

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 अमंलबजावणीच्या 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. (Instrumentation Engineering) _____		
Faulty of <u>Engineering</u> _____		
Board of Studies in <u>Instrumentation Engineering</u> _____		
U.G. Second Year Programme	Exit Degree	U.G. Diploma in Instrumentation Engineering. _____ _____
Semester		III & IV
From the Academic Year		2025-26

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B.E. (Instrumentation Engineering)
2	Exit Degree	U.G. Diploma in Instrumentation 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 - 650C R. TEU- 650 D	Attached herewith
6	Semesters	Sem. III & IV
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-

Dr. B. N. Chaudhari
BoS-Chairman-
Instrumentation 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, the 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 Electronics and Telecommunication Engineering Branch of 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 Electronics and Telecommunication Engineering for open electives and multidisciplinary minor 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.

The Program Core Course Covers Electronics and Telecommunication engineering core courses. Also, OE and MDM where a pool of subjects are given for selection. 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 the purpose Design Thinking is introduced in the First Semester to orient a journey learner to become 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 practices.

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 12-13 weeks, and the remaining 2-3 weeks are 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 Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

Sd/-

Dr. B. N. Chaudhari

**BoS-Chairman- Instrumentation
Engineering**

Faculty of Technology

Sd/-

**Dr. Deven Shah
Associate Dean**

Faculty of Science & Technology

Sd/-

**Prof. Shivram S. Garje
Dean**

Faculty of Science & Technology

Under Graduate Diploma in Instrumentation Engineering

Credit Structure (Sem. III & IV)

	R: <u>650</u> C									
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	PCC301:3 PCC302:3 PCC303:3 PCC304:2 PCL302: 1 PCL303:1 PCL304:1	--	--	OE: 2	--	VEC: 2 HSL: 2	CEP: 2	22	UG Diploma 45
	R: <u>650</u> D									
	IV	PCC401:3 PCC402:3 PCC403:3 PCL402:1 PCL403:1	--	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.

[Abbreviation - 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]

S.E. Instrumentation Engineering Scheme Semesters III and IV

Program Structure for Second Year of Instrumentation 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
PC301	Mathematics III	2	--	1	2	1	--	3
PC302	Transducers and Sensors	3	--	--	3	--	--	3
PC303	Analog and Digital Electronics	3	--	--	3	--	--	3
PC304	Signals and Systems	2	--	--	2	--	--	2
OEC301	Open Elective	2#	--	--	2	--	--	2
PCL302	Transducers and Sensors Laboratory	--	2	--	--	--	1	1
PCL303	Analog and Digital Electronics Laboratory	--	2	--	--	--	1	1
PCL304	Signals and Systems Lab		2				1	1
CEP301	Mini Project (group project)	--	2*+2	--	--	--	2	2
HS301	Entrepreneurship Development	--	2*+2	---	--	--	2	2
VEC301	Environmental Science	--	2*+2	--	--	--	2	2
Total		12	18	01	12	01	09	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.

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)					
PC301	Engineering Mathematics III	20	20	40	60	2	25	--	125
PC302	Transducers and Sensors	20	20	40	60	2	--	--	100
PC303	Analog and Digital Electronics	20	20	40	60	2	--	--	100
PC304	Signals and Systems	20	20	40	60	2	--	--	100
OEC301	Open Elective	20	20	40	60	2	--	--	100
PCL302	Transducers and Sensors Laboratory	--	--	--	--	--	25	25	50
PCL303	Analog and Digital Electronics Laboratory	--	--	--	--	--	25	25	50
PCL304	Signals and Systems Laboratory	--	--	--	--	--	25	25	50
CEP301	Mini Project (group project)	--	--	--	--	--	50	25	75
HS301	Entrepreneurship Development	--	--	--	--	--	50	--	50
VEC301	Environmental Science	--	--	--	--	--	50	--	50
Total		100	100	200	300	10	250	100	850

Vertical – 1

Major

Sem. III

Detail Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
PC301	Engineering Mathematics - III	2	-	1	2	-	1	3

		Theory					Term work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		Test1	Test2	Total					
PC301	Engineering Mathematics - III	20	20	40	60	2	25	--	125

Rationale:

The goal of this course is to make the learner conversant with the basic tools of mathematics for application in Instrumentation engineering. The syllabus designed will help the learner build a foundation to model Instrumentation engineering problems mathematically, analyze and solve the same.

Prerequisite:

Applied Mathematics-I

Applied Mathematics-II

Course Objectives:

1. To introduce the concept of Laplace Transform and Inverse Laplace Transform.
2. To familiarize with the concept of expanding periodic functions/signals in the form of Fourier Series.
3. To introduce the concept of Fourier Transform and its applications.
4. To familiarize with the concept of complex variables – differentiation.
5. To familiarize with the concept of Z-Transform for discrete function.
6. To introduce concepts and fundamentals of Matrix algebra for engineering problems.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Understand Laplace Transform and Inverse Laplace Transform its application in solving ordinary differential equations.
2. Apply the Fourier series to expand the given periodic function/signal.
3. Apply Fourier Transform and its properties to transform the function/signal from one domain (time) to another domain (frequency).
4. Understand the concept of complex variables – differentiation.

5. Understand and apply Z-transform to discrete functions.
6. Apply the concepts of Eigen values and Eigen vectors in engineering problems.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
1	Laplace Transform	Laplace Transform & Inverse Laplace Transforms of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, where $n \geq 0$ (without proof) First Shifting theorem, Laplace Transform of derivatives and integrals Properties (without proof) Inverse Laplace transform using First Shifting Theorem and Partial fractions method. Self-Learning Topics: Heaviside & Dirac Delta function, Applications of Laplace Transforms for Solutions to ODE.	5	CO1
2	Fourier Series	Fourier series for periodic function with period 2π and $2l$. Fourier series for even and odd functions. Self-learning Topics : Parseval's Identity, Half-range Cosine/sine Series, Complex form of Fourier Series $(-\infty, \infty)$ (No deductions on the basis of Fourier Series), Fourier Integral.	4	CO2
3	Fourier Transform	Fourier transform, Fourier Transform of Heaviside Unit step Function and Dirac Delta Function. Linearity Property, Time shifting Property, Frequency Shifting Property, convolution and Modulation property, Self-Learning Topics: Standard Signals-Stop, input, Delta, Exponential Signals	5	CO3
4	Complex Variables – Differentiation.	Functions of a complex variable, Analytic functions, Cauchy- Riemann equations in Cartesian co-ordinates, Harmonic functions, Harmonic conjugate, Milne Thomson methods to find $f(z)$ for simple functions, Orthogonal trajectories. Self-Learning Topics: Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles.	4	CO4

5	Z-Transform	Definition and Region of Convergence, Transform of Standard Function $\{a^k\}$, $\{\sin ak\}$, $\{\cos ak\}$, $\{\sinh ak\}$, $\{\cosh ak\}$. Properties of Z-Transform, Change of Scale, Shifting Property, Multiplication Property, and Convolution theorem. (without proof) Inverse Z transform: Partial Fraction Method. Self-learning Topics: Division by k property, Initial value theorem, Final value theorem, Inverse Using Convolution Theorem	4	CO5
6	Linear Algebra: Theory of Matrices	Characteristic Equation, Eigen values and Eigen vectors, and properties of Eigen values (without proof) Similarity of matrices, diagonalizable and non- diagonalizable matrices Self-learning Topics: Cayley-Hamilton Theorem and its usage in reduction of higher degree polynomials Derogatory and non-derogatory matrices, Function of a square Matrix	4	CO6

Note:

- **Tutorial shall be conducted batch wise.**
- **No Questions to be asked from Self-Learning Topics. Text**

/ Reference Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publication.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
3. Advanced Engineering Mathematics, R.K.Jain and S.R.K. Iyengar, Narosa publication
4. Signals and Systems, A Nagoor Kani, Tata McGraw Hill.
5. Advanced Engineering Mathematics, H. K. Dass, S. Chand & Company Ltd.

Online References:

Sr.No.	WebsiteName
1.	https://nptel.ac.in/courses/111/106/111106139/
2.	https://www.youtube.com/watch?v=2CP3m3EgLIQ
3.	https://www.youtube.com/watch?v=Hw8KHNgRaOE

Term Work:**General Instructions:**

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows–

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:**Internal Assessment (IA) Test:**

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. Total 04 questions need to be solved.
3. Question No:01 will be compulsory and should cover maximum content of the entire syllabus.
4. Remaining questions will be randomly selected from all the modules as per the weightage of each module (which is proportional to number of respective lecture hours mentioned in the syllabus).

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
PC302	Transducers and Sensors	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract./ Oral	Total
		Internal Assessment Test (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
PC302	Transducers and Sensors	20	20	40	60	25	25	150

Course Objectives:

1. To introduce the students for the purpose of explaining the measurement systems, .
2. To understand the definition and classification of sensors and transducers based of their principle of operation and their applications in the various industries.
3. To familiarize the student with the identification, classification, construction,
4. working, principle and application of various transducers used for Flow, level, Temperature, Pressure measurement

Course Outcomes: Students will be able to...

1. Explain the measurement systems, sources errors of measurement.
2. Interpret and apply different temperature transducers/sensors for industrial applications
3. List and compare various Methods used for selection of Flow sensors.
4. Describe the working principles of various Level sensors and transducers.
5. Formulate and design the solutions for given applications using appropriate Pressure transducers.
6. Apply the techniques of advanced sensors measurement in different industries

DETAILED SYLLABUS

Module	Detailed Contents	Hrs.	CO Mapping
01	Instrumentation System Introduction, block diagram, functional elements of measurement system, Definition, working principle, classification (active, passive, primary, secondary, mechanical, electrical, analog, digital),	02	CO1
02	Modes of heat transfer, laws of conduction, convection and radiation, Temperature scales, classification of Temperature Sensors, Overview of mechanical temperature Sensors (thermometer, thermostat). Resistance temperature detector (RTD): Principle, types, Configurations, construction and working of RTD, Material for RTD, Signal Measurement techniques for RTD, Comparative Response curves for RTD, 2wire, 3wire and 4wire RTD Element, Lead wire Compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD and sums. Thermistors: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications and sums. Thermocouples: Principle, thermoelectric effect, Seebeck effect, Peltier effect, laws of thermocouple, types of thermocouple with Characteristic curve, thermocouple table, Sensitivity, constructional Features of Thermocouples., Thermo couple specifications, electrical noise and noise reduction techniques, cold junction Compensation method, thermopile, thermocouple emf measurement method, Thermo well Material of construction and its specifications and sums. Pyrometers: Principle, Construction and working of Radiation and optical pyrometers and its Applications. Comparative study for Temperature Transducers.	08	CO2
03	Flow measurement Properties of fluid, types of fluid, dimensionless numbers, types of fluid flow, continuity equation, Bernoulli's equation, hydrostatic law, Pascal's law, flow through pipes – major and minor losses, flow measurement through open channel-weirs and notches. Materials used for flow sensors, performance of materials, corrosion resisters, erosion, effect of vapour pressure. Head Type: Orifice, Venturi, Nozzle, Pitot tube, Annular, characteristics of head type flow meters and its sums. Variable Area Type : Rotameter Velocity and Inertia based flowmeters: Turbine, Electromagnetic, Ultrasonic, Positive displacement, Anemometers,	10	CO3

	Mass flow measurement: Coriolis and Vortex flowmeter			
04	Level Measurement working principle, types, materials, design criterion: float, displacers, bubbler, Dipstick, Sight Glass and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, solid level detectors, fiber optic level detectors, Level switches. Comparative study for Level Transducers and Applications	05	CO4	
05	Pressure Measurement: Pressure scales, units and relations, classification Primary pressure sensors - elastic elements like bourdon tube, diaphragm, bellows, properties and selection of elastic materials, Calibration using dead weight tester. Electrical/Secondary Pressure Transducers: Capacitive, piezo-electric and its material, variable reluctance, LVDT, strain gauge. High Pressure Measurement: Bulk modulus cell, Bridgeman type. Differential pressure measurement: Materials, construction and working of DP Cell. Pressure measurement using manometer: U-tube types, well type, inclined type, micro manometer and its sums. Vacuum Measurement Units and relations, McLeod gauge, Pirani gauge, thermocouple gauge, Strain Measurement Introduction, , gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensation and applications of strain gauges and its sums.	08	CO5	
06	Advanced Sensors: Smart sensors, MEMS Sensors, DHT Sensors, IR and PIR, Accelerometer and Gyroscope, Smoke Sensors, pH Sensor, Density and Viscosity	06	CO6	

References:

1. B.C Nakra, K. K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Education, 01-Oct-2003-Electronic instruments-632 page.
2. Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2 edition (2003)-344 pages.
3. A.K. Sawhney, Puneet Sawhney, A course in Electrical and Electronic Measurement and Instrumentation, Dhanp at Rai and Co. Rai, 1996-
4. Rangan, Mani, Sharma. Instrumentation systems and Devices, 2nd Ed., Tata McGraw Hill.
5. D. V. S. Murthi, -Instrumentation and Measurement Principles II, PHI, New Delhi, Second ed. 2003.
6. Doebelin E. D., Measurement system, Tata McGraw Hill., 4th ed, 2003.

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ Question paper format

- The Question Paper will comprise a total of **six questions, each carrying 15 marks.** **Q.1** will be **compulsory** and should **cover the 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	Pract.	Tut.	Theory	TW/Pract.	Tut	Total
PC303	Analog and Digital Electronics	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract./ Oral	Total
		Internal Assessment Test (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
PC303	Analog and Digital Electronics	20	20	40	60	--	--	100

Course Objectives:

1. To familiarize the student with basic electronic devices and circuits analog and digital.
2. To analyze the DC biasing circuits, AC analysis of various electronic devices.
3. To introduce the students with basic construction and characteristics of FET, MOSFET and basic multistage amplifier.
4. To give knowledge about combinational circuits.
5. To describe working and design methods of sequential circuits.
6. To familiarize with the basics of asynchronous sequential circuits and design techniques.

Course Outcomes: Students will be able to...

1. Understand analog Electronics and Logic families of Digital Electronics. Conversions of binary to other number system
2. To formulate and attribute BJT biasing techniques, DC analysis and ac model of BJT AC Analysis
3. Apply the basic construction and characteristics of FET, MOSFET to analyze the DC and AC circuits. Discuss the power amplifiers
4. Analyze and design, digital combinational circuits using logic gates. To Formulate DeMorgans Law
5. Formulate and design sequential logic circuits.
6. Formulate and design asynchronous sequential logic circuits like counters. Study of Power supplies.

DETAILED SYLLABUS

Module	Detailed Contents	Hrs.	CO Mapping
01	Introduction to Analog electronics and Digital Electronics Introduction to Diodes, Bipolar Junction Transistor, Introduction to MOSFET, IGBT, Binary codes Logic families: Basics of digital integrated circuits, basic operational characteristics and parameters. TTL, Schottky clamped TTL, tri-state gate ECL, IIL, MOS devices CMOS. Binary number system: Binary Arithmetic, Binary codes: Weighted, BCD, 8421, ASCII, Conversion of Binary to Decimal, Octal to Decimal	03	CO1
02	Bipolar Junction Transistor: Bipolar Junction Transistor, Device structure and physical operation, characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits, Biasing BJT Amplifier Circuits, Introduction to Stability. BJT AC Analysis Introduction: Amplification in AC domain, Introduction to BJT transistor r_e model, h Hybrid model for CE configuration, Single stage BJT amplifiers CE configuration (with and without feedback), Small Signal equivalent circuit, frequency response of a CE amplifier, Introduction to low frequency response, high frequency response.	06	CO2
03	Field effect Transistors: Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET. FET as an amplifier and its analysis (CS) and its frequency response. MOS Field effect Transistors: Introduction to MOSFET as basic element in VLSI, Device structure and physical operation, current – voltage characteristics, the MOSFET as an amplifier and a switch, DC Analysis of MOSFET Circuits, Biasing MOSFET Amplifier Circuits, frequency response of a CS amplifier, low frequency response. IGBT Power Amplifier: Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Push Pull Amplifier	10	CO3

04	Design of combinational logic circuits: Adders, Subtractors, Parity checker, Magnitude comparators, BCD adder, Multiplexer, Demultiplexer, Encoder and Decoder. Implementation of combinational logic circuits using Multiplexer and Demultiplexer. Hazards in logic circuits and its elimination. PWM , Duty cycle, Data sheet study Reduction methods: Boolean laws, De-Morgan's Theorem, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions.	09	CO4	
05	Sequential logic circuits: Sequential logic circuits: Flip flops- SR, D and Master slave JK, T, Realization of one flip flop using other flip flops	05	CO5	
06	Asynchronous & Synchronous counters Asynchronous & Synchronous counters, Modulo n counter, shift registers. Asynchronous sequential circuits: Circuit Design – primitive state / flow table, Minimization of primitive state table, state assignment, Excitation table, Excitation map, cycles. Power supply design using 78xx series, 79xx series and adjustable voltage IC regulators like 723 and 317. Switched Mode Power Supply (SMPS) – Block diagram with advantages and disadvantages over conventional power supply.	06	CO6	

References:

1. Robert L. Boylestad, Louis Nashelsky, "*Electronic Devices and Circuit Theory*", PHI publishers, 2004
2. Thomas L. Floyd, "Electronic Devices", Pearson 2015.
3. M. Morris Mano, "*Digital Design*", Prentice Hall of India, 2003.
4. John .M Yarbrough, "*Digital Logic Applications and Design*", Thomson-Vikas publishing house, 2002.
5. Barry B. Brey, "*The Intel Microprocessors*", Pearson/Prentice Hall, 2006.
6. Donald P. Leach and Albert Paul Malvino, "*Digital Principles and Applications*", Tata McGraw Hill Publishing Company Limited, 2003.
7. R. P. Jain, "*Modern Digital Electronics*", Tata McGraw–Hill publishing company limited, 2003.

Online References:

Sr. No.	Website Name
1.	https://books.google.co.in/books/about/Electronic_Devices_and_Circuit_Theory.html?id=32RJvfGkJgwC
2.	https://logicwork.in/pdf-download-modern-digital-electronics-by-rp-jain-book-pdf/
3.	https://recom-power.com/en/book-of-knowledge.html

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ Question paper format

- The Question Paper will comprise a total of **six questions, each carrying 15 marks.** **Q.1** will be **compulsory** and should **cover the 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	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
PC304	Signals and Systems	02	02	--	02	01	--	03

Course Code	Course Name	Examination Scheme							
		Theory				End Sem. Exam	Term Work	Pract./ Oral	Total
		Internal Assessment Test (IAT)							
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
PC304	Signals and Systems	20	20	40	60	25	25	--	150

Course Objectives:

1. To learn fundamental characteristics of signals and systems.
2. To classify the signals and systems according to their property.
3. To acquire knowledge for the use of mathematical transforms and their applications.
4. Develop basic problem solving skills and become familiar with application area of signals and systems.

Course Outcomes: Students will be able to...

1. Describe the basic concept of signals and systems and their classification and operations on signals and plot the result.
2. Examine analysis of LTI systems using convolution and correlation.
3. Execute Fourier series analysis of periodic signals.
4. Demonstrate Fourier Transform and its applications.
5. Explain application of Laplace transform for analysis of CT signals and systems.
6. Demonstrate an ability to apply Z Transform for the analysis of DT signals and systems.

DETAILED SYLLABUS

Module	Detailed Contents	Hrs.	CO Mapping
01	Introduction: -Signals and Systems definition, Types of signals, continuous time and Discrete time signal operations, Amplitude scaling, Time shifting, Time reversal, Time scaling, Multiple transformation, Mathematical operations additions, subtraction, multiplication of signals, Classification of signals according to their property, Periodic/Aperiodic, Even/Odd, Energy/Power/Causal/Non causal, Deterministic/Random signals, Classification of systems according to their property, Linear/Nonlinear, Static /Dynamic, Time Invariant/Time variant, Causal/non causal, Stable/Unstable, Invertible/Non Invertible systems.	8	CO1
02	Linear Time Invariant System: -Characterizing CT LTI and DT LTI systems in terms of Impulse responses and Differential equations, Property of LTI systems, Convolution sum, Auto and Cross correlation of signals	4	CO2
03	Fourier Series: -Fourier series of CT and DT signals and their property ,Exponential and Trigonometric Fourier series of periodic signals, Amplitude and phase spectra of periodic signals.	4	CO3
04	Fourier Transform Analysis of Signals: -Fourier transform of CT and DT signals, Property of Fourier Transform, Magnitude and Phase calculation, Application of Fourier Transform.	4	CO4
05	Application of Laplace Transform in Signal processing: - Bilateral and Unilateral Laplace Transform of signals, Region of Convergence, Properties of Laplace Transform, Inverse Laplace Transform, Solution to differential equation, System transfer function and Response calculations, Poles and Zeros representation.	4	CO5
06	Introduction to Z Transform: -Z Transform definition, Region of convergence and it's property, Bilateral and Unilateral Z Transform, Z Transform property, Relation between Laplace Transform, Fourier Transform and Z Transform, Inverse Z Transform by Inspection, Partial fraction and power series method, System function and Response calculations, Poles and Zeros representation, Concept of Causality and Stability, Frequency Response calculation by using Z Transform.	6	CO6

References:

1. Oppenheim, Willsky, S.Hamid Nawab, "Signals and Systems" PHI, 2nd edition, 2002.
2. M.J. Roberts, "Signals and Systems" McGraw-Hill, 1st edition, 2003.
3. B.P Lathi, "Principles of linear systems and signals" Oxford, 2nd edition, 2009.
4. Narayan ayar, "Signals and systems" CENGAGE learning 1st edition 2011.
5. V. Krishnaveni, A. Rajeswari, "Signals and Systems", 1st edition Wiley India, 2012.
6. J.B. Gurung, "Signals and Systems", PHI, 1st edition, 2009
7. A Anandkumar, "Signals and Systems", PHI, 3rd edition, 2013.
8. Rameshbabu, "Signals and Systems", SCITECH, 4th edition, 2011.
9. Hwei P. Hsu, "Schaum's Outline of Signals and Systems", McGraw-Hill, 2014.
10. Simon Haykin, "Signals and Systems", Wiley, 2nd edition, 2003.
11. Rodger E. Ziemer, "Signals and Systems", Pearson, 4th edition, 1998

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ Question paper format

- The Question Paper will comprise a total of **six questions, each carrying 15 marks. Q.1** will be **compulsory** and should **cover the 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	Pract.	Tut.	Theory	Pract.	Tut.	Total
PCL302	Transducers and Sensors Lab	--	1	–	--	1	–	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT I	IAT- II	IAT-I + IAT-II (Total)				
PCL302	Transducers and Sensors Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To introduce the students for the purpose of explaining the measurement systems, .
2. To understand the definition and classification of sensors and transducers based of their principle of operation and their applications in the various industries.
3. To familiarize the student with the identification, classification, construction,
4. Working, principle and application of various transducers used for Flow, level, Temperature, Pressure Measurement

Lab Outcomes (LO):

Learners will be able to..

1. Explain the measurement systems, sources errors of measurement.
2. Interpret and apply different temperature transducers/sensors for industrial applications
3. List and compare various Methods used for selection of Flow sensors.
4. Describe the working principles of various Level sensors and transducers.
5. Formulate and design the solutions for given applications using appropriate Pressure transducers.
6. Apply the techniques of advanced sensors measurement in different industries

List of Experiments. (Minimum Ten experiments required)

Sr. No	List of Experiments	Hrs	LO
01	Demonstrate the basic measurements techniques and Measuring Instruments.	02	L1
02	Plot response curve for Flapper Nozzle system and validate the results withstand values.	02	L2
03	Plot and validate the characteristics of RTD/thermistor/thermocouple	02	L2
04	Perform and validate Liquid Level Measurement using DP Cell	02	L1
05	Plot and validate performance characteristics of capacitive level sensor	02	L2
06	Study measurement of pressure using bellows, diaphragm, bourdon tube, manometer	02	L1
07	Test and calibration of pressure gauges using dead weight tester.	02	L2
08	Measurement of flow using orifice/venturi tube/nozzle/pitot tube.	02	L1
09	Measurement of flow using rotameter	02	L2
10	Study and characterization of pH meter	02	L1

Term Work:

General Instructions:

Term work shall consist of minimum **Eight** experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance (Practical) : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut	Total
PC303	Analog and Digital Electronics	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract./ Oral	Total
		Internal Assessment Test (IAT)			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)				
PC303	Analog and Digital Electronics	20	20	40	60	--	--	100

Lab Objectives:

1. To familiarize the student with assembling circuits using basic electronic devices.
2. To demonstrate operation of bipolar and MOS transistors.
3. Demonstrate DC biasing circuits, Transistors as switching device,

Lab Outcomes (LO):

Learners will be able to

1. Demonstrate operation of basic electronic devices such as BJT .
2. Assemble and demonstrate electronic circuits using JFET
3. Design various circuits using Amplifiers
4. Design Universal GATE using BASIC GATEs and Demonstrate Multiplexer
5. Demonstrate the Truth Table for FLIP FLOP
6. Study and Demonstrate counters AND Design a power supply

List of Experiments. (Minimum Ten experiments required)

Sr. No	List of Experiments	Hrs	LO
01	Study of input / output characteristics of BJT- CB, CE, and CC Configuration. Demonstrate CE Characteristics	02	LO1
02	Study and perform input and transfer characteristics of FET.	02	LO2
03	Design and analysis of biasing circuit and observing performance of BJT as an amplifier at various operating points.	02	LO3
04	Build universal gates Using Basic gates	02	LO4
05	Study and perform Mux operation	02	LO4
06	Perform and verify SR Flipflop	02	LO5
07	Build MOD 10 UP Counter	02	LO6
08	Design Power supply to give +5V using IC 7805	02	LO6
09	Study of DeMorgan's Theorem	02	LO5
10	Read a Data sheet of digital IC and Find Power consideration	02	LO6

Term Work:

General Instructions:

Term work shall consist of minimum **Eight** experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance (Practical) : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
PCL304	Signals and Systems Lab	--	1	–	--	1	–	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT I	IAT-II	IAT-I+ IAT-II (Total)				
PCL304	Signals and Systems Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Study simulation software platform for signal processing and Plot different type. of signals.
2. To understand the concept of linear, circular convolution, correlation and simulate it by computer software.
3. To understand Fourier series in trigonometric and exponential co-efficient.
4. To understand Fourier transform and its algorithms and simulate it.
5. To understand laplace transform and its applications.
6. To understand Z-transform and their applications.

Lab Outcomes (LO):

Learners will be able to..

1. Verify basic signals in CT and DT using simulation software.
2. Demonstrate convolution and correlation concept using simulation software.
3. Perform Fourier series of a periodic signals.
4. Perform Fourier transform of aperiodic signals using simulation software platform.
5. Study laplace transform and their applications.
6. Study Z-transform and their applications.

List of Experiments. (Minimum Ten experiments required)

Sr. No	List of Experiments	Hrs	LO
01	Generate and plot the basic signals in time domain and also sketch its amplitude and phase spectrum.	02	CO1
02	Write the codes to plot the following signals also simulate the signals: (a) $\sin(200\pi t)$ (b) $\sin(200\pi t \pm \pi/6)$ (c) $\sin(200\pi t \pm \pi/6)$ (d) $\cos(200\pi t)$ (e) $\cos(200\pi t \pm \pi/4)$ (f) $\cos(200\pi t \pm \pi/6)$	02	CO1
03	Develop codes to simulate, and plot the results for an exponential signal: $x(t) = k e^{-at} u(t)$ for the cases: (a) $k = 1$, and $a = 0.35$ (b) $k = 1.2$ and $a = 0.45$	02	CO1
04	Write a program for finding linear convolution by using MATLAB.	02	CO2
05	Write a program for finding Circular convolution by using MATLAB.	02	CO2
06	Write a program for finding cross correlation by using MATLAB.	02	CO2
07	Write a program for finding auto correlation by using MATLAB	02	CO2
08	The music signal has frequency components in the audio frequency range 20 Hz to 20000 Hz of the electromagnetic spectrum	02	CO3
09	Take any one periodic signal and find its Fourier series coefficients using exponential or trigonometric FS method. Write a program to find its Fourier series coefficients.	02	CO3
10	Write a program to find frequency response. Plot magnitude and phase response for different transfer functions using MATLAB.	02	CO4
11	Write a assignment on Laplace transform.	02	CO5
12	Write a assignment on Z-transform.	02	CO6

Term Work:-

General instructions:-

Term work shall consist of minimum **Eight** experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance (Practical) : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
PCL303	Analog and Digital Electronics Lab	--	1	–	--	1	–	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment (IAT)			End Sem. Exam			
		IAT I	IAT-II	IAT-I + IAT-II (Total)				
PCL303	Analog and Digital Electronics Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize the student with assembling circuits using basic electronic devices.
2. To demonstrate operation of bipolar and MOS transistors.
3. Demonstrate DC biasing circuits, Transistors as switching device,

Lab Outcomes (LO):

Learners will be able to

1. Demonstrate operation of basic electronic devices such as BJT .
2. Assemble and demonstrate electronic circuits using JFET
3. Design various circuits using Amplifiers
4. Design Universal GATE using BASIC GATEs and Demonstrate Multiplexer
5. Demonstrate the Truth Table for FLIP FLOP
6. Study and Demonstrate counters AND Design a power supply

List of Experiments. (Minimum Ten experiments required)

Sr. No	List of Experiments	Hrs.	LO
01	Study of input / output characteristics of BJT- CB, CE, and CC Configuration. Demonstrate CE Characteristics	02	LO1
02	Study and perform input and transfer characteristics of FET.	02	LO2
03	Design and analysis of biasing circuit and observing performance of BJT as an amplifier at various operating points.	02	LO3
04	Build universal gates Using Basic gates	02	LO4
05	Study and perform Mux operation	02	LO4
06	Perform and verify SR Flipflop	02	LO5
07	Build MOD 10 UP Counter	02	LO6
08	Design Power supply to give +5V using IC 7805	02	LO6
09	Study of DeMorgan's Theorem	02	LO5
10	Read a Data sheet of digital IC and Find Power consideration	02	LO6

Term Work:

General Instructions:

Term work shall consist of minimum **Eight** experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance (Practical) : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

AC –

Item No. –

As Per NEP 2020

University of Mumbai



Syllabus for HSSM Vertical 5

Faculty of Engineering

Board of Studies in Under Engineering

Second Year Programme in HSSM– Common to All Branches

Semester	III & IV	
Title of Paper (Lab)		Credits
I) Entrepreneurship Development	III	2
II) Environmental Science	III	2
III) Business Model Development	IV	2
IV) Design Thinking	IV	2
Total Credits		8
From the Academic Year		2025-26

Sem. - III

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 &	Ideation Techniques: Design Thinking, Brainstorming, Mind	04	LO2

	Validation	Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.		
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 –

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

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		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
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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

Experiential Learning Courses

(CEP)

Detailed Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
CEP301	Mini Project (group project)	--	02*+2	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory				End Sem. Exam	Term Work	Pract./ Oral	Total
		Internal Assessment Test (IAT)							
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
CEP301	Mini Project (group project)	--	--	--	--	50	25 --	75	

* 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

Course Objectives:

The course is aimed

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research

Course Outcomes: Students will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical /experimental /simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. 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.
- ❖ With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- ❖ However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- ❖ Report should be prepared as per the guidelines issued by the University of Mumbai.
- ❖ Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- ❖ Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication.

Project Topic Selection and Approval:

1. A mini-project group shall consist of a minimum of THREE (03)
2. Project topic selection and approval should be done by a panel of two expert faculty members from the department.
3. Each group must maintain a logbook to record weekly work progress in terms of milestones. The guiding faculty should provide remarks/comments weekly. Both students and faculty must sign the logbook every week.

Project Report Format:

1. The mini-project report should include the following sections:
 - Abstract (maximum 1 page summarizing the complete report)
 - Introduction (justification for project selection, applications, and existing commercial products)
 - Implementation (proposed specifications, block diagram/circuit diagram, working principle/operation)
 - Results & Discussion (photographs, video links, recorded results such as waveforms/observations/demonstrations)
 - Conclusion and Learning Outcomes
 - References
 - Participation in Mini-project competition/Technical Paper Presentation (TPP), etc.
2. The report should not exceed 10 pages. Reports should be stapled to avoid the use of plastic.

Term Work & Practical/Oral Examination Evaluation:

1. Minimum six (06) experiments based on Modules 1, 2, 3, and 4 should be performed.
2. One mini project must be implemented.
3. It is not compulsory to select a project from the given sample list; students are encouraged to propose innovative ideas.
4. Students must deliver a presentation and demonstrate their mini project during the Practical and Oral Examination (25 Marks Evaluation).
5. Project reports must be checked for plagiarism using software such as Turnitin or any equivalent tool.
6. Evaluation should consider each student's individual contribution, understanding, and knowledge gained during the project execution. Marks should be awarded accordingly.

Term Work & Evaluation Scheme (Total 50 Marks):

Component	Marks
Performance in Experiments & Evaluation by Guide	15
Performance in mini project & Evaluation by Guide	10
Performance in mini project & Evaluation by Review Committee Evaluation	10
Logbook and Quality of Project Report	05
Research Paper	10