

University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग (ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई - ४०० ०३२
टेलिफोन नं - ०२२ - ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७

दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमलबजावणीच्या अनुषंगाने शैक्षणिक वर्ष २०२५-२६ पासून पदवी व पदव्युत्तर अभ्यासक्रम विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई - ४०० ०३२
२७ मे, २०२५


(डॉ. प्रसाद कारंडे)
कुलसचिव

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As Per NEP 2020

University of Mumbai



Syllabus for Major Vertical – 1, 4, 5 & 6

Name of the Programme – B.E. (<u>Biomedical Engineering</u>)		
Faculty of <u>Engineering</u>		
Board of Studies in <u>Biomedical Engineering</u>		
U.G. Second Year Programme	Exit Degree	U.G. Diploma in <u>Biomedical Engineering</u>
Semester		III
From the Academic Year		2025-26

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B.E. (Biomedical Engineering)
2	Exit Degree	U.G. Diploma in Biomedical Engineering
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R. TEU-515C R. TEU-515D	Attached herewith
6	Semesters	Sem. III
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-

Dr. Ghanshyam D Jindal
BoS-Chairman, Biomedical Engineering
Faculty of Technology

Sd/-

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-

Prof. Shivram S. Garje
Dean
Faculty of Science & Technology

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the branch of Bio-Medical Engineering in the learner. Keeping this in view, a pool of courses is offered in Core Courses covering fundamentals required to understand core and modern engineering practices and emerging trends in technology. Considering the shift in pedagogy and the convenience of a stress-free learning process, a choice-based subject pool is offered in the coursework under the heads of Bio-Medical Engineering for open electives (OE) and multi-disciplinary minor (MDM) courses in the third and fourth semesters. Essentially, to give a glimpse of trends in the industry under vocational and enhanced skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

Program Core Courses cover courses constituents to Bio-Medical Engineering program. Also Open Elective and Multi-Disciplinary Minor are given for selection from a pool of subjects. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional. For this purpose, Design Thinking is introduced in the Third Semester to orient a journey from a learner to a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit- point pools of Vocational skills is arranged for giving exposure to the current Industry needs.

The faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner's learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation, which will enhance the quality of education. Credit assignment for courses is based on a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in initial 12-13 weeks, leaving 2-3 weeks to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the second-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the second year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the Second Year of Engineering from the academic year 2025-26. Subsequently, this system will be carried forward for Third and Final Year of Engineering in the academic years 2026-27 and 2027-28 respectively.

Sd/-

Dr. Ghanshyam D Jindal
BoS-Chairman-Biomedical Engineering
Faculty of Technology

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Associate Dean
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Prof. Shivram S. Garje
Dean
Faculty of Science & Technology

Under Graduate Diploma in Bio-Medical Engineering
Credit Structure (Sem. III)

	R. TEU-515C									
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	PCC311:3 PCC312:3 PCC313:3 PCC314:3 PCL315:1 PCL316:1	--	--	OE:2	--	VEC: 2 HSL: 2	CEP: 2	22	UG Diploma 45
	R. TEU-515D									
	IV	PCC411:3 PCC412:3 PCC413:3 PCL414:1 PCL415:1	--	MDM: 4	OE:2	VSEC:2	VEC: 2 EEM:2	--	23	
	Cum Cr.	25	--	4	4	2	2+2+2+2	2	45	

Exit option: Award of UG Diploma in Major and MDM with 90 credits and additional 4 credits core **one** theory subject with 3 credits and **one** lab with 1 credit from one third year from where they want to take Exit degree. Along with theory and practical course student must compulsory do internship for **one month or 160 hours** which internship is equal to 4 credits.

[Abbreviations: OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – On Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Sem. – III

S.E.BME Scheme

Program Structure for Second Year of Bio-Medical Engineering
UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER III

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2053111	Biomedical Signals & Systems	2	--	1	2	1	–	3
2053112	Applied Electronics for Biomedical Engineers	3	–	--	3	–	–	3
2053113	Sensors & Actuators	3	--	--	3	–	–	3
2053114	Basic Human Anatomy & Physiology	3	--	--	3	–	–	3
	Open Elective (form other boards like Science/ Commerce/ Management stream)	2#	--	--	2	–	–	2
2053115	Applied Electronics lab for Biomedical Engineers	--	2	–	–	–	1	1
2053116	Sensors & Actuators lab	--	2	–	–	–	1	1
2053611	Mini Project (group project)	--	2*+2	–	–	–	2	2
2993511	Entrepreneurship Development	--	2*+2	---	–	–	2	2
2993512	Environmental Science for Engineers	--	2*+2	--	–	–	2	2
Total		13	16	01	13	01	08	22

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Institute shall offer a course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

Institute shall offer a course for MDM from other Engineering Boards.

Course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2053111	Biomedical Signals & Systems	20	20	40	60	2	25	--	125
2053112	Applied Electronics for Biomedical Engineers	20	20	40	60	2	--	--	100
2053113	Sensors & Actuators	20	20	40	60	2	--	--	100
2053114	Basic Human Anatomy & Physiology	20	20	40	60	2	--	--	100
	Open Elective (form other boards like Science/ Commerce/ Management stream)	20	20	40	60	2	--	--	100
2053115	Applied Electronics lab for Biomedical Engineers	--	--	--	--	--	25	25	50
2053116	Sensors & Actuators lab	--	--	--	--	--	25	25	50
2053611	Mini Project (group project)	--	--	--	--	--	50	25	75
2993511	Entrepreneurship Development	--	--	--	--	--	50	--	50
2993512	Environmental Science for Engineers	--	--	--	--	--	50	--	50
Total		100	100	200	300	10	225	75	800

Vertical – 1 Major

Detailed Syllabus

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract/Oral	Theory	Tut.	Pract/Oral	Total
2053111	Biomedical Signals & Systems	2	1	--	2	1	---	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053111	Biomedical Signals & Systems	20	20	40	60	2	25	---	125

Rationale

This introductory course „Biomedical Signals and Systems“ in second year of Biomedical Engineering is to give overall view of biomedical signals and systems, Discrete time signals and systems, various transforms used in signal processing, Fourier transform, its implementation and analysis for biosignals including random signal.

Course Objectives

1. To understand the biomedical signals and systems
2. To understand the concept of discrete time signals and systems
3. To understand Transforms in continuous and discrete signals processing
4. To understand discrete time signal processing
5. To understand the discrete Fourier, transform and its computation
6. To understand the random signal and their analysis

Course Outcomes

On completion of the course the learners will be able to:

1. Explain the types of Biomedical signals and understand their nature

- 2 Implement different discrete time signals and systems and operations on them
3. Implement the z- transform and highlight its applications
4. Describe DTFT, DFT, Inter-relations among Fourier conversions and implement them
5. Describe DFT, FFT, and implement them
6. Explain the nature of random signal and their analysis

Detailed Syllabus

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Pre-requisites	Basic knowledge of integration, summation, differentiation, limit, complex Numbers, physiological systems and signals.	0	--
I	Biomedical signals and systems	Biomedical signals: Problem Statement, Operations on time signals, Concurrent, Coupled, and Correlated Processes, Physiological systems	6	CO1
II	Discrete time signals and systems	Discretization of continuous time signals: Discrete time signals, Discrete time systems, Ensemble average and time average	6	CO2
III	Transforms in continuous and discrete signals processing	The Laplace transform: Properties of Laplace transform, Frequency response of LTI system, Pole zero plots, Frequency filters Phase shifts and time delays, Systems representation of physiological processes The Z-transform: Properties of z-transform, convolution in discrete-time domain, time shift, pole zero plot in complex-z plane, The bilinear transform	6	CO3
IV	Discrete time signal processing	Decomposition of periodic signals, Fourier conversion, Aperiodic continuous signals-Fourier Transform, System transfer function, Discrete Fourier conversions: Periodic discrete time signals-discrete Fourier series, Aperiodic discrete -Time signals-DTFT, properties of DTFT, Numerical implementation of Fourier conversion: DFT, Inter-relations among Fourier conversions	6	CO4
V	Discrete Fourier transform	Applying the discrete Fourier transform: Properties of DFT, windowing, The Fast Fourier Transform, Convolution using FFT-circular convolution	6	CO5
VI	Random signal analysis	Discrete Fourier transform of random signals: Estimation the power spectrum: spectrum estimation by averaging periodograms Transfer function estimation or system identification	6	CO6

Text Books

1. Suresh R. Devasahayam, Signals and systems in Biomedical Engineering: Signal processing and Physiological systems modelling, Kluwer Academic/Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, 2000

References

1. D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005
2. R M Rangayyan "Biomedical Signal Analysis: A Case Based Approach", IEEE Press, John Wiley & Sons. Inc, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall, Upper Saddle River, New Jersey 07458

Online References

Sr. No.	Website Name
1.	Principles of Signals and Systems, Prof. Aditya K. Jagannatham, IIT Kanpur https://onlinecourses.nptel.ac.in/noc24_ee36/announcements?force=true
2.	Signals and Systems, Prof. Hitesh Shrimali, Prof. Kushal K. Shah, IIT Mandi, IISER Bhopa https://onlinecourses.nptel.ac.in/noc25_ee78/unit?unit=19&lesson=26

Assessment:

Internal Assessment (IA) for 40 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.
 - Internal Assessment Test can be **open book**, provided all the questions are of **level IV and above** as per **Bloom's Taxonomy**.
- Question paper format
- Question Paper will comprise of a total of six questions each carrying 15 marks. Q.1 will be compulsory and should cover maximum contents of the syllabus
 - Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
 - A total of four questions needs to be answered

Tutorials: minimum 10 tutorials from the following list

Sr. No.	Title	Hours
1	Numerical examples on Operations on discrete time signals	1
2	Numerical examples on types of discrete time signals	1
3	Numerical examples on properties of systems	1
4	Numerical examples on Ensemble average and time average	1
5	Numerical examples on Laplace transform: Pole zero plots	1
6	Numerical examples on The Z-transform	1
7	Numerical examples on convolution in discrete-time domain,	1
8	Numerical examples on Fourier Transform, System transfer function	1
9	Numerical examples on DFT	1
10	Numerical examples on Fast Fourier Transform,	1
11	Numerical examples on Convolution using FFT-circular convolution	1
12	Numerical examples on analysis of random signals	1

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract/Oral	Theory	Tut.	Pract/Oral	Total
2053112	Applied Electronics for BME	3	-	--	3	-	--	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053112	Applied Electronics for BME	20	20	40	60	2	--	--	100

Rationale:

Electronic circuits are the building blocks of Biomedical Instrumentation. Its study helps Biomedical engineers to understand signal conditioning in biomedical instruments. It enables the learners to analyse and design crucial medical applications.

Course Objectives:

1. To provide comprehensive understanding of regulated power supply.
2. To understand transistors and how it works as an amplifier
3. To gain knowledge of MOSFET and its applications.
4. To provide concepts of operational amplifier to use in various applications.
5. To design various oscillators and filter circuits.
6. To design and develop different circuits using various integrated circuits.

Course Outcomes: Learner will be able to

1. Explain the characteristics of various semiconductor devices.
2. Design small signal amplifiers.
3. Select MOSFETs for various applications.
4. Apply knowledge of operational amplifier to analyse different operational amplifier based circuits.
5. Apply knowledge of operational amplifier to design various electronic circuits such as oscillators, filters, waveform generators etc
6. Apply designing concepts in various projects/applications.

Prerequisite: Students should know basics of semiconductor physics, laws and theorems of electricity.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Semiconductor Devices	Characteristics and applications of: pn junction diode, Zener diode, LED, Photodiode, Solar cell, UJT, SCR, Optocoupler	7	CO1

II	Bipolar Junction Transistor	Construction, Working and Characteristics of three different configurations of BJT, Concept of Quiescent point and load line, Concept of biasing, A.C. Equivalent Model: r_e model, use of BJT as small signal amplifier, Frequency response of BJT, Amplifier analysis	9	CO2
III	MOSFETs	Classification, Construction, Characteristics of MOSFETs, Biasing of MOSFET, MOSFET as an amplifier & MOSFET as a switch.	8	CO3
IV	Basics and linear circuits of Operational amplifiers	Introduction: Block Diagram of Op-amp, Characteristics of op-amp, Equivalent circuit, Concept of virtual ground, Voltage comparators, Concept of feedback in op-amp, Inverting, Noninverting and differential configuration, Voltage follower, Adder, Subtractor, Instrumentation amplifier, Monolithic instrumentation amplifier(eg AD620) Voltage to Current and Current to Voltage converters	7	CO4
V	Nonlinear Circuits of Operational amplifier	Integrator and Differentiator (Ideal and practical), Schmitt Trigger, Peak detector, Precision Rectifier, Concepts of Oscillations: Barkhausen's criteria for an oscillator, Types of oscillators: RC and LC. Working and design of RC Phase shift Oscillator and Wien Bridge oscillator; Crystal Oscillator	7	CO5
VI	Special Function ICs	IC 555 pin diagram and Functional Block diagram, IC 555 as Astable and Monostable multivibrator(functional diagram, circuit diagram and applications), Fundamentals of Phase Locked Loop and PLL applications. (IC 4046/ IC 565) Design of voltage regulator using IC 78XX, 79XX, LM 317 (High voltage regulator) Concept of large signal amplifier(power amplifier), classes of power amplifier, Power amplifier IC LM380	7	CO6

Text Books:

1. Electronic Devices and Circuit Theory, by Robert L. Boylestad and Louis Nashelsky, Pearson Education.
2. Op-Amps and linear integrated circuits by Ramakant Gayakwad, Prentice Hall

References:

1. Design with Operational Amplifiers and Analog Integrated Circuits, by Sergio Franco, McGraw Hill, 2002
2. Electronic design, by Martin S. Roden, Gordon L. carpenter, William R Wieseman, Shroff Publishers & Distributors Pvt. Limited

Online References:

Sr. No.	Website Name
1.	Fundamentals Of Electronic Materials And Devices - Course https://onlinecourses.nptel.ac.in/noc25_mm15/preview
2.	Integrated Circuits and Applications - Course https://onlinecourses.nptel.ac.in/noc24_ee73/preview

Assessment:

Internal Assessment (IA) for 40 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- Internal Assessment Test can be **open book**, provided all the questions are of **level IV and above** as per **Bloom's Taxonomy**.

End Semester Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks**. **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature**. Sub question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract	Theory	Tut.	Pract	Total
2053113	Sensors and Actuators	2	--	--	2	--	--	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053113	Sensors and Actuators	20	20	40	60	2	--	--	100

Rationale:

Measure the physiological parameters with high accuracy is one of the key area in Biomedical Engineering. This depends on the proper selection of transducer for application. This course introduces students to working principles, construction of basic transducers, biosensors and actuators. It also covers the applications of sensors and actuators in biomedical engineering.

Course Objectives:

1. To provide the knowledge of basic concepts such as generalized medical instrumentation system, transducer characteristics.
2. To provide a thorough understanding of principle and working of transducers and sensors used for measuring displacement, motion, force, pressure, temperature, bio-potentials, biochemical concentrations.
3. Enable learners to understand principle and working of biosensors.
4. To study the medical applications of the mentioned transducers and sensors.
5. Enable learners to understand principle and working of actuators and its medical applications
6. To perform experiments based on some of the mentioned transducers and sensors.

Course Outcomes: Learner will be able to

1. Explain different components of a generalized medical instrumentation system, and transducer characteristics.
2. Apply the knowledge of principles of various types of transducers and sensors including motion, displacement, force, pressure sensors to different medical applications.
3. Apply the knowledge of principles of various types of temperature sensors to different medical applications.
4. Apply the knowledge of the various biopotential electrodes for measuring different types of bio potentials, various chemical sensors for measuring concentration of biochemical analytes and biosensors with medical applications.
5. Discuss the principle and working of different types of actuators
6. Demonstrate the working of electric actuators such as relays, DC, servo and stepper motors

Prerequisite: Basic physics, chemistry, electronics, Measurements and Instruments

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Sensors Introduction	Generalized medical instrumentation system; Sensors characteristics: Accuracy, precision, resolution, reproducibility, sensitivity, drift, hysteresis, linearity, input impedance and output impedance	03	CO1

II	Displacement, Force and Pressure Sensors	Strain gauges, L.V.D.T., capacitive sensors; Piezoelectric sensor, Diaphragms, Load cell, Bourdon tube, Medical Applications	05	CO2
III	Temperature and Radiation Sensors	Thermistor, thermocouple, resistive temperature detector; IC-based sensor, IR sensor, Photomultiplier tube, Photo-resistive sensor, Medical Applications.	05	CO3
IV	Biopotential Electrodes	Electrode circuit model, electrode-skin interface, Body surface electrodes; Internal electrodes: Needle and wire electrodes (different types); Microelectrodes: Metal and supported metal micropipette (metal filled glass and glass micropipette) electrodes.	05	CO4
V	Chemical Sensors and Biosensors	pH, PCO ₂ , PO ₂ electrodes; ISFETs; Fiber optic sensor, Optical and piezoelectric Biosensor, Medical Applications	06	CO5
VI	Actuators	Definition, linear; rotary Actuators, Pneumatic actuator, Hydraulic actuator, Diaphragm pump, Control valves; Micro Actuator, Relays, Principle of operation and its application: D. C. motors, Servo motors, Stepper motors, Medical applications	06	CO6

Text Books:

1. Medical Instrumentation-Application and Design, John G. Webster, Wiley India Private Limited.
2. Instrument Transducers: An Introduction to Their Performance and Design, Hermann K. P. Neubert, Oxford University Press.
3. Biomedical Sensors: Fundamentals and Applications, Harry N. Norton, Noyes Publications.
4. Biosensors: Fundamentals and Applications, Banshi Dhar Malhotra and Chandra Mouli Pandey, Smithers Rapra Technology.
5. W. Bolton-Mechatronics, Pearson Education Limited.
6. Control system components, B. Chatterjee, Khanna Publisher.

References:

1. Principles of Applied Biomedical Instrumentation, L.A. Geddes and L.E. Baker, Wiley India Pvt Ltd.
2. Biomedical Instrumentation and Measurements, Leslie Cromwell, Erich A. Pfeiffer and Fred J. Wiebell, Prentice-Hall of India Pvt. Ltd.
3. Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merrill Publishing Company.
4. Measurement Systems, Application and Design, Ernest O. Doebelin, McGraw Hill Higher Education.
5. Robert H. Bishop-The Mechatronics Handbook, 2nd Ed., Mechatronic Systems, Sensors and Actuators, fundamentals and modeling.
6. Control system components, MD desai, PHI learning

Online References:

Sr. No.	Website Name
1.	Course: Industrial Instrumentation by Prof. Alok Barua - IIT Kharagpur https://nptel.ac.in/courses/108/105/108105064/
2.	Transducers For Instrumentation https://onlinecourses.nptel.ac.in/noc23_ee105/preview

Assessment:

Internal Assessment (IA) for 40 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test
- Internal Assessment Test can be **open book**, provided all the questions are of **level IV and above** as per **Bloom's Taxonomy**.

End Semester Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract/Oral	Theory	Tut.	Pract/Oral	Total
2053114	Basics of Human Anatomy and Physiology	3	-	--	3	--	--	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053114	Basics of Human Anatomy and Physiology	20	20	40	60	2	--	--	100

Rationale:

Biomedical Engineering course remains incomplete if the learner is not aware about the human body, generation of bio potential and the correct usage of devices before placing them on human body. This can be achieved only by having the basic understanding about the anatomy of each organs and its functioning. Thus this course provides an insight to students about the overall anatomy and physiological functioning of the human body.

Course Objectives:

1. To understand the anatomical structures of the human body
2. The study how these organs are interrelated.
3. To be cognizant of the bio potential concepts.
4. To understand the different physiological processes taking place inside the human body
5. To realize some of the basic gadgets that will help us to observe these physiological signals.
6. To perform experiments based on physiological signal measurements from human body.

Course Outcomes: Learner will be able to

1. Illustrate the organization of the human body, homeostasis and its maintenance, structure and functions of a cell and basic tissues.
2. Demonstrate the components of blood and their functions.
3. Interpret the anatomical parts and physiological processes of the cardiovascular system and respiratory system.
4. Explain the anatomical parts and physiological processes of the alimentary system and renal system.
5. Define the structure and functions of nervous system
6. Define the structure and function of endocrine system

Prerequisite: Basic concepts of Biology.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
1	Introduction to Human Body, Cells, Tissues and Types	Homeostasis and its maintenance. Structure and functions of a cell; Tissues: epithelial, connective, muscle and nervous Transport across the plasma membrane: Passive	05	CO1

		and Active		
2	Cardiovascular and Respiratory system	Generation of Action Potential, Anatomy of the heart; Heart valves, Systemic and Pulmonary circulation; Conduction system of the heart; Cardiac action potential, Electrocardiogram(ECG); Cardiac cycle; Cardiac output; Blood pressure. Anatomy of respiratory system; Internal and External respiration, Gas laws – Boyle's Law, Dalton's law and Henry's law, Spirometry	11	CO2
3	Blood	Composition of Blood, blood cells and their functions, Clotting and factors, Blood Grouping and various blood disorders	05	CO3
4	Digestive System and Renal System	Anatomy of the alimentary system; Secretions of different organs of the alimentary system and their main function. Anatomy of the renal system; Functions of kidney and Micturition. BP regulation by renal system.	11	CO4
5	Nervous System	Classification of the nervous system, Brain, its parts and functions, spinal cord, Ventricles, Formation and circulation of Cerebrospinal fluid, Reflex action and reflex arc; Monosynapse and Polysynapse, Nerve action potential, Nerve conduction in Myelinated and Non Myelinated neurons.	08	CO5
6	Endocrine System	All Glands of the endocrine system, their secretions and functions.	05	CO6

Text books:

1. Anatomy and Physiology in Health and Illness: Ross and Wilson. (ELBS Publication)
2. Essentials of Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

Reference Books:

1. Physiology of Human Body: Guyton. (Prism Book)
2. Review of Medical Physiology: William Ganong. (Prentice Hall Int.)
3. Principles of Anatomy and Physiology: Tortora and Grabowski. (Harper collin Pub.)
4. Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

NPTEL/Swayam Course:

Course: Animal Physiology by Prof. Mainak Das
IIT Kanpur

<https://nptel.ac.in/courses/102/104/10210405/>

https://swayam.gov.in/nd1_noc20_bt42/preview

Assessment:

Internal Assessment (IA) for 40 marks:

- IA will consist of Two Compulsory Internal Assessment Tests of 20 marks each. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.
- Internal Assessment Test can be **open book**, provided all the questions are of **level IV and above** as per **Bloom's Taxonomy**.

End Semester Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

**OEC 301 to be picked up from the bucket provided by other boards like Science/ Commerce/
Management streams**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract/Oral	Theory	Tut.	Pract/Oral	Total
2053115	Applied Electronics for BME Lab	--	-	2	--	--	1	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053115	Applied Electronics for BME Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. Learn to operate electronic lab instruments.
2. To practically verify characteristics of different semiconductor devices like diodes, BJT, MOSFET etc
3. To practically implement and verify operational amplifier based circuits.
4. To practically verify outputs/ frequency response of various circuits such as amplifiers, filters, oscillators.
5. To design and implement regulated power supply, waveform generators etc.
6. To design and implement a power supply circuit on a PCB.

Lab Outcomes (LO):

The learner will be able to:

1. Use electronic lab instruments for testing and troubleshooting electronic circuits.
2. Understand the transfer characteristics of basic semiconductor devices.
3. Verify frequency response of amplifier circuits.
4. Read the data sheet of different ICs, compare the parameters to select appropriate IC.
5. To learn soldering
6. To design and implement various building blocks of different biomedical instruments.

Prerequisite: Basic electronics, sensors characteristics

List of Experiments:

Sr No	List of Experiments	Hrs	LO Mapping
01	To verify transfer characteristics of various semiconductor devices.	2	LO2
02	To verify input and output characteristics of BJT.	2	LO2
03	To implement CE amplifier and study its frequency response.	2	LO3
04	To verify input and output characteristics of MOSFET.	2	LO2
05	To study MOSFET as a switch	2	LO3

[illegible]

07	To verify outputs of various nonlinear circuits using op-amps.	2	LO3
08	To generate sine wave using RC phase shift oscillator using 2 different op amp ICs	2	LO4
09	To generate sine wave using Wein bridge oscillator	2	LO5
10	Design and implement monostable multivibrator using IC 555	2	LO5
11	Design and implement astable multivibrator using IC 555	2	LO5
12	Verify various outputs of IC 4047	2	LO5
13	To verify output of PLL	2	LO5
14	Implement any one Biomedical application	2	LO5
15	To design regulated power supply.	2	LO6

Any other experiment/student presentation based on the syllabus which will help the learner to understand a topic/concept.

Assessment:

Term Work: Term Work shall consist of at least 10 practicals based on the above list. Also, Term work Journal must include at least 5 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract/Oral	Theory	Tut.	Pract/Oral	Total
2053116	Sensors and Actuators Lab	--	--	2	--	--	1	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053116	Sensors and Actuators Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To measure pressure using a pressure sensor.
2. To measure displacement using various displacement sensors.
3. To measure temperature using various temperature sensors.
4. To study different types of Biopotential electrodes
5. To measure pH of a solution using a pH electrode.
6. To study the principle and working of Actuator

Lab Outcomes (LO):

The learner will be able to:

1. Demonstrate the measurement of pressure using a pressure sensor.
2. Demonstrate the measurement of displacement using displacement sensor.
3. Demonstrate the measurement of temperature using various temperature sensors.
4. Distinguish various types of biopotential electrodes.
5. Demonstrate the measurement of pH of a solution using a pH electrode.
6. Demonstrate the principle and working of Actuator

Prerequisite: Basic electronics, sensors characteristics

List of Experiments:

Sr No	List of Experiments	Hrs	LO Mapping
01	To study principle and working of a strain gage sensor	2	LO1
02	To study principle and working of LVDT	2	LO2
03	To study principle and working of a pressure transducer	2	LO1
04	To study measurement of angular displacement using of a capacitive transducer	2	LO2
05	To study the resistance vs temperature characteristics of a thermistor	2	LO3
06	To study the temperature measurement using thermocouple	2	LO3

07	To study the temperature measurement using IC based sensor	2	LO3
08	To study various Biopotential electrodes	2	LO4
09	To study principle and working of a pH electrode	2	LO5
10	To study principle and working of any one type of Actuator	2	LO6
11	To study principle and working of a DC motor	2	LO6
12	To study principle and working of stepper motor	2	LO6

Any other experiment/student presentation based on the syllabus which will help the learner to understand a topic/concept.

Assessment:

Term Work: Term Work shall consist of at least 10 practicals based on the above list. Also, Term work Journal must include at least 5 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus

Vertical – 5

Detailed Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2993511	Entrepreneurship Development	--	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II				
2993511	Entrepreneurship Development	--	--	--	--	50	--	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce students to entrepreneurship concepts and startup development.
2. To develop business idea generation, validation, and business model preparation.
3. To provide hands-on experience in market research, financial planning, and business pitching.
4. To enhance problem-solving and decision-making skills in entrepreneurial ventures.
5. To familiarize students with government schemes and support systems for entrepreneurs.
6. To develop communication and presentation skills required for business pitching.

Lab Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the fundamental concepts of entrepreneurship and business models.
2. Conduct market research and develop business plans.
3. Utilize financial planning and cost analysis for startups.
4. Apply entrepreneurial skills to identify and solve business challenges.
5. Develop prototypes using open-source software for business operations.
6. Pitch business ideas effectively with structured presentations.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.	01	--
I	Introduction to Entrepreneurship	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	02	LO1

II	Business Idea Generation & Validation	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.	04	LO2
III	Business Planning & Strategy	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management	04	LO3
IV	Funding and Legal Framework	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities. Intellectual Property Rights (IPR) & Patents	05	LO4
V	Marketing & Digital Presence	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models	05	LO5
VI	Business Pitching & Prototype Development	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch. Case Studies of Successful Start-ups	05	LO6

Text Books:

1. "Entrepreneurship Development and Small Business Enterprises" – Poornima M. Charantimath, Pearson, 3rd Edition, 2021.
2. "Innovation and Entrepreneurship" – Peter F. Drucker, Harper Business, Reprint Edition, 2019.
3. "Startup and Entrepreneurship: A Practical Guide" – Rajeev Roy, Oxford University Press, 2022.
4. "Essentials of Entrepreneurship and Small Business Management" – Norman Scarborough, Pearson, 9th Edition, 2021.
5. "The Lean Startup" – Eric Ries, Crown Publishing, 2018.

References:

1. "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" – Bill Aulet, MIT Press, 2017.
2. "Zero to One: Notes on Startups, or How to Build the Future" – Peter Thiel, 2014.
3. "The \$100 Startup" – Chris Guillebeau, Crown Business, 2019.
4. "Business Model Generation" – Alexander Osterwalder & Yves Pigneur, Wiley, 2020.
5. "Blue Ocean Strategy" – W. Chan Kim & Renée Mauborgne, Harvard Business Review Press, 2019.

Online Resources:

Website Name
1. Startup India Portal – https://www.startupindia.gov.in 2. MIT OpenCourseWare – Entrepreneurship – https://ocw.mit.edu/courses/sloan-school-of-management/ 3. Coursera – Entrepreneurship Specialization – https://www.coursera.org/specializations/entrepreneurship 4. Harvard Business Review – Entrepreneurship Articles – https://hbr.org/topic/entrepreneurship 5. Udemy – Startup & Business Courses – https://www.udemy.com/courses/business/entrepreneurship/

List of Experiments.

Sr No	List of Experiments	Hrs
01	Business Idea Generation using Mind Mapping.	02
02	Conducting Market Research & Customer Validation.	02
03	Preparing a Business Model Canvas for a Startup Idea.	02
04	Developing a Financial Plan & Break-even Analysis.	02
05	Creating a Website using WordPress/Wix.	02
06	Social Media Marketing Campaign using Open-source Tools.	02
07	Digital Prototyping using Figma/Inkscape.	02
08	Business Pitch Deck Preparation & Presentation.	02
09	Exploring Government Schemes for Startups.	02
10	Legal Compliance & IPR Basics (Case Study).	02

Sr No	List of Assignments / Tutorials	Hrs
01	a. Write a report on any successful entrepreneur and their startup journey. b. Conduct SWOT analysis for a real-life startup.	02
02	Develop a business idea and create a one-page business plan.	02
03	Conduct market research using surveys & present findings.	02
04	Design a simple logo and branding strategy for a startup.	02
05	Create a financial model and cost estimation for a startup.	02
06	Make a case study report on startup failure analysis.	02

List of Open-Source Software
1. Canva – Designing pitch decks, social media posts, and branding materials. 2. Trello / Asana – Project management for startups. 3. GIMP / Inkscape – Graphic design and logo creation. 4. WordPress / Wix – Website development for startups. 5. OpenCart / PrestaShop – E-commerce website setup. 6. Figma – UI/UX design and prototyping. 7. LibreOffice Calc – Financial planning and budgeting. 8. Google Suite (Docs, Sheets, Slides) – Documentation and presentations. 9. Python (Pandas, Flask, Django) – Data analytics and web application development. 10. MailChimp – Email marketing and customer engagement.

Assessment :

Term Work: Term Work shall consist of at least 08 to 10 practicals based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 50 Marks (Total marks) = 20 Marks (Experiment) + 15 Marks (Assignments) + 5 Marks (Attendance) + 10 Marks (Report)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2993512	Environmental Science	--	2*+2	-	--	2*+2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II				
2993512	Environmental Science	--	--	--	--	50	--	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Rationale:

Most of the engineering branches are offspring of applied sciences, and their practices have a significant impact on the environment. Understanding environmental studies is essential for engineers to develop sustainable solutions, minimize ecological footprints, and promote responsible resource management. This course equips students with the knowledge of ecosystems, biodiversity, pollution control, and environmental laws, enabling them to integrate sustainability into engineering practices.

Lab Objectives:

1. To understand the scope, importance, and role of environmental studies in public awareness and health.
2. To study different natural resources, their issues, and sustainable conservation.
3. To understand ecosystem types, structures, and functions.
4. To explore biodiversity, its importance, threats, and conservation.
5. To learn about pollution types, causes, effects, and control measures.
6. To understand environmental challenges, sustainability, and ethics.

Lab Outcomes:

1. Explain the significance of environmental studies and the role of IT in environment and health.
2. Describe resource types, associated problems, and conservation methods.
3. Classify ecosystems and explain their role in ecological balance
4. Analyze biodiversity levels and conservation strategies, especially in India.
5. Explain pollution impacts and suggest preventive measures.
6. Discuss environmental issues and propose sustainable solutions.

DETAILED SYLLABUS:

Unit Name	Topic Name	Topic Description	Hours	LO Mapping

I	The Multidisciplinary Nature of Environmental Studies	Definition, scope and importance. Need for public awareness, Role of information technology in environment and human health. Human population and the environment: Population growth, variation among nations. Population Explosion- family welfare program. Environment and human health Women and child welfare	03	LO1
II	Natural Resources	Renewable and non-renewable resources. Natural resources & associated problems: a) Forest resources: b) Water resources: Natural resources & associated problems c) Mineral resources: d) Food resources: e) Energy resources: Role of an individual in conservation of natural resources: f) Equitable use of resources for sustainable lifestyles.	04	LO2
III	Ecosystems	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries). Case study on various ecosystems in India.	05	LO3
IV	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, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	05	LO4
V	Environmental Pollution Definition	Causes, effects and control measures of: a) Air pollution b) Water pollution c) Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Case study on Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	05	LO5
VI	Social Issues and Environment	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solution. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Consumerism and waste products. Environment protection act. Public awareness Case study on Environmental Ethics	04	LO6

Textbooks

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott

Spoolman, 13th Edition, Cengage Learning 2021

2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd Edition, PHI Learning, Publication Year: 2016
3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann, Springer 2008
4. Sustainable IT: Slimming Down and Greening Up Your IT Infrastructure, David F. Linthicum, IBM Press 2009
5. Environmental Modelling: Finding Solutions to Environmental Problems, David L. Murray, Cambridge University Press 2016
6. Remote Sensing and Image Interpretation, Thomas M. Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, 9th Edition, John Wiley & Sons 2020
7. Business Ethics: Concepts and Cases, Manuel Velasquez, Pearson 2012

Reference Books

1. Environmental Law and Policy in India, Shyam Divan and Armin Rosencranz, 2nd Edition, Oxford University Press 2018
2. The International Handbook of Environmental Laws, David Freestone and Jonathon L. Rubin, Edward Elgar Publishing 2000
3. E-Waste Management: Challenges and Opportunities in Developing Countries, Ruediger Kuehr and Ram K. Jain, Springer 2008
4. The E-Waste Handbook: Managing Electronic Waste, Klaus Hieronymi, Ruediger Kuehr, and Ram K. Jain, Earthscan 2009
5. Environmental Ethics: An Introduction, J. Baird Callicott, University of Georgia Press 1999

Online References:

Sr. No.	Website Name
1.	Centre for Science and Environment (CSE), Website: cseindia.org
2.	Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India
3.	CSIR-National Environmental Engineering Research Institute (NEERI)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study of Environmental Components and Ecosystems.	2
02	Visit and Report on Solid Waste Management Plant.	2
03	Study of Renewable Energy Sources (Solar, Wind, Biogas).	2
04	Analysis of Air and Water Quality Parameters.	2
05	Study of Local Biodiversity and Conservation Methods.	2
06	Awareness Activity on Environmental Issues.	2
07	Rainwater Harvesting System Design	2
08	Case Study on Environmental Pollution & Control Measures.	2
09	Report on Climate Change Impact and Adaptation.	2
10	Study of Environmental Laws and Acts.	2
11	Study of Disaster Management Techniques.	2
12	Report on Role of IT in Environmental Protection.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Prepare a report on Renewable and Non-Renewable Resources.	2
02	Write a case study on Ecosystem Types in India	2
03	Write a report on Biodiversity in India.	2
04	Prepare a report on Pollution Types and Control Measures.	2
05	Prepare a report on Environmental Ethics and Sustainability.	2
06	Prepare a case study report on Global Warming and Climate Change.	2
07	Report on Role of an Individual in Environmental Protection.	2
08	Write a report on Disaster Management Techniques.	2
09	Prepare a report on Environmental Laws and Acts in India.	2
10	Case Study on E-waste Management and Recycling Techniques.	2

Assessment :

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also, Term work Journal must include at least 8 to 10 assignments.

Term Work Marks: 50 Marks (Total marks) = 20 Marks (Experiment) + 15 Marks (Assignments) + 5 Marks (Attendance)+ 10 Marks (Report)

Vertical – 6

Detailed Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Tut.	Pract/Oral	Theory	Tut.	Pract/Oral	Total
2053611	Mini Project (group activity)	--	--	4	--	--	2	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I + IAT-II					
2053611	Mini Project (group activity)	--	--	--	--	--	50	25	75

Course Objective	- To acquaint with the process of identifying the needs and converting it into the problem. - To familiarize the process of solving the problem in a group. - To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. - To inculcate the process of self-learning and research.
Course Outcome	Learner will be able to: - Identify problems based on societal /research needs. - Apply Knowledge and skill to solve societal problems in a group. - Develop interpersonal skills to work as member of a group or leader. - Draw the proper inferences from available results through theoretical/ experimental/simulations. - Analyse the impact of solutions in societal and environmental context for sustainable development. - Use standard norms of engineering practices - Excel in written and oral communication. - Demonstrate capabilities of self-learning in a group, which leads to life long learning. - Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks shall be as below;

○ Marks awarded by guide/supervisor based on log book	: 20
○ Marks awarded by review committee	20
○ Quality of Project report	10

Oral will be conducted by supervisor and external examiner.

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-

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Dr. Deven Shah
Associate Dean
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