE examination. The evaluation report must be submitted to The Director, Board of Examination and Evaluation, Shivaji University, Kolhapur.

[III] Examination scheme:

Students admitted directly into the second year of a programme from another programme 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 programme 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 Director, Board of Examination and Evaluation, Shivaji University, Kolhapur.

Guidelines for Open Elective Courses: Teaching Methodology, Assessment and Evaluation

Open Elective (OE) courses other than faculty of Science and Technology through Massive Open Online Courses (MOOCs) allowing students to engage with a broad spectrum of ideas and knowledge areas. The OE courses are likely to be available online and can be completed at the student's own pace within a set timeframe. For OE course, students are required to visit to the website <https://swayam.gov.in> for registration and create an account. Afterward, students should Login the account and join the course assigned by the course coordinator and follow the instructions to complete the course through self-learning mode. Additionally, the respective institution should download the relevant study materials to ensure students have access to them as needed. Minimum 25 students can register for one OE course in the concerned institute. There will be one course coordinator for one OE course. Students need to cover OE Courses of 08 credits. These 08 credits over semesters III to V. OE courses are chosen from faculty other than Faculty of Science and Technology. It is offered in Second and Third year as per Semester wise credit distribution table. Students need to take up the courses of 08 credits over semesters III to V.

1. **For Semester-III**, OE theory course of 3 credits consists of Mid Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.
2. **For Semester-III**, OE practical lab course of 1 credit consists of In Semester Evaluation/Continuous Assessment (ISE/CA) of 25 Marks

and End Semester Examination-Practical Oral Examination (ESE-POE) of 25 Marks. Course Coordinator assigned by Institute should complete the selected course practical through expert of that course. The lab exercises and demonstrations prepared by concern expert must be aligned with the specific OE course that the students have chosen.

3. **For Semester-IV**, OE theory course of 2 credits consists of Mid Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.
4. The Mid Semester Examination (MSE) of 30 Marks based on selected OE Course will be conducted by Concerned Departmental Course Coordinator. The course expert of concerned faculty should set question paper of MSE and evaluate the same.
5. Online submitted assignments by students using SWAYAM platform for concerned OE course will be used for In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks by Concerned Departmental Course Coordinator appointed for particular course by Principal of the Institute. Assignments may be of varied in nature for OE course.
6. The ESE of OE courses will be conducted by the University. The setting of question papers for both MSE and ESE, as well as the evaluation of the concerned OE course, should be carried out by the course expert from the Board of Studies (BoS) of the respective faculty

in accordance with the provisions under Panel of Paper Setters, Examiners, and Moderators – Clauses 41(f) and 48(3)(a).

7. MSE will be based on 50% syllabus from beginning (First 50% Weeks).
8. ESE paper setting weightage will be 25% on syllabus covered for MSE (First 50% Weeks) and 75% on remaining syllabus (Last 50% Weeks).

The number of optional questions marks in a theory paper shall be 25 to 30 percent of the maximum marks.

Note: One OE course may be floated by the institute for 60 intake.

Open Electives Courses Offered to the students under Faculty of Science and Technology

In line with New Education Policy 2020 (Effective from Academic year 2025-26)

Open Electives

The students need to cover Open Elective Courses (OE) of 08 credits. These 08 credits over semesters III to V.

Semester wise credit distribution table for OE is given below

Sr. No.	Semester	Open Elective	Teaching scheme			Credits
			L	T	P	
01	III	OE-01	3	-	-	3
	III	OE-01 Lab	-	-	2	1
	IV	OE-02	2	-	-	2
02	V	OE-03	2	-	-	2
	Total		7	-	2	8

Semester wise baskets of OE from faculty other than Faculty of Science and Technology, Viz. Faculty of Commerce and Management, Faculty of Humanities and Faculty of Interdisciplinary Studies is given below

List of Open Elective Courses might be taken by students under Faculty of Science and Technology
Semester – III

Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.

Sr. No.	Name of the Course	Category	Duration (Weeks)	Credit Points	Institute Offering Course	Name of Professor/ Resource person	Link
01	Principles of Economics	Economics	12	03	IIT Madras	Prof. Sabuj Kumar Mandal	https://onlinecourses.nptel.ac.in/noc25_ec15/preview
02	German - I	Humanities and Social Science	12	03	IIT Madras	Prof. Milind Brahme	https://onlinecourses.nptel.ac.in/noc25_hs121/preview
03	Science, Technology and Society	Humanities and Social Science	12	03	IIT Guwahati	Prof. Sambit Mallick	https://onlinecourses.nptel.ac.in/noc25_hs189/preview
04	Environment and Development	Humanities and Social Science	12	03	IIT Guwahati	Prof. Ngamjahao Kipgen	https://onlinecourses.nptel.ac.in/noc25_hs195/preview
05	Logistics & Supply Chain Management	Humanities and Social Science	12	03	IIT Kharagpur	Prof. Vikas Thakur	https://onlinecourses.nptel.ac.in/noc25_hs205/preview
06	Introduction to Film Studies	Humanities and Social Sciences English studies	12	03	IIT Madras	Prof. Aysha Viswamohan	https://onlinecourses.nptel.ac.in/noc25_hs138/preview
07	Entrepreneurship	Management	12	03	IIT Madras	Prof. C Bhaktavatsala Rao	https://onlinecourses.nptel.ac.in/noc25_mg81/preview
08	Managerial Skills for Interpersonal Dynamics	Management	12	03	IIT Roorkee	Prof. Santosh Rangnekar	https://onlinecourses.nptel.ac.in/noc25_mg91/preview
09	Automation in Production Systems and Management	Management	12	03	IIT Kharagpur	Prof. Pradip Kumar Ray	https://onlinecourses.nptel.ac.in/noc25_mg135/preview
10	Numerical Methods for Engineers	Multidisciplinary	12	03	IIT Madras	Prof. Niket Kaisare	https://onlinecourses.nptel.ac.in/noc25_ge59/preview

Semester – IV

Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.

Sr. No.	Name of Course	Category	Duration (Weeks)	Credit Points	Institute Offering Course	Name of Professor/ Resource person	Link
01	Indian Business History	Humanities And Social Sciences	08	02	IIT Guwahati	Prof. Vipul Dutta	https://onlinecourses.nptel.ac.in/noc25_hs32/preview
02	Probability and Stochastic for Finance	Economic Sciences	08	02	IIT Kanpur	Prof. Joydeep Dutta	https://onlinecourses.nptel.ac.in/noc25_ma58/preview
03	Enhancing Soft Skills and Personality	Humanities and Social Sciences	08	02	IIT Kanpur	Prof. T. Ravichandran	https://onlinecourses.nptel.ac.in/noc25_hs87/preview
04	Mastering Speaking and Presentations: A case Based Approach	Humanities and Social Sciences	08	02	IIT Kharagpur	Prof. Seema Singh	https://onlinecourses.nptel.ac.in/noc25_hs96/preview
05	The Science of Happiness and Wellbeing	Humanities and Social Sciences	08	02	IIT Kharagpur	Prof. Priyadarshi Patnaik Prof. Manas K Mandal	https://onlinecourses.nptel.ac.in/noc25_hs103/preview
06	Philosophical Foundations Of Social Research	Humanities And Social Sciences	08	02	IIT Guwahati	Prof. Sambit Mallick	https://onlinecourses.nptel.ac.in/noc25_hs63/preview
07	Emotional Intelligence	Humanities and Social Science	08	02	IIT Kharagpur	Prof. Rabindra Kumar Pradhan	https://onlinecourses.nptel.ac.in/noc25_hs16/preview
08	Employment Communication: A Lab based course	Humanities and Social Science	08	02	IIT Kharagpur	Prof. Seema Singh	https://onlinecourses.nptel.ac.in/noc25_hs17/preview
09	Soft Skill Development	Humanities and Social Science	08	02	IIT Kharagpur	Prof. Priyadarshi Patnaik Prof. V. N. Giri Prof. D. Suar	https://onlinecourses.nptel.ac.in/noc25_hs72/preview
10	Social Behavior and the Brain: An Introduction to Social Neuroscience	Humanities and Social Science, Psychology, Neuroscience, Cognitive Science	08	02	IIT Kanpur	Prof. Ark Verma	https://onlinecourses.nptel.ac.in/noc25_hs101/preview
11	Economic Growth And Development	Humanities and Social Sciences	08	02	IIT Guwahati	Prof. Rajshree Bedamatta	https://onlinecourses.nptel.ac.in/noc25_hs11/preview

12	Effective Writing	Humanities and Social Sciences	08	02	IIT Roorkee	Prof. Binod Mishra	https://onlinecourses.nptel.ac.in/noc25_hs14/preview
13	Centre-State Relations in India	Law	08	02	IIT Kharagpur	Prof. Uday Shankar	https://onlinecourses.nptel.ac.in/noc25_lw04/preview
14	Foundation Course in Managerial Economics	Management	08	02	IIT Kharagpur	Prof. Barnali Nag	https://onlinecourses.nptel.ac.in/noc25_mg25/preview
15	International Marketing	Management	08	02	IIT Kharagpur	Prof. Biswarup Ghosh	https://onlinecourses.nptel.ac.in/noc25_mg32/preview
16	Introduction to System Dynamics Modeling	Management	08	02	IIT Bombay	Prof. Jayendran Venkateswaran	https://onlinecourses.nptel.ac.in/noc25_mg37/preview
17	Management of New Products and Services	Management	08	02	IIT Kharagpur	Prof. KBL Srivastava	https://onlinecourses.nptel.ac.in/noc25_mg44/preview
18	Business Forecasting	Management	08	02	IIT Bombay	Prof. Pankaj Dutta	https://onlinecourses.nptel.ac.in/noc25_mg66/preview
19	Yoga and Positive Psychology for Managing Career and Life	Management	08	02	IIT Bombay	Prof. Ashish Pandey	https://onlinecourses.nptel.ac.in/noc25_mg75/preview
20	Roadmap for patent creation	Multidisciplinary	08	02	IIT Kharagpur	Prof. Gouri Gargate	https://onlinecourses.nptel.ac.in/noc25_ge30/preview

Semester – V

Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.

Sr. No.	Name of Course	Category	Duration (Weeks)	Credit Points	Institute Offering Course	Name of Professor/ Resource person	Link
01	Enhancing Study Skills	Multidisciplinary	08	02	Indira Gandhi National Open University, New Delhi	Dr. P. Lakshmi; Dr. G. Mythili	https://onlinecourses.swayam2.ac.in/no_u25_ge69/preview
02	Community Engagement and Social Responsibility	Multidisciplinary	10	02	Dayalbagh Educational Institute, Agra, Uttar Pradesh	Prof. Akshay Kumar Satsangi	https://onlinecourses.swayam2.ac.in/ug_c25_ge10/preview
03	Economic Environment and Business Strategy	Economics	8	02	IIT Kanpur	Prof. Sukumar Vellakkal	https://onlinecourses.nptel.ac.in/noc25_ec16/preview
04	Corporate Social Responsibility	Management	8	02	IIT Kharagpur	Prof. Aradhna Malik	https://onlinecourses.nptel.ac.in/noc25_mg139/preview
05	Soft Skill Development	Humanities and Social Science	8	02	IIT Kharagpur	Prof. Priyadarshi Patnaik, Prof. V. N. Giri, Prof. D. Suar	https://onlinecourses.nptel.ac.in/noc25_hs142/preview
06	Developing Soft Skills and Personality	Humanities and Social Science	8	02	IIT Kanpur	Prof. T Ravichandran	https://onlinecourses.nptel.ac.in/noc25_hs174/preview
07	Introduction to Advanced Cognitive Processes	Humanities and Social Science	8	02	IIT Kanpur	Prof. Ark Verma	https://onlinecourses.nptel.ac.in/noc25_hs177/preview
08	Entrepreneurship and IP Strategy	Humanities and Social Science	8	02	IIT Kharagpur	Prof. Gouri Gargate	https://onlinecourses.nptel.ac.in/noc25_hs213/preview
09	Artificial Intelligence, Law and Justice	Law	8	02	NALSAR University of Law	Prof. Krishna Ravi Srinivas	https://onlinecourses.nptel.ac.in/noc25_lw12/preview
10	Innovation, Business Models and Entrepreneurship	Management	8	02	IIT Roorkee	Prof. Rajat Agrawal Prof. Vinay Sharma	https://onlinecourses.nptel.ac.in/noc25_mg95/preview
11	Organization Development and Change in 21st Century	Management	8	02	IIT Bombay	Prof. Ashish Pandey	https://onlinecourses.nptel.ac.in/noc25_mg103/preview

List of S. Y. B. Tech. Open Elective Courses Offered by Various Engineering Programmes under Faculty of Science and Technology for the students of the programmes under faculty other than Science and Technology, Viz. Faculty of Commerce and Management, Faculty of Humanities and Faculty of Interdisciplinary Studies of Shivaji University, Kolhapur

Sr. No.	Name of the Programme Offering Open Electives	Semester	Open Elective Course Title	Teaching scheme			Credits
				L	T	P	
01	Mechanical Engineering	III	OE-01:Marketing Management	3	-	-	3
		III	OE-01 Lab: Marketing Management Practical	-	-	2	1
		IV	OE-02: Entrepreneurship Development	2	-	-	2
02	Computer Science and Engineering	III	OE-01: Advanced Computer Graphics	3	-	-	3
		III	OE-01 Lab: Advanced Computer Graphics Lab	-	-	2	1
		IV	OE-02: Computer Organization & Architecture	2	-	-	2
03	Electronics and Computer Science	III	OE-01: Sensor & Applications	3	-	-	3
		III	OE-01 Lab: Sensor & Applications Lab	-	-	2	1
		IV	OE-02: Block Chain Technology	2	-	-	2
04	Computer Science and Engineering (AIML)	III	OE-01: <i>Programming Fundamentals using C++</i> OR OE-01: <i>Web Technologies</i>	3	-	-	3
		III	OE-01 Lab: Programming Fundamentals using C++ Lab	-	-	2	1
		IV	OE-02: <i>Advanced Computer Network</i> OR OE-02: <i>Software Development using Agile</i>	2	-	-	2
05	Civil Engineering	III	OE-01: Building Construction and Planning	3	-	-	3
		III	OE-01 Lab: Building Construction and Planning Lab	-	-	2	1
		IV	OE-02: Municipal Solid Waste Management	2	-	-	2

06	Electronics and Telecommunication Engineering	III	OE-01: Introduction To IoT	3	-	-	3
		III	OE-01 Lab: Introduction To IoT Lab	-	-	2	1
		IV	OE-02: Control System Engineering	2	-	-	2
07	Computer Science and Engineering (Data Science)	III	OE-01: Programming for Everyone	3	-	-	3
		III	OE-01 Lab: Programming for Everyone lab	-	-	2	1
		IV	OE-02: E-Commerce & Digital Marketing	2	-	-	2
08	Electrical Engineering	III	OE-01: Energy Storage Systems	3	-	-	3
		III	OE-01 Lab: Energy Storage Systems Lab	-	-	2	1
		IV	OE-02: Electrical Maintenance and Energy Audit	2	-	-	2
09	Artificial Intelligence & Data Science	III	OE-01: Computer Networks	3	-	-	3
		III	OE-01 Lab: Open Elective -01 Lab	-	-	2	1
		IV	OE-02: Ethics in AI & DS	2	-	-	2
10	Electrical and Computer Engineering	III	OE-01: Electrical Machine	3	-	-	3
		III	OE-01 Lab: Electrical Machines-I Lab	-	-	2	1
		IV	OE-02: Electrical Design Estimation and Costing	2	-	-	2
11	Mechanical Mechatronics Engineering (Additive Manufacturing)	III	OE-01: Auto CAD	3	-	-	3
		III	OE-01 Lab: Auto CAD Lab	-	-	2	1
		IV	OE-02: Design and Technology	2	-	-	2
12	Electronics and Communication Engineering (Bio-Medical Engineering)	III	OE-01: Solid and e-Waste Management	3	-	-	3
		III	OE-01 Lab: Solid and e-Waste Management Lab	-	-	2	1
		IV	OE-02: Hospital Safety and Management	2	-	-	2

Guidelines for Multidisciplinary Minor (MDM) Programmes

As per the directives of the Government of Maharashtra, engineering colleges are encouraged to update their curricula in alignment with the guidelines of the National Education Policy (NEP) 2020. As part of this transformative initiative, the 'Minor Programme' has been introduced to promote multidisciplinary learning at the undergraduate level. These programmes are structured to provide students with interdisciplinary knowledge, enhancing their core academic disciplines and preparing them to meet the evolving demands of the global job market.

Minor programmes across various disciplines have been introduced to provide students with the opportunity to explore fields beyond their core B. Tech curriculum. These programmes enable students from specific branches to broaden their knowledge and skill sets. For example, a student pursuing Mechanical Engineering can opt for a Minor in Computer Science and Engineering, thereby acquiring interdisciplinary expertise that enhances both academic depth and professional flexibility. However, students enrolled in the Computer Science and Engineering (CSE) programme are restricted from choosing MDM's in Artificial Intelligence and Data Science, CSE (Data Science), and CSE (Artificial Intelligence and Machine Learning) in order to prevent overlap between the core curriculum of CSE and the content of these minors, ensuring that students gain diverse and non-redundant knowledge through their minor specializations. **(Refer Table: MDM Courses)**

Common guidelines to students:

1. The Multidisciplinary Minor (MDM) must be compulsorily chosen from engineering discipline different from the student's Major engineering programme. Students should take MDM from the list of MDM Offered by Other Departments/Branches/ programmes only. Ex: A Student of Mechanical Engineering should take MDM from other departments/branches/Programmes except MDM offered by Mechanical Engineering Dept. **(Refer Table: MDM Courses)**
2. The entry point for any compulsory MDM programme is the 3rd semester. The required credits for MDM courses must be acquired from the 3rd semester of second year to the final year of UG Programme.
3. A student is required to continue with the selected Minor programme consistently throughout all six semesters.
4. No changes to the selected Minor programme will be permitted under any circumstances.
5. A student may choose only one Minor programme (track), from the list of MDM courses offered by the institute.
6. The allotment of the MDM course will be based on the marks obtained by the student in the first year for Sem-I and Sem-II combinely.
7. The compulsory MDM programme will admit a maximum of 75 students into its minor course, with selection strictly based on first-year academic merit. Preference order for allocating MDM minor will follow the hierarchy: Candidates with no backlogs first, then those with one backlog, followed by those with two backlogs, and so on.

8. All students must complete the Google form provided by the Institute, indicating their preferences to MDM programme within the specified deadline. Students should ensure that they enter their accurate first year marks in the form along with the attachment of marksheets of Sem-I and Sem-II to avoid any discrepancies.

(Refer Table: MDM Courses)

List of S. Y. B. Tech. MDM Courses Offered by the Various Programmes under the Faculty of Science and Technology at Shivaji University, Kolhapur

Sr. No.	Name of the Programme (Major) Offering MDM	Name of the corresponding Minor Programme to be offered	Semester	Name of the MDM Course offered by the Major Programme	Teaching scheme			Credits
					L	T	P	
01	Mechanical Engineering	1. Computer Science and Engineering 2. Electronics and Computer Science 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Electronics and Telecommunication Engineering 6. Computer Science and Engineering (Data Science) 7. Electrical Engineering 8. Artificial Intelligence & Data Science 9. Electrical and Computer Engineering 10. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Thermodynamics	2	-	-	2
			IV	MDM 02: Theory of Machines	2	-	-	2
02	Computer Science and Engineering	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing) 6. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Data Structures using C	2	-	-	2
			IV	MDM 02: Object Oriented Programming	2	-	-	2
		1. Mechanical Engineering	III	MDM 01: Logic Design	2	-	-	2

03	Electronics and Computer Science	2. Civil Engineering 3. Electrical Engineering 4. Mechanical and Mechatronics Engineering (Additive Manufacturing)	IV	MDM 02: Electronics Measurements	2	-	-	2
04	Computer Science and Engineering (AIML)	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing) 6. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Object Oriented Programming	2	-	-	2
			IV	MDM 02: Introduction to AI	2	-	-	2
05	Civil Engineering	1. Mechanical Engineering 2. Computer Science and Engineering 3. Electronics and Computer Science 4. Computer Science and Engineering (AIML) 5. Electronics and Telecommunication Engineering 6. Computer Science and Engineering (Data Science) 7. Electrical Engineering 8. Artificial Intelligence & Data Science 9. Electrical and Computer Engineering 10. Mechanical and Mechatronics Engineering (Additive Manufacturing) 11. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Building Construction	2	-	-	2
			IV	MDM 02: Waste Management	2	-	-	2
			III	MDM 01: Electronics System	2	-	-	2

06	Electronics and Telecommunication Engineering	1. Mechanical Engineering 2. Computer Science and Engineering 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Computer Science and Engineering (Data Science) 6. Electrical Engineering 7. Artificial Intelligence & Data Science 8. Electrical and Computer Engineering 9. Mechanical and Mechatronics Engineering (Additive Manufacturing)	IV	MDM 02: Electronics Measurements	2	-	-	2
07	Computer Science and Engineering (Data Science)	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing) 6. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: C Programming	2	-	-	2
			IV	MDM 02: Python Programming	2	-	-	2
		1. Mechanical Engineering 2. Computer Science and Engineering 3. Electronics and Computer Science	III	MDM 01: Introduction to Electrical and Electronics Circuits	2	-	-	2

08	Electrical Engineering	4. Computer Science and Engineering (AIML) 5. Civil Engineering 6. Electronics and Telecommunication Engineering 7. Computer Science and Engineering (Data Science) 8. Artificial Intelligence & Data Science 9. Mechanical and Mechatronics Engineering (Additive Manufacturing) 10. Electronics and Communication Engineering (Bio-Medical Engineering)	IV	MDM 02: Electrical Power System	2	-	-	2
09	Artificial Intelligence & Data Science	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing) 6. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Fundamentals of AI	2	-	-	2
			IV	MDM 02: Python for Data Science	2	-	-	2
10	Electrical and Computer Engineering	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Mechanical and Mechatronics Engineering (Additive Manufacturing) 5. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Renewable Energy Sources	2	-	-	2
			IV	MDM 02: Python Programming	2	-	-	2

11	Mechanical and Mechatronics Engineering (Additive Manufacturing)	1. Computer Science and Engineering 2. Electronics and Computer Science 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Electronics and Telecommunication Engineering 6. Computer Science and Engineering (Data Science) 7. Electrical Engineering 8. Artificial Intelligence & Data Science 9. Electrical and Computer Engineering 10. Electronics and Communication Engineering (Bio-Medical Engineering)	III	MDM 01: Computer Aided Design (CAD)	2	-	-	2
			IV	MDM 02: Product Design & Development	2	-	-	2
12	Electronics and Communication Engineering (Bio-Medical Engineering)	1. Mechanical Engineering 2. Computer Science and Engineering 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Computer Science and Engineering (Data Science) 6. Electrical Engineering 7. Artificial Intelligence & Data Science 8. Electrical and Computer Engineering 9. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Data Analytics for Healthcare System	2	-	-	2
			IV	MDM 02: Environmental Management in Healthcare	2	-	-	2

Second Year Exit: Teaching Methodology, Assessment and Evaluation

[I] As per R. R. B. Tech. 12.2 Rule: Award of Degree

If a student passes all the courses of first year, second year and earns the requisite number of credits, the student will become entitled to Undergraduate Diploma (Two years or four semesters) in the programme of his/her major subject. If he/she wants to exit, can exit the programme with UG Diploma certificate. However, for the award of two years UG Diploma Certificate in Major with 88 credits, an additional 8 credits from Exit Courses are required to earn.

[II] Second Year Exit Course:

Methodology 1:

1. The students should complete two online certification courses (NPTEL) related to their programme, each of 3 credits. In addition to this, they will also need to complete 2 credits worth of two Virtual Lab work related to online certification courses. These additional 8 credits earn by students shall be based upon skill based vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study or programme. The skill based vocational courses shall be analogous to the Baskets/Areas provided by the concerned BoS.

3. The student must complete two virtual lab work that adds 2 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (3 credits each) are converted to a total of 100 marks. The report for the two Virtual Lab work of 2 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of the virtual lab experiments conducted, encompassing the methodology, results, and conclusions.
5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website <https://swayam.gov.in> and create their account. Log in the account and join the required course and follow the instructions to compete the course. Similarly, for Virtual Lab, the students are required to visit to website <https://www.vlab.co.in> and create their account. Log in the account and join the required lab and follow the instructions to compete the course (need to perform all listed experiments under that Lab). To fulfill the requirement of 06 credits, students can go for two courses each of 12 weeks.

Methodology 2:

1. The students should complete two online certification courses (NPTEL) related to their programme, each carrying 2 credits. In addition to this, they will also need to complete 4 credits worth of two physical internship/Apprenticeship (each of 40 hrs) work from relevant industry. These additional 8 credits earned by the students shall be based upon skill based vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study/programme. The skill-based vocational courses shall be analogous with the list provided by the concerned BoS.
3. The student should complete two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices that adds 4 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (2 credits each) are converted to a total of 100 marks. The report for the performed two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices of 4 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of two physical internship/Apprenticeship (each of 40 hrs) work along with certificate of internship/Apprenticeship from

relevant industrial practices conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website <https://swayam.gov.in> and create their account. Log in the account and join the required course and follow the instructions to complete the course.

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	--		MT	--
Tutorials	--		CA	--
Total Credits	2		ESE	100 Marks
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.		

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			
									Internal Evaluation (IE)		ESE	TOTAL
									MT	CA		
1	PCC	BM0231	Human Anatomy and Physiology	3	--	--	3	3	10	30	60	100
2	PCC	BM0232	Analog and Linear Integrated Circuits	3	--	--	3	3	10	30	60	100
3	PCC	BM0233	Electrical Circuits	3	--	-	3	3	10	30	60	100
4	PCC	BM0234	Mathematics for Biomedical Engineering	2	--	--	2	2	10	30	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	10	30	60	100
7	OE	BM0237	Open Elective -01	3	--	--	3	3	10	30	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	50
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	60	305	435	800

L-Lecture

T-Tutorial

P-Practical

IE-Internal Evaluation

MT-Midterm Test

CA-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			
									Internal Evaluation (IE)		ESE	TOTAL
									MT	CA		
1	PCC	BM0242	Medical Instrumentation	3	--	--	3	3	10	30	60	100
2	PCC	BM0243	Biomedical Sensors and Transducers	3	--	--	3	3	10	30	60	100
3	PCC	BM0244	Biochemistry	3	--	--	3	3	10	30	60	100
4	MDM	BM0245	Multi-disciplinary Minor-02	2	--	--	2	2	10	30	60	100
5	OE	BM0246	Open Elective -02	2	--	--	2	2	10	30	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	10	30	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	60	355	485	800+100 (Audit)

L-Lecture

T-Tutorial

P-Practical

IE-Internal Evaluation

MT-Midterm Test

CA-Continuous Assessment

ESE-End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	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-01	Solid and e-Waste Management Lab
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.	Semester	Code	Course Offered	L	P	Hrs.	Credits
No							
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		MT	10	
Tutorials	--		CA	30	
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 Code : BM0232					
Course Name : Analog and Linear Integrated Circuit					
Teaching Scheme			Examination Scheme		
Lectures	03		MT	10	
Tutorials	--		CA	30	
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

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: BM233 Course Name: Electrical Circuits				
Teaching Scheme			Examination Scheme		
Lectures	03		MT		10
Tutorials	--		CA		30
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.				
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

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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
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		

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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		MT	10	
Tutorials	--		CA	30	
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)				
Corse Name: Human Anatomy and Physiology Lab Corse Code : BM0235				
Laboratory Scheme:			Examination Scheme:	
Practical	02		CA	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).			

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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)					
Course Code :- BM0236					
Corse Name: MDM-1 (Data Analytics for Healthcare System)					
Teaching Scheme			Examination Scheme		
Lectures		02	MT	10	
Tutorials		--	CA	30	
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					
CO1	Describe the structure of healthcare systems and identify types of healthcare data.				
CO2	Apply basic data preprocessing techniques to organize and prepare healthcare datasets for analysis.				
CO3	Analyze healthcare data using exploratory data analysis and interpret patterns.				
CO4	Develop simple predictive models and evaluate their role in clinical decision-making.				
CO5	Assess ethical, legal, and security issues related to healthcare data analytics.				
CO6	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			CO1	(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			CO2	(05)

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S.T.B Tech: Electronics and Communication Engineering (Bio-Medical Engineering) / W.E.T Academic Year 2020-21, as per NEP 21			
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)
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	MT	10		
Tutorials	--	CA	30		
Total Credits	03	ESE	60		
		Total	100		
Prerequisite: Knowledge of pollution, ecosystems, and sustainable development.					
Course Outcomes (CO): Students will be able to					
C01	Identify various types of solid waste and explain their physical/chemical characteristics and impacts on human health.				
C02	Describe different disposal techniques like composting (Indore/Bangalore methods) and summarize the factors for landfill site selection.				
C03	Explain the sources of biomedical and industrial waste and explain basic energy recovery concepts like Biofuels and RDF				
C04	Identify the salient features of the 2016 Management Rules and identify the roles of the CPCB, MPCB, and local Gram Panchayats.				
C05	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)					
Corse Code: BM0238 Course Name: Universal Human Values					
Teaching Scheme		Examination Scheme			
Lectures	02		MT	--	
Tutorials	--		CA	25	
Total Credits	02		ESE	--	
			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=8ovkLRYXIjE>
- <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)				
Course Code:- BM0239				
Lab Name:- Analog and Linear Integrated Circuits Lab				
Laboratory Scheme:			Examination Scheme:	
Practical	02		CA	25
Total Credits	01		ESE	25
			TOTAL:	50
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			
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			

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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	

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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		MT	--	
Tutorials	--		CA	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	Hour s
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.

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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: (OE-1 Lab) Solid and e Waste Management Lab				
Laboratory Scheme:			Examination Scheme:	
Practical	02		CA	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				

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		MT	10	
Tutorials	--		CA	30	
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)
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)

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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)
	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.		

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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	

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		MT	10	
Tutorials	---		CA	30	
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				(05)
	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				
Unit 2	Bioelectrodes and Biopotential Measurement				(05)
	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				

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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)					
Corse Code : BM0244					
Course Name : Biochemistry					
Teaching Scheme			Examination Scheme		
Lectures	3		MT	10	
Tutorials	--		CA	30	
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
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)

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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

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.

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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	MT	10	
Tutorials	---	CA	30	
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				
C01	Describe the basic concepts of environmental management, environmental health, and sustainability in healthcare systems.			
C02	Explain environmental laws, policies, and biomedical waste regulations applicable to healthcare organizations			
C03	Apply standard procedures for segregation, handling, treatment, and disposal of healthcare waste in healthcare facilities.			
C04	Apply pollution control and resource conservation practices in healthcare facilities to minimize environmental impact.			
C05	Explain the concepts and components of environmental management systems and environmental assessment methods used in healthcare institutions.			
C06	Apply sustainable healthcare practices and modern environmental management techniques in healthcare settings.			
	Course Contents			CO Hou rs

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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)

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

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

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Shivaji University, Kolhapur					
Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering (Bio-Medical Engineering)					
Corse Code : BM0246					
Course Name: (OE-2)Hospital Safety and Management					
Teaching Scheme			Examination Scheme		
Lectures	3		MT	10	
Tutorials	--		CA	30	
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.	Royal 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		MT	--
Tutorials	---		CA	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.			C01
				03

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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		MT	--
Tutorials	---		CA	25
Total Credits	02		ESE	--
Prerequisite : Basic Communication Skills				
Course Outcomes (CO): Students will be able to				
C01	Create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.			
C02	Understand Engineering Ethics			
C03	Create an awareness of seeing Engineering as Social Experimentation			
C04	Understand Safety, Responsibilities and Rights			
C05	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.	C01	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.	C02	03	
Unit 3	Engineering As Social Experimentation Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.	C03	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.	C04	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.	C05	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 Name : Medical Instrumentation Lab Course Code : BM0249				
Laboratory Scheme:			Examination Scheme:	
Practical	02		CA	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				

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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		CA	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		

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**Second Year (Sem – IV) B. Tech. Electronics and Communication Engineering
(Bio-Medical Engineering)****Course Name : Biochemistry Lab****Course Code : BM0251**

Laboratory Scheme:			Examination Scheme:	
Practical	02		CA	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			
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				

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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		MT	10
Tutorials	---		CA	30
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

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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 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	C02	04
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		

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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

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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	MT	--	
Tutorials	--	CA	--	
Total Credits	01	ESE	--	
Prerequisite : Basic knowledge of electronics, electrical circuits, and biomedical instrumentation.				
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	CO4	(02)
Unit 6	Introduction to Arduino & Raspberry Pi: Basic programming, interfacing sensors in biomedical applications	CO5	(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.			

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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		CA	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.			
CO5	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.)			

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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	

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Emerging (Specialization) Minor (18 Credits) in Electronics and Communication Engineering (Bio-Medical Engineering)
(Biomedical Innovation & Robotics) to be implemented from Academic Year 2026-27 (As per GR NEP-2022(67/23) / Tanshi -2, Dated 04th July 2023)

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	--	MT	10	
Tutorials	--	CA	30	
Total Credits	03	ESE	60	
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				
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.

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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		MT	10	
Tutorials	--		CA	30	
Total Credits	3		ESE	60	
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

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

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

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	---	MT	10	
Tutorials	---	CA	30	
Total Credits	03	ESE	60	
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,			

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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
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	CO2	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	CO3	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	CO4	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	CO5	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	CO6	6
Text Books			
1.	Biomedical Instrumentation and Measurements – Leslie Cromwell, Erich A. Pfeiffer & Fred J. Weibell — Classic textbook covering instrumentation principles and measurements.		

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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.