

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)
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As Per NEP 2020

University of Mumbai



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

Name of the Programme – <u>B.E. (Automation and Robotics)</u>		
Faculty of <u>Engineering</u>		
Board of Studies in <u>Mechanical Engineering</u>		
U.G. Second Year Programme	Exit Degree	U.G. Diploma in <u>Engineering- Automation and Robotics</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. (<u>Automation and Robotics</u>)
2	Exit Degree	U.G. Diploma in <u>Engineering- Automation and Robotics.</u>
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-665C R. TEU-665D	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

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BoS-Chairman-Mechanical Engg
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Dr. Deven Shah
Associate Dean
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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 Information Technology Branch of 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 Information Technology in 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.

Program Core Course Cover Information Technology 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 2054-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

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Dean
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Under Graduate Diploma in Engineering- Automation and Robotics.

Credit Structure (Sem. III & IV)

	R. TEU-665C									
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	2033111 2033112 2033113 2033114 2033115 2033116	--	--	OE:2	--	VEC:2 HSL: 2	CEP:2	22	UG Diploma45
	R. TEU-665D									
	IV	2034111 2034112 2034113 2034114 2034115 2034116	--	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 4credits 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]

Sem. - III

S.E.

**Automation
and Robotics
Scheme**

Program Structure for Second Year of Automation and Robotics

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
2033111	Engineering Mathematics III	2	--	1	2	1	–	3
2033112	Strength of Materials	3	–	--	3	–	–	3
2033113	Sensors and Actuators	3	--	--	3	–	–	3
2033114	Digital Electronics	3	--	--	3	–	–	3
OEC301	To be taken from the bucket provided by the University from other Faculty	2	--	--	2	–	–	2
2033115	Material Testing Lab	--	2	–	–	–	1	1
2033116	Sensors and Actuators Lab	--	2	–	–	–	1	1
2033611	Mini Project (group project)	--	4	–	–	–	2	2
2993511	Entrepreneurship Development (Syllabus common to all Branches).	--	2*+2	---	–	–	2	2
2993512	Environmental Science for Engineers (Syllabus common to all Branches).	--	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)					
2033111	Engineering Mathematics III	20	20	40	60	2	25	--	125
2033112	Strength of Materials	20	20	40	60	2	--	--	100
2033113	Sensors and Actuators	20	20	40	60	2	--	--	100
2033114	Digital Electronics	20	20	40	60	2	--	--	100
OEC301	To be taken from the bucket provided by the University from other Faculty	20	20	40	60	2	--	--	100
2033115	Material Testing Lab	--	--	--	--	--	25	25	50
2033116	Sensors and Actuators Lab	--	--	--	--	--	25	25	50
2033611	Mini Project (group project)	--	--	--	--	--	50	25	75
2993511	Entrepreneurship Development (Syllabus common to all Branches).	--	--	--	--	--	50	--	50
2993512	Environmental Science for Engineers (Syllabus common to all Branches).	--	--	--	--	--	50	--	50
Total		100	100	200	300	10	225	75	800

Vertical –1 Major

Course Code	Course Name	Contact Hours			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
2033111	Engineering Mathematics-III	02	-	01	02	-	01	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment Test (IAT)			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
IAT-I	IAT-II	IAT-I + IAT-II (Total)						
20	20	40	60	02	25	-	-	125

Pre-requisite: Applied Mathematics-I, Applied Mathematics-II

Rationale: Engineering has always been the backbone of modern industries and civilization now, new technologies like Artificial Intelligence (AI) in engineering are entirely changing existing engineering fields and creating new ones. Mechanical engineering concern with the responsible development of products, processes, and power, at scales ranging from molecules to large and complex systems. Mechanical engineering principles and skills are involved at some stage during the conception, design, development, and manufacture of every human-made object with moving parts.

Course Objectives:

1. To familiarize with the Laplace transform, Inverse of various functions, its applications.
2. To familiarize with the Inverse Laplace transform of various functions, its applications.
3. To acquaint with the concept of Fourier series of periodic functions with various period.
4. To familiarize with the concept of complex variables, C-R equations with applications.
5. To introduce concepts and fundamentals Matrix algebra for engineering problems.
6. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Course Outcomes: Learner will be able to....

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations.

Module	Detailed Contents	Hrs.	CO mapping
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, where $n \geq 0$. 1.2 Properties of Laplace Transform: Linearity, First Shifting theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of integrals (Properties without proof). 1.3 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Laplace Transform of derivatives, Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function, Second Shifting Theorem.	05	CO1
02	Module: Inverse Laplace Transform 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.	04	CO2
03	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series. Fourier series of periodic function with period 2π and $2l$ (No questions should be ask on split function) 3.2 Fourier series of even and odd functions. (No question should be ask on split function) 3.3 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Parseval's Identity.	05	CO3

04	Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), Cauchy-Riemann equations in cartesian coordinates (without proof) 4.2 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) is given. 4.3 Harmonic function, Harmonic conjugate. Self-learning Topics: Milne-Thomson method to determine analytic function $f(z)$ when (u+v or u-v) is given, Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations, orthogonal trajectories.	04	CO4
05	Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction), Functions of square matrix.	04	CO5
06	Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method Self-learning Topics: Analytical method for one dimensional wave equations, Analytical methods of solving two and three dimensional problems.	04	CO6

Term Work:

General Instructions:

- 1 Batch wise tutorials are to be conducted. The number of student's per batch should be as per University Pattern for practicals.
- 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) for 20 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 Duration of each test shall be one hour.

End Semester Theory Examination:**Question paper format**

- a. 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**
- b. **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)
- c. A total of **Four questions** need to be answered.

References:

1. 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. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Course Code	Course Name	Contact Hours			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
2473112	Strength of Materials	03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment Test (IAT)			End Sem . Exam	Duration of End Sem. Exam	TW	PR	OR	
IAT-I	IAT-II	IAT-I + IAT-II (Total)						
20	20	40	60	02 hrs	-	-	-	100

Objectives:

1. To introduce students to the fundamental concepts of stress, strain, and mechanical properties of materials, including the analysis of principal stresses and strains under different loading conditions.
2. To equip students with the ability to analyze structural members subjected to axial, torsional, and bending loads, using theoretical formulations such as torsion equations, bending theory, and stress-strain relationships.
3. To develop the skills in students to construct shear force and bending moment diagrams and evaluate beam deflections using methods such as double integration and Maxwell's reciprocal theorem.
4. To explain failure theories related to columns, and to enable students to compute critical buckling loads and stress distributions in thin shells.

Outcomes: Learner will be able to...

1. *Identify* and *compute* different types of stresses and strains and determine principal stresses and planes using analytical and graphical methods.
2. *Analyze* torsional stresses in solid and hollow shafts and evaluate strain energy under various loading conditions.
3. *Construct* shear force and bending moment diagrams for statically determinate beams and apply area moment of inertia concepts.
4. *Determine* bending and shear stress distributions in beams and analyze stresses in thin cylindrical and spherical shells.
5. *Calculate* deflections and slopes of beams under various loading.
6. *Evaluate* buckling loads for columns with different end conditions.

Module	Detailed Contents	Hrs	CO mapping
	Pre-requisites: Concepts of equilibrium in beams, support reactions; Centroid		
1.	1.1 Introduction-Concept of Stress Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, Stress Strain Diagram, elastic constants and their relations-volumetric, linear and shear strains. Thermal stress and strain.	05	CO1
	1.2 Principal Stresses Principal stresses and Principal planes- Mohr's circle.	03	
2.	2.1 Area Moment of Inertia Area Moment of Inertia about centroidal axes, Parallel Axes theorem, Polar Moment of Inertia.	02	CO2
	2.2 Torsion: Torsion equation, Torsion of circular shafts-solid and hollow, stresses in shafts when transmitting power	05	
	2.3 Strain Energy: Strain energy stored in the member due to gradual, sudden and impact loads, Strain energy due to bending and torsion.	03	
3.	Shear Force and Bending Moment Diagrams in Beams	05	CO3
	Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to point load, uniformly distributed loads, couple and their combinations.		
4.	Stresses in Beams and Thin Shells		CO4
	4.1 Bending and Shear Stresses in Beams	04	

	Theory of bending of beams, bending stress distribution, shear stress distribution for point and distributed loads in simply supported and cantilever beams.		
	4.2 Thin Shells Stresses and deformation in Thin Cylindrical and Spherical Shells subjected to internal pressure.	02	
5.	Deflection of Beams Deflection of a beam: Double integration method, Macauley's method for computation of slopes and deflection in beams for point and distributed loads.	05	CO5
6.	Columns Buckling load, Types of end conditions for column, Euler's column theory and its limitations and Rankine formula.	05	CO6
Total Hours		39	

Assessment:

Internal Assessment (IA) for 20 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 Duration of each test shall be one hour.

End Semester Theory Examination:

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.

Textbooks

- James M. Gere and Barry J. Goodno: Mechanics of Materials, 2nd Edition, Cengage Learning (2009)
- S. Ramamrutham: Strength of Materials, 14th Edition, Dhanpat Rai Pvt. Ltd. (2014)
- S. B. Junnarkar: Mechanics of Structures, 24th Edition, Charotar Publication. (2015)

4. S. S. Ratan: Mechanics of Materials, 2nd Edition, Tata McGraw Hill Pvt. Ltd. (2011)

Reference Books

1. W. Nash, Schaum's Outline Series: Strength of Materials, 5th Edition, McGraw Hill Publication, Special Indian Edition. (2015)
2. Beer, Johnston, DeWolf and Mazurek: Mechanics of Materials, 8th Edition, TMH Pvt Ltd, New Delhi. (2020)
3. Ryder: Strength of Materials, 3rd Edition, Macmillan (Publisher) (1969)
4. Irwin H. Shames: Introduction to Solid Mechanics, 3rd Edition, Pearson Publisher (2015)
5. R. Subramanian: Strength of Materials, 3rd Edition, Oxford University Press (2016)

Web Resources

- 1 https://swayam.gov.in/nd1_noc20_ce34 – Swayam Course Material.
- 2 <https://nptel.ac.in/courses/112107146> – NPTEL Course Material.
- 3 <https://archive.nptel.ac.in/courses/105/105/105105108> – NPTEL Course Material.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2033113	Sensors and Actuators	3	-	-	3	-	-	3

		Theory					Ter m work	Pract / Oral	Tot al
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		Test 1	Test 2	Total					
2033113	Sensors and Actuators	20	20	40	60	2	--	--	100

Rationale:

The rationale behind this curriculum is to incorporating transducer studies into engineering education is vital for preparing students to meet the demands of modern technology-driven industries. It ensures that graduates possess the necessary knowledge and skills to develop, implement, and maintain systems that rely on accurate and reliable measurements.

Course Objectives:

- 1.To explain the measurement systems, errors of measurement and understanding of the operation of sensors and transducers
- 2.To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used in Industry for Temperature measurement
- 3.To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used in Industry for Pressure & Vacuum, Level measurement
4. To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used in Industry for Flow measurement
- 5.To study the working principles, characteristics, and applications of various types of actuators
6. To develop the ability to select appropriate signal conditioning circuits tailored to different types of temperature and Pressure sensors.

Course Outcomes:

1. Explain the measurement systems, errors of measurement. List and compare various standards used for selection of transducers/sensors.

2. Describe the working principles of Temperature transducers and their applications.
3. Understand the working principles of Pressure & Vacuum Gauges and level transducers and their applications.
4. Identify types of Flow and understand working of different transducers for Flow measurement.
5. To study the working principles, characteristics, and applications of various types of actuators used in industrial automation systems
6. To analyze design considerations and applications for temperature and pressure transducer signal conditioning.

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	To understand this subject, student should have a foundational understanding of physics, especially regarding energy conversion and measurement. You should also be familiar with basic concepts of electronics and electrical signals.		
I	Introduction to Measurement Systems & Sensors	1.1. Introduction, Block diagram, Functional elements of measurement system, Static and Dynamic characteristics of transducers. Errors, Remedies for Errors. 1.2. Definition of Sensor & Transducer, classification, selection criteria, transducer specifications.	4	CO1
II	Transducers for Temperature Measurement	2.1 Definition and units of temperature 2.2 Different temperature scales ($^{\circ}\text{C}$, $^{\circ}\text{F}$, $^{\circ}\text{K}$, $^{\circ}\text{R}$, $^{\circ}\text{R}'$) and their conversions 2.3 Resistance Temperature Detector (RTD): Working Principle (PT 100), 2 wire, 3 wire and 4 wire RTD Element, Lead wire compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD 2.4 Thermocouple: Working principle, thermo electric effect, See-beck effect, Peltier effect, Laws of thermocouple, types of thermocouples, cold junction compensation method, thermopile, Thermowell material of construction. Specifications, advantages, disadvantages and applications of Thermocouple 2.5 Thermistor, NTC & PTC Types, Specifications, advantages, disadvantages and applications of Thermistor 2.6 Pyrometers: Principle, construction and working of radiation and optical Pyrometers and its applications	8	CO2
III	Transducers for Pressure	3.1 Pressure scales, units and relations, classification 3.2 Primary pressure sensors – elastic elements like bourdon tube, diaphragm, bellows, capsule properties	8	CO3

	and Vacuum Measurement	and selection of elastic materials, Calibration using Dead Weight Tester 3.3 Electrical/secondary Pressure Transducers: a) Bourdon tube with LVDT, b) Bellow with LVDT , c) Diaphragm with Strain gauge 3.4 Differential pressure measurement: construction & working of DP Cell 3.5 Pressure measurement using manometer: U – Tube types, well type, inclined type, micro manometer 3.6 Pneumatic transducer: Flapper – nozzle transducer. 3.7 Vacuum Measurement: Units and relations, Mcleod gauge, Pirani gauge, thermocouple gauge. 3.8 Calibration of Pressure Gauge 3.9 Level and units of Level, Classification ,construction, working, applications of : a) Direct method : methods- Sight glass, Hydrostatic type (air purge). b) Indirect measurement method: Float type with linear and rotary potentiometer, Capacitive type , Ultrasonic type, Nuclear Radiation type, Radar type Transducer.		
IV	Transducers for Flow Measurement	4.1 Introduction to fluid flow: properties of fluid, types of fluid, Reynolds number, types of fluid flow, continuity equation. Bernoulli's equation 4.2 Head type: Orifice, Venturi, nozzle, pitot tube, annubar, characteristics of Head type flow meters, Variable area type: Rotameter 4.3 Velocity and Inertia based flowmeters: Turbine, electromagnetic, ultrasonic, positive displacement meter -nutating disc type, anemometers, Coriolis Mass flow metermass flow meters.	6	CO4
V	Actuators	5.1 Definition and Classification: linear; rotary; Logical and Continuous Actuators 5.2 Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, 5.3 Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. 5.4 Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors , AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper	8	CO5

		motors - Piezoelectric Actuators: working and applications.		
VI	Case studies	6.1 Temperature Transducer signal conditioning Design: design considerations and application for RTD, Thermistor and thermocouple temperature sensor. 6.2 Pressure Transducer signal conditioning Design: design considerations and applications for various pressure sensors	5	CO6
Total Hours			39	

Text Books:

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, Dhanpat Rai and Co. Rai, 1996.
4. Rangan, Mani, Sharma. Instrumentation systems and Devices, 2nd EdTata McGraw Hill.
5. D.V.S. Murthi, Instrumentation and Measurement Principles, PHI, New Delhi, 2nd ed. 2003.

References:

1. Doebelin E.D., Measurement system, Tata McGraw Hill., 4th ed, 2003.
2. Bela G. Liptak, Instrument Engineers' Handbook, Fourth Edition, Volume One: Process Measurement and Analysis, June 27, 2003.
3. W.G.Andrew, H.B.Williams, Applied Instrumentation in the Process Industries, Volume II – Gulf Publication Company , Paris, Tokyo.
4. Neubert Hermann K. P., Instrument Transducer, 2nd ed., Oxford University Press, New Delhi, 2003.
5. Johnson Curtis D., Process Control Instrumentation Technology, 8th Ed., 2005
6. S.P. Sukhatme, Heat Transfer, 3rd edition, University Press.
7. Chortle Keith R., Fundamentals of Test, Measurement Instrument Instrumentation, ISA Publication.
8. Alan S Morris, Measurement and Instrumentation Principles; 3rd Edition
9. Sawhney A.K., —Mechanical Measurement, Dhanpatrai and Co.
10. Bansal R.K., —Fluid Mechanics and Hydraulic Machines, Laxmi publications.
11. David W. Spitzer, —Industrial Flow Measurement, ISA Publication

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_ee105/

2.	https://archive.nptel.ac.in/courses/112/107/112107242/
3.	https://archive.nptel.ac.in/courses/108/105/108105064/

Assessment:

Internal Assessment (IA) for 20 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

□ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 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 **Three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2033114	Digital Electronics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2033114	Digital Electronics	20	20	40	60	2	--	--	100

Rationale:

The rationale behind this curriculum is to provide a comprehensive and practical understanding of digital electronics, empowering students to design, analyze, and implement digital systems effectively.

This syllabus is designed to provide students with a foundational understanding of digital electronics, a core discipline essential for numerous fields, including computer engineering, electronics, telecommunications, and embedded systems.

Course Objectives: Six Course Objectives

1. How to apply Number Systems and Boolean Algebra in Digital systems.
2. Analyze and Simplify Combinational Logic Circuits.
3. Design and Implement Combinational Logic Functions.
4. Comprehend and Design Sequential Logic Circuits.
5. Evaluate and Compare Digital Integrated Circuit Technologies.
6. Develop Digital Systems using Programmable Logic Devices and Hardware Description Languages.

Course Outcomes:

- 1) Explain the conversion between different number systems (decimal, binary, octal, hexadecimal) and apply Boolean algebra theorems to simplify logic expressions. (Bloom's Taxonomy: Understand, Apply)
- 2) Analyze and simplify complex combinational logic circuits using Karnaugh maps and Quine-McCluskey methods to derive minimal sum-of-product or product-of-sum expressions. (Bloom's Taxonomy: Analyze, Evaluate)
- 3) Design and implement various combinational logic circuits such as decoders, encoders, multiplexers, adders, and comparators to solve specific digital design problems. (Bloom's Taxonomy: Apply, Create)

- 4) Describe the operation of flip-flops, counters, and registers, and develop sequential logic \ circuits using these components for specific applications. (Bloom's Taxonomy: Understand, Create)
- 5) Compare and contrast the characteristics of different digital logic families (TTL, CMOS, ECL) based on parameters like propagation delay, power dissipation, and noise margin. (Bloom's Taxonomy: Analyze, Evaluate)
- 6) Implement basic digital circuits using VHDL or Verilog on programmable logic devices (PLDs) like PLA, PAL, CPLDs, and FPGAs, and evaluate the functionality of memory devices. (Bloom's Taxonomy: Apply, Evaluate)

DETAILED SYLLABUS: Total six modules for each subject (13 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite:	Logic gates- Basic gates- AND, OR and NOT, Universal Gates- NAND and NOR, Derived Gates- EX-OR and EX-NOR		
I	Number Systems & Boolean Algebra:	Decimal, binary, octal, hexadecimal number system and conversion, binary weighted codes, signed numbers, 1s and 2s complement codes, Binary arithmetic Binary logic functions, Boolean laws, truth tables, associative and distributive properties, De-Morgans theorems, realization using logic gates.	07	CO1
II	Combinational Logic	Switching equations, canonical logic forms, sum of product & product of sums, Karnaugh maps- two, three and four variable, simplification of expressions, don't care conditions K-map, Quine-McCluskey minimization technique, mixed logic combinational circuits, multiple output functions.	06	CO2
III	Analysis & design of Combinational Logic:	Adders, Subtractors, Code conversion, Parity checker, BCD adder, Multiplexer, Demultiplexer, Encoder and Decoder. Implementation of combinational logic circuits using Multiplexer and Demultiplexer. Hazards in logic circuits and its elimination.	06	CO3
IV	Sequential Logic:	Flip flops- SR, JK, D, T and Master slave JK, Realization of one flip flop	08	CO4

		using other flip flops, Shift registers, Universal Shift Register, Asynchronous & Synchronous counters, Modulus of counters.		
V	Digital integrated circuits:	Logic levels, propagation delay time, power dissipation fan-out and fan-in, noise margin, logic families and their characteristics TTL, CMOS and ECL integrated circuits and their performance comparison, open collector and tristate gates and buffers.	06	CO5
VI	Memory and programmable logic devices:	PROM / EPROM / EEPROM / EAPROM Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL), Introduction to Complex Programmable Logic Device (CPLD), Introduction and basic concepts of FPGA, VHDL and Verilog – Implementation of AND, OR, Adders using VHDL and Verilog	06	CO6
Total Hours			39	

Text Books:

1. A.S. Sedra & K.C.Smith, Microelectronics Circuits, Oxford University Press (1997)
2. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications
3. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory
4. William Kleitz, Digital Electronics, Prentice Hall International Inc.

References:

1. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley & Sons Inc.
2. Michael Shur, Introduction to Electronic Devices, John Wiley & Sons Inc., 2000.
3. R. T. Howe and C. G. Sodini, Microelectronics: An Integrated Approach, PrenticeHall Inc. 1997.
4. Jacob Millman, and C.C. Halkias, “Electronic devices and circuits”, TMH Publications.
5. Ben G. Streetman, Solid State Electronic Devices, PHI, 5th Ed, 2001.3.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/108/105/108105132/
2.	https://www.tpointtech.com/digital-electronics
3.	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Assessment:

Internal Assessment (IA) for 20 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

□ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 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 **Three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2033115	Material Testing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
2033115	Material Testing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize students with examination techniques of microstructure in ferrous and or non-ferrous metals to make them understand a correlation between microstructure and mechanical properties.
2. To introduce students to fundamentals of testing methods used to evaluate the mechanical properties of engineering materials.
3. To familiarize the students about fatigue test and S-N curve.
4. To introduce to the students simple tension test to analyze the stress - strain behavior of materials
5. To develop hands-on skills in students in conducting standard material tests such as impact, hardness, torsion, and compression.
6. To cultivate the ability in students to interpret and analyze test results in relation to properties and behavior of materials under different loading conditions.

Lab Outcomes: After completion of this laboratory course, the students will be able to

1. *Prepare* metallic samples for studying its microstructure following the appropriate procedure.
2. *Identify* effects of heat treatment on microstructure of medium carbon steel and hardenability of steel using Jominy end quench test.
3. *Perform* fatigue test and draw S-N curve.
4. *Perform* simple tension test to analyze the stress - strain behavior of materials.
5. *Measure* torsional strength, hardness and impact resistance of the material.
6. *Perform* flexural test with central and three-point loading conditions.

A. List of Experiments: Minimum *eight* experiments to be performed (*Four* Experiments each from both the groups):

Expt. No.	Description	No. of Hours
	Group A	
1.	Study of Characterization techniques and Metallographic sample preparation and etching.	02
2.	Comparison of Microstructures and hardness before and after Annealing, Normalizing and Hardening in medium carbon steel.	02
3.	Study of tempering characteristics of hardened steel.	02
4.	Determination of hardenability of steel using Jominy end Quench Test (Using different hardness testers to measure the Hardness)	02
5.	Fatigue test using Rotating Beam Specimen.	02
	Group B	
1.	Tension test on mild steel bar (stress-strain behaviour, Determination of yield strength and modulus of elasticity)	02
2.	Torsion test on mild steel bar/cast iron bar	02
3.	Impact test on metal specimen (Izod/Charpy Impact test)	02
4.	Hardness test on metals—(Brinell/Rockwell Hardness Number)	02
5.	Flexural test on beam(central loading)	02

Sr No	Group C. List of Assignments / Tutorials(At least <i>two</i> problems on each of the following topics)	Hrs
01	Simple Stress and Strain	
02	Torsion and Strain Energy	
03	SFD and BMD	
04	Stresses in Beams and Thin Shells	
05	Deflection of Beams	
06	Buckling of Columns	

Project Based Learning may be incorporated by judiciously reducing number of assignments. For example, project on topics like, Preparation and Testing of parts made of composite material/s, testing of components made using 3D printing, etc. ***may be*** considered.

Assessment:

Term Work: Term Work shall consist of at least 8 to 9 practical based on the above list. Also, Term work Journal must include at least 2 assignments.

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

Practical& Oral Exam: An Oral & Practical exam should be conducted.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2033116	Transducers Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
2033116	Transducer Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the principle of various Transducers
2. To experimentally verify the characteristics of Temperature transducers
3. To experimentally verify the characteristics of Pressure, vacuum and level transducers.
4. To experimentally verify the characteristics of flow transducers.
5. To explore and analyze various types of actuators
6. To design and implement signal conditioning circuits for temperature and pressure transducers.

Lab Outcomes

1. Understand the fundamental principles and classifications of various transducers, including their working mechanisms and applications in measuring physical parameters..
2. Experimentally analyze the characteristics of temperature transducers such as RTDs, thermistors, and thermocouples, and interpret their response to temperature variations.
3. Experimentally analyze the characteristics of pressure, vacuum, and level transducers through practical experiments, understanding their behavior under different conditions.
4. Experimentally analyze the characteristics of flow transducers, interpreting their output in relation to varying flow rates..
5. Analyze various types of actuators, including linear, rotary, logical, and continuous actuators, understanding their construction, operation, and applications in Automation..

6. Design and implement signal conditioning circuits tailored for temperature and pressure transducers, ensuring accurate signal processing for reliable measurements.

List of Experiments: Minimum *eight* experiments to be performed

List of Experiments.

Sr No	List of Experiments	Hrs
01	Demonstrate the basic measurements techniques and Measuring Instruments.	2
02	Plot response curve for Flapper Nozzle system and validate the results with stand values.	2
03	Plot and validate the LVDT characteristics.	2
04	Plot and validate the strain gauge characteristics	2
05	Plot and validate the characteristics of RTD	2
06	Draw and validate the characteristics of various Thermocouples.	2
07	Draw and validate the characteristics of Thermistors.	2
08	Test and compare temperature measurement with and without Thermo-well.	2
09	Plot and validate performance characteristics of Hydrostatic type (air purge) system.	2
10	Identify constant head type flow sensors such as Orifice, Venturi tube and study the applications.	2
11	Identify variable area such as Rotameter and study the applications.	2
12	Study of Linear and Rotary Actuators	2
13	Operation of Directional Control Valves	2
14	Speed and Direction Control of DC Motor	2

Sr No	List of Assignments / Tutorials	Hrs
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01	Assignment based on classification, specification and selection criteria of transducer	
02	Assignment based on types of temperature transducers	
03	Assignment based on types of Pressure and vacuum transducers	
04	Assignment based on types of level transducers	
05	Assignment based on types of flow transducers	
06	Assignment based on types of Actuators	

Assessment :

Term Work: Term Work shall consist of at least 8 to 10 practicals' based on the above list. Also, Term work Journal must include at least 2 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	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
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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
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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.									
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:	05	

		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.		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)